REPORT
OF
THE DESIGN OF AUTOMATIC TELEGRAPH SWITCHING SYSTEM IN THAILAND

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OVERSEAS TECHNICAL COOPERATION AGENCY

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P R E F A C E

During the last decade, Thailand has witnessed the rapid expansion of telecommunications together with her swift growth in socio-economic activity. In the near future, the telegraph services in this nation will be seen insufficient to cope with such a prompt growth of socio-economic activity. Some measures have been taken so far by the Post & Telegraph Department by introducing "Torn Tape System". Nevertheless, various kinds of problems to be solved so urgently still remain in the telegraph services.

Recently, the automatic public telegraph relaying system has been taken into consideration by the Department. For the purpose of the technical cooperation in designing of this system, the expert was attached to the department under the Colombo Plan by the Japanese Government. During his stay in Thailand for 18 months (Dec.1970 till Jun.1972), he studied and surveyed the situation of telegraph services, as the first step. As the second step, he has schemed the appropriate layout of this system through discussions with the related top managements.

Finally, in this report, he has detailed in the design of automatic public telegraph switching system in Thailand also in the arrangement for the advanced 15 years' stage process, corresponding to telegraph network trunking as well as maintenance.

It would be very appreciated if this report could contribute to the promotion of telegraph service in this Kingdom to some extent.

May, 1972

Mr.Hitoshi OZAWA

Colombo Plan Telegraph Expert

To

Post & Telegraph Department

Ministry Of Communications

Thailand

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C O N T E N T S

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APPENDIX

1. DEMAND ESTIMATION OF TELEGRAM

Demand estimation will be indispensable for a long-period plan of automatic telegraph switching system. The more accuracy of the demand estimation will be preferable because of the basis of the technical and economical considerations. However, the forecast of demand for telegrams is not an easy task especially for such a long period like fifteen years. In forecasting, different factors will be found. We employed the annual increase of population, the expansion rate of economy, and the existing circumstances of the telephone and telegraph service, as the forecast's factors.

1.1 Increment of Population

Thailand has a population of 34.152 million (1970 census) with a high annual increase rate of 3%. The concentration of the population in the cities is significant. In the past ten years, the capital Bangkok itself has been expanding at an annual rate of 5.2%. Even in other provinces, some areas have registered an increase rate of 4.8%.

Since it could be expected that such trend would continue into the futute, by extrapolating the average expanding rate of the past 9 years of every province, it might be said that by 1972 (the intermediate year of the plan for the mechanization of telegraph relaying process) the population would become 46.810 million and by 1987 (the final year of the plan) the population would reach 59.801 million. (Appendix 1.1)

1.2 Coefficient of Telegram Utilization

During the past 10 years, the number of dispatched telegram per capita per annum (telegram per capita) has increased 1.7 times and becomes 0.137(in 1970). Taking all the 71 provinces into account, the value for the high rate is 0.33 and the value for the low rate is 0.02, showing such a great difference. The distinct features are :

1) the telegram per capita for Bangkok-Thon Buri which is the center of the political, economic and cultural - activities of the country is still the highest, surpassing the high rate of concentration of the population in the cities, and passed the 0.3 mark per capita several years ago.
2) In the southern part where the mining industry is flourishing, the number had already reached 0.3 mark in the 1960's.
3) However, the trend in the past 2-3 years showed that the increasing rate of these areas has slowed down.

4) In areas other than the above-mentioned, the increase of telegram per capita is sharp and shows no sign of reaching saturation. From the above, it would seem reasonable to foresee the telegram per capita of the next few years by extrapolating the results of all provinces. Table 1.2 shows the result of the linear equation c = ax + b, where a is the directional coefficient of the increasing rate of the past 5 years, b is the average value of the past 5 years and c is the forecasted value for the intermediate year.

1.3 Upward Tendency of Telegram

Concerning the domestic public telegram of Thailand, the despatched number during the past 40 years is shown in Fig. 1. in Appendix 1.3. Fitting this to the logistic curve*the following has been obtained. By substituting t with the number of years the forecast value for the future could be obtained.

$$Y_t = \frac{K}{1 + Ae^{-\beta t}} \qquad \text{.....(1)}$$

*Logistic Curve is used as a forecasting formula when the demand grows according to the life cycle curve which consists of four stages-development, growth, permeation and saturation. The formula is shown as above equation. (1)

Where Y_t = revealed demand at time "t"

e = base of natural logarithm

K = limit value

A = constant

a = constant

to differentiate Y_t with respect to t, we obtain

$$\frac{d\,Y_t}{dt} = a.Y_t\left(1 - \frac{Y_t}{K}\right)$$

$$= a.Y_t - \frac{aY_t^2}{K} \qquad \text{.....(2)}$$

substitute d Y_t by ΔY_t, and dt by Δt

the above equation is written in the form of

$$\frac{\Delta Y_t}{\Delta t} = a.Y_t - \frac{a}{K} Y_t^2$$

now put $\Delta t = 1$, then divide common terms by Y_t,

this may be written in the form of

$$\frac{\Delta Y_t}{Y_t} = a - \frac{a}{K} Y_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

equation (3) can be rearranged as

$$R = P + q\, Y_t \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

where $\frac{\Delta Y_t}{Y_t} = R$, $P = a$, $q = -\frac{a}{K}$

Apply the method of least squares upon equation (4), we have

$$\Sigma R = nP + q \Sigma Y$$

$$\Sigma \Delta Y_t = \Sigma Y_t R = P \Sigma Y_t + q \Sigma Y_t^2 \ldots\ldots (5)$$

P, q is obtained from the above equation substitute them in equation (3) we obtain the figure a, K.

As for the figure M, let us first consider tr as is corresponding to Yr

$$Yr = \tfrac{1}{2}K$$

We thus see

$$tr = \frac{1}{a} \log_e M$$

Figures represented on the Appendix 1.3 Cont.which shows the calculation process of logistic curve are substituted for equation (5)

$$\Sigma \Delta Y_t = 488.5$$

$$\Sigma R = 3.603$$

$$\Sigma Y_t^2 = 1494224.74$$

$$\Sigma Y_t = 5784.08$$

hence, we can see the normal equation

$3.6026 = 38\ P + q\ 5784.08$

$488.5 = 5784.08\ P + q\ 1494224.74$

$\therefore q = - 0.0000975$

$P = 0.1096459$

$K = -\frac{P}{q} = 1124.57$

put $tr = 40$ into equation (6)

$\log M = 1.9047$

$\therefore M = 80.3$

accordingly, required equation may be shown

$$Y_t = \frac{11246}{1 - 80.3e^{-0.10965t}}$$

The above mentioned figure in Appendix 1.3 shows the calculated value correspond to the actual value for past fourty years, and the chart in Appendix 1.3 cont. describes the process of the calculation.

Above all, it is apparent from the figure and the table that the ultimate forecast value is on the growth curve aiming at 10 million copies.

1.4 Economic Activity

The demand for telecommunication reflects the socio-economical activity of that particular country and is related to the GNP and the national income. Therefore in deciding the expected value of the demand, it is needless to say that the following factors must be considered. 80% of the Thai labour forces is engaged in agriculture, chiefly in - rice-planting. Thus, the economy of the country relies greatly on the primary products, the main items of which are rice, rubber, jute, etc. In order to promote the - economy, the first 6-year national development plan was launched in 1961, and up to September of 1966, the GNP had reached an annual average virtual increase rate of 7.2%.

Following this, the second plan which aims at an annual increase rate of 8.5 was started in 1967. Consequently, the GNP which stood at 89.2 billion baht in 1966, had reached 119.1 billion baht in the final year of 1971 (increased 133%), resulting in an average increase rate of 9.5% for the same period. The rapid increase of telegram dispatches during this period has already been shown in Appendix 1.3. The important thing in the change in economic structure accompanying the economic development has been the expansion of the non-agricultural field causing the decrease in the relative ratio of agriculture. As can be seen in Appendix 1.4, the percentage of Agriculture in the GNP has decreased and instead, the percentage of the manufacturing field has been on the increase, showing a first step towards industrialization. At present the third five year plan has been launched (Appendix 1.5), with a total investment of 100 billion baht for the

1) expansion of production and increase of income,
2) the stabilization of economy,
3) the narrowing of the difference in income between the cities and the rural areas. It is said that if this plan is successful, the increase in GNP for this period would be 7%.

1.5 Expansion of Telecommunications

In the investment connected with the national development, although the allocation of sum to the transportation and communication is the highest except for education, the emphasis is placed on the highways and port facilities, with less weight being put on the communication. In the field of telecommunication, in 1964 with the American assistance, and in 1969 with the assistance of West Germany, the microwave trunk route was completed and in 1972 with the

Japanese assistance, the construction of the domestic trunk line to Laos was started. However,it is thought that several more years will be necessary before these could be effectively used. The reason behind this lies in the small absolute number of telephone. The increase of telephone in the metropolitan area in the past few years has been very significant, as is shown in Appendix 1.6. Nevertheless, when comparing this with 25 main cities in the ECAFE region, this is still low(Appendix 1.7) Moreover, telephone has just been installed in the past few years in the rural areas. Therefore, for the whole country there are only 3.4 sets per 1,000 people (Appendix 1.8) which is low. Coupling to that is the fact that 78% of all the telephones in the country is in Bangkok which is an extreme case of maldistribution and the utilization is also lagging behind. The long distance call is very few, the annual utilized call for each telephone being less than 19 times. (Appendix 1.9)

1.6 Growth of Telegram Per Capita and GDP

Therefore, the proposition will come to one's mind that if telephone, especially, the long distance trunk call is being used extensively in the future, telegram would decrease. The conclusion may be previously said that this is a matter of a very distant future ;even though there might be a sudden change, the need for telegram will continue to increase. With the increase in GNP, there is no doubt in the expansion of telephone facilities, but the growth of the society necessitates the information, the expansion of economy brings about information ; this being reproduced like a circle. This has the effect in raising the high level of news of general telecommunication, such as, telephone, telegram, and telex service. In all of these, it could be seen that

the end demand is decided by the field whereby the characteristics of each telecommunication medium could be used effectively (In the case of telegram, this means recordability, reliability, and speediness). With the increase in GNP, the market is stimulated and the transmission of information by telephone results in still greater demand for telegram : The example for this phenomenon is obvious from Appendix 1.10 which shows the growth of per capita GDP for the past 10 years The telegram per capita increases in proportion with the increase in GDP. So clearly noted in Appendix 1.6 the expansion of telephone during this period was significant. Besides, attempt was made to determine the effect on the public telegram despatch of newly established telephone facilities in the rural areas before and after the inaugurations of telephone service. However, it was found that there existed no correlation between the two. Suppose there are some effects, these are more likely to be a temporal one. Since the social and economic foundation of different countries are not the same, it is not possible to simply compare only the telegram utilization percentage. Nevertheless, even in the examples of countries in the ECAFE region, there are countries having telegram per capita of more than 0.3 even though the telephone distribution rate of such countries are quite high. Therefore, from Appendix 1.11 the expected average value of 0.18 for Thailand could not be thought of as extraordinarily high. For the period after the intermediate year, this value is considered to continue along this condition.

1.7 Utilization of Telegram Service

The utilization of domestic telegram is chiefly between individuals. For the rural areas, with the telegram per capita being less than 0.2, this stands for more than half the number of utilization. (Appendix 1.12)

On the contrary, for Central Telegraph Office, a great many are the commercial telegrams. Of the high telegram per capita for the metropolitan area, a fixed portion, for example, approximately 0.2 is the utilization rate in proportion to the population as in the case of rural areas. Whereas the portion in the excess of this could possibly be assumed to come from the activities of companies, factories and trading companies, etc., and this shows a sensitive reaction to the high and low level of telegram rates. Telegram rates were increased twofold in July, 1971. However, there has been no substantial decrease of despatched telegrams in the rural areas. One of the reasons for this might be due to the large number of individually necessary telegrams.

1.8 International Telegram

Although international telegrams in 1960 totalled to 710,000 telegrams, owing to the economic growth, and the expansion of foreign trade since, the demand has been growing by the steady rate of 9% per year and thus reached a million mark in 1966. (Appendix 1.13)

Such demand of telegrams is concentrated in the economically thriving area of the metropolis where 97% of the incoming-outgoing messages [illegible]

The outgoing telegrams always have the tendency in traffic less than the incoming telegrams, which shows up year by year.

In addition, the increased rate of demand in recent years has declined and in 1971, the first lower rate compared to the previous year was registered.

That might be due to the recent world-wide stagnation.

1.9 Relations between Telex and Telegram

1) With the expansion of telex subscribers, the amount of sending and receiving telegrams via telex are increasing to some extent, as shown in Appendix 1.19,1.20.

This trend is found conspicuous in the field of international telegram rather than domestic telegram. That is Appendix 1.22 shows that month by month, the receipt of international telegrams via domestic telex has increased and by the end of 1971, 9% of the international outgoing telegrams are originated from domestic telex subscribers.

2) Among the telex users of both 5 unit and 6 unit, trading companies take the share of 40% (Appendix 1.17) and consequently, the ratio of overseas telex communication is very prevalent in the nation.

From the inauguration in 1966, there has been an average annual increase of over 30% in the international telex traffic.

As seen in Appendix 1.23, the 16% of the gross international outgoing telegrams have been handled via telex. This trend will continue within 1972 too, as seen in Appendix 1.23 Cont.

One of the reasons why the traffic of international telex lifted so much is that out of all the daily dispatched telegrams by 5-unit-code domestic telex subscribers, the half will be overseas bound. Even in case of the 6-unit-code domestic telex subscribers, the 20% of the telex outgoing telegrams are overseas bound.

After all, the decline of increased rate of international telegrams in the foregoing Appendix 1.14,might be due to the expansion of international telex communication.

3) Since most of telex subscribers are stationed in the metropolitan area, other than 7% of subscribers in the provinces, as seen in Appendix 1.17, whole scale utilization of domestic telex over the nation-wide network can not be seen yet.

Moreover, as indicated in Appendix 1.18, the total volume of traffic in the metropolitan area is too low compared to that of domestic telegram, according to the statistics shown in Appendix 1.18 Cont., originated business calls from the business firms (6-unit-code domestic telex) are only 2 times per day.

In the meanwhile, the same extent of calls are made for the sake of telegram. Accordingly, telex, in this stage, seems to play a supplemental role in the field of telegraph.

4) Even though the number of telex calls show certain extent of increase, the ratio of telex calls to the domestic public telegrams are still negligibly small. This fact is different from international telex taking some effection to the international telegram at this moment.

It can, therefore, be concluded that the degree of utilization of domestic telex is too low to foresee the effection towards domestic telegram in the future.

The expansion of domestic telex system should be warmly expected and watched attentively. In the future, it should be devised to encourage the receipt of public telegrams through telex and conversely to positively promote the phonogram by telex of telegrams in order to rationalize the delivery

1.10 Forecasted Demand

As a result of the various estimation as specified above, as is seen in Appendix 1.24, the micro estimation (cf 1.2) and forecasted value from logistic curve (cf 1.4) almost agreed on the figure totalling 9,427 thousands to 11,747 thousands which will appear in fifteen years. Consequently, it has been decided to set 11,747 thousands as the demand figure expected to appear in ultimate year. Both figures are different for the demands in eight years, but it has been decided to choose 7,778 thousands as a figure to appear in eight years. This figure has been calculated under "telegram per Capita" and the population in each province. Appendix 1.24 shows the domestic telegrams in future. As a result, utilization of telegram will remain 0.18 in average in future. However, this figure seems to be moderately estimated, judging from her aiming to attain industrialization. It is needed to grasp the present status of demands all the time to make proper revision thereof.

As for the international telegram, the demand is forecasted on the basis of the past traffic curve, which is coming up slightly.

ESTIMATED DEMAND OF TELEGRAM

Table 1.23

FORMULA	DESCRIPTION	1979 7 years after	1987 15years after
$Y = Y.(1 + a)^n$	Y : No.of Telegrams in 1970 = 4,891 (thousands) a . Increasing factor in latest three years = 0.0529	n = 9 7,778	n = 17 11,747
$Y = \frac{K}{1 + Ae^{-\beta t}}$	No.of Telegrams applied are the numbers during 1932 to 1970. K = 11,246 thousands A = 80.3 C = constant β = 0.10965	t = 47 7,682	t = 55 9,427
$Y = \sum_{n=0}^{71} P.T.$	No.of Provinces n = 71 T : Forecasted Telegram per Capita in each province (See Appendix 1.2) P = Forecasted population in each province. (See Appendix 1.1)	8,462	10,810

2. DESIGN OF SWITCHING NETWORK

2.1 Establishment of Relaying Center

The result of surveying the origin of incoming and outgoing telegrams for a period of 10 days simultaneously for the whole country shows that the interchange of telegram within the same province is few, with an average of not more than 4.63%, and the telegrams despatched to the metropolitan area account for 39% (Appendix 2.1). On the basis of dividing the postal administration of the country geographically into 4 zones, the incoming and outgoing within the same region reach 40%.(Appendix 2,2, 2.3). From the projection of future size, it is possible to construct one telegraph switching center in the metropolitan area to cover the communication of the whole country. However, leaving considerations of finance aside, having considered the following points, several telegraph switching centers have been planned.

1) The telegrams in the rural areas are expanding.
2) The interchange of telegrams within the zone is as much as 40%.
3) The relaying route between the provinces and Bangkok could be brought together, thus rendering the economy of relaying routes.
4) In case of accidental disaster to the telegraph switching center, this would spread the danger of telecommunication paralysis of a national-wide scale.

Taking the geographical condition and the telegram disposal volume into consideration, it is decided to establish 3 telegraph switching centers in the rural areas. These three centers would have the same facilities and capacity. The following tables 2.1.1.-5 are the summary of domestic telegram flow in every zone in 1979, based on the above-mentioned statistics.

SUMMARY OF ESTIMATED TRAFFIC IN 1979

CENTRAL ZONE

Table 2.1.1

REGION No.	NO.OF TELEGRAMS ORIGINATED (G)	NO.OF TELEGRAMS DESTINATED TO					RATIO OF	
		REGION 1 (1)	REGION 2 (2)	REGION 3 (3)	REGION 4 (4)	TOTAL (T) (1)+ (2) +(3)+(4)	TELEGRAMS WITHIN THE REGION (T)/(G)	DESTINATED TO BANGKOK (1)/(G)
1	973.64	52.72	57.41	76.47	58.93	245.53	25.22	5.41
2	161.99	87.74	20.57	7.18	7.48	122.97	75.91	54.16
3	203.09	99.92	8.28	47.18	7.42	162.80	80.16	49.20
4	215.14	87.42	8.28	9.95	43.04	148.69	69.11	40.63
TOTAL	1553.86	327.80	94.54	140.78	116.87	679.99	43.76	21.10

Unit : No. of Messages/BUSY HOUR

NORTHERN ZONE

REGION No.	NO.OF TELEGRAMS ORIGINATED (G)	NO.OF TELEGRAMS DESTINATED TO REGION 1 (1)	REGION 5 (5)	REGION 6 (6)	REGION 7 (7)	REGION 8 (8)	TOTAL (T)=(5)+(6)+(7)+(8)	RATIO OF TELEGRAMS DESTINATED WITHIN THE REGION (T)/(G)	TO BANGKOK (1)/(G)
5	180.00	85.97	33.23	10.37	5.83	11.69	61.12	33.96	47.76
6	223.94	123.42	7.96	24.43	24.12	9.20	65.71	29.35	55.12
7	200.85	94.32	6.32	34.55	31.59	9,43	81.89	40.77	46.96
8	155.66	80.51	11.58	11.30	8.28	18.67	49.83	32.01	51.72
TOTAL	760.41	384.22	59.09	80.65	69.82	48.99	258.55	34.00	5C.53

NORTH-EASTERN ZONE

REGION No.	NO.OF TELEGRAMS ORIGINATED (G)	NO.OF TELEGRAMS DESTINATED TO REGION 1 (1)	REGION 9 (9)	REGION 10 (10)	REGION 11 (11)	REGION 12 (12)	TOTAL (T)=(9)+(10)+(11)+(12)	RATIO OF TELEGRAMS DESTINATED WITHIN THE REGION (T)/(G)	TO BANGKOK (1)/(G)
9	228.74	105.38	37.69	15.46	13.93	16.36	83.44	36.48	46.07
10	189.07	78.70	24.63	41.69	15.43	11.71	93.46	49.43	41.62
11	227.60	109.58	18.17	11.76	39.87	17.19	86.99	38.22	48.14
12	199.07	85.91	17.63	8.00	13.62	32.84	72.09	36.21	43.16
TOTAL	844.48	379.57	98.12	76.91	82.85	78.10	335.98	39.79	44.95

SOUTHERN ZONE

REGION No.	NO.OF TELEGRAMS ORIGINATED (G)	NO.OF TELEGRAMS DESTINATED TO					RATIO OF TELEGRAMS DESTINATED	
		REGION 1 (1)	REGION 13 (13)	REGION 14 (14)	REGION 15 (15)	TOTAL (T) = (13)+(14)+(15)	WITHIN THE REGION (T)/(G)	TO BANGKOK (1)/(G)
13	133.93	73.78	17.25	16.67	12.07	45.99	34.34	55.09
14	281.69	141.57	20.03	48.00	40.93	108.96	38.49	55.00
15	284.83	156.60	15.23	35.85	45.53	96.61	33.92	54.98
TOTAL	700.45	371.95	52.51	100.52	98.53	251.56	35.84	53.00

Table 2.1.5

GRAND TOTAL

NO.OF TELEGRAMS (G)	DESTINATED TO RG1 (1)	DESTINATED TO THE SAME AREA(T)	(T)/G	(1)/G
3859.24	1463.54	1526.08	39.53	37.90

2.2 Traffic In CTO.

The telegrams in CTO would be relay-switched using torn tape system in the near future. However, even at present 14,000 copies per day of which 97% are transitted to provincial offices or delivered to the metropolitan ward offices are being run through the route shown in Appendix 2.4. The manual supervision of routing including the portion of window receipt (about 20%) is a great strain on the nerve and requires much effort. To reduce the elapsing time of cross-office telegram transit at 2 hours 50 minutes (busy hour)(see Appendix 2.5) is therefore not an easy task.

After the automation has been accomplished both of domestic and international telegrams at present are transitted from or to the subsidiary offices, would be able to handle automatically without the aid of such offices,

With an exception, international telegrams accepted at CTO's counter would be handled by the pneumatic carrier system to CRB as before.

As is shown in Appendix 1.14, 60% of all international telegrams will be accepted through this simple and expedient existing system which is recommended for saving the cost of equipments.

2.3 Establishment Of Toll Center

Since the interchange of telegram within the same province is few in number, it is not advisable to establish a large number of subscriber stations and to automate the route between them. Based on the predicted value of receiving and despatching copies of telegrams of each center, the terminal doing the telegram transit is established (called toll - center), whereas smaller centers are specified the telegraph transit route according to Appendix 2.12. The toll centers are established on the following basis.

1) The terminal which has more than 100 copies per day including the service telegrams in the intermediate year, or important terminal which is geographically distant.
2) The terminal which has the incoming or outgoing telegrams of 30,000 copies per year in the final year. (30,000 copies per year means $\frac{30,000}{299}$ = 100.3 copies per day).

According to the final scheme, 112 toll centers are to be set up, while their tributary offices are arranged, as shown in Appendix 2.12.

The number of domestic telegrams dealt in all of the toll centers are indicated in Appendix 2.8.

The number of subscriber station lines can be figured out individually, by referring to the table in the above appendix.

LOCATION OF TOLL CENTERS

Table 2.3

ZONE	EXCHANGE CENTER	TOLL CENTER *1	SUBSIDIARY OFFICE *2
Central	Bangkok	51	96
North	Nakhon Sawan	21	79
North-East	Nakhon Ratchasima	20	95
South	Hat-Yai	20	58
TOTAL	4	112	328

As of 1987

*1 CRB.is excluded.

*2 Licence Post Offices are excluded.

2.4 Network Planning

A variety of means are in use for switching messages. A small number of lines may be handled by a manual exchange in which an operator makes switching as required. Similarly, automatic line switching like a telex exchange, is in use, in which the switching is done by relays. However, with a large volume of traffic, it becomes desirable to store - messages at the switching center.

Suppose that, terminal A wishes to send telegram to terminal C. but the line to C. is occupied by other traffic to or from terminal B.C. or D. The switching center can not send the telegram until the line becomes free. A small localized - system may be able to hold the telegram at terminal A until the requisite lines become free. To do this, the system must receive and analyze the address in advance and establish a communication path before the data are sent. This could be done, for example, by dialing and receiving a "busy tone" if the line was not free. With a large system handling many locations and lines such as the Nationwide Telegram network in Thailand. The delays of the messages can become considerable at times, and it may be undesirable to hold a telegram at the terminal for a long time, and when the number of lines provided are insufficient, the workless holding time must be increased by many-time-dialing. To circumvent this difficulty, the switching center receives the telegram regardless and stores it until it can be sent to its correct destination. This system of processing is called message switching in comparison with line switching. A primitive system commonly in use for doing this can be a torn-tape-switching center. In this, paper tape is the storage medium, and the switching is done manually.

Queues of transactions will develop in such a system. If a large number of telegrams are received in a short period on one line, these will sit in a receiving box waiting for the operators to inspect them. Similarly, a temporary high load on an outgoing line will result in a number of pieces of torn paper tape waiting to be transmitted on that line.

The more the amount of telegrams increase, the less service quality will be obtained by torn tape system, the new system to cope with the rapid increase of telegraph demand should be required. An automatic telegraph relay switching center may be considered to be an automation of the system just described.

In planning the automation of telegraph relaying system, it is necessary to review which system to adopt; namely, the line switching or the message switching. Besides, assuming from the expected future size as obtained above, by comparing the number of required routes, trunk lines among the switching centers or the annual rental cost of telephone transmission lines and the annual route cost, the limitation of the advantages of utilizing the voice frequency carrier telegraph circuit could be found. From this, the line configuration is conceived. While the comparison of system would be discussed in the section of evaluation, the process and the result of calculation of both cases will be described here.

2.5 Design of lines in case of message switching

2.5.1. Prior to the designing of subscriber station lines and trunk lines, the calculation of the total "Holding Time" of the facility (line and equipment)occupied by a telegram in average is needed as the first step. For that, we assume the following factors based on investigations surveys, estimation, or customs in the field of telegraph services of Thailand or foreign countries.

Note : *Detailed Explanation of The "Holding Time of Facility occupied By A Telegram".

As the concept of the "Holding Time" is of the utmost importance for the Traffic Theory, the detailed explannation will be advisable.

In other words, the "Holding Time" represents the - average occupation time of a facility by a telegram. In practice, the value is determined from the survey in respect to the actual working and trouble time of a facility during a busy hour of traffic and the real number of sending and receiving telegrams during the same hour, by applying the following expression.

Holding Time Per Telegram

$$= \frac{\text{Overall Working And Trouble Time Of Facility}}{\text{Number Of Sending and Receiving Telegrams}}$$

= Average Occupation Time Of Facility By A Telegram

(a) Average Overall Characters

The average overall characters contained in a telegram for the Message Switching System were accounted for 253.9 characters from our investigation.(Appendix 2.13)

(b) Transmission Time Per Telegram

The transmission time per telegram will be seen with ease by the following formula.

Transmission Time per Telegram

$$= \frac{\text{mean codes per telegram}}{\text{telegraph speed(in Bauds)}}$$

$$= \frac{253.9 \times 8}{50} = 41 \text{ (seconds)}$$

(c) Number of Telegrams Originated In Each Office

The number of telegrams originated in each office is shown in Appendix 2.13.

(d) Staying Time of Sending Telegram

The staying Time of Telegram at an operator's desk represents the time periods in average, from the acceptance till the end of transmission of a telegram loaded on an operator.

We may step up 7 minutes for this period as custom.

(e) Average Trouble Time Of Line And/Or Equipment In An Hour.

According to the trouble records of 1970, in Thailand, the average trouble times of line and/or equipment in a month are accounted for about 114 hours. Although the trouble times in an hour can become 560 seconds on calculation, expecting the future improvement in the maintenance in Thailand, the preferrable trouble times per hour could be estimated at 120 seconds, down 80% of the figure.

(f) Switching Process (Mechanical Process) Time

Some times are spent as prerequisite to the switching process (mechanical process) on the common subscriber method.

Each time is identified in the latter Table 2.5.2.1.

(g) Supplemental Process Time.

Furthermore, we will notice that there are some extra factors in the Holding Time involved. For example, we will have to take into account, the extra times attendent on dealing with error telegrams mainly, as follows.

(g - 1) Collation Time

The Average Collation Time of error telegram may be estimated at 140 seconds.

(g - 2) Correction Time

The average Correction Time of error telegram may be estimated at 50 seconds.

(g - 3) Error Rate

The Error Rate represents the probability percentage of error telegrams and the value can be usually set up for 0.5%.

(g - 4) Traffic Rate of Intra Office Information

The traffic rate of such intra office communication is like inquiry, investigation and information incidental to a telegram will be 5% in average.

(g - 5) Miscellaneous Times

The miscellaneous times represent the lost times in vain per telegram, due to the maloperation or redundant Keying by operators. This time will be 2 seconds on estimation.

For the convenience of observation, most of these factors are tabulated in Table 2-5-2-1.

Table 2-5-2-1

FACTORS OF HOLDING TIMES IN CASE OF MESSAGE SWITCHING

Type of Office / Type of Communication / Category	Single Subscriber Station		Common Subscriber Station		Exchange Office		LEGEND
	Send	Receive	Send	Receive	Receive From Common Subscriber Station	Send & Receive Via Trunk Line	
Average Trouble Time In An Hour	120 sec.	120 sec.	120 sec.	120 sec.	60* sec.	120 sec.	A
Transmission Time Per Telegram	41 sec.	41 sec.	41 sec.	41 sec.	42** sec.	-	
(f) Switching Process Times: Call	-	-	1 sec.	1.7 sec.	-	-	B
(f) Switching Process Times: Connection	-	-	1 sec.	-	1 sec.	-	B
(f) Switching Process Times: Response	-	-	1 sec.	1 sec.	0.5 sec.	-	B
(f) Switching Process Times: Counter Response	-	-	1 sec.	0.5 sec.	1 sec.	-	B
(g - 3) Error Rate	0.5 %	0.5 %	0.5 %	0.5 %	0.5 %	0.2 %	α
(g) Supplement Process Times: (g - 1) Collation Time	140 sec.	140 sec.	140 sec.	140 sec.	-	140 sec.	C_1
(g) Supplement Process Times: (g - 2) Correction Time	50 sec.	50 sec.	50 sec.	50 sec.	50 sec.	50 sec.	C_2
(g) Supplement Process Times: (g - 4) Traffic Rate Of Intra Office - Communication	5 %	5 %	5 %	5 %	5 %	5 %	β
(g) Supplement Process Times: (g - 5) Miscellaneous Time	2 sec.	-	2 sec.	-	2 sec.	-	γ
Staying Time of Sending Telegram	7 min.	-	7 min.	-	-	-	

Note : * The "Average Trouble Time In An Hour" over Light Loaded Line (common subscriber line) of an exchange office can be estimated at the half of that at a subscriber station.

** The "Transmission Time Per Telegram" at an exchange office can be given by adding the extra value (for the function in the "Incoming Position" of the office), 1 second to the normal Transmission Time.

2.5.2 Calculation of Total Holding Time Per Telegram

(1) Total Holding Time Per Sending Telegram At Single Subscriber Station

The total Holding Time per sending telegram at a single subscriber station can be calculated by using the following formula.

$$h = \left\{ B\,(1+\beta) + (2C_1 + C_2)\cdot\alpha \right\} \times \left(1 + \frac{A}{3600}\right) + \gamma \quad \text{(seconds)} \qquad \ldots\ldots\ldots (2.2.9)$$

where, h : total Holding Time Per Telegram

B : Basic Holding Time Per Telegram (inclusive of Transmission Time Per Telegram (b) and in addition, Switching Process Time (f))

β : Traffic Rate of Intra Office Communication (g - 4)

C_1 : Collation Time (g - 1)

C_2 : Correction Time (g - 2)

γ : Miscellaneous Time (g - 5)

A : Average Trouble Time In An Hour (e)

Substituting the relevant values directed in the Table 2-5-2-1 to the formula

$$h = \left\{ 41\,(1 + 0.05) + (2 \times 140 + 50) \times 0.005 \right\} \times \left(1 + \frac{120}{3600}\right) + 2$$

$$= 49 \text{ (seconds)}$$

Thus we can get 49 seconds for the total Holding Time per sending telgram.

(2) Total Holding Time Per Receiving Telegram At Single Subscriber Station. The value of 47 seconds for the total Holding Time per receiving telegram at a single subscriber station, is obtained by applying the same formula (2.2.2) similarly.

(3) Total Holding Time Of Trunk Line

The value of 46 secondsfor the total Holding Time of a trunk line at an exchange office, is gained by applying the same formula.

(4) Total Holding Time Per Sending Telegram At common Subscriber Station, The value of 60 secondsfor the total Holding Time per sending telegram at a common subscriber station, is acquired by applying the same formula.

(5) Total Holding Time Per Receiving Telegram At Common Subscriber Station. The value of 50 seconds for the total Holding Time per receiving telegram at a common subscriber station, is obtained by applying the same formula.

These values of the Holding Time are tabulated in Table 2-3-2-2, for convenience.

TOTAL HOLDING TIME PER TELEGRAM

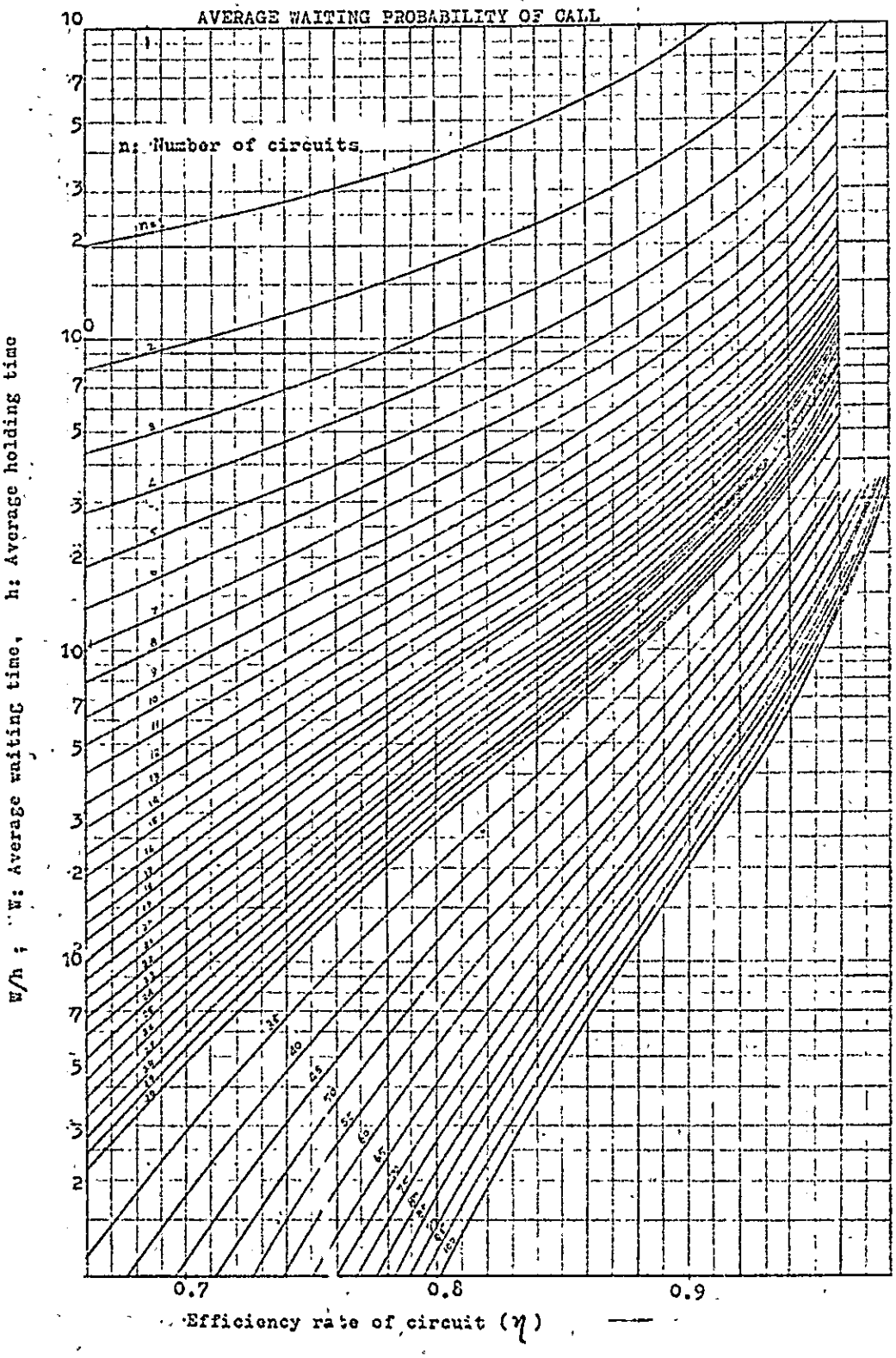
Table 2-5-2-2

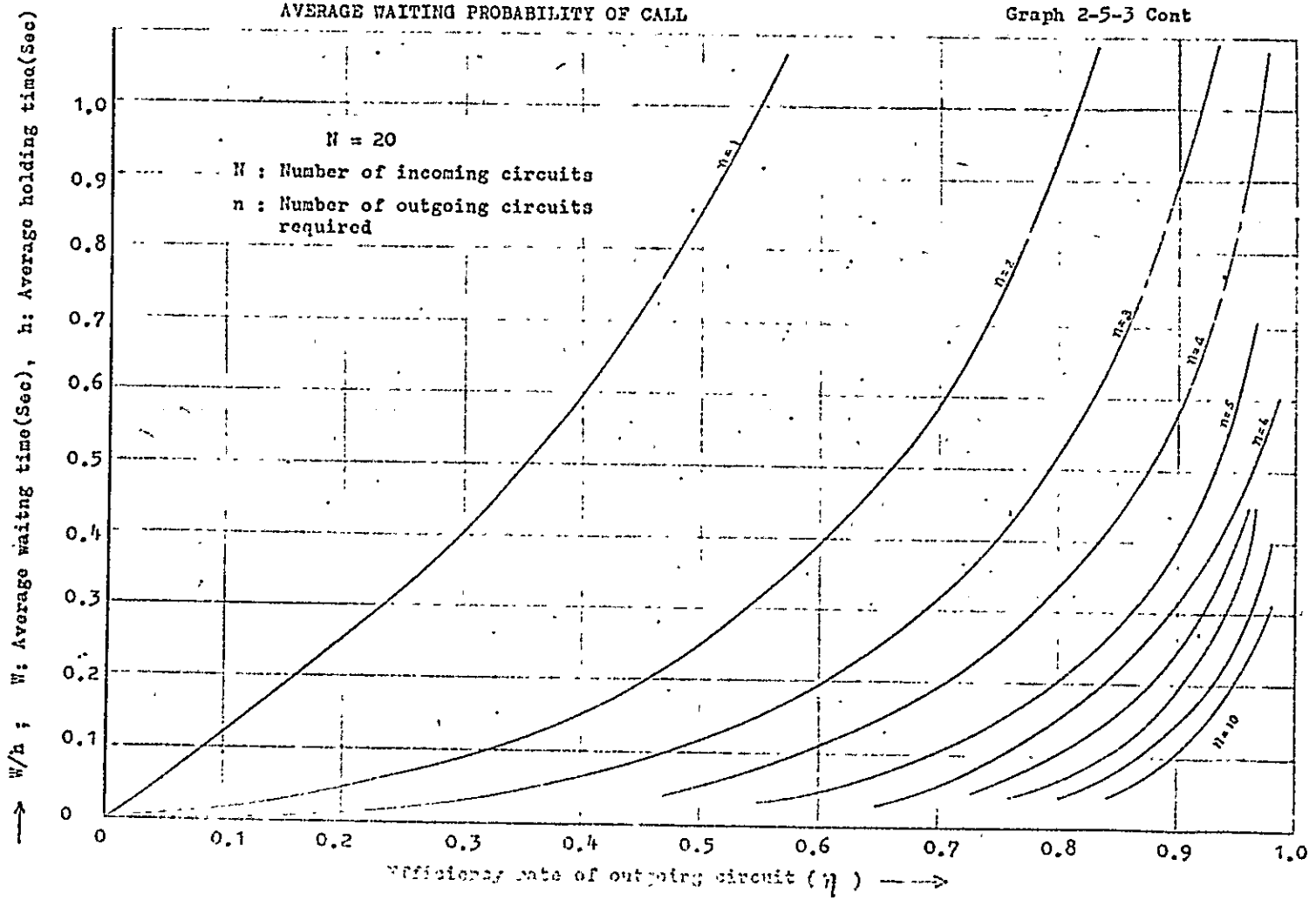
TYPE OF LINES			TOTAL HOLDING TIME (IN SECOND)
Single Subscriber Station (Heavy Load Subscriber Station)		Send	49
		Receive	47
		——	——
Exchange Office	Trunk Line	Send & Receive	46
Common Subscriber Station (Light Load Subscriber Station)		Send	60
		Receive	50

2.5.3 Calculation Of Number Of Lines To Traffic Load

(a) Calculation of number of Single Subscriber Station Lines To Traffic Load

Graph 2-5-3


AVERAGE WAITING PROBABILITY OF CALL
n: Number of circuits
W/h ; W: Average waiting time, h: Average holding time
Efficiency rate of circuit (η)
0.7
0.8
0.9


AVERAGE WAITING PROBABILITY OF CALL
Graph 2-5-3 Cont
N = 20
N : Number of incoming circuits
n : Number of outgoing circuits required
n=1
n=2
n=3
n=4
n=5
n=6
n=10
W/h ; W: Average waiting time(Sec), h: Average holding time(Sec)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
Efficiency rate of outgoing circuit (η) ——→

- 34 Cont -

Now since the total Holding Time per sending telegram, h is 49 seconds as shown in Table 2-2-2-2 and the Staying Time of Telegram At Operator's Desk (refer to 2.5.1 (d)) is 7 minutes, we can get the value of 371 seconds for the average "Waiting Time of Telegram For Handling", by the aid of the following expression.

The Average Waiting Time Of Telegram For Handling : $\overline{W}$ = The Staying Time Of Telegram At Operator's Desk - The Total - Holding Time Per Sending Telegram.

Then, $\overline{W}$ = 60 sec. × 7 - 49 sec. = 371sec.

Next, we calculate the value of $\overline{W}/h$.

$$\overline{W}/h = \frac{371 \text{ sec.}}{49 \text{ sec.}} = 7.57$$

By the aid of the graph of Average Waiting Probability Of Call (Graph 2-5-3) originated from Molina's formula on - traffic theory, the value of the efficiency rate of line, n (η = 0.89) when the number of line, n is 1, will be obtained.

Here, the efficiency of line expresses the ratio of traffic quantity in Erlang Versus number of line, n.

Thus we can get the traffic load of a line per busy hour, 65 telegrams by the following expression.

$$\frac{3600 \text{ sec.}}{\text{Total Holding Time}} \times \text{Efficiency Rate Of Line} = \text{Number Of Telegrams (Per Busy Hour)}$$

$$= \frac{3600 \text{ sec.}}{49 \text{ sec.}} \times 0.89 = 65 \text{ telegrams/hour}$$

To ease the traffic load of line per day, it can be obtained by 8 times as much as the value.

That is,

65 (telegrams) X 8 = 520 (telegrams)

When the number of lines is 2, since η is given 0.94 likewise the traffic load per day can be given by 552 telegrams.

When the number of lines is 3, since η is given 0.97 the traffic load per day can be given by 568 telegrams.

On the occasion of the receiving line, the calculation's procedure will be considerably reduced.

Seeing that the total Holding Time of a receiving telegram is 47 seconds as shown in Table 2-2-2-2, the traffic load of line per busy hour is given by

$$\frac{3600 \text{ sec.}}{47 \text{ sec.}} = 77 \text{ telegrams/hour}$$

Then we can get the traffic load per day by

77 X 8 = 616 telegrams/day

Note that the value of the traffic load per line is the same in each line on the occasion of receiving line, as shown in the Table 2-2-3.

For example, when n = 3, the total traffic load in a day will be 3 X 568 = 1,704 telegrams on the occasion of sending line, and will be 3 X 616 = 1,848 telegrams on the occasion of receiving line, respectively.

When n = 2, that is 440 telegrams.

When n = 3, that is 456 telegrams.

(b) Calculation Of Number Of Common Subscriber Station Line To Traffic Load.

We can get the traffic load of sending and receiving station line at a common subscriber station by the similar analogy.

(c) Calculation Of Number Of Trunk Lines To Traffic Load At An Exchange Office.

Also this calculation can be carried out by the similar analogy.

All these results of calculation are indicated in Table 2-5-3.

THE TRAFFIC LOAD PER LINE IN CASE OF MESSAGE SWITCHING.

Table 2-5-3.

NO. OF LINES / PER TIME / TYPE OF LINE		1		2		3	
		PER HOUR	PER DAY	PER HOUR	PER DAY	PER HOUR	PER DAY
gle Sub. ation	Sending Line	65 T.	520 T.	69 T.	552 T.	71 T.	563 T
	Receiving Line	77 T.	616 T.	77 T..	616 T.	77 T.	616 T
mon Sub. ation	Sending Line	51 T.	408 T.	55 T.	440 T.	57 T.	456 T
	Receiving Line	72 T.	576 T.	72 T.	576 T.	72 T.	576 T
change fice	Sending & Receiving Trunk Line	78 T.	624 T.	78 T.	624 T.	78 T.	624 T

Note : T : Telegrams

(d) Calculation of Number of lines required in message switching.

We can find the number of lines required in case of message switching in every office by applying Table 2.5.3. The result is summarized as Table 2.5.4.

NUMBER OF LINES REQUIRED

Table 2.5.4.

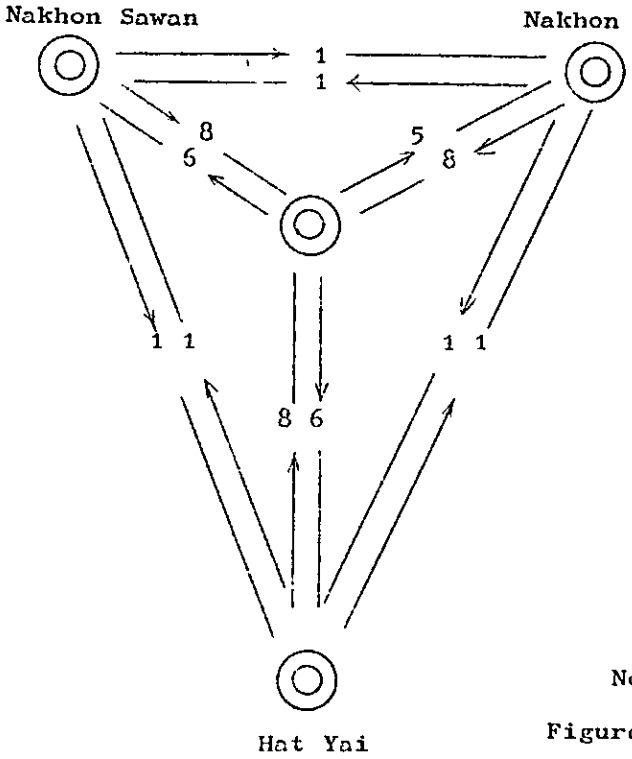
EXCHANGE ZONE	SENDING LINE	RECEIVING LINE
Central	47	70
North	17	23
North-East	24	23
South	21	25
TOTAL	109	141

(e) Calculation of Number of trunk lines required among the Switching Centers

At the same time, number of trunk lines required in 1987 are figured out from the volume of traffic among the Switching Centers based on the result of survey listed in Appendix 2.4, which is shown in Drawing 2.5.5.

Drawing 2.5.5

Number of Trunk Lines Required in 1987 in case of Message Switching



Note :

Figure shows

No.of Trunk Lines

among the Exchange Centers.

TRAFFIC AMONG EXCHANGE ZONES IN BUSY HOUR

Table 2.5.5

ORIGIN \ DESTINATION	CENTRAL	NORTH	NORTH EAST	SOUTH	TOTAL
CENTRAL	679.99 887.15	317.82 426.12	248.72 333.59	307.33 413.51	1553.86 2060.37
NORTH	440.28 540.87	258.55 318.02	39.21 48.07	22.41 27.25	760.45 934.21
NORTH EAST	441.00 572.45	50.02 65.19	335.98 435.51	17.48 22.68	844.48 1095.83
SOUTH	416.64 539.35	20.59 26.54	11.66 15.05	251.56 325.31	700.45 906.25
TOTAL	1977.91 2539.82	646.98 835.87	635.57 832.22	598.78 788.75	3859.24 4996.66

UPPER ROW FIGURES : No.of telegrams in 1979

LOWER ROW FIGURES : No.of telegrams in 1987

SUPPLEMENT

2.5.4 Calculation of Number of Incoming Positions to Traffic Load.

In the switching center, incoming positions for light load lines are common to many subscriber station lines. If the traffic is low, or few incoming positions will be required and conversely, if it is high, more imcoming positions will be requested. The number of positions depends on the traffic load.

When a message at a subscriber station is sent to the switching center, precedently or call signal is sent and next signal for acknowledgement is returned from the center if the center is ready to connect. A is often the case, the incoming positions are wholly held by another subscriber stations. On that case, the said office should wait for a while. We can tell by experience that the average waiting time should be 15 seconds by the aid of the following expression.

The average waiting time at the subscriber station after the depressing of key : $\bar{\eta}$, $\bar{\vartheta}$ = the Waiting Time - The Total Holding Time per Sending Telegram

Then $\bar{\eta}$ = 60 sec. X 1.25 - 60 sec. = 15 sec.

Next, we calculate the value of $\bar{\eta}/h$

$$\bar{\eta}/h = \frac{15}{60} = 0.25$$

By the aid of the graph of Average Waiting Probability of Call (Graph 2-5-3) originated from Molina's formula or traffic theory, the value of the efficiency rate of line, will be obtained if we fix the number of lines accommodated into the incoming positions.

Suppose that 20 lines are provided, and traffic per day is 4000 message, the required number of incoming position would be 8 positions by the aid of following expression.

traffic in busy hour = 0.0139 erl X 4000 X 0.125

= 6.95 erl

(because one telegraph call in Thailand in case of message switching is 0.0139 erl and "the concentration ratio"of traffic is 0.125, cf.Appendix 2.11)

$8^{Pos.} \times 0.88^{*} = 7.04^{erl} \quad 6.95^{erl}$

* n obtained from the table 2-5-3

when n = 20

That is, in such a condition, capable traffic over 8 positions is beyond 6.95 erl which is to be loaded to the incoming positions.

2.5.5 Calculation Of Number Of Outgoing Positions To Traffic Load.

At the outgoing position, whenever the messages are set onto the line transmitter, all of which stored in paper tapes can be sent without a bit of waiting time. Since they have a certain number of limited processing - telegrams with regard to an outgoing position, always the actual number of processing telegrams is more conservative than its upmost capacity. In other words, certain extent of efficiency with respect to accommodation will be existed. Assuming that the efficiency of operation is 80% and total number of outgoing messages is 5,000, the required outgoing positions are figured out by 12 positions by the aid of following expression.

$$5000 \div \overset{*1}{576} \div \overset{*2}{0.8} = 11.9 = 12 \text{ pos.}$$

*1 capability

*2 efficiency

(obtained from the table 2-5-3)

2.6 DESIGN OF LINES IN CASE OF LINE SWITCHING

2.6.1 Factors Of Holding Times

In the foregoing section, we have studied the Holding Time per telegram in case of Message Switching. Also in this section, we should observe the following factors of Holding Times in case of Line Switching.

(1) Transmission Time Per Telegram

(a) Average Number Of Characters In A Telegram.

The average number of characters in a telegram may be 253.9 characters, the same that in case of Message Switching.

(b) Typing Speed In The Field.

Judging from the percentage of "operators' field attendance", the field typing speed as a factor of the Holding Time might be estimated at 85% of the normal typing speed (224.3 - characters/minute) in Thailand. (See Appendix 2.14)

Then the field typing speed will be given by 190.7 characters/minute.

Therefore, the transmission time of a telegram in case of Line Switching will be 80 seconds on calculation.

$\therefore$ 60 sec. X 254characters $\div$ 190.7 characters

= 80 seconds

(2) Staying Time Of Sending Telegram At Subscriber Station.

The Staying Time Of Sending Telegram on an operator's desk of a subscriber station, will be - identical with that in case of Message Switching.

Hence, the time is given by 7 minutes.

(3) Average Trouble Time In An Hour.

The average trouble time of line and/or equipment in an hour may be 240 seconds twice as much as in case of Line Switching.

(4) Functional Process Time (Mechanical And Personal Process Time)

First, we estimate the respective time periods - corresponding to the consecutive processes at a subscriber station of this system.

(a) Seizure of Selector.

The time period (the time of seizure of Selector) from the depression of a "Dial" push button by an operator till the lighting of a "Call Lamp", will be 1 second in average.

(b) Dialling

The time period of dialling 5 digit call number by the operator after seeing the "Call Lamp" on, will be 10 seconds.

(c) Start Of Motor At Distant Subscriber Station.

The time period from the completion of dialling at the subscriber station till the start of Motor at a distant subscriber station, will be 1 second.

(d) Receiving Of Answer-back.

The time period from the start of the remote Motor till the reception of "Answer-back" signal will be 4 seconds.

(e) Sending of "Answer-back".

The time period from the reception of the "Answer-back" signal till the depression of a "Here-is" Key (send of "Answer-back" signal) by the operator will be 4 seconds.

(f) Confirmation Of End

The time period from the completion of sending a telegram till the sending of Answer-back signal by the operator for the confirmation at the end, will be 4 seconds.

(g) Release

The time period from the depression of a "Clear Key" by the operator till the release of the connection ("Call Lamp" off), will be 1 second.

(5) Supplemental Process Time

We have seen the supplemental process times on the Holding Times in case of Message Switching. Likewise we set up them on the Holding Time in this case.

(a) Collation Time

The average Collation Time for wrong telegrams may be equal to that in case of Message Switching. Namely, the value is given by 140 seconds.

(b) Correction Time

The average correction work time for wrong telegrams may be also equal to that in case of Message Switching. Namely, the value is given by 50 seconds.

(c) Error Rate

The probability percentage of error telegrams may be estimated at 0.7%, more than that in case of Message Switching.

(d) Traffic Rate Of Intra Office Communication.

The traffic rate of intra office communication including inquiry, investigation or the like will be 5%, the same that in case of Message Switching.

(e) Miscellaneous Time

The miscellaneous time inclusive of the repetition time due to his maloperation, redundant time of Keying or the like, by an operator, will be identical with that in case of Message Switching.

Hence, the value is given by 2 seconds. For the easy observation, these above mentioned factors can be indicated altogether in Table 2-6-1.

FACTORS OF HOLDING TIMES IN CASE OF LINE SWITCHING

Table 2-6-1

CATEGORY \ TYPE OF COMMUNICATION		SEND	RECEIVE	LEGEND
(3) Average Trouble Time In An Hour		240 sec.	240 sec.	A
(1) Transmission Time Per Telegram		80 sec.	80 sec.	B
(4) Functional Process Time	(4 - a) Seizure of Selector	1 sec.		- B
	(4 - b) Dialling	10 sec.		
	(4 - c) Start Of Motor	1 sec.	1 sec.	
	(4 - d) Receiving Of Answer-back	4 sec.	4 sec.	
	(4 - e) Sending Of Answer-back	4 sec.	4 sec.	
	(4 - f) Confirmation Of End	4 sec.	4 sec.	
	(4 - g) Release	1 sec.	1 sec.	
(5) Supplemental Process Time	(5 - c) Error Rate	7 %	7 %	α
	(5 - a) Collation Time	140 sec.	140 sec.	c_1
	(5 - b) Correction Time	50 sec.	50 sec.	c_2
	(5 - d) Traffic Rate of Intra Office Communication	5 %	5 %	β
	(5 - e) Miscellaneous Time	2 sec.	2 sec.	γ
(2) Staying Time Of Sending Telegram		7 min.		

2.6.2 Calculation Of Total Holding Time Per Telegram

The Total Holding Time per sending telegram at a subscriber station can be calculated by using the same formula (2.2.2) as in case of Message Switching.

That is,

$$h = \{B(1+\beta) + (2C_1 + C_2)\alpha\}(1 + \frac{A}{3600}) + \gamma$$

(seconds) .....(2.2.2)

Applying the respective value indicated in Table(2-6-1) to the formula.

$$h = \left\{80(1+0.05) + (2X140+50) \times 0.07 \quad (1+\frac{240}{3600}) + 2\right\}$$

= 122 seconds

Thus, we can get 122 seconds for the Total Holding Time per sending telegram.

By the similar way, we can get 108 seconds for the Total Holding Time per receiving telegram.

2.6.3 Calculation Of Number Of Lines To Traffic Load

First, computing the Traffic Unit (in Erlang) for the two Holding Times obtained previously, that is, 122 seconds for a sending telegram and 108 seconds for a receiving telegram, we can get 0.0339 Erlangs and 0.0300 Erlangs respectively. Because, by the definition of Erlang, the Traffic Unit(in Erlang)

$$\cong \frac{\text{Holding Time Per Telegram}}{3600 \text{ seconds}} \text{ Erlangs}$$

$$\cong \frac{122}{3600} = 0.0339 \text{ Erlangs}$$

and $$\cong \frac{108}{3600} = 0.0300 \text{ Erlangs}$$

Back to Sending calculation, the latter, that is receiving traffic 0.03 Erlang will be used in the next paragraph(b). Secondly, we calculate $\bar{W}/h$, where $\bar{W}$ is the Waiting Time of a sending telegram and h is the total Holding Time. Practically, the Waiting Time is obtained from the following same expression as in case of Message Switching.

$\bar{W} = T - h$

Where T : The Staying Time of A Sending Telegram indicated in Table (2-6-1).

Then

$$\frac{\bar{W}}{h} = \frac{T - h}{h} = \frac{60 \times 7 - 122}{122} = 2.44$$

As the third step, referring to Graph (2-5-3) originated from Molina's theory, we can get the following values of η , the Efficiency Rate Of Line, corresponding to the number of outgoing lines.

Here, the Efficiency Rate Of Line expresses the ratio of traffic quantity in Erlang versus number of lines. Table 2-6-2-1 shows the various values of η corresponding to n thus the carriable value of traffic is also indicated.

THE VALUES OF η

Table 2-6-2-1

n	η	CARRIABLE TRAFFIC IN ERLANG
1	0.705	0.705 (= 0.705 X 1)
2	0.845	1.790 (= 0.845 X 2)
3	0.895	2.685 (= 0.895 X 3)
4	0.915	3.660 (= 0.915 X 4)
5	0.935	4.675 (= 0.935 X 5)
6	0.945	5.670 (= 0.945 X 6)
7	0.952	6.664 (= 0.952 X 7)

Regarding the above table, we can get directly, the number of Sending lines required in each subscriber offices according to their traffic.

CARRIABLE TRAFFIC IN FULL AVAILABILITY TRUNK-GROUP

(FOR RANDOM CALL)

Table 2-6-2-2
1 - 100

n \ E_n	0.01	0.02	0.03	n \ E_n	0.01	0.02	0.03
1	0.01	0.02	0.03	51	38.80	41.19	42.89
2	0.15	0.22	0.28	52	39.70	42.12	43.85
3	0.46	0.60	0.72	53	40.60	43.06	44.81
4	0.87	1.09	1.26	54	41.50	44.00	45.78
5	1.36	1.66	1.88	55	42.41	44.94	46.74
6	1.91	2.28	2.54	56	43.31	45.88	47.70
7	2.50	2.94	3.25	57	44.22	46.82	48.67
8	3.13	3.63	3.99	58	45.13	47.76	49.63
9	3.78	4.34	4.75	59	46.04	48.70	50.60
10	4.46	5.08	5.53	60	46.95	49.64	51.57
11	5.16	5.84	6.33	61	47.86	50.59	52.54
12	5.88	6.61	7.14	62	48.77	51.53	53.51
13	6.61	7.40	7.97	63	49.69	52.48	54.48
14	7.35	8.20	8.80	64	50.60	53.43	55.45
15	8.11	9.01	9.65	65	51.52	54.38	56.42
16	8.88	9.83	10.51	66	52.44	55.33	57.39
17	9.65	10.66	11.37	66	53.55	56.28	58.37
18	10.44	11.49	12.24	68	54.27	57.23	59.34
19	11.23	12.33	13.12	69	55.19	58.18	60.32
20	12.03	13.18	14.00	70	56.11	59.13	61.29
21	12.84	14.04	14.89	71	57.03	60.08	62.27
22	13.65	14.90	15.78	72	57.96	61.04	63.24
23	14.47	15.76	16.68	73	58.88	61.99	64.22
24	15.30	16.63	17.58	74	59.80	62.95	65.20
25	16.12	17.50	18.48	75	60.73	63.90	66.18

n \ $\bar{E}_n$	0.01	0.02	0.03	n \ $\bar{E}_n$	0.01	0.02	0.03
26	16.96	18.38	19.39	76	61.65	64.86	67.16
27	17.80	19.26	20.31	77	62.58	65.81	68.14
28	18.64	20.15	21.22	78	63.51	66.77	69.12
29	19.49	21.04	22.14	79	64.43	67.73	70.10
30	20.34	21.93	23.06	80	65.36	68.69	71.08
31	21.19	22.83	23.99	81	66.29	69.65	72.06
32	22.05	23.72	24.91	82	67.22	70.61	73.04
33	22.91	24.63	25.84	83	68.15	71.57	74.02
34	23.77	25.53	26.78	84	69.08	72.53	75.01
35	24.64	26.43	27.71	85	70.02	73.49	75.99
36	25.51	27.34	28.65	86	70.95	74.45	76.96
37	26.38	28.25	29.59	87	71.88	75.42	77.96
38	27.25	29.17	30.53	88	72.82	76.38	78.94
39	28.13	30.08	31.47	89	73.75	77.34	79.93
40	29.01	31.00	32.41	90	74.68	78.31	80.91
41	29.89	31.92	33.36	91	75.62	79.27	81.90
42	30.77	32.84	34.30	92	76.56	80.24	82.89
43	31.66	33.76	35.25	93	77.49	81.20	83.87
44	32.54	34.68	36.20	94	78.43	82.17	84.86
45	33.43	35.61	37.16	95	79.37	83.13	85.85
46	34.32	36.53	38.11	96	80.31	84.10	86.84
47	35.21	37.46	39.06	97	81.24	85.07	87.83
48	36.11	38.39	40.02	98	62.18	86.04	88.82
49	37.00	39.32	40.97	99	83.12	87.00	89.80
50	37.90	40.26	41.93	100	84.06	87.97	90.79

(b) Number of Receiving Lines To Traffic Load.

As for the number of receiving lines to traffic load, we can get it directly from the Table 2-6-2-2 by using the value of 0.03 Erlang for the receiving traffic.

If we design the rate of call loss* 3/100, the appropriate number of receiving lines can be set up. The following table 2-6-2-3 summarized the number of receiving lines together with sending lines figured out by preceeding item. (For the detail, see appendix 2.17)

NO.OF LINES REQUIRED IN LINE SWITCHING

Table 2.6.2.3.

EXCHANGE ZONE	TOTAL	SEND	RECEIVE
Central	347	116	231
North	131	47	84
North-East	140	54	86
South	132	47	85
TOTAL	750	264	486

At the same time, number of trunk lines required among the switching centers in 1987 can be computed from the traffic (expressed on the base of Erlang, Table 2.6.2.4) The requisite lines are shown in the Drawing 2.6.2.5.

* Lost Call

The best way to furnish a good and prompt service with the minimum expense is to establish a standard for grade of service then to install the allowable least facilities to meet this grade. An overall grade of service of 1/8 - indicates a standard of service furnished at least expense and get capable enough to satisfy the subscribers.

The overall grade of service is nearly equal to the sum of lost call rates at each stage of calling switching and connecting. Since it is a fundamental method to allow a comparatively large lost call rate at the part, which - involves expensive equipment among all stages a large lost call rate is generally given to line links. In this viewpoint 3/100 is used for the lost call of subscriber lines and trunk lines. It is believed that a junction path for line switching in Thailand will not exceed three links in the future. Accordingly, with grade of service 3/100 for interexchange junction, together with the other loses in the exchange equipment in consideration the overall lost call rate will stay 1/8 by the aid of following formula.

$$\underset{1^*}{\frac{3}{100}} \times \underset{2^*}{3} + \underset{3^*}{\frac{1}{200}} \times \underset{4^*}{5} = \frac{11.5}{100} < \frac{1}{8}$$

1* Lost Call rate of line link

2* No.of Junction Paths

3* Lost Call rate of Switching

4* No.of stages

TRAFFIC IN 1987

Table 2.6.2.4

ORIGIN \ DESTINATION	CENTRAL	NORTH	NORTH EAST	SOUTH	TOTAL
Central	23.05 30.07	10.77 14.45	8.43 11.31	10.42 14.02	52.67 69.85
North	14.93 18.34	8.76 10.78	1.33 1.63	0.76 0.92	25.78 31.67
North-East	14.95 19.41	1.70 2.21	11.39 14.76	0.59 0.77	28.63 37.15
South	14.12 18.28	0.70 0.90	0.40 0.51	8.53 11.03	23.75 30.72
TOTAL	67.05 86.10	21.93 28.34	21.55 28.21	20.30 26.74	130.83 169.39

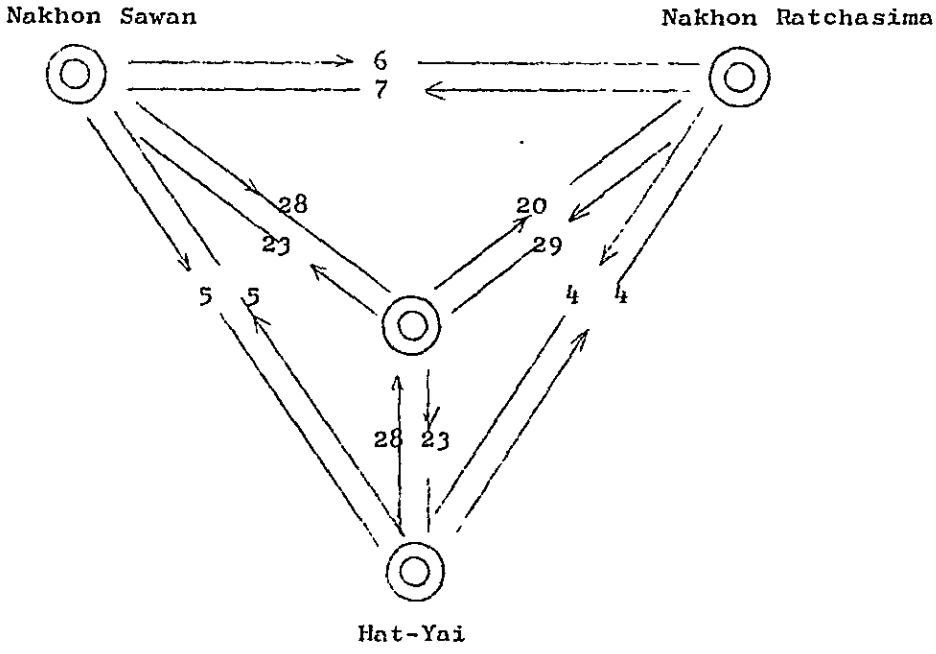
unit : erl

UPPER ROW FIGURES IN 1979

LOWER ROW FIGURES IN 1987

NUMBER OF TRUNK LINES REQUIRED IN CASE OF LINE SWITCHING

Drawing 2.6.2.5



REMARKS :

In case of line switching, as mentioned previously, we can get the number of lines required directly from traffic expressed in Erlang, by the aid of table 2-6-2-2. However, since the number of lines required in case of message switching were described on the basis of number of telegrams as shown in Table 2-5-3. Some conversion from the Erlang's table will help further comprehension in comparison.

(a) In case of Sending.

Taking example for n = 2, number of telegrams capable of sending, will be obtained by the aid of $n = 0.845$

$$2^{*1} \times 0.845^{*2} \times \frac{1}{0.0339} = 50$$

*1 n

*2 η

Accordingly, the number of telegrams per one line will be 25 (= 50 ÷ 2) in busy hour. Then we can get the traffic load of line per day, by 8 times as much as the value.

25 X 8 =200 telegrams/day

(b) In case of Receiving

Assuming that the rate of call loss is 0.03, 3 receiving lines can handle 0.72 erl altogether. Since the holding hour of a telegram is 0.03 erl, this value can be converted into the number of telegrams in one hour.

$$0.72 \times \frac{1}{0.03} = 24$$

Accordingly, one receiving line is allotted to 8 telegrams per hour. Similarly, the relations between the number of lines and their allotted number of telegrams are calculated.

As a result, the following table 2-6-2-2 can be introduced.

THE TRAFFIC LOAD PER LINE IN CASE OF LINE SWITCHING

Table 2.6.2.6

TYPE OF LINE \ NO.OF LINE PER TIME		1		2		3	
		HOUR	DAY	HOUR	DAY	HOUR	DAY
Subscriber Station	Sending Line	21 T	168 T	25 T	200 T	26 T	208 T
	Receiving Line	1 T	8 T	4.7 T	38 T	8.0 T	64 T

Note T : Telegram

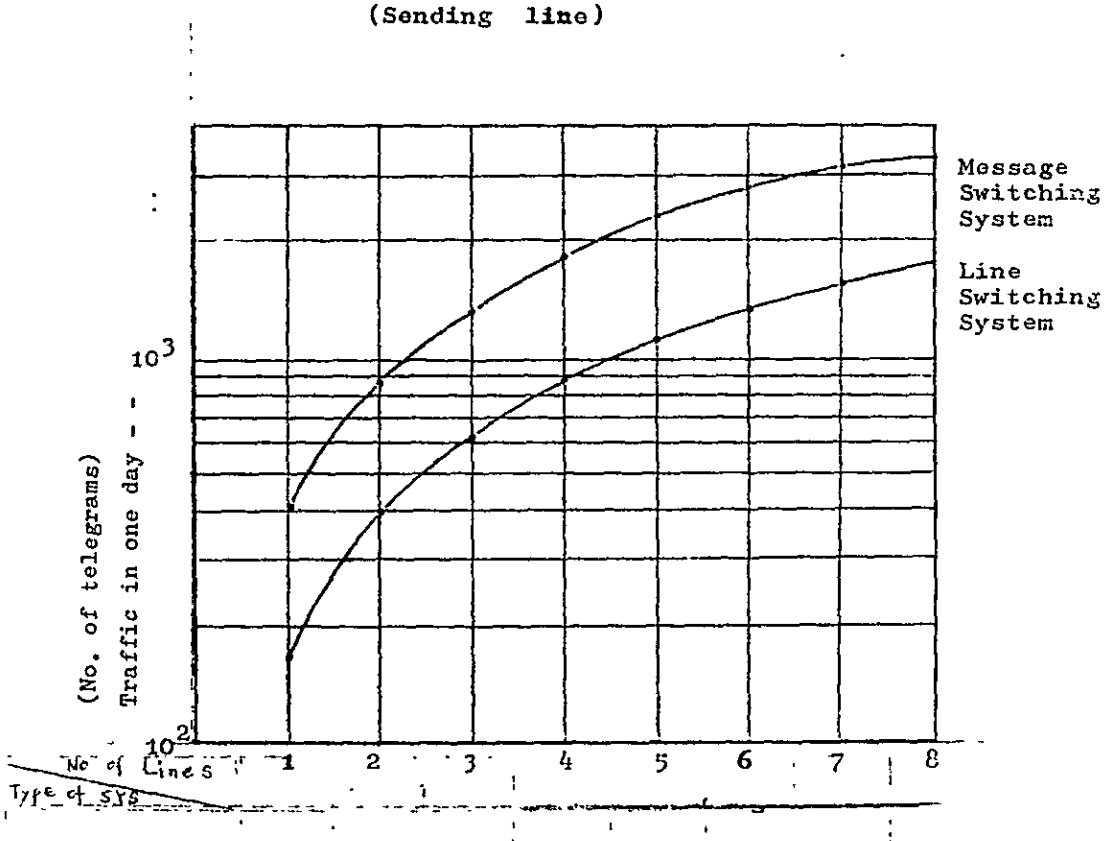
2.7 Comparison in number of requisite lines

The number of subscriber lines and trunk circuits calculated on the basis of the number of calls quoted in the foregoing paragraph, is shown on Drawing 2.7.1 and Drawing 2.7.2. From these figures, we can make clear that the number of lines required by line switching system are over several times as much as message switching system. (Usually as the lost call rate, 1/100 is given, instead of 3/100 used in the preceeding paragraph.) In such a case, the probability of busy line would be reduced. For this such plenty of lines as eight or nine times as much as message switching system must be required.

Drawing 2.7.1

COMPARISON CURVE OF CARRIABLE TRAFFIC,

IN MESSAGE SWITCHING AND LINE SWITCHING SYSTEMS



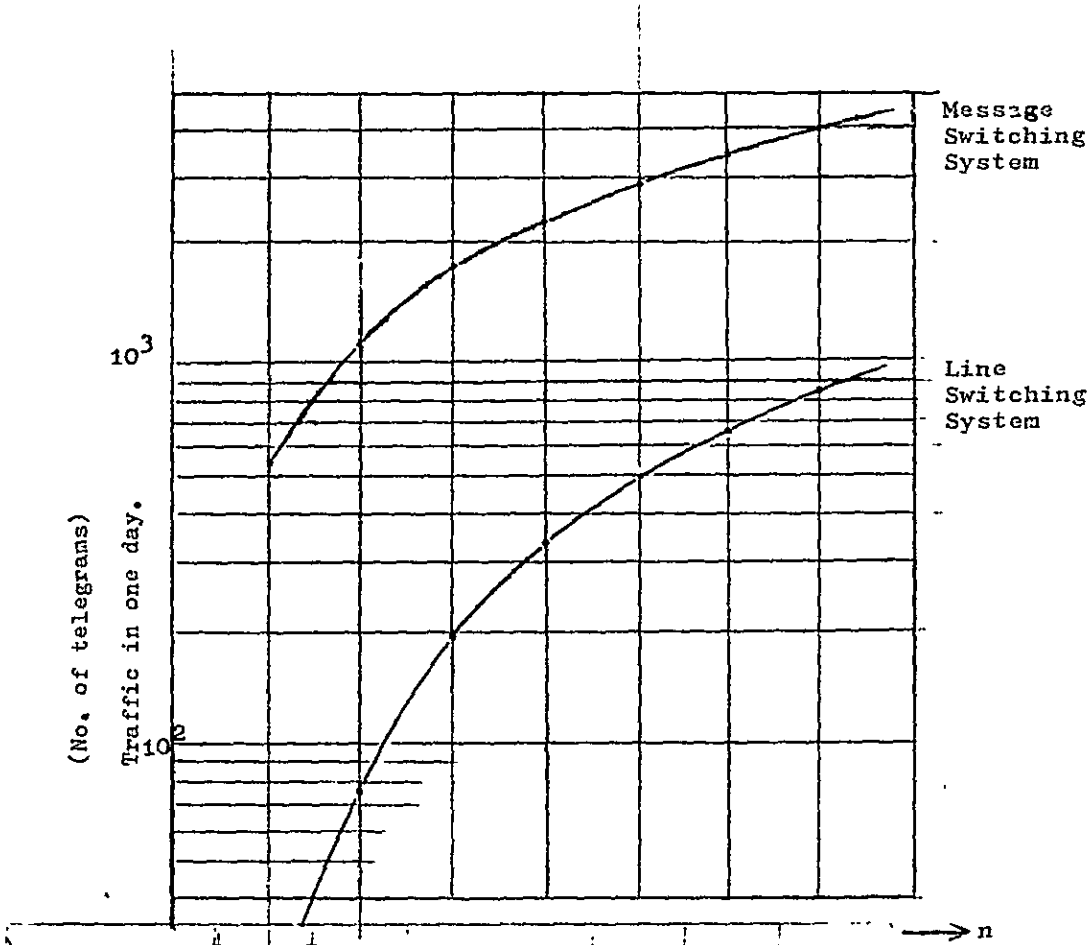
Type of SYS	1	2	3	4	5	6	7	8
Message SW.	408	880	1368	1850	2330	2780	3260	
Line SW.	168	400	632	864	1104	1336	1576	

COMPARISON CURVE OF ACCEPTABLE TRAFFIC FROM THE CENTER,

IN MESSAGE SWITCHING AND LINE SWITCHING SYSTEMS.

(Receiving Line)

Drawing 2.7.2



No. of Line / Type of SYS	1	2	3	4	5	6	7
Message SW.	576	1152	1728	2304	2880	3456	4032
Line SW.	8	76	192	336	501	677	867

Comparison in Message Switching and Line Switching systems with respect to No.of Requisite Subscriber Station Lines.

Table 2.7.1

EXCHANGE SYSTEM / ZONE	(STORE & FOR-WARD) MESSAGE SWITCHING *			LINE SWITCHING		
	TOTAL	Sent	Rec.	TOTAL	Sent.	Rec.
Central	70	47	70	347	116	231
North	23	17	23	131	47	84
North-East	24	24	23	140	54	86
South	25	21	25	132	47	85
TOTAL	149	109	141	750	264	486

* Two Wire Duplex

2.7 PROSPECT OF CARRIER TELEGRAPH

2.7.1. General

On the occasion when number of telegraph channels will be required in the field of the CTO. We should pay economical contemplation deliberately, seeing the tariff for the provisions of telecommunication in the TCT.

In other words, our major consideration must be taken into the economy of the leased telegraph channel and the leased telephone channel respectively.

2.7.2 Leased Telephone Channel

2.7.2.1. Annual Expenses Of Carrier Telegraph Equipment.

In case of the leased telephone channel, the CTO's own installation of a carrier telegraph equipment will be needed.

On the assumption of 13 years for the durability of each type of the equipment, the annual expenses of each type will be indicated in the following Table 2.7.1.

ANNUAL EXPENSES OF EACH TYPE

Table 2.7.1

TYPE OF EQUIPMENT	INSTALLATION COST	INITIAL COST	DURABILITY (IN YEAR)	INSTALLMENT FACTOR	DEPRE-CIATION COST	MAINTE-NANCE CHARGE	ANNUAL EXPENSES
24 ch.	1159.2	1217.16	13	0.1265	153.97	60.86	214.83
16 ch.	1021.0	1072.05	"	"	135.61	53.60	189.21
12 ch.	879.2	923.16	"	"	116.78	46.16	162.94
8 ch.	355.2	372.96	"	"	47.18	18.65	65.83
LEGEND	(1)	(2)=(1) X 1.05	-	(3)	(4)=(2) X (3)	(5)=(2) X 0.05	(6)=(4) + (5)

Unit of Expenses ; in thousand Baht.

REMARKS :

(a) The "Initial Cost" comprises the different expenditures incidental to the installation of an equipment.

Usually, the cost can be given by 1.05 X "Installation Cost".

(b) The "Depreciation Cost" represents the annual expenditure for the recovery of the "Initial Cost".

(c) Although the"Installment Factor" can be computed on the basis of the "Durability" and the annual interest rate, the procedure may be omitted.

The annual interest rate may be presumed at 8%.

(d) The "Maintenance Charge" can be given by 0.05 X "Initial Cost" as custom.

2.7.2.2 Rental of A Telephone Channel

The annual leased charge of a telephone channel corresponding to the distance in the TOT, will be seen in the Table 2.7.2.

ANNUAL RENTAL OF A TELEPHONE CHANNEL

Table 2.7.2

DISTANCE (IN km.)	UNDER 25	50	75	125	200	350	600	900	OVER 900
Leased Charge (In 10^{-3} Rs)	36	72	108	144	180	216	288	360	432

2.7.3 Leased Telegraph Channel

The Table 2.7.3. below shows the annual leased charge of A Telegraph Channel. Also the leased charge of a telegraph channel is set up in proportion to telephone channel.

ANNUAL LEASED CHARGE OF TELEGRAPH CHANNEL

Table 2.7.3

DISTANCE (IN km.)	UNDER 25	50	75	125	200	350	600	900	OVER 900
Leased Charge (In 10^{-3} Rs)	12	24	36	48	60	72	96	120	144

2.7.4 Economical Boundary

As we have seen in the Table 1-2-1, usually the annual expenses per channels of the carrier telegraph equipment comes up in accordance with the number of channels. In addition, judging from the future traffic, in this country, the maximum capacity of any trunk line will be sufficient at 8 telegraph channels.

Hence, we may consider about the recommended 8 channel carrier telegraph system only. Next, we construct the Table 2.7.4.so that we may acknowledge the eccnomical boundary concerning the 8 telegraph channels system.

ECCNCMICAL BCUNDARY OF 8-CHANNEL CARRIER SYSTEM

Table 2.7.4

DISTANCE (IN km.) / CATEGORY	UNDER 25	50	75	125	200	350	600	900	OVER 900
Lease Charge of A Telephone CH. (In 10^3 ¥)	36	72	108	142	180	216	288	360	432
Annual Expenses of Carrier Telegraph Equipment (In 10^3 ¥)	65.83	"	"	"	"	"	"	"	"
Total Amount (In 10^3 ¥)	101.83	137.83	173.83	209.83	245.83	281.83	353.83	428.83	497.83
Lease Charge of A. Telegraph CH. (In 10^3 ¥)	12	24	36	48	60	72	96	120	148
Economical Boundary (Quotient)	8.49	5.74	4.83	4.37	4.10	3.91	3.69	3.55	3.46

Note : The figure of the Economical Boundary is given by the total amount/Rental of a telegraph channel.

For instance, in the distance of 100 km., the figure of the economical boundary is seen at 4.37.

The figure comprises that the total charge of a leased telephone channel, annual expense of a self-installed 8-channel carrier telegraph equipment, corresponds to 4.37 times as much as that of a leased telegraph channel.

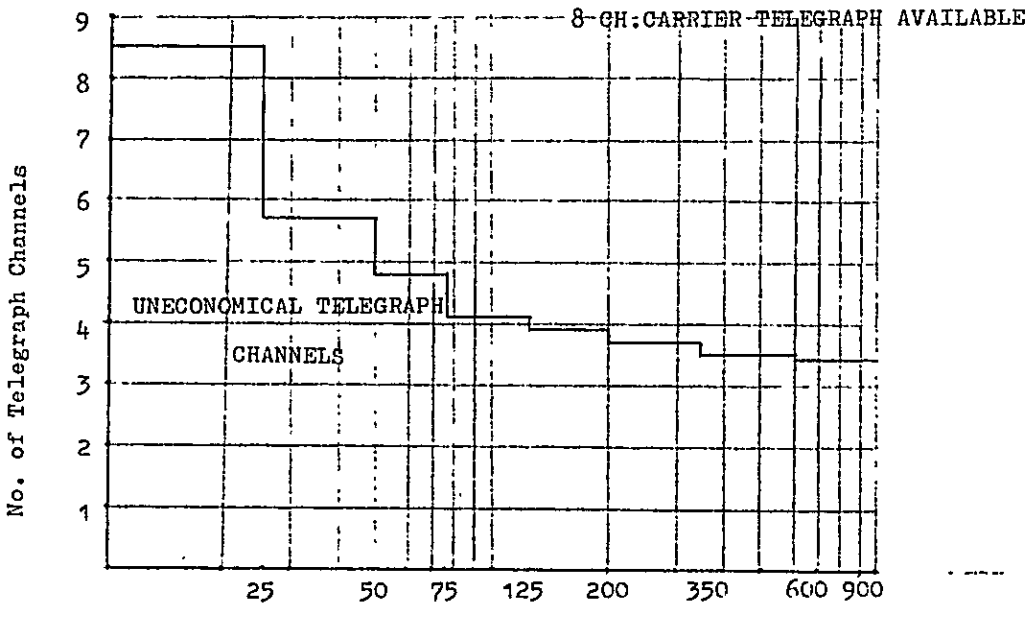
Accordingly, on economy, such a lease of a telephone channel proves unprofitable if we require only 4 - channels in the said section. As long as we provide 8-channel carrier telegraph equipment, we should avail more than 5 telegraph channels in case of 100 km.

Likewise, if the distance is longer than 200 km, at least, we should make use of 4 telegraph.

Thus, we can get the curve of the economical boundary with regard to a leased telephone channel, as shown in Graph 2.7.5.

The nation-wide network which will be displayed later has been designed based on this idea.

Graph 2.7.5 Curve Of Economical Boundary ;



3. Proposed System

3.1 Automation System Scheme

Message Switching System

This chapter describes a type of message switching system designed for mechanized retransmission of public telegrams at the New Bangkok Central Telegraph Office and other 4 offices.

The maximum number of circuits possible in this system is 80 incoming and 80 outgoing for BANGKOK and 30 incoming and 30 outgoing for another three offices respectively.

Introduction.

The nation-wide automatic telegraph network will be accommodated into this system which composed of one regional center (Bangkok), three direct centers (Nakhon Sawan, Nakhon Ratchasima and Hat Yai) and about 110 toll centers.

About 22,000 telegrams a day will be handled over this network in 1987 as the ultimate year of this plan.
Switching equipment will be installed at the toll centers which are tributary offices of the automatic telegraph switching network. The Regional Center and the district centers are generally called switching centers.

The switching system adopted for these centers is the full automatic switching system which uses the perforated tape relay method.

3.2 General

3.2.1 Network

The network for the automatic telegraph switching system will be constructed in the following manner:

(1) A terminal office is basically connected with its toll center by telephone lines or morse lines, over which messages are transmitted by telephone, facsimile sets or morse devices.

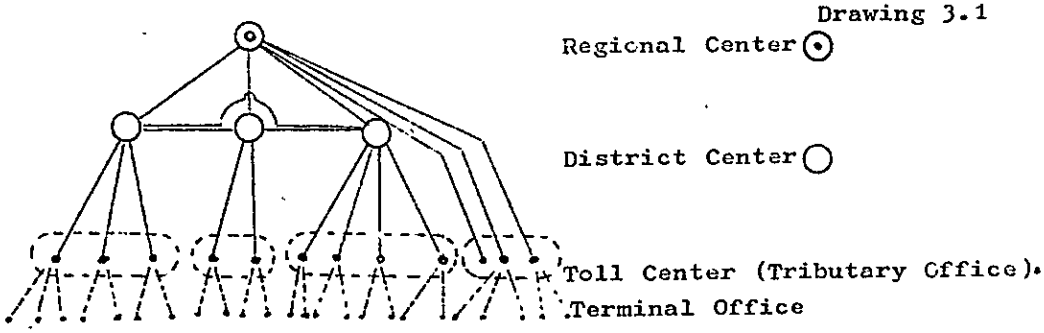
(2) The toll center is generally connected with the Regional Center by a direct teleprinter circuit, and messages over two district centers are exchanged at the Regional Center at the early stage of automation when the traffic is rare among the district centers.

(3) The district center is connected with the Regional Center by direct teleprinter trunk circuit, and temporary direct circuit may be established between the Regional Center and some toll centers belonging to another direct center, in case of emergency with consideration to traffic and line length.

The above description is illustrated in Drawing 3.1

Office Rank and Network configuration of telegraph switching relay system.

Drawing 3.1



3.2.2. Classification of circuits

The teleprinter circuits on this system are classified into a trunk circuit and a subscription circuit. The circuits between switching centers are called trunk circuits, and those between switching centers and

toll centers are called subscription circuits. According to the quantity of traffic, the subscription circuits are also divided into two classes, namely heavy-loaded circuits and light-loaded circuits. The former can handle more than 600 outgoing telegrams and 500 incoming telegrams per day, and the latter can send and receive more than 150 telegrams per day.

The heavy-loaded circuit is connected with its exclusive incoming and outgoing equipment at the switching center, and the light-loaded circuit is connected with incoming and outgoing equipment used in common for more than two subscription circuits. It is necessary, therefore, for transmission over the light-loaded circuit to make a connection between the circuit and the equipment at the switching center.

3.2.3 Perforation Format

This system is a perforated tape relay which exchanges messages automatically at the switching center by an address code perforated on the tape (Drawing 3.2) To prevent faults, various supervisory and inspection routines should be performed at each switching stage. For this purpose, various functions are included in the messages, and a perforation message format is provided for the nation-wide network, as follows ;

Signal "A"

Message Number (three digits)

"Letters"

Address code (two or three characters)

Space X 2

Text

"Figures"

Signal "B"

Space X 1

Signal "C"

Note (1) The signals between signal "A" and address code, are called the antecedent code.

(2) Signal "C" is perforated only at the light-loaded tributary office.

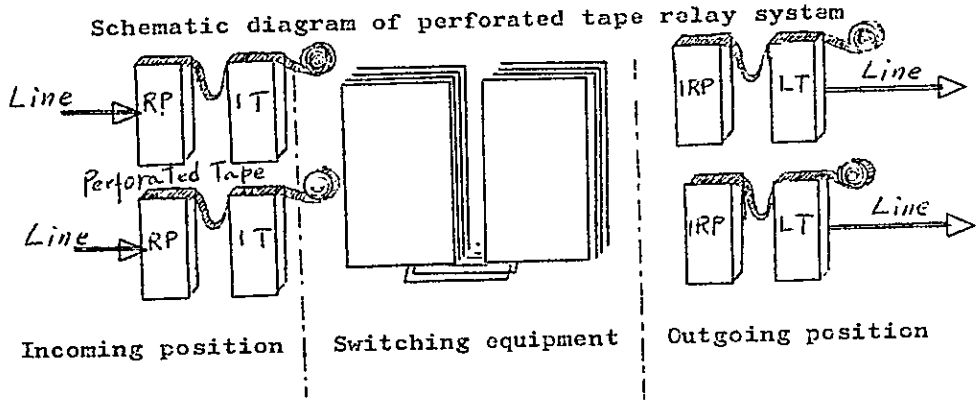
Signals "A" and "B" indicate the start and end of a measage, respectively. The message is inspected for correctness, and the switching operation at the switching center is controlled by these signals.

Signal "C" is used to disconnect the circuit and the incoming equipment at the switching center when a train of messages has been transmitted completely from the toll center to the switching center over a light-loaded circuit.

Consecutive numbers from 000 to 999 are given to the messages in each circuit for convenience of identification and safe-guarding of messages. Two or three characters are assigned for an address code.

Drawing 3.2

Schematic diagram of perforated tape relay system



3.2.4 Arrangement of address code

In order to distinguish the destination of each telegram, two or three available roman characters are assigned for an address code.

(1) Address code consists of District Code and office code. The district codes are assigned as follows:

For Central Zone K

For Northern Zone N

For North-Eastern Zone E

For Southern Zone S

(2) As for the office code, since the number of offices in the Central Zone exceeds the limit of available character, two digits of office code are allowed to use namely the first character and the second one.

The toll centers under the Bangkok Regional Center are

T plus their own characters

or P plus their own characters

(3) The following particular characters are used for special purpose commonly in every switching centers, should be avoided for the toll centers.

Z : own office

O : Test Position

M : Disposal Position

I : Special Position

Y : "

(4) After all, address code of all the toll centers are assigned as Table 3.1.

ADDRESS CODE TABLE

Table 3.1

	NAME OF OFFICE	ADDRESS CODE		NAME OF OFFICE	ADDRESS CODE
1.	BANGKOK CTO.	K Z	35.	CHACHOENGSAO	K T J
2.	INTERNATIONAL GATE	K X, K F	36.	NAKHON NAYOK	K T K
3.	BK.1	K C	37.	PRACHIN BURI	K T P
4.	2	K R	38.	TRAT	K T Q
5.	3	K D	39.	CHANTHA BURI	K T V
6.	4	K S	40.	RAYONG	K T R
7.	5	K N	41.	CHONBURI	K T C
8.	6	K E	42.	SIRACHA	K T B
9.	7	K B	43.	SATTA HIP	K T H
10.	8	K U	...	.....	.....
11.	9	K Q	44.	RATCHA BURI	K P R
12.	10	K L	45.	BAN PONG	K P B
13.	11	K H	46.	KANCHANABURI	K P K
14.	12	K J	47.	NAKHONPATHOM	K P N
15.	WAT LIAP		48.	SAMUT SAKHON	K P U
16.	NAPHRA LAN		49.	SAMUTSONGKHRAM	K P S
17.	HUA LAM PHONG		50.	PHETCHABURI	K P C
18.	BANGLAMPHU-BCN	Receive	51.	PRACHUAPKHIRIKHAN	K P Q
19.	BANGKRABUE	only	52.	THAP SAKAE	K P T
20.	POM PRAP		53.	HUA HIN	K P H
21.	PATHUM WAN		...	.....	.....
22.	SANTITHAM		54.	NAKHON SAWAN	N Z
23.	DON MUANG	K G	55.	TAKHLI	N H
24.	WONGWIEN YAI	K W	56.	TAK	N T
25.	DON MUANG AIR PORT	K A	57.	KAMPHAENGPHET	N K
26.	NONTHABURI	K T N	58.	UTHAITHANI	N D
27.	PATHUMTHANI	K T D	59.	CHAI NAT	N J
28.	SAMUT PRAKAN	K T F	...	.....	.....
-/.	.....	.....	60.	CHIANG MAI	Ñ C
29.	AYUTTHAYA	K T A	61.	" " 1	N *
30.	SUPHANBURI	K T U	62.	MAEHONGSON	N E
31.	ANG THONG	K T F	63.	LAMPHUN	N Q
32.	SING BURI	K T G	64.	LAMPANG	N L
33.	LOP BURI	K T L			
34.	SARA BURI	K T S			

	NAME OF OFFICE	ADDRESS CODE	NAME OF OFFICE	ADDRESS CODE
65.	UTTARADIT	N U	92. NAKHONRATCHASIMA	E Z
66.	CHIANG RAI	N R	93. " " 1	E *
67.	PHA YAO	N V	94. PAKCHONG	E P
68.	NAN	N A	95. CHAIYA PHUM	E C
69.	PHRAE	N W	96. BURI RAM	E W
70.	PHITSANULOK	N P	.....	.....
71.	SUKHO THAI	N S	97. CHUM PHON	S C
72.	PHETCHA BUN	N B	98. RANONG	S R
73.	LOMSAK	N X	99. PHANGNGA	S H
74.	PHICHIT	N G	100. TAKUAPA	S *
75.	TAPHAN HIN	N F	101. KRABI	S K
76.	UDON THANI	E U	102. PHUKET	S P
77.	" " 1	E *	103. NAKHONSITHAMARAT	S N
78.	LOEI	E L	104. PAKPHANANG	S J
79.	NONG KHAI	E N	105. THUNG SONG	S T
80.	KHON KAEN	E K	106. SURATTHANI	S V
81.	BAN PHAI	E F	107. HUN PHIN	S D
82.	SAKHON NAKHON	E S	108. PHATTALUNG	S A
83.	NAKHON PHANOM	E A	109. RANG	S G
84.	MUKDAHAN	E D	110. SONG KHLA	S B
85.	KALASIN	E J	111. HAT YAI	S Z
86.	MAHA SARAKHAM	E H	112. " " 2	S *
87.	UBON	E B	113. PATTANI	S E
88.	YASO THON	E T	114. NARATHIWAT	S W
89.	SISAKET	E Q	115. SUNGAI-KOLOK	S F
90.	SURIN	E V	116. YALA	S L
91.	ROIET	E R	117. SATUN	S U

* : As an exceptional use, a Thai character involved together with the Roman character in the same row of the Keyboard Perforator machine can be used.

3.2.5 Inspection and Supervision

From the sociological point of view, it is imperative that telegrams will be delivered quickly and without errors. Especially, there should be absolutely no lost telegrams. For this purpose the switching condition of each message is automatically supervised. An audible and visible alarm will be given to alert the switching operator when any trouble occurs. Then suitable action may be taken by the switching operator to maintain - normal switching operation.

Principal inspection and supervisory actions are as follows :

(1) AB Check

To prevent loss of telegrams, the alternate transmission of Signal "A" and Signal "B" is checked automatically at every stage of retransmission. This check is popularly named the "AB Check".

(2) Number Check

Consecutive running numbers, from 000 to 999, are given to the messages in each circuit. The sequence of running numbers is checked automatically at the incoming switching position. This check is popularly named the "No.Check".

(3) Called Circuit Check

When the outgoing circuit corresponding to an address code is selected in cross-office transmission, the address code set at the signal contacts of the intra-office transmitter is compared with the particular code of the selected outgoing circuit to prevent incorrect routing of the message. This check is popularly named the "Called Circuit Check".

(40 Supervision of Switching Time

The switching operation time in each stage is restricted, and a regular supervisory time is assigned to each stage. Then the switching time goes over the limit, an alarm is given to facilitate detection of trouble and to alert the switching operate.

(5) Observation of Tape Feed

If the feed holes on a tape are garbled and the tape does not feed smoothly at the reperforator or the intra-office reperforator, normal switching of messages is not performed, and the correction of this trouble is very complicated. Consequently, the condition of the tape feed at the reperforator or the intra-office reperforator is observed by the regular supervisory time to discover garbled tape easily in order that suitable action may be taken immediately.

3.3 : Main Equipment and Instrument

This chapter describes the main equipment and instrument to be installed at the switching center.

3.3.1 Switch-frame

In order to stabilize switching operations and reduce switching time, the switch-frames for this system are composed of cross bar switches and wire spring relays. Switch-frames (3500 mm.in height) are used about 50.

3.3.2 Switching Cabinet

Incoming and outgoing cabinets are of the same size and external appearance , and both are double-decked. Each position in an incoming switching cabinet houses Reperforator (RP) and Intra-office Transmitter (IT), and each position in an outgoing switching cabinet houses Intra-office Reperforator (IRP) and a Line Transmitter (LT).

A tape accumulator is provided to store the unsent tape between RP and IT or IRP and LT. A motor-driven tape winder is provided with each transmitter for easy storage of the sent tape.

In the top section of a switching cabinet, the waiting indicators (WI), the lamp panels and the switch panels, etc., are mounted in case of operational necessity.

Also, in the top section of an incoming switching cabinet, the counting meters and numerical discharge tubes are mounted. The receiving and sending messages are counted by these counting meters.

The numerical discharge tubes which glow on operating a key are used for displaying the next receiving message number.

3.3.3 Teleprinters

(1) Reperforator

A reperforator in an incoming position receives the messages over a line in the form of 6-unit codes perforated on the tape.

This reperforator is provided with the function contacts which operate on reception of the function signals included in the message, and the six signal contacts for checking the message running numbers are received through a light-loade circuit. In order to send a complete message through the associated intra-office transmitter, the reperforator is equipped with an automatic, non-interfering tape-feed device.

The RP perforation speed is 375 characters per minute (50 bauds) over a line.

(2) Intra-office Transmitter

An Intra-office Transmitter transmits information contained in the perforated tape to the desired outgoing position.

The transmitter is provided with six signal contacts to read or transmit electrically the codes on the perforated tape, and with the function contacts which are operated by sensing the function codes. Also, IT is equipped with a seventh-hole perforating mechanism for confirmation of complete cross-office transmission. Further information will be described in item 5(1).

The IT transmission speed is 750 characters per minute as each element of six unit signals is transmitted in parallel.

(3) Intra-office Reperforator

An Intra-office Reperforator receives the messages over a cross-office transmitting circuit in the form of perforated tape.

IRP is provided with six selector magnets corresponding to each element of the six-unit code, the punching unit perforating the tape, and the function contact confirming reception of Signal "B".

The IRP perforating speed is 750 characters per minute.

(4) Line Transmitter

A Line Transmitter reads electrically the codes on the perforated tape and sends out information to a line in the form of a series of electrical signals. LT is provided with six signal contacts to inform the marker of the address code for selecting the

desired light-loaded circuit, and with function contacts which are operated by sensing the function codes.

The LT transmission speed is 375 characters per minute (50 bauds) over a line.

(5) Printer

A Printer is usually installed at tributary offices to print receiving messages on the paper tape. At the switching center, the printer is installed in a special position for communication with other offices. The printer is provided with function contacts which operate on reception of the function signals, and with a gong which rings on reception of a bell signal.

The printer has a type cylinder with three shift operation.

The printing speed of the printer is 375 characters per minute (50 bauds).

(6) Keyboard Perforator

A Keyboard Perforator is usually installed at tributary offices to perforate the corresponding code on a tape by depressing a key. When conversation with other offices is necessary, it is possible to send telegraph signals directly to a line by depressing the keys after moving the toggle switch to "Transmission".

The highest consecutive perforation speed is 1,150 characters per minute, and the transmission speed is 375 characters per minute (50 bauds).

3.3.4 Special Position

This position is for inquiries to other office operators about incorrectly handled messages, and is composed of push-button and lamp panels, and teleprinters (a keyboard perforater and a printer) are installed for conversation. Each circuit is assigned one push-button and one lamp.

3.3.5 Master Sending Equipment

This equipment is used for simultaneous transmission of emergency telegrams or service telegrams to tributary offices. Also, transmission of messages from a single tape to a maximum of fourteen offices is possible.

3.4 Transmission and Switching

This chapter describes the transmission of messages to and from offices through lines and switching operation at a switching center. Drawing 3.3 shows the schematic diagram of the switching system.

3.4.1.Transmission over Light-Loaded Circuit

Line transmission of messages is described only for transmission over a light-loaded circuit as transmission over a heavy-loaded circuit or a trunk circuit is similar to that of a point-to-point teleprinter circuit.

(1) Receiving

A group of light-loaded circuits consists of about twenty circuits, and a number of incoming positions are used in common for these circuits. Each light-loaded circuit can be connected to any idle position in the group.

On reception of a calling pulse from some light-loaded tributary office, the associated light-loaded line circuit (LL) is started. Also an idle line-finder (LFD) is selected after the line-finder connector controller (LFD C CONT) has been operated. Then a line-finder controller (LFD CONT), LFD, and LL are connected by a relay connector, and the horizontal bars of crossbar switches corresponding to the started LL are selected. On the one hand, when an idle LFD is selected, the vertical bar corresponding to the selected LFD is decided. When connection between LL and LFD has been completed, LFD CONT is released and prepared for the next switching operation.

After preparation for reception has been completed at LFD, a bell signal is sent back to the calling office under the control of LL. If a message is being sent to this office from LT in the outgoing position, the sending line connected with LT is switched to a bell signal sender after LT has been stopped, and then a bell signal is sent out.

Upon reception of the bell signal at the calling office, a train of messages is sent to the switching center. The messages from the tributary office are received at RF in the incoming position associated with the selected LFD. In this receiving step, the sequence of message numbers is checked. After receiving each complete message, WI and the counting meter for receiving move one step forward, and "ABCK" is also done. When reception of a train of messages has been completed and Signal "C" has been received at RF, all operated circuits are released.

(2) Sending

For an outgoing position used for light-loaded circuits, it is necessary that the desired circuit will be selected by the address code contained in the antecedent code of the cross-office transmitted message. When a complete message has been received at IRP,WI of the outgoing position moves one step and the tape feed in LT is started upon recognition Signal "A" by the tape sensing mechanism of LT, the line transmission circuit (LT U) is operated and the tape feed is stopped where the address code signal combination is set at six contacts of LT. A line transmission connector controller (LT C CONT) is started by the operated LT U. An idle line transmission marker (LTM) is selected by the started LT C CONT, and LTM is connected with LTU.

By this connection, the LT signal combination is recorded at the tree circuit contained in LTM. The desired LL associated with the destination is selected, and a one-second calling pulse is sent to the desired office from LT under the control of LT U.

The teleprinters installed at the tributary office are started by this calling pulse, and the response pulse is sent back to the switching center after complete preparation for reception has been made.

LT starts sending the message on reception of the response pulse.

Upon recognition of Signal "B" by the tape sending mechanism of LT, the tape feed is stopped. WI goes back one step and "ABCK" is also done. In the tributary office, the teleprinters are stopped by receipt of Signal "B".

3.4.2 Cross-office Transmission

(1) Start of Outgoing Circuit

The pointer of WI mounted on the incoming position moves one step each time one message is received, and the tape perforated at RP is fed through the associated intra-office transmitter. Upon recognition of Signal "A" by the tape sensing mechanism of LT, the counter circuit contained in the intra-office transmission circuit (IT U) associated with IT will be started. The tape feed is stopped at the second digit of the running number by this counter circuit, and the signal combination of this digit is set at the six signal contacts of IT. The number checker associated with IT checks the number for correctness. The third digit of the running number is checked continuously in the same manner.

After checking the sequence of the running number, IT feeds out the tape for two characters, and stops moving when the signal combination of the first character of the address code is set at the six signal contacts of IT. This signal combination is recorded at the tree circuit (used for decoding) contained in IT U. By this recording, the marker start controller (MST CONT) associated with the desired idle outgoing position operates and the marker connector controller (MC CONT) is started by MST CONT.

MC CONT is associated with each outgoing group, which consists of ten outgoing circuits.

(2) Operation of Marker

The idle marker (MKR) is selected by MC CONT, and MRK, MST CONT and the intra-office receiving circuit (IRP U) are connected to each other by the marker connector (MC). To ensure uniform operation of MC CONT, only one common marker connector control circuits is installed. If the desired outgoing circuit is multi-channel, one circuit is selected by MKR. Also, MKR selects one originated incoming group which consists of ten incoming circuits on information received from MST CONT. Upon determining the incoming group, the incoming group connector (IGC) is started by MKR. The incoming group, the primary crossbar switch, the secondary crossbar switch, and MKR, are mutually connected by IGC. After MKR has selected the originating incoming circuit included in the selected incoming group, MKR scans the idle links between the incoming and outgoing groups, and finds an available link.

The primary, secondary, and tertiary crossbar switches are simultaneously operated by MKR, and the cross-office transmitting route, from the incoming circuit to the outgoing circuit, is complete. When the cross-office connection is complete, MKR checks the double connection in the operated crossbar switches and for confusion in selected links. MKR continuously scans for confusion or disconnection of cross-office transmitting wires. When these checks show negative, MKR will be released after the operating condition or any circuit failure has been recorded by the trouble recorder.

(3) Operation of Sender

Three senders (SND) are assigned to the two outgoing groups which include the twenty IRP U, and are used in common. When MKR is released an idle sender is started by the desired IRP U. IRP U and SND are connected by the sender connector (SC).

The particular abbreviation code assigned to the incoming position is perforated at IRP under the control of SND. Following this perforation, the SND check circuit confirms whether or not the signal combination of the address code formed at the six signal contacts of IT corresponds with the signal combination of the desired outgoing circuit. If this confirmation is positive the automatic number sender (NOS) associated with the desired outgoing circuit sends the antecedent code to IRP.

(4) Cross-office Transmission

Cross-office transmission will now follow immediately.

(5) Receiving Confirmation of Signal "B"

Upon recognition of Signal "B" by the tape sensing mechanism of IT, the tape feed is stopped, while Signal "B" is received at IRP simultaneously, and information on the receiving confirmation picked up by the function contact is sent back to IT U.

(6) Release

Upon receipt of this information at IT U the operated switches and circuits are released, and WI, NOK, and the counting meter for sending in the incoming position move one step forward and/or backward.

In order to mark completion of cross-office transmission, the seventh hole is perforated by IT on the sent tape, between the eighth and ninth characters behind the Signal "B" perforation. WI and NOS in the outgoing position move one step after IRP U has confirmed release of the cross-office connection.

3.5 Countermeasure of protection on message transmission

To lose a telegram during the transmission process is the most significant problem in telegraph operation and so far. This trouble has been fully avoided by manual collation of the serial numbers of messages sent and received. In stead of this cumbersome manual practice. Various kinds of checking are adopted in this system.

(1) Omission from transmission of message at a subscriber office or loss between line transmitter (LT) and reperforator (RP) caused by trouble on transmission line or at incoming position.

As a countermeasure to meet the loss trouble, checking of the final digit of the message running number and the initial and end codes (abbreviated to "A" and "B" codes respectively) at the incoming position, has adopted. And this check shows that this tape of trouble is generally detected at a rate of 0.1 percent, including one not due to mechanical defects.

The collation of running numbers is performed at the IT position on both heavy-loaded and trunk circuits or at the RP position on light-loaded circuits. Therefore, as a measure to lower errors between the LT and the RP, both the initial and end codes are checked, collation of message running number and an observation circuit for irregular tape-feeding at the concentrated incoming position, are to be provided respectively.

(2)Message lost between intra-office transmitter (IT) and intra-office reperforator (IRP).

When the IRP has trouble in reperforation or tape-feeding or otherwise the IT circuit has not been closed, due to the disposition service on the IT, this kind of trouble is likely to occur. As for tape feed trouble, the conventional observation circuit for an irregular tape-feed pitch at the IRP shall be used again and, moreover, another check-through circuit between IT and IRP is to be adopted, because the number of switches and contacts for connection between these two positions is quite large.

The rate of lost messages caused by the IRP itself is only about 1 per 1 million messages. The non-mechanical fault in the IT causing omission of message is mainly due to misoperation by the operator when the trouble disposition is performed and the rate of occurrence is estimated at about 1 per ten or twenty thousands messages. Accordingly in case a tape finishes sending, the seventh hole is punched in the upper part of the holes for the six unit code. Then, when in normal condition, the perforation tape is always punched with both the end code and the seventh hole at a ratio of 1 : 1, and if the ratio is disturbed an alarm allows it to be detected by the tape-winder device. Trouble caused by misfeeding of the tape is obviated manually.

(3) Detecting method of blocked messages

The occurrence of this tape of trouble and the alarm signal are not always simultaneous. For instance, in case the transmission line has been faulty for some time, and several messages such as 10, 20, ...etc. have been blocked in transit the alarm may be given only when the first number check is done after restoration of the circuit. In case the traffic is quite slow, as late at night, detection of the trouble is sometimes very much delayed.

Constant observation of the transmission line for instantaneous notice of any break should, of course, be continuously carried on, but to make surveillance more complete confirmation messages are sent at regular intervals for automatic checking when transmitted to the offices of origin, and thus immediate detection of any block in the stream of messages can be achieved.

After the accomplishment of three district centers, a test transmission circuit would be installed, from which a short message is sent to the IRP of each outgoing position to be retransmitted to the test position after it has been sent to each primary outlet.

(4) Centralized disposition for misaddressed messages

Wrongly addressed messages found at the incoming position must disturb the following normal messages, therefore, such messages are automatically concentrate at the trouble disposition desk and handled there for re-arrangement into regular form to be sent back to the transmission circuit again.

3.6 Features of this Switching Facility

Features provided in this system are as follows :

(1) The main part of the switching equipment is composed of cross-bar switches and wire spring relays for stabilization of switching operation and reduction of switching time.

(2) The intra-office reperforator is equipped with a function contact, in order to confirm reception of Signal "B" of intra-office transmission.

(3) The trouble by-path position is installed at the switching center. When a desired outgoing switching position is faulty in cross-office transmission the messages destined for this position will make a detour and be automatically received at the trouble by-path position to obviate delay of subsequent messages.

(4) Two counting meters are provided for each incoming switching position to indicate the number of messages received and sent. It will be simple to check the number of unsent messages by comparing the indications on the two meters.

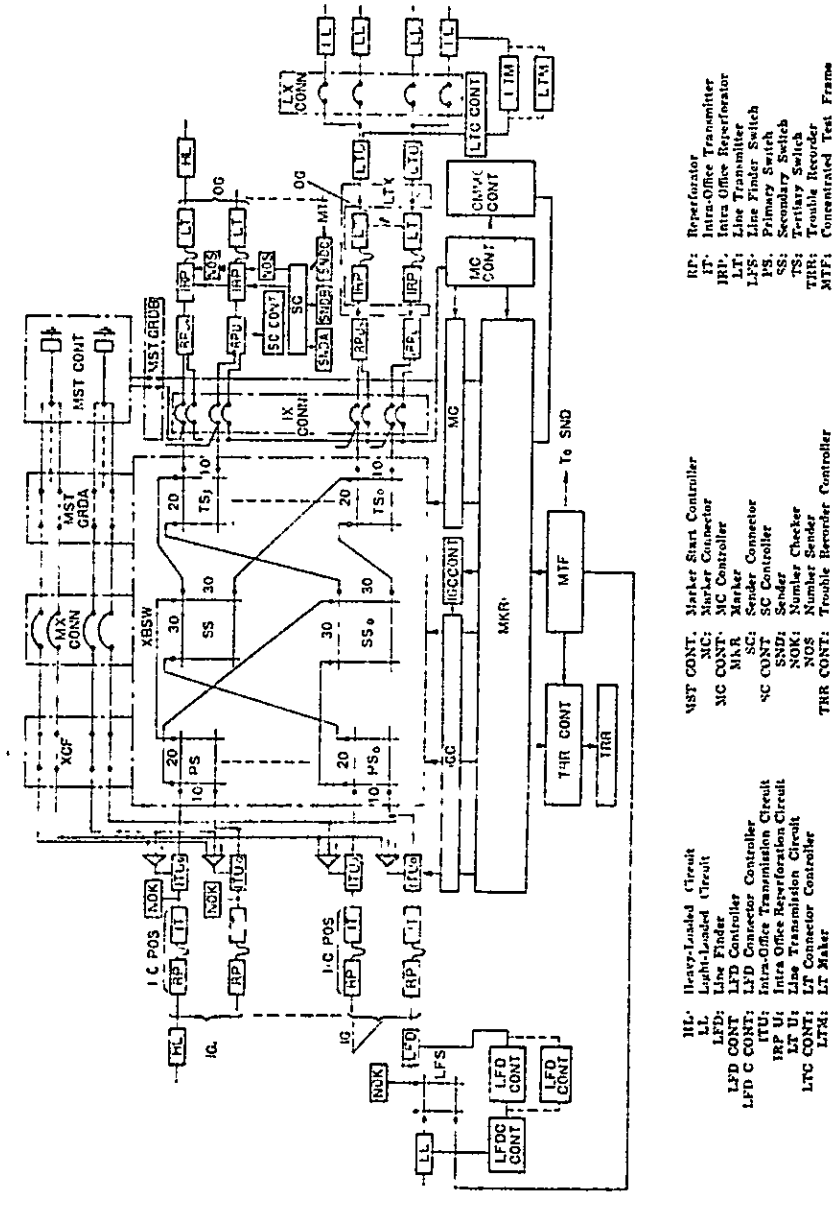
(5) Pauses between reception of messages over a heavy-loaded circuit or a trunk circuit are supervised to find out easily the unreceived messages at the incoming switching positions.

(6) A common supervisory frame (CSF), with lamps and switches, is installed to check switching conditions and to close out desired circuits.

A concentrated test frame (MTF), which is used for various tests, is installed for convenience of [illegible] maintenance.

(7) A trouble recorder is provided, and trouble information on common control circuits will be perforated on paper tape.

(f) A switch-frame with connectors is provided to facilitate alteration of an address code and alternate routing is possible.



3.7 Facilities At The Switching Centers

According to the recent statistics in Thailand, the gross amount of the public telegrams within this year will be 5 million telegrams with the annual increase about 3%.

In the metropolitan area and its vicinity, the growth of telegraph traffic will be more extensive than other local areas with the urbanization and enlargement of economy. So thus, in this area and vicinity 4 million telegrams by far 1979, and 5 million telegrams by far 1987 will be handled respectively.

The required numbers of telegram lines and positions for the initial stage (1973) and the scope for the ultimate stage (1987) are shown in the following Figures in the table 3.2, 3.3 & 3.4, the Drawing 3.4 & 3.5 respectively. It will be noteworthy that the layout for the initial stage must be inadequate from the background of the ultimate stage.

As the switching centers (exchange offices) for the local areas are to be installed after several years with reconsidering the increasing trend of traffic, the layout may be only for the ultimate stage, as shown in the following figures in the Table 3.5 & 3.6.

ARRANGEMENT OF POSITIONS AT CTO.

Table 3.2

KIND OF POSITIONS	NO. OF POSITIONS I/C	NO. OF POSITIONS O/G	REMARKS
Heavy loaded substituted by trunk line (I/C & O/G)	HL* Pos. 20	HL* Pos. 20	Nakhon Sawan, Roiet, Chiang Mai, Nakhon Ratchasima, Lampang X 2, Chiang Rai, Nakhon Sithammarat, Phrae, Suratthani, Phitsanulok, Trang, Udonthani, Song Khla, Khon Kaen, Hat Yai, Nakhon Phanom, Yala, Ubon, Thung Song
Heavy Load (I/C & O/G)	HL Pos. 3	HL Pos. 3	BK2, BK4, BK11
CTO Own Office Heavy Load(O/G)	No. Pos. (2 cct)	HL. Pos. 1	No. is used for the own office. I/C pos.
CRB Heavy Load (I/C & O/G)	HL pos. 2	HL pos. 2	CRB
Heavy Load (O/G) Light Load (I/C)		HL pos. 8	BK3, BK5, BK6, BK7, BK12, BK1 X 3
Light Load(I/C & O/G)	LL* pos. 13	LL* pos. 10	CRB, BK8, BK9, BK10; Ayutthaya, Ang Tong, Suphanburi, Bang Pong, Lopburi, Saraburi, Chachoengsao, Prachinburi, Don Muang, Chonburi, Sing Buri, Sattahip, Samut Songkhram, Ratchaburi, Kanchanaburi, Nakhonphathom, Phetchaburi, Samut Prakan

Table 3.2 Cont.

KIND OF POSITIONS	NO. OF POSITIONS		REMARKS
	T/C	O/G	
			PrachuapkhirikhanThap Sakae Chanthaburi Hua Hin Rayong Siracha (28 offices)
Light Load (T/C only)		0	Watlıap Naphralan Hua Lampong Bang Lamphu-bon Pomprab Pathumwan Wong Wien Yai (7 offices)
TOTAL	pcs. 38 2cct.	pcs. 44	Total Number of lines Heavy T/C : 27 Heavy O/G : 34 Light T/C : 43 Light O/G : 28

*1 HL = HEAVY LOAD

*2 LL = LIGHT LOAD

THE SCALE OF THE BANGKOK EXCHANGE OFFICE

IN ULTIMATE STAGE (PROSPECT)

1. NUMBER OF INCOMING POSITIONS

Table 3.3

KIND OF POSITIONS		NO.OF POSITIONS	NO.OF OFFICES ACCOMMODATED	REMARKS
(1) Trunk Line (Heavy Load)		24 + 1	3	Nakhon Sawan - 8 Nakhon Ratchasima 8 Hat Yai - 8 Spare 1
WITHIN THE EXCHANGE ZONE (2)	(2.1) Heavy Load	7	7	BK 2 BK 3 BK 4 BK 5 BK 7 BK11 Lopburi
	(2.2) Heavy Load Incoming Only	3	3	Hua Lamphong Danglamphu-bon Pomprab
	(2.3) Heavy Load C/G - Side Light	2	2	Prachin Buri Chon Buri
	(2.4) Light Load	18	(C/G Side heavy 5	BK 1 BK 6 BK 9 BK10 BK12
			SEND ONLY 5	Wat Liap Naphra Lan Bang Krabue Pathum Wan Santitham
			SEND & REC. 29	BK 8 CRB Wongwien Yai Nonthaburi Samut Prakan Donmuang Pathumthani Ayutthaya Suphan Buri Ratchaburi Angthong Ban Pong Sing Buri Kanchanaburi Saraburi Nakhon Pathom Chachoengsao Samut Sakhon Nakhon Nayok Samutsongkhram Trat Phetchaburi

Table 3.3 Cont.

KIND OF POSITIONS	NO.OF POSITIONS	NO.OF OFFICES ACCOMMODATED	REMARKS
			Chanthaburi Prachuapkhirikhan Rayong Thap Sakae Sira Cha Hua Hin Satta Hip
(2.5) Heavy Load	4	1	C R B
TOTAL	58 + 1	55	-
Own Office Telegram Handling Position	0	4cct.	In case of own office they have No.1/C Pos.

THE SCALE OF THE BANGKOK EXCHANGE OFFICE

IN THE ULTIMATE STAGE (PROSPECT) - CONT -

2. NUMBER OF OUTGOING POSITIONS

Table 3.3 cont.

KIND OF POSITIONS		NO.OF POSITIONS	NO.OF OFFICES ACCOMMODATED	REMARKS
(1) Trunk Line (Heavy Load)		17 + 3	3	Nakhon Sawan 6 Nakhon Ratchasima 5 Hat Yai 6 Spare 3
WITHIN THE EXCHANGE ZONE (2)	(2.1) Heavy Load	7	7	BK 2 BK 3 BK 4 BK 5 BK 7 BK11, Lopburi
	(2.2) Heavy Load	16	8	BK 1. X 5 BK 5. X 3 BK 2. X 2 BK 6. X 1 BK 3. X 1 BK11. X 1 BK 4. X 2 BK12. X 1
	(2.3) 1/C Side Light C/G Side Heavy	5	2 (5)	*BK 1, X 1 *BK 6, X 1 BK 9, X 1 BK10, X 1 *BK12, X 1 Out of 5 offices marked * are counted in the above column already.
	(2.4) Light Load	13	31	Prachinburi CRB(Disposal pos) Chonburi BK 8 Wong Wien Yai Nonthaburi Samut Prakan Donmuang Pathumthani Ayutthaya Suphanburi Ratchaburi Ang Thong Ban Pong Sing Buri Kanchanaburi Saraburi Nakhon Pathom Chachoengsao Samut Sakhon Nakhon Nayok Samut Songkhram Trat Phetchaburi Chanthaburi Prachuapkhirikhan Rayong Thap Sakae Siracha Hua Hin Sattahip
	(2.5) Heavy Load	2	1	CRB.
TOTAL		60 + 3	52	-
OWN OFFICE		1	1	-

NO. OF ACCESSORY POSITIONS IN THE SWITCHING CENTERS

Table 3.4

NAME OF POSITIONS	USAGE	BANGKOK CTO.. INITIAL STAGE	1987	REMARKS : TELEPRINTERS LOCATED
SPECIAL DISPOSITIONS	To have conversation between subscriber stations by Teleprinter.	1	2	KP PP
TROUBLE BY PATH DISPOSITIONS	To store telegrams addressed to out-of-order outgoing positions so that the following telegrams can be processed without delay.	1	2	IT IRP
MISADDRESS POSITIONS	To collect messages of which address is invalid.	1	1	KP IT IRI
NIGHT DUTY DISPOSITIONS	To store telegrams addressed to non-stationed offices at night.	1	1	PP IRP IT
MONITOR DISPOSITIONS	To substitute 1/c pos.by RP, C/G pos. by RI, O/G pos.by LT and to monitor by IRP.	1	1	LT RT IRP X 2
PRINTING MONITOR DISPOSITIONS	Monitor Printing and Simultaneous transmission.	1	1	PP
TEST SEND(I) DISPOSITIONS	To examine status of communication by - ordinary subsidiary subscriber station	1	1	KT PP LT
TEST SEND(II)	To find blocking telegram through connection test.	1	1	IRP
TOTAL	-	8	10	-

SUBSCRIBER LINES ACCOMMODATED IN DISTRICT CENTERS

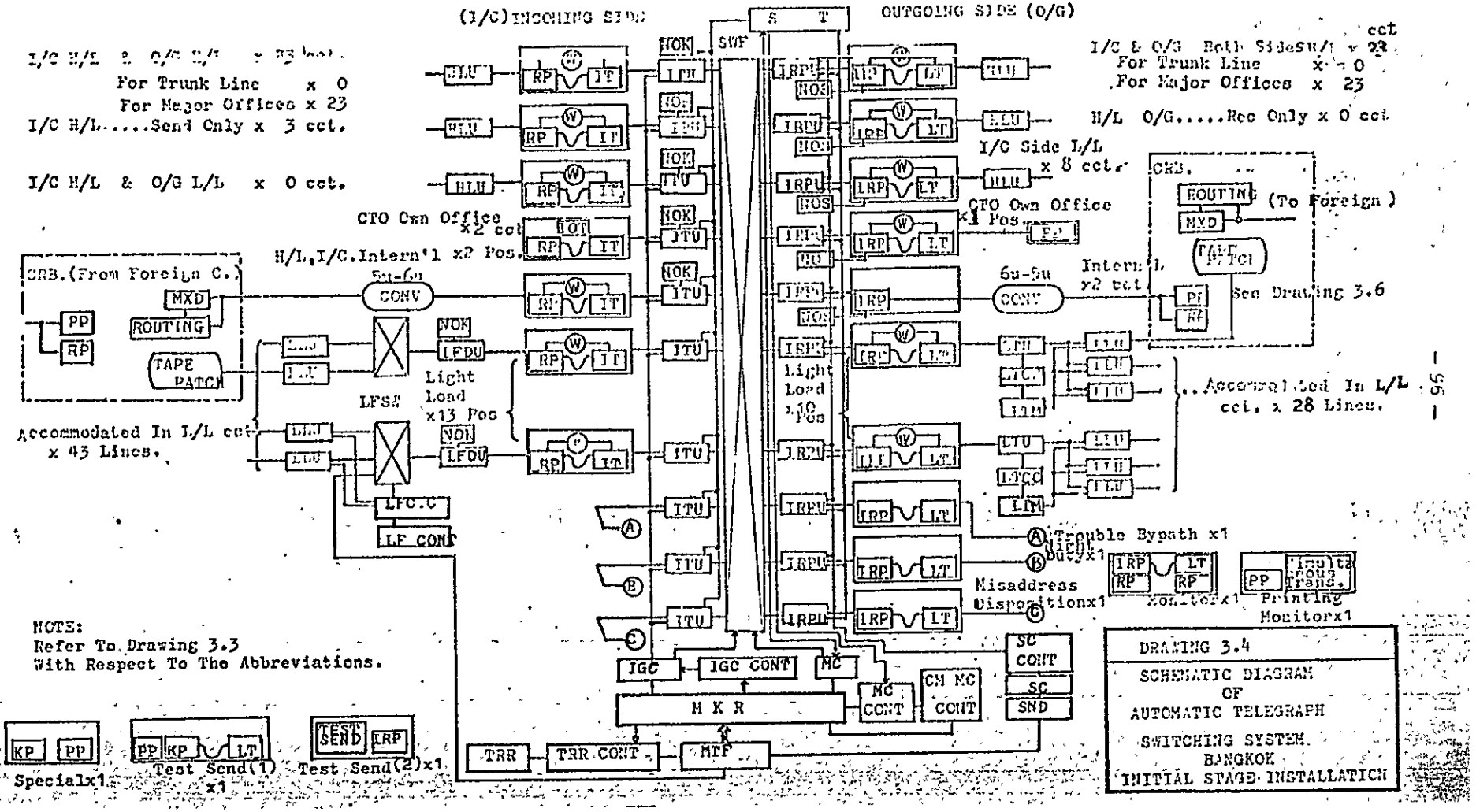
Table 3.5

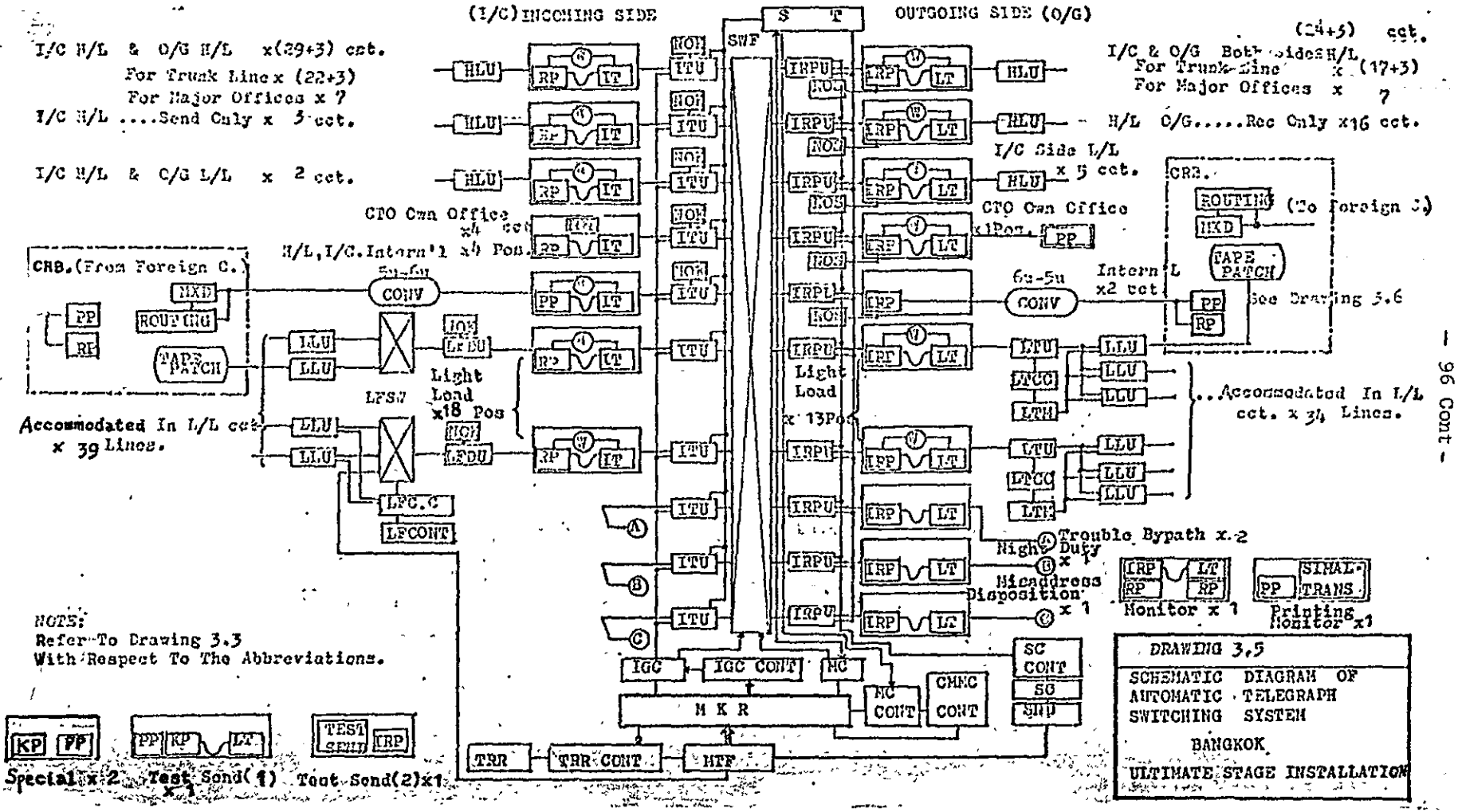
KIND OF LINES	NAKHON SAWAN		NAKHON RATCHASIMA		HAT YAI	
	I/C	O/G	I/C	O/G	I/C	O/G
Heavy load for - Trunk	8	10	7	10	8	10
Heavy load for Subsidiary Office	6	6	8	8	8	8
Heavy load for sending only	1	-	-	-	1	-
I/C Heavy, O/G Light	-	-	4	-	-	-
Own Offices	2	2	2	2	2	2
Light Loaded Subsidiary Offices	15	15	13	13	12	12
Light Load for sending only	-	-	1	-	-	-
TOTAL	32	33	35	33	31	32

EXCHANGE POSITIONS IN DISTRICT CENTERS

Table 3.6

EXCHANGE POSITIONS		NAKHON SAWAN	NAKHON RATCHASIMA	HAT YAI
Incoming Positions	Trunk Lines	8	7	8
	Heavy Load	6 + 1	8 + 5	8 + 1
	Light Load	7	6	7
	TOTAL	21 + 1	21 + 5	23 + 1
Outgoing Positions	Trunk Lines	10	10	10
	Heavy Load	6 + 1	8 + 1	8 + 1
	Light Load	6	6	5
	TOTAL	22 + 1	24 + 1	23 + 1
OWN OFFICE POSITIONS		2	2	2
Others	Special - Disposition	1	1	1
	Trouble by path Disposition	1	1	1
	Misaddress - Disposition	1	1	1
	Monitor - Disposition	1	1	1
	Printing Monitor Disposition	1	1	1
	Night Duty - Disposition	1	1	1
	Test Send - Disposition(I)	1	1	1
	Test Send Disposition(II)	1	1	1
	TOTAL	8	8	8


(I/C)INCOMING SIDE
OUTGOING SIDE (O/G)
S T
SWF
I/C H/L & O/G L/L x 0 cct.
For Trunk Line x 0
For Major Offices x 23
I/C H/L.....Send Only x 3 cct.
I/C & O/G Both Side x 23
For Trunk Line x 0
For Major Offices x 23
H/L O/G.....Rec Only x 0 cct.
I/C Side L/L x 8 cct.
CTO Own Office x2 cct
H/L,I/C.Intern'l x2 Pos.
CTO Own Office x1 Pos.
Intern'l x2 cct.
CRB.(From Foreign C.)
CRB.
ROUTING (To Foreign)
See Drawing 3.6
Accommodated In L/L cct x 43 Lines.
Accommodated In L/L cct. x 28 Lines.
Light Load x13 Pos
Light Load x10 Pos
LFSW
LFC.C
LF CONT
Trouble Bypath x1
Busy x1
Misaddress Disposition x1
Monitor x1
Printing Monitor x1
Special x1
Test Send(1) x1
Test Send(2) x1
IGC
IGC CONT
MC
MC CONT
CH MC CONT
SC CONT
SC SND
M K R
TRR
TRR CONT
MTF
NOTE:
Refer To Drawing 3.3
With Respect To The Abbreviations.
DRAWING 3.4
SCHEMATIC DIAGRAM OF AUTOMATIC TELEGRAPH SWITCHING SYSTEM BANGKOK INITIAL STAGE INSTALLATION


(I/C) INCOMING SIDE
S T
OUTGOING SIDE (O/G)
I/C H/L & O/G H/L x(29+3) cct.
For Trunk Line x (22+3)
For Major Offices x 7
I/C H/L ....Send Only x 3 cct.
I/C H/L & O/G L/L x 2 cct.
I/C & O/G Both sides H/L (24+5) cct.
For Trunk Line x (17+3)
For Major Offices x 7
H/L O/G.....Rec Only x16 cct.
I/C Side L/L x 5 cct.
CTO Own Office x4 cct
H/L,I/C.Intern'l x9 Pos.
CTO Own Office x1Pos.
CRB.(From Foreign C.)
CRB.
ROUTING
(To Foreign C.)
TAPE PATCH
See Drawing 3.6
Intern'l x2 cct
Light Load x 13Pos
Light Load x18 Pos
LFSW
Accommodated In L/L cct. x 39 Lines.
..Accommodated In L/L cct. x 34 Lines.
Trouble Bypath x 2
High Duty x 1
Hicaddress Disposition x 1
Monitor x 1
Printing Monitor x1
NOTE:
Refer To Drawing 3.3
With Respect To The Abbreviations.
Special x 2
Test Send(1) x 1
Test Send(2) x1
DRAWING 3.5
SCHEMATIC DIAGRAM OF AUTOMATIC TELEGRAPH SWITCHING SYSTEM
BANGKOK
ULTIMATE STAGE INSTALLATION

POWER CONSUMPTION OF THE SWITCHING FACILITIES

Table 3.7

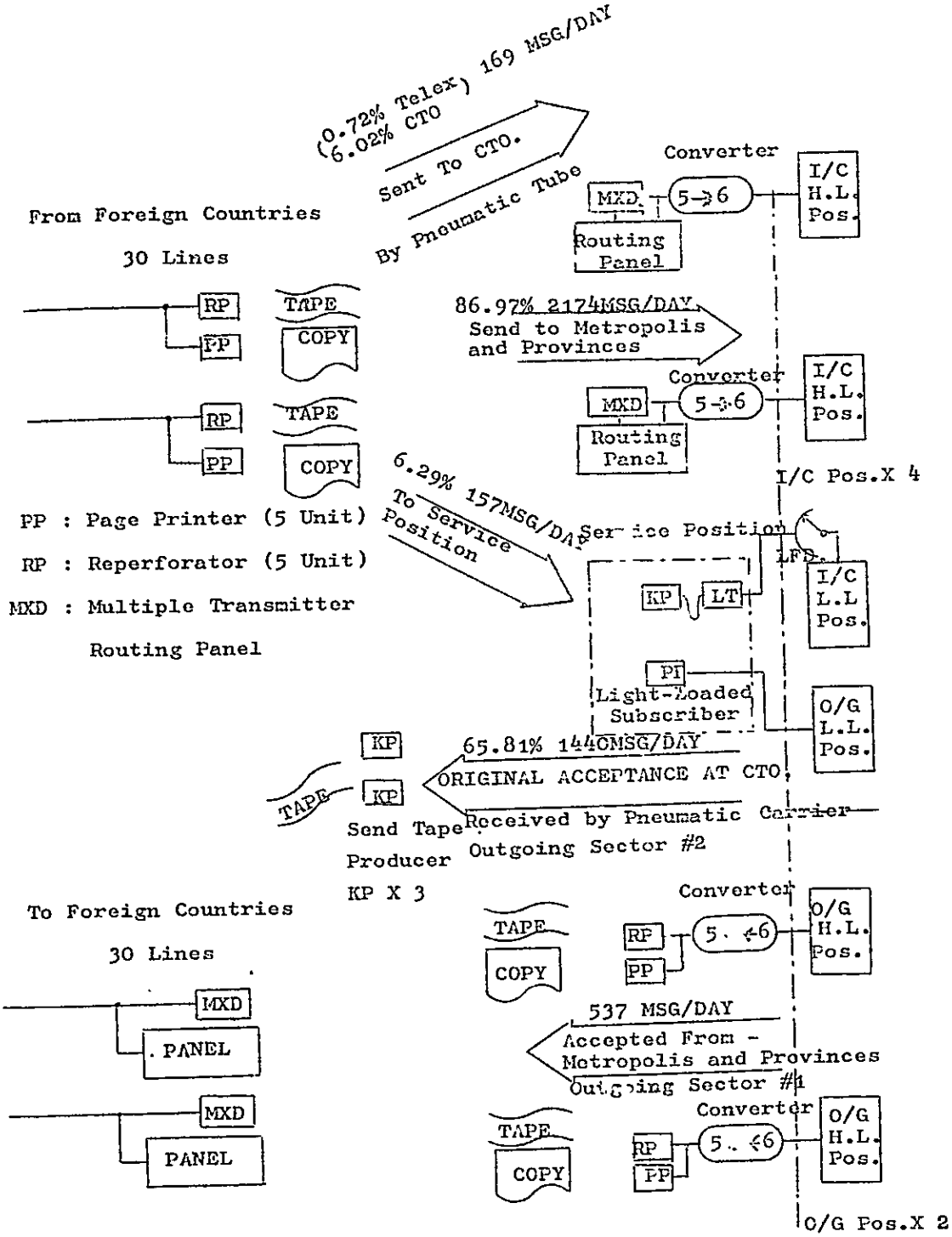
SCALE OF OFFICE	KIND OF (POWER) VOLTAGE	EXCHANGE FRAME	RELAY POSITION	OTHERS	TOTAL
BANGKOK FOR THE INITIAL STAGE (49 DAYS)	- 50 V.	220A	176A	20A	416A
	+ 50 V.	11A	176A	20A	207A
	+150 V.	5.5A	-	-	5.5A
BANGKOK FOR ULTIMATE STAGE* (55 DAYS)	- 50 V.	280A	252A	30A	562A
	+ 50 V.	12A	252A	30A	294A
	+150 V.	6A	-	-	6A
DISTRICT CENTERS (THREE CENTERS IN - COMMON) (29 DAYS)	- 50 V.	130A	106A	20A	256A
	+ 50 V.	10A	106A	20A	136A
	+150 V.	4A	-	-	4A

CAPACITIES OF EMERGENCY ENGINE · Diesel Engine 150 KVA.

* ULTIMATE STAGE · To meet the requirement of telegram demand in 1987. Further description will be given in the following paragraphs.

TRAFFIC FLOW OF INTERNATIONAL TELEGRAMS IN 1987

Drawing 3.6



3.8 A Proposal of Junction Work at CRB.

3.8.1 Outgoing Sector No.1

Since the Central Radio Bureau (CRB) will be treated as one of the subscriber stations of the proposed automation network. Every international telegram originated from the toll center can be received directly by CRB.(See Drawing 3.6) Message Format used in this case should be as follows.

Message Format
Space
Space
Initial Signal (A)
Message Number (3 Digits)
Upper Shift Code
K
F } Address Code For CRB.
Space
Space
} Antecedent Code

Z
C
Z
C
.
.
.
.
.
X
N
N
N
:
:
END CODE

* TEXT *

Instead of text International Message F 31 Format is inserted.

At the outgoing position of the proposed Switching Facility in CTO, whenever the International telegrams are cross-office-transmitted, it will be converted into 5 unit then it will be received by a reperforator associated with a Printer.

As the total amount of international telegrams accepted and transmitted through Provinces all over the country including metropolitan area can be estimated at 500 messages per day (in the ultimate year). Providing two outgoing positions, that will be enough to accept all international telegrams of this incoming sector.

3.8.2 Outgoing Sector No.2

As for the international telegrams transmitted to the foreign countries as shown in appendix 1.14, about 60% of telegrams are accepted at the CTO counter. These telegrams will be sent directly to the CRB by Pneumatic Carrier System.

3.8.3 Incoming Sector

Incoming international telegrams are received at CRB, by the form of perforated tape together with the copy for monitor and carried to the Sending seats at the CRB.Subscriber Stations for the proposed switching system, where the tape is to be sent to a distant office through the proposed automatic switching network.

3.8.4 Information Service

In addition to incoming and outgoing positions for the international telegram transmission mentioned above, a service disposal position will be provided, where serves in the inquiry from subscribers will be processed. A light loaded subscriber station -

(address code : KX) has been earmarked for the service work.

3.8.5 International Torn-Tape Operation

The operation of international telegrams would utilize the torn tape system whereby the 5 unit incoming message perforated tape is applied to MXD. (Multiple Transmitter Distributor) In order to automate the determination of the first position of tape applied to MXD and the fixing of outgoing message running number, following proposal will be available.

1)For the MXD used for international transmission, use the 2 stripe set for the transmission tape. (Tape can be set either simultaneous for both or just for one).

2)Attach the control box for controlling the MXD. (Start key, stop key are provided as the non-locked key of the internal lamps). The control box circuit possesses the tape detection contact and the function contact capable of reading the start of message code ZCZC and end of message code NNNN. From the inside of the control box, SCM code which includes the outgoing message running number, is composed and sent out.

3)There are two units of message transmission set. If tape is not set the corresponding transmission set will not work.

4)By pressing the start key the message tape will advance in the line with no message sending out as it is, after reading ZCZC, it will advance one word and then stop. In this condition when the next restart control signal comes, the preparation of transmitting channel sequence is completed.

5) The CRB outgoing message running number is sent out using the format = ZCZC BKK 001 (after sending out, prepare 002)

6) The outgoing line is automatically switched over to the message outgoing unit side. Having transmitted the telegram after the channel sequential number for each preceding channel, it will send end of message code NNNN and 10 carriage return signal and then stop.

7) Even if the telegram mentioned above is in the outgoing operation, at the moment the antecedent code group sender is, preparing the new number 002, the clutch circuit of other message outgoing unit will turn and wait at the initial set position.

3.8.6 Torn Taping into domestic incoming position

1) The MXD to be used with the domestic message outgoing circuit has also 2 stripe set for the outgoing tape, capable of being sent out alternately by the control command from the control box. In this case, from 1 position the manual routing addressed to any domestic terminal is carried out. It is necessary to put the prefix in front of the address code of the proposed telegraph relay switching system and insert into the system using the prescribed telegram format, and have it switch-connected. The address code is either made lup by using the keyboard - perforator or constructed by arranging the - key-selected portion (26 alphabetical letters) inside the antecedent code sending unit.

2) Under the condition of message tape (5 unit) being, set, if characters (two or three) for address code is specified, the antecedent code will be transmitted through the incoming position of the line in the proposed domestic system.

The said antecedent code must be the same as that in the domestic system as described in 3.7.1.

3) The line is switched over from the antecedent code group sender which is composed in a control box to MXD side, and then MXD will transmit the international telegram message from the place where the tape is set (ZCZC). Following the end of message code NNNN, 10 carriage return code is sent after which MXD will stop.

4) The line will then be switched over to the control box side and the domestic system end of message code is sent out. With the completion of transmitting the end of message code, the transmission of a copy of telegram is finished. At the same time the running number which is a portion of the antecedent code inside the control box is renewed, preparing for the next telegram.

5) Finally, in this case, the operator must first of all look at the monitor of international telegram received from foreign countries, and must know the address of incoming message tape which is received together. Then he must set this tape to MXD. Having determined the addressing terminal, the transmission is automatically carried out.

4. REALIZATION PROCESS

4.1 Taking into consideration the increasing manner of telegraph demand and the expansion of circuit facilities, the [illegible] telegraph relay switching network, and therefore, the construction of telegraph relay switching terminals should be carried out in steps. In such case there are several things which deserve due consideration :

1) First of all, when to start ? With the realization of the scheduled inaugumation of the torn tape operation in the near future, there is also a way to start from one of the provincial terminals, for example, Hat Yai, by shelving Bangkok for the moment. However, since the effect of relay automation in the metropolitan area is greatest it seems best to start the operation here. In that case, it would be logical to remove the torn tape system and use it in the province to accomplish the role of a small relay switching terminal. It would be - desirable to be able to use the existing incoming message perforator as well as the incoming message printing teletype as the on-line composing elements of the - automatic system discussed here. Nevertheless, after careful study, this is shown to be very difficult. (The reasons are that the automatic exchange system adopted the calling response system in order to avoid the accident of blank despatching of telegraph, and several optional functions are added to the teletype in order to prevent the accident of erroneous running number as well as the wrong format, the reconstruction of the existing equipment to account for these extra functions is therefore uneconomical or almost impossible). Only the exception is for the MXD, 6 unit MXD will be able to remodel to the 5 unit MXD for the international torn tape system.

2) As the first phase construction work of the telegraph relay switching mechanization, telegraph automatic relay switching facilities having 80 points are to be constructed at Bangkok CTO. The accommodating range would cover from Postal Region 1 to Postal Region 4. However, since at this period, the construction of the switching - terminals in the provinces have not yet been started, the relaying routes between switching terminals are therefore not needed. This facility can instead be allotted to 20 main terminals in the provinces. The concrete implementation will be described in the follcwing paragraph 4.2.

3) The carrier telegraph transmission lines for different terminals are to be constructed and secured for 8 channel carrier telegraph transmission. With the completion of this, the existing 3 channel ones are to be removed. (After studying the places where the sets are to be divertted). As for the carrier telegraph sets, by ascertaining the trend of future increase in subscribers of telex, if it appears that the demand is large it is possible to change to 24 channel type by adding up with the one used for public telegraph. However, the decision should be based on the comparison in economy for each case.

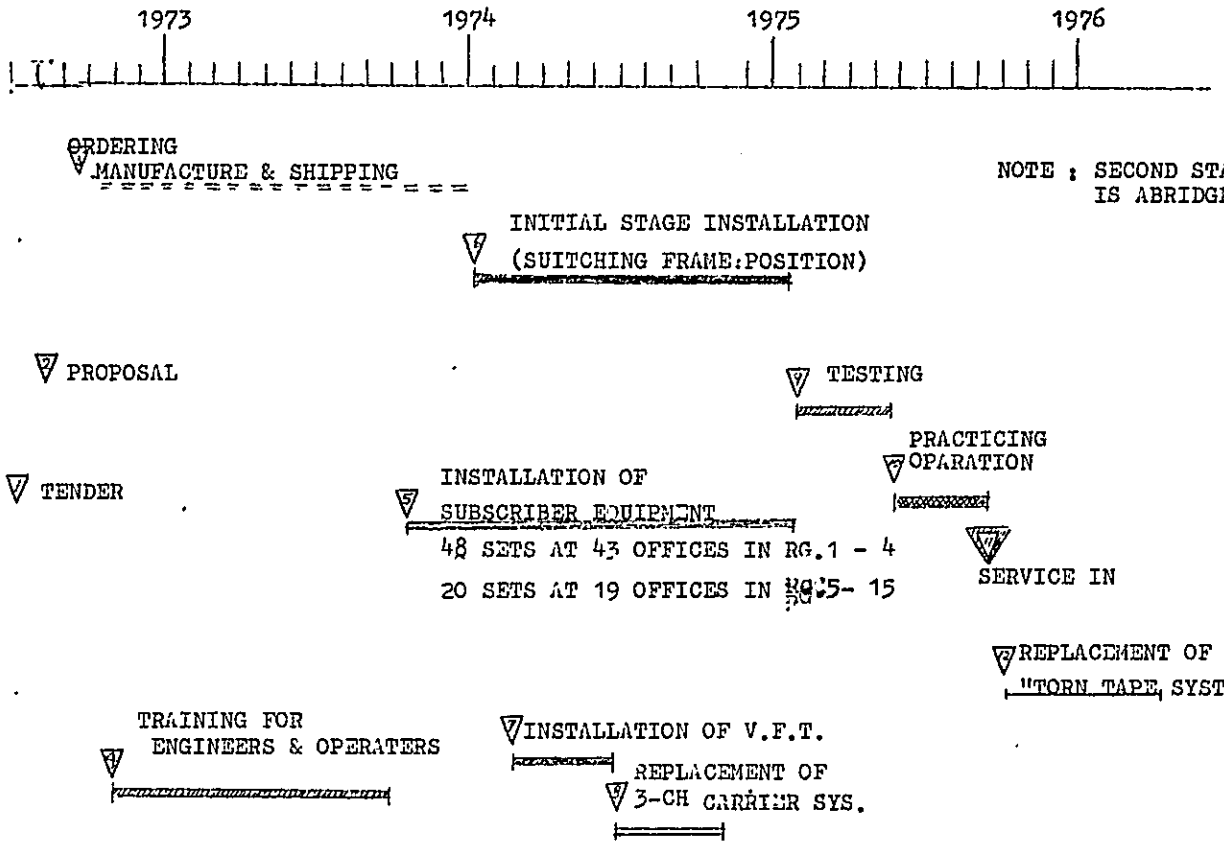
4) The construction of such facilities, e.g., the relay communication room and the switching frame room in the Bangkok CTO., should ascertain the availability of 250m^2 excluding the room for the teletypewriter maintenance, in the 2F receiving section room. For the provincial switching terminals, about 170 m^2 should be planned. In either case, a small room should be allotted away from the dust to be used as the switching room.

5) At the time of construction of the Bangkok switching terminal, of course the equipping of peripheral equipment and the switching equipment has to be carried out. Moreover, appropriation should be planned of the personnel capable of carrying out different tests. Especially, due consideration should be given to the training of technologists among the afore-mentioned personnel who would in the future become the nucleus of maintenance team. The construction steps cannot be missed out in the practical affairs of maintenance training. The operation training after the opening test is chiefly for the operator to familiarize with the operation of the system by carrying out the trial communication in the fixed appropriate period. Since this is carried out with the operation of the existing point-to-point communication and at the same time administering the practical business of this system, at least 3 months of training is required.

6) The total number of switching frame amounts to 54 bays (for 80 point terminal). And since these are equipped one after another after which wiring is done and circuit composed, the construction period would take about one year, and if the testing and the training, etc., are included, this would become approximately one and a half years construction work. The date of determining the definite subscribing terminals must be fixed, and following this, it is necessary to adjust the overall construction work, such as the circuit plan. The general scheme for that is shown in the introduction chart on an attached paper drawing 4.1.

CONSTRUCTION SCHEME OF AUTOMATIC TELEGRAPF SWITCHING SYSTEM

Drawing 4.1



4.2 Initial Stage Installation

1) In the Initial Stage of this proposed message switching system, the facilities previously described in the table 3.3 will be installed in CTC. as shown in the Drawing 3.5 major facilities are listed as follows :

1.	Switching facilities	49 Days
2.	Switching positions I/C & O/G Positions including Switching teleprinting apparatus	100 Pos. Teleprinters approx. 250 sets
3.	Accessory Positions	8 Pos.
4.	Power Supply Rectifier, Battery including emergency engine 150 KVA	Rectifier : 3 - 50 V. : 3200 AH + 50 V. : 1600 AH +150 V. : 45 AH Engine ; 150 KVA.

2) Lines accommodated in the initial stage installation are about 60. Although some of the subscriber offices are expected to become heavy loaded positions later, most of them are operated as the light loaded positions in their initial stage. With the growth of traffic, the replacement of subscriber station facility (i.e.control panel and relay group) should be carried out and then transferred to the heavy loaded position.

3) When the automation is set up, morse devices are to be abolished as long as CTO.is concerned. However, if four private lines still continue to use, morse devices, operators must be kept as usual. In order to improve this situation it would be recommended to provide - facsimile equipment with dial calling instead of morse.

A set of facsimile equipment will cost about 50 thousands Baht.

LOCATION	KIND OF FACSIMILE	
CTO.	S X 2 S X 1*	R X 2 R X 1
Krung Thai Bank	S X 1	R X 1
Bangkok Bank	S X 1	R X 1
Thai Development Bank	S X 1*	R X 1
East-Asiatic Company	S X 1*	R X 1
TOTAL	7	7

Legend, S : Transmitter send only

* : Transmitter with dial

R : Receive only

4.3 The Second Stage Installation

In case, if the demand increment of telegram is far from our expectation, adding some expansion to the facilities CTO. concerned will be enough , but starting from the demand forecasting mentioned preceeding section, it will be necessary to construct the second stage installation within a few years after the first one. The contents of the second installation is summarized as follows :

1) At three of the district centers, exchange facilities of 29 Bays, about 50 relaying positions and necessary accessory installations will be constructed. About 20 offices will be the tributary offices in each district centers.

2) Some of the facilities to meet the requirement that of 1987 will be equipped in order to cover the increasing telegram. demand for the central Regions.

3) At the same time, trunk lines have to be connected among these four centers.

4.4 Budget

4.4.1 Budget for the Initial Stage

Budget for the Initial Stage installation is estimated as follows :

4.4.1.1 Bangkok Exchange Center 27,558 thousands Baht

Switching Frames	49 Days	5,534 T.B.	TOTAL*
Switching Positions		8,495 T.B.	
Others (Parts, materials		1,819 T.B.	
Power Source		1,783 T.B.	
Emergency Engine		461 T.B.	

Total* = { C.I.F. / Tax etc. 36%

18,092 T.B. + 6,513 T.B. = 24,605 T.B.

(1 $ = 20.855 Baht = 308 Yen)

Assuming Installation cost 12% to purchasing cost.

Installation cost = 24,605 T.B. X 1.12 = 27,558 T.B.

4.4.1.2 CRB. referred to Torn Tape 2,256 T.B.

1) Incoming from Foreign Countries

5 unit RP 16 T.B. X [21 + 5(spare)] = 416 T.B.

MXD & Routing panel 400 T.B. X 2 = 800 T.B.

Converter (5u - 6u) 140 T.B. X 2 = 280 T.B.

2) Outgoing to Foreign Countries

5 unit RP 16T.B.X [2 + 1(spare)] = 48 T.B.

Converter (6u - 5u) 70 T.B. X 2 = 140 T.B.

MXD Remodeling 10 X 33 = 330 T.B.

(Automatic MXD controllers are excluded)

Installation Cost = 2,104 T.B.X 1.12 = 2,256 T.B.

4.4.1.3 Subscriber Stations

Approximately 60 stations 9,680 T.B.

121 T.B. X 60 = 7,260 T.B.

4.4.1.4 Carrier Telegraph

8 CH. Carrier Telegraph equipment

355.2 T.D. X 6* section = 2,131.2 T.D.

* BK - Nakhon Sawan DK - Sriracha

BK - Nakhon Ratchasima DK - Thung Song

BK - Ayutthaya DK - Hat Yai

4.4.2 Budget for the Second Stage

4.4.2.1 Budget for installation of three exchange offices.

Although the price value is subject to change, installation of these exchange centers would cost about 32 million Baht worth C.I.F.at the present currency level.

Installation cost in each office totals 49,130 thousands Baht, made up as follows. (¥ 308 = 20,855 Baht)

FACILITIES \ OFFICES	NAKHON SAWAN	NAKHON RATCHASIMA	HAT YAI	C.I.F. TOTAL
Switching Frames(29 Bays)	2,731	2,730	2,711	8,172
Switching Positions	5,079	5,464	4,976	15,519
Others	1,270	1,270	1,270	3,810
Power Source	1,122	1,122	1,122	3,366
Emergency Engine	461	461	461	1,383
TOTAL	10,663	11,047	10,540	32,250

Taxes etc. 32,250 T.D. X 0.36 = 11,610 T.D.

Purchase cost 32,250 T.D. + 11,610 T.D. = 43,860 T.D.

Installation cost (12%) 43,860 T.D.X 0.12 = 5,270 T.D.

TOTAL 43,860 T.D. + 5,270 T.D. = 49,130 T.D.

4.4.2.2 Expansion at Bangkok Installation ; cost about 8.9 million Baht.

Ultimate Stage Estimation 36,458 T.B.

Initial Stage Installation 27,558 T.B.

The Difference is 8,900 T.B.

4.4.2.3 Expansion at CRB. cost about 1,335 T.B.

5 unit RP. 16 T.B. X 7 = 112 T.B.

Converter 140 T.B. X 2 = 280 T.B.

MXD & Routing Panel 400 T.B.X 2 = 800 T.B.

TOTAL 1,192

Installation Cost (12%) 1,192 X 1.12 = 1,335 T.B.

4.4.2.4 Subscriber Stations Installation Cost abcut 9,680 T.B.

121 X 80 = 9,680 T.B.

4.4.2.5 Carrier Telegraph Equipment Installation cost abcut 2,842 T.B.

355.2 T.B. X 8 section = 2,842 T.B.

5. EVALUATION

Electronic computer can handle both international and domestic telegram traffic altogether without using code converter. Moreover, if we could use a computer with large number of memory capacity. Some advantages would be gained. They are :

1) The automatic extraction of domestic terminal address from the cable address of incoming telegram.
2) Even though the continuity of running sequencial number is collapsed due to the priority of telegram, if the number is within some extent of allowable range the telegram can be handled.

However, at present, the use of computer will still be expensive. With the automation of the telegraph relaying switching, the costs of facilities must be discussed in order to get the better results.

Since the total number of international telegrams accepted at the office counter except CTO, occupies only 2.4% to all telegram originated and international incoming telegrams

TELEGRAM IN 1987 (UNIT 1000)					RATIO	
Domestic	International (To Foreign)			From Foreign	(4)	(5)
	TOTAL	Accepted At CTO.	Except CTO.	TOTAL		
(1)					(1)+(2)	(1)+(5)
	(2)	(3)	(2)-(3)= (4)	(5)		
10903	700	420	280	800	2.4%	6.9%

occupy 6.9% to all telegrams handled in 1987. Using computers for such a small amount of international telegram will be a wasteful expenditure if the computer system costs more than twice than mechanical one. With the development in computer technology, if there appears a handy electronic computer which simplifies the operation of switching connection and -

also provides a unique scheme of supervision of abnormal - running number of the international telegrams, thereby offerring the merits of integral operation of domestic and international telegraph communication, then the reevalution of the adoption of electronic switching system would be reserved.

For the above reason, if telegraph relay switching is to be put into service in the near soon, the mechanical type message switching system is to be recommended.

5.1 Advantages of store and Forward Switching System

5.1.1. The advantages and disadvantages between the mechanical type message switching system just recommended here and the mechanical type circuit switching system are compared below.

The advantages of circuit switching are ;

1) The suitability to talk-mode communication, i.e, it is possible to respond to other party.
2) The ability for both sides to simultaneously confirm the other side.
3) The simplicity of switching process with no particular problems.
4) No need to have the message protection function at the switching terminal, etc.

The disadvantages are :

1) The incapability to know the volume of telegrams at the switching terminal.
2) The incapability to handle simultaneously the - instruction communication to every terminal.
3) The allotment of traffic volume to the subscriber being small.

That is, the dial time, the connecting time, the response time, and the circuit holding time such as the - interchange of signals for the confirmation of incoming and outgoing at the end of each transmission, would become longer.

4) The operating efficiency becoming low in case of circuit busy of the partner.

5) The circuit efficiency being bad, thus necessitating the establishment of a large number of circuits.

6) Owing to the fact that the transmission of code is carried out through the simultaneous connection and routing between a large number of circuit intervals, if the quality of the circuit is not high, the erroneous connection and the error printing would increase.

On the other hand, the message switching system has almost the reversed advantages and disadvantages to the above system. The advantages are :

1) Even though the quality of line transmission is somewhat inferior, the causing of error printing is rare. That is, even in long distance communication, since it is divided into the transmission up to the switching terminal and the transmission from the switching terminal, which in fact results in short distance transmission ; the influence due to the accumulation of telegraph distortion which is the cause of erroneous printing can be avoided.

2) The simultaneous instruction to every terminal of the same telegraph is possible.

3) The utilization efficiency of the circuit is high resulting in the capability to receive or transmit telegram by a small number of circuits.

4) Accumulate the arriving telegram at the switching terminal, after that other interferences are kept out. For example, if the telegram from Udon addressed to Yala is received at Hat Yai, once the reception is complete, even the circuit between Hat Yai and Yala is out of order, that telegram would still be kept at Hat Yai terminal.

5) It is possible to check the format error of the input telegram (wrong address, the successive order of the running number).

6) The change of communication speed and the commission of codes are relatively simple. For example, when the speed of trunk lines between Regional Center and District Center is raised in the future to 200 B/s, this change will be easily accomplished.

(Note) In the case of electronic system, besides the above advantages, the capability of the priority call operation, and of the integrated data processing such as extraction of information concerning the calculation of outgoing telegraph rates, and automatic disposal of telegram statistic calculation and so on can be added.

The disadvantages are :

1) In order to store the telegram at the switching terminal different types of checking function are necessary, thus increasing the price of the system.

2) In order to prevent the loss of telegram, it is necessary to include much of the counter measures of interruption in the design of equipment functions.

3) It is not possible for the despatching terminal to immediately inquire the receiving terminal of the condition of the telegram, etc.

5.1.2 From the Financial View Point, both switching systems which meet the requirement of telegram demand are - compared as shown in the table 5.1, in the ultimate scale.

1) Although the initial cost of switching centers in case of message switching system is more expensive then that of line switching system, the former doesn't require much subscriber station equipment, and carrier telegraph equipments. Whereby, the total initial cost of the former system is more economical.

2) Beside this, the line rental for the former system which occupies the big part of annual expense is less than that for the latter system.

3) After all, the former system is 45% $\left(=\frac{54,545.2-35,058.5}{35,058.5}\right)$ less expensive than the latter system as regard to the annual expense.

FINANCIAL COMPARISON OF TELEGRAPH SWITCHING SYSTEM

Table 5.1

(Unit : 1000 Baht.)

TYPE OF SYS.	FACILITIES	INSTALLATION COST (1)	INITIAL COST(2) (1)X 1.05	INSTALLMENT FACTOR(3) (2)X(Sec*1)	MAINTENANCE COST (4)	OPERATIONAL COST (5)	LINE RENTAL	ANNUAL EXPENSE (3)+(4)+(5)+(6)
STORE & FORWARD MESSAGE SWITCHING SYSTEM	Subscriber Equipment (117 Offices) 142 Sets	Sets 121 X 142 = 17,182	18,041.1	(2)X 0.149 2,688.1	*2 .574	*3 8,844	-	12,106.1
	Switching Center BANGKOK	36,458	38,280.9	(2)XO.1168 4,471.2	*4 448	*5 276	-	5,195.2
	Nakhon Sawan	16,243		(2)XO.1168	*6	*7		
	Nakhon Ratchasima	16,828	49,125.0		630	360	-	7,014.7
	Hat Yai	16,054	51,581.3	6,024.7				
	4 Centers	85,583	89,862.2	10,495.9	1,078	636	-	12,209.9
	Direct cct. Section 142 lines	-	-	-	-	-	Average 48X142 =6,816	6,816.0
	Carrier 8 CH. Sys.. 14 Sections	355.2 X14 = 4,972.8	5,221.4	(2)XO.1265 660,5	*8 350	-	*12 2,916	3,926.5
	TOTAL	107,737.8	113,124.7	13,844.5	2,002	9,480	9,732	35,058.5
	Subscriber Equipment (117 offices) 750 Sets	97 X 750 = 74,250	77,962.5	(2)X 0.149 11,616.4	*9 1,200	*3 8,844	-	21,660.4
	Switching Center BANGKOK	7,044		(2)XO.1168	*10			
	Nakhon Sawan Nakhon Ratchasima Hat Yai	3612 X 3 = 10,836	18,774.0	2,192.8	419	-	-	2,611.8
		17,880						
	Direct cct Section 750 lines	-	-	-	-	-	Average 24X750 18,000	18,000.0
	Carrier 24 CH.Sys. 34 Sections	1,159.2X34 39,412.8	41,383.4	X 0.1265 =5,235	*11 918	-	*13 6,120	12,273.0
	TOTAL	131,542.8	138,117.9	19,044.2	2,537	8,844	24,120	54,545.2

COST OF CRD TORN TAPE SYSTEM IS EXCLUDED

REMARKS : Installation Cost = Personnel Expense + Construction Expense

Initial Cost = Installation Cost + Indirect Cost

Indirect Cost = Installation Cost X Overhead Percentage

REMARKS *1

DURABLE YEARS	INSTALLMENT FACTOR
10	0.1490
11	
12	
13	0.1265
14	
15	0.1168

BREAK DOWN OF MAINTENANCE COST, OPERATIONAL COST ETC.

Table 5.1 Cont.

Unit : thousand Baht

FACILITIES	MAINTENANCE PERSONNEL	MAINTENANCE COST	MATERIAL USED	OPERATIONAL COST OR LINE RENTAL
SUBSCRIBER EQUIPMENT (117 OFFICES) 142 Sets	Number of Offices: 117 No.of Subscriber Station Sets ; 142 Sets Maintenance Personnel Per Set : 0.25 Personnel Required : PERS Sets PERS 0.25 X 142 = 36	TB. 12 X PERS 36 TB. =432 *2 Maintenance Expense : 432 + 142 =574TB	TB. Sets 1.0 X 142 TB. = 142	Operational Personnel Per Office ; Teletyping(1) 2.5PERS Origination Check (2) 0.2PERS Destination Check (3) 1.5PERS TOTAL(1)+(2)+(3) 4.2PERS PERS Shift PERS 4.2 X 1.5 = 6.3 Personnel Required Office PERS PERS 117 X 6.3 = 737 TB. PERS TB. 12 X 737 =8,844 *3
BANGKOK CENTER	Switch Adjust PERS PERS Shift 10 + (2 X 4) X 1.05 PERS = 10 + 8.4 = 18.4 Teleprinter Adjust 335 Sets + 10 Sets (own office etc.) = 334 Sets Sets 334 /20 17.2 PERS Switches + Teleprinters = 36 PERS	TB. 12 X PERS 36 TB. =432 TOTAL *4	TB. 0.2/Point 0.2 X 80 TB. = 16 448 TB.	Patrol For Repeating Pos. 0.23 PERS Per Position 0.23 X (I/C55+O/G43) = 23 PERS *5 TB. PERS TB. 12 X 23 = 276
DISTRICT 3 CENTERS	Switch Adjust PERS PERS Shift 6 + (1 X 4) X 1.1 = 10.4 PERS Teleprinter Adjust Approx 130 Sets 130 Sets/20= 6.5 PS. OfficesPERS PERS 3 X 17 = 51	TB. 12 X PS. 51 TB. =612 TOTAL *6	0.2 X 30 Pt X 3 TB. = 18 630 TB.	Patrol For Repeating Pos. 0.23 X (I/C55+O/G22) = 10 PERS PERSOffices PERS 10X 3 = 30 TB. PERS TB. 12 X 30 = 360 *7
CARRIER TELEGRAPH	One PERS For 8 Channel System At One Side - Terminal Equipment. No.of Sections : 14 PLS. 2 X 14 = 28 PERS	TB. 12 X PERS 28 TB. =336 TOTAL *8	1TB./One Side 1 X 14 = 14 TB. 350 TB.	*12 LINE RENTAL CHARGE By Actual Calculation 2,916 TB.

FACILITIES	MAINTENANCE PERSONNEL	MAINTE-NANCE COST	MATERIAL USED	OPERATIONAL COST OR LINE RENTAL
SUBSCRIBER EQUIPMENT	Number of Offices : 117 No.of Subscriber Station Sets : 750 Sets Maintenance Personnel Per Set 0.10 Personnel Required $0.10 \frac{Pers}{Sets} \times 750 Sets = 75$ Pers	TB. 12 X 750 PS. = 900 TB.	0.4 X 750 Sets = 300 TB.	Operational Personnel: Same as above case Message Switching Sys. Hence, Operational Cost is 8,844 TB. *3
		*9 Maintenance - Expense 900 + 300 =1200 TB.		
SWITCHING CENTER	BANGKOK : 500 pt Office PS. PS. Shift PS. 5 + (1 X 4) X 1.05 =10 District Centers PS. PS. Shift PS. 3 + (1 X 4) X 1.05 = 8 PS. Offices PS. 8 X 3 PS. = 24 PS. TOTAL 10 + 24 = 34	TB. 12 Pers X 34 TB. = 400	0.1PERS/1Cpt. 0.1X(500t +200t X3) X $\frac{1}{10}$ TB. = 11	
		TOTAL 419 TB. *10		
	One Pers For 24 Channel System At One Side - Terminal Equipment. No.of Sections ; 34 PERS 2 X 34 = 68 PERS	TB. 12 X PERS 68 = 816	TB. 1.5/One-Side 1.5 X 2 X 34 =102 TB.	* 13 LINE RENTAL CHARGE TB. Sections 180 X 34 TB. = 6,120
		TOTAL 918 TB. *11		

5.2 Merit of this system

1) Since the telegraph relay switching in the proposed system is performed by the tape relay switching, there is no problem of system recovery which is most - troublesome in the design of electronic computer system. Thus the design with low cost could be achieved. At the time of faulty operation, it is possible to see the phenomena in steps. Besides, by using the - trouble-recorder the discovery of faulty places is simple which is an advantageous point in the maintenance of the system. On the contrary, code converter between 5 unit and 6 unit codes is necessary, and many different kinds of printing teletypes for the relay switching must be used. These are the major disadvantages.

2) As for the connecting point to the international - telegraph, since the proposed system adopts the torn tape system whereby messages are brought from the incoming or outgoing of the domestic circuits to the incoming or outgoing of international circuits, the international outgoing messages of each domestic circuit need only be perforated once, and the incoming international telegrams also omit the manual reperforation at the relaying terminal. Since the domestic outgoing messages are concentrated after which they are code converted into 5 units at the system outgoing and the incoming domestic messages are converted into 6 units at the system incoming, only a small number of operators are needed at the converging point for the domestic and international circuits (4 persons for the incoming positions will be needed at the ultimate stage).

3) Since the equipment is unified into 6 unit printing teletypes for all the domestic circuits and 5 unit printing teletypes for the CRB, the advantage in maintenance is obvious.

4) As described in Section 7, with the centralization of the despatching and receiving operations of messages, the present total personnel of CRB terminal dealing only with the international telegrams (at present 108 persons) could be cut down to half. Moreover, the hitherto elapsing time of cross-office telegram transit between the CTO and the CRB of 2 hours (busy hour) could be shortened to less than 30 minutes.

5) The present CTO office elapsing time of 2 hours 50 minutes (busy hour) could be reduced to about 10 minutes Even for the terminals in the provinces, the domestic telegram which is repeated through several relay - transit terminals, at least the elapsing time between the telegraph relay switching subscribing terminals would become approximately 15 minutes. The speediness of telegram would be much improved, as is the service.

6) In keeping up with the increase in telegraph demand, even though manual relay personnel of each terminals are increased all over the country, and torn-tape system is adopted in CTO, the realization of fast and reliable telegraph relay is not easy. However, with the adoption of the proposed system, the present - operation requiring 535 persons at CTO could be accomplished with only 193 persons in the final year, resulting in the reduction of 342 persons. The personnel expenses thus saved over 15 years amount to more than 60 million baht. (See Table 5.2)

7) Of course, in order to improve the service, the printing teletypes for subscribing terminals must be placed at different places, the reduced personnel are therefore not really reduced but could be assigned as personnel at those subscribing terminals. As a result, the improvement of both the quality and quantity of telegraph service which could not be expected by human labour could therefore be accomplished with a small number of personnel.

8) Tape format is extremely simple, in the despatch and receiving of domestic telegrams, the circuit holding time is reduced, and the international telegram using F31 system is wrapped up in the manner of insertion in this simple tape system, and though this might be directly perforated at the domestic outgoing subscribing terminal for transmission, no disturbance is introduced.

Table 5.2

EFFECT OF AUTOMATION IN THE SWITCHING CENTER INCLUDING INTERNATIONAL JUNCTION

YEAR / JOBS / SECTIONS	1971		1987			EFFECT
	Jobs in Sections No. of Telegrams Dealt or No.of Teleprinters	Existing Personnel (1)	Jobs in Sections No.of Teleprinters Dealt or No.of Teleprinters	Expected Personnel (2)	REMARKS (Contents of Job)	(1) - (2)
I. Transit (CTO)	15,265 Domestic 12.144*1 International 3.121*2	235	As the Regional *3 Switching Center 38000 DomesticI/C15000 O/G18000 International I/C 2500 O/G 2200	23	Patrol for I/C, O/G Positions only, No typing work is requested	212
II. International Junction (CRB)	2500 Sent 1600 Received 1900	108	4700 Sent 2200 Received 2500	60	Typing Position : 3 I/C Position to Switch : 4 O/G Position to Switch : 2 Torn Tape Circuit : 30	48
III. Acceptance (CTO)	2000 Domestic 1040 International 960	58	4190 Domestic 2650 International 1440	58*4	I/C Position to Switch : 4 Typing work will be added	0
IV. Delivery (CTO)	Collect or Deliver to/from Metropolitan Post Office by Motor Cycle	93	Direct Delivery & Acceptance declines	16	O/G Position to Switch : 1	77

YEAR / JOBS / SECTIONS	1971		1987			EFFECT (1) - (2)
	Jobs in Sections No. of Telegrams Dealt or No,of Teleprinters	Existing Personnel	Jobs in Sections No.of Teleprinters Dealt of No.of Teleprinters	Expected Personnel	REMARKS (Contents of Job)	
V. Investigation (CTO)	-	11		0	Supervision of Running Number is practised automatically	11
VI. Technicial	Teleprinters 44	30	Teleprinters for Switching 270	36		5
TOTAL	-	535	-	193	-	342

*1 Domestic : Total No.of Telegrams in 1971 At CTO ÷ 299

*2 International : Total No.of Telegrams in 1971 At CTO ÷ 320

*3 Excluding Transmit Telegrams Handled by District Centers

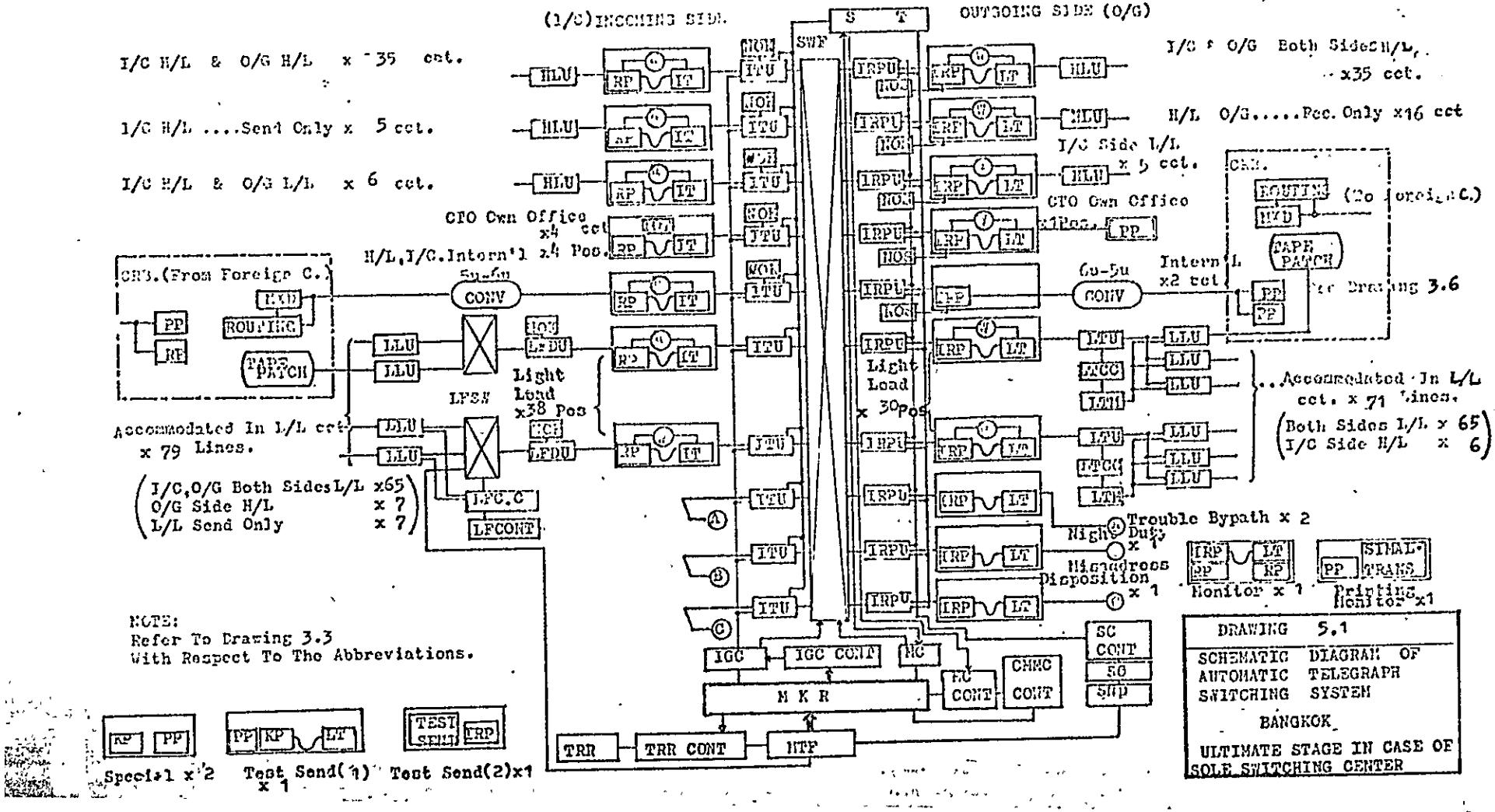
*4 Number of Personnel are remained untouched since typing work of Telegram will be added to this Section.

THE ULTIMATE SCALE OF THE BANGKOK

SWITCHING CENTER IN CASE OF SOLE CENTER PLAN

Table 5.3

KIND OF POSITIONS	NO.OF POSS. I/C	NO.OF POSS. O/G	REMARKS
Heavy Load I/C Heavy Load O/G 28 offices 35poss.	35	35	Regard to the list of - offices, see Appendix 2.16
Heavy Load Send Only 51 offices 5 lines	5	0	Hua Lam Pong Banglam Phu-Don Pom-Prap Chiang Mai #1 Suratthani
Heavy Load Rec.Only 8 offices 16 lines	0	16	BK 1 X 5 BK 2 X 2 BK 3 X 1 BK 4 X 2 BK 5 X 3 BK 6 X 1 BK11 X 1 BK12 X 1 a supplementary use to other - communication pass, see Appendix 2.16
CTO Own Office	(4)	1	No I/C Pos. is used for the own office.
CRB Heavy Load I/C Heavy Load O/G	4	2	CRB
Heavy Load O/G Light Load I/C	Common with	5	5 lines BK 1 Bk 10 BK 6 DK 12 BK 9
Heavy Load I/C Light Load O/G	6		6 Lines Prachin Buri Chaiyaphut. Chon Buri Loei Nong Khai Mahasarakham
I/C, O/G Both Sides	38	30	65 Lines See Appendix 2.16
Light Load Send Only		0	7 Lines
TOTAL	88	89	-


(I/C)INCOMING SIDE
S T
OUTGOING SIDE (O/G)
I/C H/L & O/G H/L x 35 cct.
I/C H/L ....Send Only x 5 cct.
I/C H/L & O/G L/L x 6 cct.
CTO Own Office x4 cct
H/L,I/C.Intern'l x4 Pos.
CRS.(From Foreign C.
ROUTING
TAPE PATCH
PP
RE
CONV
LLU
LFSW
LFDU
LFC.C
LFCONT
Light Load x38 Pos
Accommodated In L/L cct x 79 Lines.
I/C,O/G Both Sides L/L x65
O/G Side H/L x 7
L/L Send Only x 7
SWF
HLU
ITU
IRPU
Light Load x 30Pos
I/C & O/G Both Sides H/L x35 cct.
H/L O/G.....Pos. Only x16 cct
I/C Side L/L x 5 cct.
CTO Own Office x1Pos.
Intern'l x2 cct
LTU
LTCC
LTTU
Accommodated In L/L cct. x 71 Lines.
Both Sides L/L x 65
I/C Side H/L x 6
Trouble Bypath x 2
Night Duty x 1
Night Address Disposition x 1
Monitor x 1
Printing Monitor x1
IGC
IGC CONT
MC
MKR
FC CONT
CHMC CONT
SC CONT
SG
SMP
TRR
TRR CONT
HTP
Special x 2
Test Send(1) x 1
Test Send(2)x1
NOTE:
Refer To Drawing 3.3
With Respect To The Abbreviations.
DRAWING 5.1
SCHEMATIC DIAGRAM OF AUTOMATIC TELEGRAPH SWITCHING SYSTEM
BANGKOK
ULTIMATE STAGE IN CASE OF SOLE SWITCHING CENTER

5.3 Comparison of Multi Office Plan to Single Office Plan

On designing the Nation-wide telegraph automatic switching network, we have studied the follcwing two plans, namely, single exchange office switching (described below), and multi exchange office switching as already mentioned. In this section, the advantages and disadvantages of both plans are indicated.

1) Plan A : The sole and big scale's exchange board tc be installed at Bangkok CTO, covers the whole country.
2) Plan B : Consists of four exchange boards in Tctal. First, a medium scale's exchange board to be installed at Bangkok CTO, covers central regions and major offices all over the ccuntry. The number of major offices to be accommodated is equal to the number of trunk positions which will be used as trunk lines after the rest of three district centers are established. Instruments of the three small scale: ' exchange offices in rural regions follow the first one after five years' absence. These offices cover the respective districts.
3) In either case. ,there is no difference in initial stage, so we have to compare with regard to the second stage.

5.3.1. General Comparison

Plan A is superior to Plan B, in respect of the invested Capital. That is to say, the initial cost would be less than 63% tc that of Plan B (see the table below). Instead, Plan B will have the following advantages :-

1) Since the location of exchange offices are - diversified, the fault of the whole scale by the calamity or accident can be avoided.
2) The wave form of signal can be corrected through the "stored and forward message switching function", and the telegraph distortion across long distance lines will be reduced and better stability of communication will be obtained.

3) The "effect of concentration" due to switching function will result in saving of trunk lines between rural regions where the exchange boards are located to the CTO.

4) The localization of telecommunication technology may be promoted.

5) The existing facility of "Torn-Tape system" can be utilized in some districts.

6) In near future, on the occasion when the use of "electronic data processing system" should become economical, the Plan B will be profitable for the replacement to the system. That is to say, we can wait and see the utility of small computer to be installed there instead of mechanical way of tape relay system if necessary.

5.3.2 Financial Comparison

From the financial viewpoint, the comparison of both Plans are laid down, under the terms of the period of 15 years. Both Plans, in the early stage start with the same situation (initial stage installation 27,558 thousands baht. That is Initial Cost 28,935.9 thousands baht (28.935.9 = 27,558 X 1.05)

For the second stage assuming that

Plan A : To expand CTO by the investment of 20,714.4 thousands baht.

Plan B : To expand CTO by the investment of 9,345 thousands baht.

and construct three centers, by total - investment of 51,581.3 thousands baht bythe aid of the following Table.

Table 5.4

unit : thousand baht.

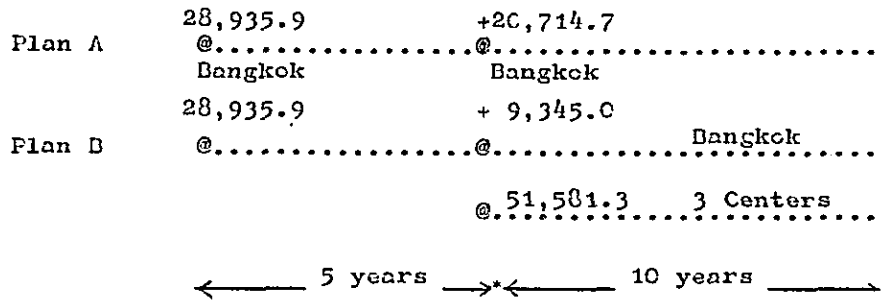
PLAN	INITIAL STAGE INSTALLATION (1)	SECOND STAGE (2)INSTALLATION	(2) - (1) INVESTMENT FOR - THE SECOND STAGE
A	*1 27,558 X 1.05 = 28,935.9	Bangkok *2 49,650.3	20,714.4
B	*1 27,558 X 1.05 = 28,935.9	Bangkok *3 38,280.9	9,345.0
	-	3 District Centers *3 51,581.3	51,581.3

* 1 See Section 4.4.1 (1) Page 111.

* 2 For the Sole office Plan which scale is listed in Table 5.3 and Drawing 5.1

* 3 See Table 5.1

The above comment is listed as follows :



1) Current value of Annuity

Before making comparison, we have to define some terms concerning money. Interest is defined as the money paid as consideration against the use of borrowed money. In case a certain amount of money is paid continuously for a certain period, such money is - called an annuity. The final value of an annuity is

the grand total of money carried with interest up to the end of the payment period (compared period). If the amount of annuity is represented by 1, the interest rate per year by i, the number of years in which the annuity continues by n, the current value of annuity S is determined as follows :

$$a = \frac{1}{(1+i)} + \frac{1}{(1+i)^2} + \frac{1}{(1+i)^3} + \cdots + \frac{1}{(1+i)^n}$$

$$= \frac{(1+i)^n - 1}{i\,(1+i)^n}$$

The following formala as represented by $a\ \overline{n}|i$ is called the final value rate of an annuity. That is,

$$a\ \overline{n}|i = \frac{(1+i)^n - 1}{i\,(1+i)^n}$$

Here letting $\frac{1}{(1+i)} = V$ then, $a\ \overline{n}|i = \frac{1 - V^n}{i}$

If the current value of an annuity with the amcunt of annuity R is represented by A

$A = R.\ a\ \overline{n}|i$

So, the current value of an annuity is the annuity as evaluated at the beginning of the payment of the annuity. Here letting i = 8% per annum, the coefficien be obtained as 8.559. Accordingly, current value of annuity, in case of Plan A for initial stage, be obtained as

(annual expense) X 8.559 = 3,379.7 X 8.559 = 28,926.9

2) The current value of deferred annuity

The deferred annuity is such the payment starts after a certain number of years. The period during which no payment made is called the period of annuity. In obtaining the current value of a deferred annuity, two steps of procedures are required. First, obtain

the final value of the annuity at the end of the - deferred period, and then obtain the current value of compound interest for the deferred period. The current value of an annuity which has been deferred for m years and is paid at the end of each year for n years will be obtained through the following formula :-

$$A = R \times a\overline{n}|i \times \frac{1}{(1+i)^m}$$

In the case of calculation on the second stage of CTC Letting deferred period m be 5, and annuity payment period n be 10, the coefficient be obtained as 3.933, then "the current value of annual expense till the end of 15 years after a deference of 5 years" be

$7461.3 \times 3.993 = 25,499.7$

Likewise, current value of annuity for Plan B is obtaine as the sum of both CTC and another 3 offices in district

As a result as seen in the following table.

Plan A (Sole Office) is 34% less expensive than Plan B (Multi Office) in fifteen years duration.

COMPARISON OF ANNUAL EXPENSE WITH REGARD TO "SOLE OFFICE" OR - "MULTI OFFICE"

Table 5.5

PLAN	Investment Place	Investment thousand baht (1)	Annual Expenses of *1 Centers (2)=(1)X 0.1168	Annual Expenses of Lines (3)	Total Annual Expenses (2)+ (3) = (4)	Duration (Years)	Final value rate of Annuity (5)	Current value of annuity (6)=(4)X(5)	
A	CTO. Initial	28,935.9	3379.7	omitted	3379.7	1~15	8,559	28,926.9	54426.
	CTO Second	20,714.4	2419.4	5041.9	7461.3	6~15	3,993	25499.7	
B	CTO Initial	28,935.9	3379.7	omitted	3379.7	1~15	8,559	28926.9	73020.
	CTO Second	9,345	1091.4	3926.5	11042.6	6~15	3,993	44093.1	
	District Centers	51,581.3	6024.7						

*1 Installment factor 0.1168 is equal to the coefficient of durable 15 years

$$\frac{73020 - 54426.6}{54426.6} = \frac{18593.4}{54426.6} = 0.34$$

6. SUGGESTIONS FOR MAINTENANCE AND ENGINEERING RESPONSIBILITIES

While the Colombo Plan Expert had been working on designing the telegraph automation, he had the apportunities to look at the field work how it has been going on.

Here, it should be grateful if you consider these points as were in the following maintenance activity concerned.

Unless reliability of the transmission and the grade of - maintenance are improved, Fully Automatic Telegraph Relay System would not operate effectively. In order to improve the present situation in maintenance, the following should be observed.

6.1 Clarification of "out-of-order" or "failure"

Normally, there is a standard practice of observing the operating conditions of any equipment in order to keep it in the best of operating condition all the time. The - technician must check the values of current, voltages and signals to see that these values are working at their standard efficiency or "standard values". An equipment whose mechanism deviates from that of "standard values", eventhough it may continue to be in operating order, should immediately be termed "out-of-order" or "failure" and the technicians must immediately find the cause of these faults and make the corrections.

At present, because of unclear definitions of the "failure". sometimes the"out-of-order" is left unattended, and this degrades the transmission quality, and in many cases, when the equipment actually fails -- that is, when it entirely ceases to function -- the technicians would be kept quite uninformed by the operators and would only find out from complaints from other sources. Efficient maintenance, therefore, cannot be accomplished unless there is good cooperation between the operators and technicians.

6.2 Concept of Service Quality :

Criteria is the first thing to be taken into consideration to improve the future maintenance service and this will be used to evaluate the service quality. Usually, the service quality is determined by operator's complaints.

6.3 Preventive and Corrective Maintenance :

Preventive maintenance is to perform routine tests and checks periodically regardless of any indication of faults. Faults can be found and corrected at the early stage before it develops and causes the equipment or system to become actually failed.

Corrective maintenance is the action taken to repair the equipment or system which already ceased to operate. Very few technicians practice the preventive maintenance. Therefor in order to upgrade the maintenance service, more emphasis should be put on preventive maintenance.

6.4 Maintenance Records :

Preventive and corrective maintenance being done must be recorded and kept as future reference. From this record, effectiveness of maintenance and standard of service can be easily checked. All effort should be made to decrease the number of events and duration of faults. See Drawing No.6.1, 6.2, 6.3, 6.4 & 6.7.

6.5 Standard Maintenance Manuals :

Each telegraph office should have standard maintenance manuals, because it will help the technician to maintain or repair effectively and accurately, These manuals will help the maintenance level in the country become uniform.

6.6 Concentration of Technicians :

Some telegraph offices do not have many telegraph equipments but still have technicians to look after the equipments. This is inefficient and uneconomical. Therefore, it is recommended to concentrate the technicians to the leading offices in those regions and these technicians must inspect and maintain terminal telegraph office periodically.

As for the number of technicians in charge of teleprinter or other telegraph devices. About 180 personnels excluding CTO are taking care of many facilities at about 60 offices all over the country.

Nowadays, since the high-ways lead to many districts and expanding, transportation in some areas leaves nothing to be desired so far as road is concerned, the presented table shows a tentative plan of office location where the technicians are to be concentrated.

INTENSIVE MAINTENANCE OF TELEGRAPH EQUIPMENTS

Table 6.1

CONCENTRATING OFFICE	NO. OF PROV	NAME OF THE OFFICES PATROLLED(PROVINCES)
CTO	14	Bangkok, (30)Thonburi, Nonthaburi, Pathumthan. Samut Prakan, Ayutthaya(3), Suphanburi(2) Angthong(2), Singburi(2), Lopburi (4)Chachoengsao(3), Nakhon Nayok(1), Prachin Buri(2), Aranyaprathet(1), Chonburi(3), Sattahip(1)
Saraburi	1	Saraburi(6)
Chanthaburi	3	Chanthaburi(7), Trat(4), Rayong(3)
Nakhon Pathom	5	Nakhon Pathom(5), Ratchaburi(4), Dan Pong(1), Kanchanaburi(1), Samut Sakhon, Samutsongkhram
Prachuap	2	Prachuap(1), Hua Hin(2), Phetchaburi(3)
Nakhon Sawan	5	Nakhon Sawan(3), Tak(3), Kamphaeng Phet, Uthai Thani(1), Chainat(2)
Chiang Rai	1	Chiang Rai(3)
Lampang	4	Chiang Mai(5), Maehong Son, Lamphun(3), Lampang(9)
Phrae	3	Uttaradit(4), Phrae(2), Nan(2)
Phitsanulok	4	Phitsanulok(2), Sukhothai, Phetchabun, Phichit
Udon Thani	2	Udon Thani(4), Nongkhai(6)
Loei	1	Loei(2)
Khon Kaen	4	Khon Kaen(3), Kalasin(3), Maha Sarakham(2), Roiet(1)
Sakon Nakhon	2	Sakon Nakhon(2), Nakhon Phanom(3)
Ubon Ratchathani	3	Ubon Ratchathani(3), Sisaket(-), Surin(2)
Nakhon Ratchasima	3	Nakhon Ratchasima(5), Chaiyaphum, Buriram(3)
Chumphon	2	Chumphon(3), Ranong(3)
Phangnga	3	Phangnga(2), Krabi(3), Phuket(1)
Thung Song	4	Nakhonsithamarat(2), Phatthalung(5), Trang(4), Suratthani(2), Thung Song(3)
Hat Yai	5	Songkhla, Pattani(2), Narathiwat(2), Yala(1), Satun, Hat Yai(7)
TOTAL	71	Figures in parenthesis shows Number of Technicians in each office

As. of November 10, 1971.

6.7 SPECIAL INSPECTION GROUP :

In telecommunications, maintenance quality should be uniform in every office so that the quality of the transmission will be kept at its maximum reliability.

In order to see that each telegraph office has maintained according to the standard maintenance manuals, special inspection groups should be set up.

Their job and their aims are described as follows :

Inspection of Administration through Maintenance's Management

6.7.1 General

It goes without saying that the telecommunication - services rely on the performance of duties on each person engaged in these services. In particular, the maintenance of an up-to-date facility requires the closer coordination. In addition, the efficiency of pecuniary expenditure to services should be matters of consideration.

This paper lays down for the inspection of administration through maintenance's management from the technical, personal and economical view points.

6.7.2 Substantial Aim

This inspection is aimed at the checking of the substantial matters as follows.

a) Promotion for the Quality Of Service.

b) Nation-wide uniformity of service.

c) Prevention from the fire and thievery.

d) Continuous attention to the equipments, outside plants, Vehicles and materials.

e) Progress of the faculty of staffs.

f) Progress of the morale of staffs.

g) Improvement of the economical balance.

h) Acknowledgement of obstacles in the field.

6.7.3 Check Items

1) Check Items For Technical Affairs

a) Is the target of maintenance presented to staffs ?

b) Is the maintenance carried out as scheduled ?

c) Are the engineering instructions observed satisfactorily ?

d) Is the policy of maintenance by the top management penetrated among staffs ?

e) How is the patrol maintenance to the subsidiary office ?

f) In case of the failure, what is the process of clearance ?

g) Are the trouble record, plant record, network record, different statistics of maintenance and the like, filled up completely ?

h) Is any precautionary measure against fire and thievery taken ?

i) Are the spare parts always being reserved in good condition ?

j) Are there some outstanding plans for the improvement of the services ?

h) For such emergency like the power failure or accidents, what means are available ?

2) Check Item For Personal Affairs

a) Do the maintenance staffs have enough ability to maintain the facilities ?

b) In case of the shortage of skilled maintenance staffs, how the management staff deal with ?

c) How is the on-the-job or off-the-job training practiced ?

d) How many is the staffs'labour days per month, in average ? Are there any unbalances among them ?

e) Is there any staffs' originality on technology or maintenance ?

f) On that day when the staffs-on-duty is short, what countermeasure is taken ?

g) Is the number of staffs arranged according to the amount of maintenance jobs in every office. ?

3) Check Items For Economical Affairs

a) How much is the cost of maintenance a year ?

b) How much is the annual expense for the spare parts ?

6.8 Line Control Office

At present, when a telegraph line become out of order, the technician in the office concerned will check and locate the point of failure. If he knows that the failure occured is in his responsible section, he will go and repair. If he does not know where the faults are, he also must go out and check to see if the fault is in his responsible section. As he finds that there is no cause of fault in his responsible section, he may notify to the adjacent office and that office will repeat what he has been doing. This way of trouble shooting is time consuming and inefficient. To improve this, "Line Control Office System" should be set up. The Line Control Office must have power to direct any offices to locate the faults under its instructions. The repair of faults itself is in the responsibility of each office. Therefore, whenever there is a fault, the office which recognized this fault first must inform this matter to the line control office concerned.

The Line Control Office is set up in every line respectively, and the organization in which the test office and the control office are contained is designated as follows.

6.8.1 Designation of the Test Office :

Telegraph offices which have telegraph lines are designated test offices.

6.8.2 Marking & Numbering for the Test Offices.

Marks and numbers are given to all the Test Offices designated as attached table titled "Designation of Test Office."

1) Rank Mark

Four Kinds of Marks are given as the first letter of Code to all of the Test Offices according to the rank of offices.

A : Regional Center	:	Bangkok
D : District Center	:	Nakhon Sawan, Nakhon Ratchasima, Hat Yai
C : Toll Center	:	(about 115 offices all over the country)
D : End Office		

2) Area Mark

Fifteen Kinds of Marks are given as the second letter of code to all the Test Offices according to the Regional order with respect to transmission.

Marks	Region
J	1
K	2
L	3
M	4
N	5
P	8
Q	6
R	7
S	12
T	9
U	10
V	11
W	15
X	14
Y	13

Notes

1) Letter "O" is not used to avoid mistakes occurred by zero.

2) Arrangement of the Regions are not in order for the convenience of line control function.

3) Serial Number :

Serial number is given, as a rule, to the offices according to the arrangement of size and regarding the importance along route. Usually, "00" is the leading office within the close area of the regicn (1 - 15).

Table of Codes for all the offices are given as Table 6.2.

For example "B W 00" is to Hat Yai.

"B" is the rank mark for the district center

"W" is area mark which also - indicates that the office is in the area of No.15 Region.

"00" is serial number

6.8.3 Control Function

If a line between Hat Yai "B W 00" and Thung Song "C X 00" is out of order, Hat Yai office should be the Line Control Office because Hat Yai's code is "B W 00" which is lower alphabet than "C X 00"

Line Control Office has the right to do everything to fix the line trouble as soon as possible. Test Office Thung Song should help and cooperate to fix the line trouble.

CODE DESIGNATION OF TEST OFFICE

Table 6.2

1. BANGKOK CTO.	A J 00
2. INTERNATIONAL GATE	C J 50
3. BK.1	C J 01
4. 2	C J 02
5. 3	C J 03
6. 4	C J 04
7. 5	C J 05
8. 6	C J 06
9. 7	C J 07
10. 8	C J 08
11. 9	C J 09
12. 10	C J 10
13. 11	C J 11
14. 12	C J 12
15. WAT LIAP	C J 13
16. NAPHRA LAN	C J 14
17. HUA LAM PHONG	C J 15
18. BANGLAMPHU-DON	C J 16
19. BANGKRABUE	C J 17
20. POM PRAP	C J 18
21. PATHUM WAN	C J 19
22. SANTITHAM	C J 20
23. DON MUANG	C J 21
24. WONGWIEN YAI	C J 22
25. DON MUANG AIR PORT	C J 23
26. NONTHABURI	C J 70
27. PATHUMTHANI	C J 80
28. SAMUT PRAKAN	C J 90
29. AYUTTHAYA	C K 10
30. SUPHANBURI	C K 20

31. ANG THONG	C K 30
32. SING BURI	C K 40
33. LOP BURI	C K 50
34. SARA BURI	C K 00
35. CHACHOENGSAO	C L 10
36. NAKHON NAYOK	C L 20
37. PRACHIN BURI	C L 30
38. TRAT	C L 40
39. CHANTHA BURI	C L 50
40. RAYONG	C L 60
41. CHONBURI	C L 00
42. SIRACHA	C L 01
43. SATTA HIP	C L 02
44. RATCHA BURI	C M 10
45. BAN PONG	C M 11
46. KANCHANABURI	C M 20
47. NAKHON PHATHOM	C M 00
48. SAMUT SAKHON	C M 30
49. SAMUTSONGKHRAM	C M 40
50. PHETCHABURI	C M 50
51. PRACHUAPKHIRIKHAN	C M 60
52. THAP SAKAE	C M 70
53. HUA HIN	C M 80
54. NAKHON SAWAN	B N 00
55. TAKHLI	C N 01
56. TAK	C N 10
57. KAMPHAENGPHET	C N 20
58. UTHAITHANI	C N 30
59. CHAI NAT	C N 40
60. CHIANG MAI	C Q 10
61. " " 1	C Q 11
62. MAEHONGSON	C Q 20
63. LAMPHUN	C Q 00
64. LAMPANG	C Q 30
65. UTTARADIT	C R 00

66. CHIANG RAI	C R 10
67. PHA YAO	C R 11
68. NAN	C R 20
69. PHRAE	C R 30
70. PHITSANULOK	C P 00
71. SUKHO THAI	C P 10
72. PHETCHA BUN	C P 20
73. LOMSAK	C P 21
74. PHICHIT	C P 30
75. TAPHAN HIN	C P 31
76. UDON THANI	C T 00
77. " " 1	C T 01
78. LOEI	C T 10
79. NONG KHAI	C T 20
80. KHON KAEN	C T 30
81. BAN PHAI	C T 31
82. SAKHON NAKHON	C U 00
83. NAKHON PHANOM	C U 10
84. MUKDAHAN	C U 11
85. KALASIN	C U 20
86. MAHA SARAKHAM	C U 30
87. UBON	C V 10
88. YASO THON	C V 11
89. SISAKET	C V 20
90. SURIN	C V 30
91. ROIET	C V 40
92. NAKHONRATCHASIMA	B S 00
93. " " " 1	C S 01
94. PAKCHONG	C S 10
95. CHAIYA PHUM	C S 20
96. BURI RAM	C S 21
97. CHUM PHON	C Y 00
98. RANONG	C Y 10
99. PHANGNGA	C Y 20
100. TAKUAPA	C Y 21

101. KRABI	C Y 30
102. PHUKET	C Y 40
103. NAKHONSITHAMARAT	C X 20
104. PAKPHANANG	C X 10
105. THUNG SONG	C X 00
106. SURATTHANI	C X 30
107. PHUN PHIN	C X 31
108. PHATTALUNG	C X 40
109. TRANG	C X 50
110. SONG KHLA	C W 10
111. HAT YAI	D W 00
112. " " 2	C W 01
113. PATTANI	C W 20
114. NARATHIWAT	C W 30
115. SUNGAI KOLOK	C W 31
116 YALA	C W 40
117. SATUN	C W 50

6.9 Training

Most of the technicians do not have enough knowledge on the equipment they are handling, therefore, the quality of maintenance is not as good as it should be. To overcome this, it is the responsibilities of engineering and technical divisions concerned to provide instruction and system manuals written in Thai and proper training to the technicians.

Drawing 6.1

CORRECTIVE MAINTENANCE TICKET		Inspector's Signature :	
Name of the Equipment SJ	Equipment No.	OUTAGE Date : Time :	RECOVERED Date : Time :

Material used for repairing.

Condition of equipment before repairing in details.

Causes of Trouble

1. Parts Damage

2. Wirings

3. Mis-adjustment

Action to be taken

Performance Test (minutes)	Present Value	Standard Value	Adjusted Value	Test

Remarks :

Drawing No.6.2

MAINTENANCE CHECK CARD			Name of Equipment SJ	
1. Date Equipment Installed 2. Line Used 3. Others				
No.	Checked Items	Standard Value	Adjusted Value	Checked Value
	Motor			
1	Unusual sound	Good		
2	Governor	Good		
	Selecting Unit			
1	Gap between magnet and armature excited	0.1 mm		
2	Movement of armature	0.8 mm		
3	Alignment of selector lever & cam	Good		
4	Unusual friction about cam shaft	Good		
5	Friction pressure of cam shaft	500-750 grm		
6	Tension of armature - spring	more than 140 grm		
7	Tension of rocking lever spring	280-340 grm		
8	Tension of selector lever spring	390-460 grm		
9	Gap of post	0.5-1.1 mm		
10	Reletionship between sword& extension	Same		
11	Gap of rocking edge and rocking lever	0.2-0.5 mm		
12	Gap of rocking edge & upper part of separator	0.1-0.3 mm		
13	Gap of stop lever & stop lever post	0.1-0.15 mm		
14	Gap of orientation trip latch and stop lever (released)	0.1-0.2 mm		
15	T lever and T lever guide	0.1-0.3 mm		
16	Gap of driven clutch and driving clutch	0.5-1.0 mm		
17	Gap of driven clutch & throw-out lever	0.1-0.3 mm		
	Printing Unit			
1	Code bar and L lever	0.1-0.3 mm		
2	Gap of code bar and pull-bar	0.8-1.3 mm		
3	Gap of operating bail and pull-bar	7.0-8.0 mm		
4	Gap of shift adjusting-arm & operating screw	about 1 mm		
5	Gap of space locking pawl and ratchet	0.5-0.8 mm		
6	Platten shaft friction	Good		
7	Paper feed mechanism	Good		
8	Ribbon feed and ribbon reverse	Good		
9	Characters	Good		
10	B.and C. contacts	Good		
11	Local margin ,....upper .....lower ....margin	- - more than 35%		
12	Greasing	Good		
13	Screw	Good		

SJ	Equipment No.	Date Adjusted :	Technician's Signature
		Date Checked :	Inspector's Signature

Drawing 6.3

MAINTENANCE CHECK CARD			Name of Equipment KP	
	1. Date Equipment Installed 2. Line Used 3. Others			
No.	Checked Items	Standard Value	Adjusted Value	Checked Value
	Motor			
1	Unusual sound	Good		
2	Governor	Good		
	Clutch			
1	Tension of clutch spring	400-700 grm		
2	Stop position of clutch	3-5 teeth		
3	Spring tension of trip latch	50-80 grm		
4	Gap between trip latch and stop lever	0.2-0.5 mm		
5	Relation between trip latch and stop lever	0.4-0.6 mm		
6	Tension of back stop pole spring	more than 25 grm		
	Transmitting Unit			
1	Dot contact ..... contact gap	0.5-0.6 mm		
2	Dot contact ..... pressure	more than 20 grm		
3	Contact tongue gap	0.1-0.15 grm		
4	Contact tongue transfer	70-100 grm		
5	Dot code distortion	less than 3%		
6	Dot code contact ratio	more than95%		
	Punching Unit			
1	Spring tension of tape tension fork	150-200 grm		
2	Spring tension of detent lever spring	400-600 grm		
3	Corresponding ratchet to tape feed pole	0.2-0.5 mm		
4	Spring tension of selector finger spring	30-45 mm		
5	Punch pin corresponding to selector finger(mark)	0.3-0.7 mm		
6	" " " " (space)	0.7-1.3 mm		
7	Feed roll pin	Good		
8	Center hole	Good		
9	Punching pitch and - sharpness	Good		
	Universal Contact			
1	Universal contact gap	0.5-0.8 mm		
2	Universal contact - pressure	30-60 grm		
3	Spring tension of universal rocker connector	50-100 grm		
4	Position relating every part	Good		
5	Lubrication	Good		
6	Screw	Good		
7	Insulation	more than15MW		
8	Overall test	OK		
KP	Equipment No.	Date Adjusted :	Technician's Signature	
		Date Checked :	Inspector 's Signature	

Drawing 6.4 .

MAINTENANCE RECORD								NAME OF OFFICE		
Date	Voltage		Current		Speed Check			Working Condition Equipment	Remarks	Technician Signature
	+	-	Receive	Send	KP	TD	PP			

LIST OF TELEGRAPH LINES

Drawing . 6.6

Code Number	Name of Line	Terminal Equipment	Distance, Km.	Channels Used	Date Operated	Remarks
Line Control Office				Code Number		

TELEGRAPH CIRCUIT AND ITS CHARACTERISTICS	Date Recorded : Date Corrected :

Characteristics \ Section Between 2 ..... Offices				A & B		B & C		C & D		Examination of Margin			Remarks
				L1	L2	L1	L2	L1	L2	Test Office	Dot(%)	Code(%)	
Insulation	to earth	MW								Local			
	to line	MW								To.....			
Capacitance		uF								To.....			
Induced Current	Open	mA								Local			
	Short	mA								To.....			
Line Resistance		W								To.....			
Loop Resistance		W								Local			
Operating Current		mA								To.....			
Signalling Voltage		V								To.....			
Name of Line				Terminal Equipment		Distance, Km:				Line Control Office			Date Circuit Constructed:

Drawing No.6.7

RECORD OF FAULTS

NAME OF OFFICE .....

Date	Number	Name of Line	Kind of Fault	Time of Fault Informed	Name of		Time Recovered	Name of	
					Informer	Receiver		Informer	Receiver

7. ADVANCED PROSPECT

1) It is taken for grant that Telecommunication is indispensable for the socio-economic growth of a country. Therefore, the appropriate networks of telecommunication should be on assumption to compete with such growth. In Thailand, Telegraph service still plays an important role although the telephone is replacing.

The project of the automatic Telegraph relay switching undertaken by the Post & Telegraph may be considered as the first step towards improvement of the service for quickness and reliability of telegrams.

However, emphasizing that anyone of the public will be eligible for the benifit of telegram service anytime and anywhere, much yet remains to be carried out, for example

1. Telegrams among principal offices will be handled - auto-mechanically after the completion of the proposed Telegraph relay switching network. There will be, nevertheless, a considerable number of telegrams handled manually with the aid of Morse which requires inefficient manual repeat, among rural local offices. Although it is not easy as limitations of economy will come up, improving this situation is a question that must be solved in the future.
2. If we should set up interconnections of this system onto the above rural offices which have few traffic, despite of our effort, it wouldn't pay economically. This implies that the solution by the Department can be beyond their might and subsequently the reorganization in the telecommunication field in Thailand namely the unification of Post & Telegraph Department and The Telephone Organization of Thailand, must be taken into consideration. The merit derived from unification will be as follows :

1) Double investment could be avoided, for instance, in the rural area, an open wire, carrier system could be preferably shared by Telephone and Telegraph.
2) In the rural area, performance of maintenance of telecommunication facilities which are not concentrated, would be rationalized with comparatively few man power.
3) Trouble shooting and clearance would be hastened. As things are controlled under the same organization, the range of responsibility upon anyone, would be distinctive, from the top management to the field technicians. This would promise the reliable maintenance more than before. Once happens a fault, the quick sequence of actions made of the recognition and the localization of the faults by the relative Line Control Office could be expected and in addition, the alternative transmission path could rapidly be secured, if anything.
4) Expenditure for not only labour but also such properties as buildings, emergency engines, vehicles for maintenance etc.could be saved.
5) Telegrams could be accepted directly from the telephone subscribers also, without the coming to a telegraph office.
This would encourage the public to use telegram more frequent whenever they come to think of using telegram anytime.
6) Message of telegram could be informed quickly to the addressee by telephones this would not only rescue the tordiness of delivery but also save the labour power.

Appendix 1.1

NUMBER OF POPULATION IN EACH PROVINCE.

	PROVINCE		Increasing ratio%	YEAR 1969	YEAR 1979	YEAR 1987
1	1+2	BANGKOK +	5.2	2,427,776		
		THONBURI	5.1	954,445	4,962,245	6,738,244
	3	NONTHA BURI	2.8	264,657	355,451	450,238
	4	PATHUM THANI	2.8	246,792	325,899	409,832
	5	SAMUT PRAKAN	3.6	317,068	455,540	604,295
		TOTAL	4.7	4,210,738	6,099,135	8,202,609
2	6	AYUTTHAYA	2.8	556,511	644,448	720,667
	7	SUPHAN BURI	3.2	625,603	779,585	928,321
	8	ANGTHONG	3.1	228,941	260,406	288,928
	9	SING BURI	4.8	175,521	199,580	221,439
	10	LOP BURI	2.8	490,120	685,455	902,709
	11	SARA BURI	3.2	371,636	465,778	558,781
		TOTAL	3.2	2,448,332	3,035,252	3,620,845
3	12	CHACHOENGSAO	2.4	394,605	475,298	552,308
	13	NAKHON NAYOK	2.8	181,361	213,822	244,683
	14	PRACHIN BURI	2.8	438,331	567,211	743,800
	15	TRAT	2.8	87,842	121,478	156,238
	16	CHANTHABURI	2.8	215,012	312,183	420,632
	17	RAYONG	2.7	232,363	379,409	564,629
	18	CHON BURI	2.8	539,320	784,905	1,057,574
		TOTAL	2.7	2,088,834	2,874,306	3,739,864
4	19	RATCHABURI	2.8	499,934	635,502	768,455
	20	KANCHANABURI	2.8	329,293	496,321	689,982
	21	NAKHON PATHOM	2.6	455,303	554,890	650,080
	22	SAMUT SAKHON	4.8	227,425	259,816	311,695
	23	SAMUT SONGKHRAM	2.9	181,096	206,785	231,241
	24.	PHETCHABURI	2.8	304,467	381,371	457,521
	25	PRACHUAP	2.8	232,738	386,473	562,350

Appendix 1.1

		TOTAL	3.0	2,210,256	2,921,158	3,671,324
	26	NAKHON SAWAN	3.0	774,062	957,961	1,140,730
	27	TAK	3.0	199,647	274,012	352,418
	28	KAMPHAENG PHET	3.1	337,442	567,455	684,821
	29	UTHAI THANI	3.0	175,211	235,978	257,678
	30	CHAI NAT	2.8	285,505	366,013	394,291
	..	TOTAL	3.0	1,741,867	2,401,419	2,829,938
6	31	CHIANG MAI	3.0	983,422	1,187,720	1,380,160
	32	MAEHONG SON	2.9	89,306	107,961	126,482
	33	LAMPHUN	3.0	299,931	347,182	391,225
	34	LAMPANG	3.0	577,164	689,752	795,506
		TOTAL	3.0	1,949,823	2,332,615	2,693,373
7	35	UTTARADIT	3.0	327,682	411,455	493,612
	36	CHIANG RAI	3.0	1,074,216	1,448,779	1,849,505
	37	NAN	3.0	317,063	396,744	475,964
	38	PHRAE	3.0	382,144	460,228	534,797
		TOTAL	3.0	2,101,105	2,717,206	3,353,878
8	39	PHITSANULOK	3.0	496,903	760,564	1,073,465
	40	SUKHOTHAI	3.0	422,582	555,946	693,414
	41	PHETCHABUN	3.0	504,294	832,048	1,229,564
	42	PHICHIT	3.0	479,158	597,130	722,054
		TOTAL	3.0	1,902,937	2,745,688	3,718,497
9	43	UDON THANI	3.0	960,421	1,282,644	1,612,977
	44	LOEI	3.0	320,809	540,916	816,136
	45	NONG KHAI	3.0	388,564	667,956	1,040,664
	46	KHON KAEN	3.0	1,040,686	1,335,124	1,626,948
		TOTAL	3.0	2,710,480	3,826,640	5,096,725
10	47	SAKON NAKHON	3.0	565,440,	799,706	1,053,171
	48	NAKHON PHANOM	3.0	567,469	778,337	1,001,054
	49	KALASIN	3.0	571,704	769,112	974,209
	50	MAHA SARAKHAM	3.0	612,377	794,991	976,072
		TOTAL	3.0	2,316,990	3,142,146	4,004,506

Appendix 1.1

11	51	UBON RATCHATHANI	3.0	1,457,947	1,994,369	2,565,047
	52	SISAKET	3.0	789,878	1,047,095	1,316,764
	53	SURIN	3.0	721,963	966,710	1,224,499
	54	ROI ET	3.0	826,380	1,051,696	1,271,720
		TOTAL	3.0	3,796,168	5,059,870	6,378,030
12	55	NAKHON RATCHASIMA	3.0	1,377,052	1,915,557	2,502,560
	56	CHAIYAPHUM	3.0	670,975	883,895	1,121,072
	57	BURI RAM	3.0	741,551	1,065,656	1,425,228
		TOTAL	3.0	2,789,578	3,865,108	5,048,860
13	58	CHUMPHON	3.0	336,487	335,881	445,561
	59	RANONG	2.9	54,402	87,869	128,833
	60	PHANGNGA	3.0	124,889	180,490	241,391
	61	KRABI	2.9	137,653	216,769	310,620
	62	PHUKET	3.0	100,583	136,115	173,764
		TOTAL	3.0	654,014	957,124	1,300,169
14	63	NAKHON SITHAMMARAT	3.0	915,893	1,204,400	1,502,213
		THUNG SONG	3.0			
	64	SURAT THANI	3.0	448,255	633,882	834,790
	65	PHATTHALUNG	3.0	307,237	408,411	513,593
	66	TRANG	3.0	328,272	457,250	597,370
		TOTAL	3.0	1,999,657	2,703,943	3,447,966
15	67	SONG KHLA	3.0	627,861	817,992	1,012,353
		EAT YAI	3.0			
	68	PATTANI	3.0	345,597	424,921	501,731
	69	NARATHIWAT	3.0	326,902	417,917	509,263
	70	YALA	3.0	197,833	288,415	391,640
	71	SATUN	2.7	104,150	179,523	279,694
		TOTAL	3.0	1,602,343	2,128,768	2,694,681
		GRAND TOTAL		34,523,122	46,810,378	59,801,265

X Increasing ratio = annual increase (average of past nine years)

TELEGRAM PER CAPITA AT PRESENT AND NEAR FUTURE

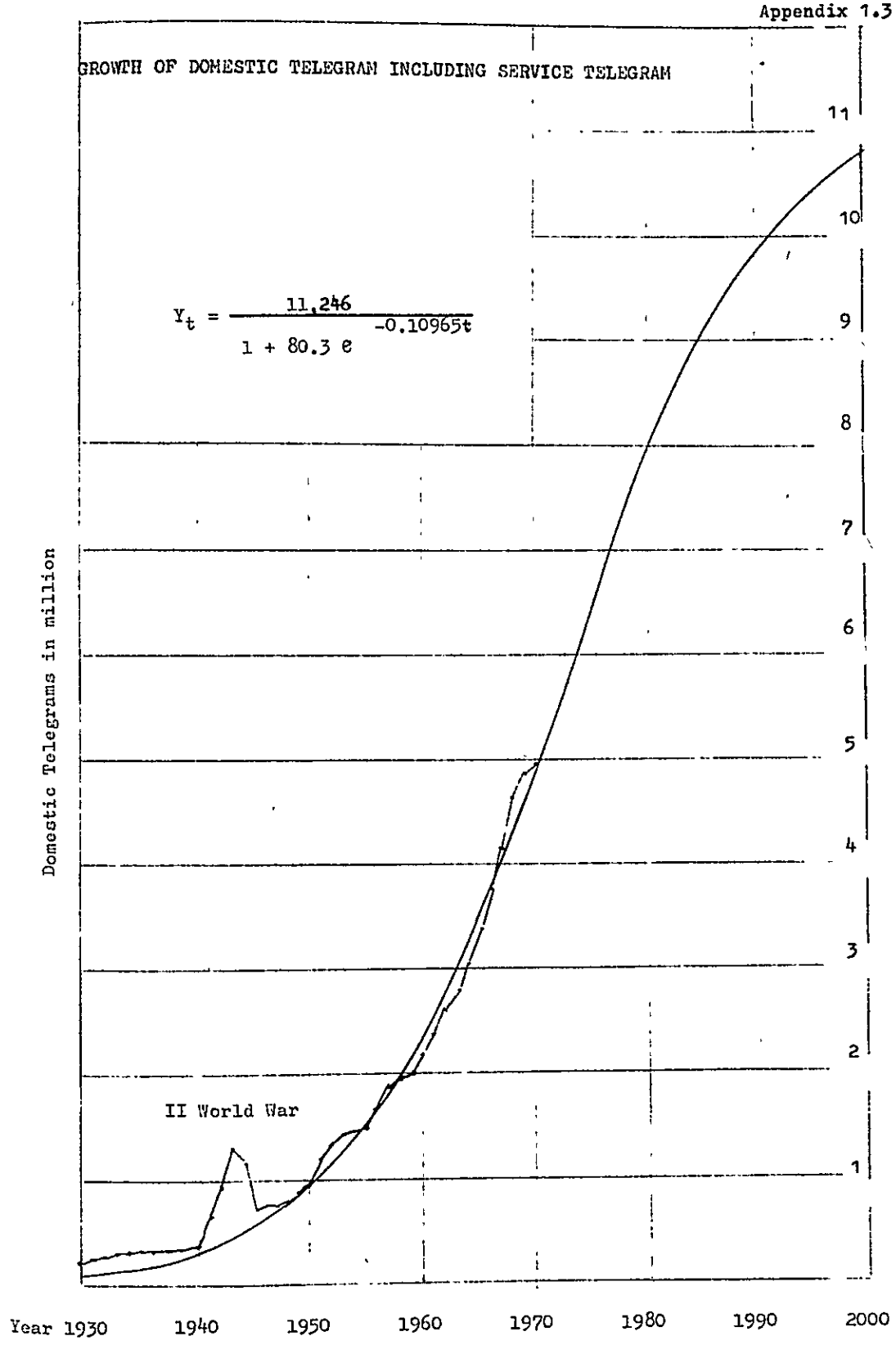
Provincial number	Coefficient of increment (a)	Telegram per capitax100 mean value in past 5 years * (b)	Telegram per capitax100 in 1979 ** (c)	Provincial number	Coefficient of increment (a)	Telegram per capitax100 mean value in past 5 years * (b)	Telegram per capitax100 in 1979 ** (c)
1,2	0.779	32.87	40.66	37	0.660	6.99	13.59
3	0.867	5.11	13.78	38	0.897	13.15	22.12
4	0.211	2.13	4.24	39	0.080	15.38	14.58
5	0.480	5.41	10.21	40	0.006	9.34	9.28
6	0.449	6.31	10.80	41	0.307	7.05	10.12
7	0.430	5.11	9.41	42	0.420	10.68	14.88
8	0.925	8.07	17.32	43	0.512	8.78	13.90
9	0.954	8.92	18.46	44	0.519	8.72	13.91
10	0.019	10.64	10.83	45	0.005	9.84	9.79
11	0.382	8.91	12.73	46	0.361	10.11	13.72
12	0.706	6.59	13.65	47	0.443	7.51	11.94
13	0.740	7.93	15.33	48	0.972	10.42	20.14
14	0.568	8.94	14.62	49	0.461	4.46	9.07
15	0.403	15.93	19.96	50	0.669	4.96	11.65
16	0.086	15.36	16.22	51	0.372	8.20	11.92
17	0.197	9.37	11.34	52	0.225	3.64	5.89
18	0.544	13.15	18.59	53	0.333	4.63	7.96
19	0.674	10.49	17.23	54	0.592	5.72	11.64
20	0.830	4.43	12.73	55	0.527	9.55	14.82
21	0.640	6.23	12.63	56	0.412	5.18	9.30
22	0.365	4.59	8.24	57	0.142	5.20	6.62
23	0.848	6.04	14.52	58	0.359	26.02	22.43
24	0.701	8.96	15.97	59	1.083	5.5	6.58
25	1.608	14.75	30.83	60	1.023	19.57	29.80
26	0.533	14.85	20.18	61	0.631	11.38	17.69
27	0.176	18.49	16.73	62	1.460	56.95	42.35
28	0.561	5.72	11.33	63	0.811	15.39	23.50
29	0.369	11.10	14.79	64	0.697	19.79	26.76
30	0.327	11.13	14.40	65	0.347	7.78	11.25
31	1.057	14.08	24.65	66	0.040	24.80	25.20
32	0.493	11.93	16.86	67	0.959	28.07	37.66
33	0.576	5.08	10.84	68	0.394	10.962	14.90
34	0.875	11.90	20.65	69	0.773	17.468	25.20
35	0.460	11.07	15.67	70	0.921	30.384	39.59
36	0.702	8.16	15.18	71	0.638	12.382	18.76
				Total	--	-	18.20

** Forecasted Telegram per Capita

C = ax + b where x = 10

* Past five years (1966 - 1970)

Appendix 1.3


GROWTH OF DOMESTIC TELEGRAM INCLUDING SERVICE TELEGRAM
$Y_t = \frac{11.246}{1 + 80.3\ e^{-0.10965t}}$
Domestic Telegrams in million
11
10
9
8
7
6
5
4
3
2
1
II World War
Year 1930
1940
1950
1960
1970
1980
1990
2000

CALCULATION PROCESS OF LOGISTIC CURVE

Appendix 1.3 Cont.

YEAR	TELEGRAM (unit:ten thousands) Yt	t	△ Yt	$R_t = \Delta Yt/Yt$	Y_t^2	$\log e^{at} = (a.\log e)t$ (1) 0.048584t	e^{at} (from log table) (2)	Me^{-at} (M/(2)) (3)	$1 + Me^{-at}$ (a + (3)) (4)	$Yt = \frac{K}{1 + Me^{-at}}$ K/(4) (5)
1932	23.41	0	5.34	0.2281	548.03	.0.00000	1.000	74.22	75.22	13.34
33	28.75	1	3.95	0.1374	826.56	0.04858	1.011	73.41	74.41	13.48
34	32.70	2	3.60	0.1101	1069.29	0.09717	1.250	59.37	60.37	16.62
35	36.30	3	-0.40	-0.0110	1317.69	0.14575	1.398	53.09	54.09	18.55
36	35.90	4	1.46	0.0407	1288.81	0.19434	1.560	47.57	48.57	20.65
37	37.36	5	1.12	0.0299	1395.77	0.24292	1.750	42.41	43.41	23.11
38	38.48	6	6.37	0.1655	1480.71	0.29151	1.957	37.92	38.92	25.77
39	45.21	7	-7.54	-0.1668	2043.94	0.34009	2.188	33.92	34.92	28.73
40	37.67	8	12.33	0.3273	1419.03	0.38868	2.447	30.33	31.33	32.02
41	(50.00)	9	4.00	0.0800	2500.00	0.43726	2.737	27.12	28.12	35.60
42	(54.00)	10	4.00	0.0741	2916.00	0.48584	3.061	24.25	25.25	39.73
43	(58.00)	11	2.00	0.0345	3364.00	0.53443	3.423	21.68	22.68	44.23
44	(60.00)	12	4.41	0.0735	3600.00	0.58301	3.829	19.38	20.38	49.22
45	64.41	13	10.88	0.1689	4148.65	0.63160	4.281	17.34	18.34	54.65
46	75.29	14	-3.94	-0.0523	5668.58	0.68018	4.788	15.50	16.50	60.79
47	71.35	15	5.91	0.0828	5090.82	0.72877	5.355	13.86	14.86	67.50
48	77.26	16	8.18	0.1059	5969.11	0.77735	5.989	12.39	13.39	74.91
49	85.44	17	14.01	0.1670	7299.99	0.82594	6.698	11.08	12.08	83.04
50	99.45	18	21.05	0.2117	9890.30	0.87452	7.491	9.91	10.91	91.94

YEAR	TELEGRAM (unit:ten thousands) Yt	t	ΔYt	R = ΔYt/Yt	Y^2t	$\log_e Y = (\wedge.\log_e)t$ (1) 0.48584t	e^Y (from log table) (2)	Me^{-nt} (M/(2)) (3)	$1 + Me^{-nt}$ (1 + (3)) (4)	$Yt = \frac{K}{1 + Me^{-nt}}$ K/(4) (5)
1951	120.5	19	11.40	0.0946	14520.25	0.92310	8.377	8.86	9.86	101.73
52	131,9	20	8.50	0.0644	17397.61	0.97169	9.369	7.92	8.92	112.45
53	140.4	21	-0,50	0.0036,	19712.16	1.02027	10.477	7.08	8.08	124.14
54	140.9	22	4.00	0.0284	19852.81	1.06885	11.717	6.33	7.33	136.85
55	144.9	23	20.70	0.1429	20996.01	1.11744	13.105	5.66	6.66	150.61
56	165.6	24	22.30	0.1347	27423.36	1.16603	14.657	5.08	6.08	164.98
57	187.9	25	4.50	0.0239	35306.41	1.21461	16.391	4.53	5.53	181.39
58	192.4	26	7.60	0.0395	37017.76	1.26319	18.332	4.05	5.05	198.63
59	200.0	27	17.60	0.0880	40000.00	1.31175	20.502	3.62	4.62	217.11
60	217.6	28	18.60	0.0855	47349.76	1.36036	22.928	3.24	4.24	236.57
61	236.2	29	21.90	0.0927	55790.44	1.40895	25.641	2.89	3.89	257.86
62	258.1	30	16.90	0.0655	66615.61	1.45753	28.677	2.59	3.59	279.41
63	275.0	31	26.80	0.0975	75625.00	1.50612	32.071	2.31	3.31	303.04
64	301.8	32	29.60	0.0981	91083.24	1.55470	35.867	2.07	3.07	326.73
65	331.4	33	41.40	0.1249	109825.96	1.60329	40.114	1.85	2.85	351.95
66	372.8	34	41.80	0.1121	138979.84	1.65187	44.861	1.65	2.65	378.51
67	414.6	35	45.70	0.1102	171893.16	1.70045	50.179	1.48	2.48	404.46
68	460.3	36	20.50	0.0445	211876.09	1.74904	56.110	1.32	2.32	432.35
69	480.8	37	8.30	0.0173	231168.64	1.79762	62.752	1.18	2.18	460.12
1970	(489.1)	38								
37 Σ t =0	5784.08		465.35 (5% increased =488.5)	3.2756 (10% increased =3.6031)	1494224.74					

Appendix 1.4

GRAND DOMESTIC PRODUCT

Unit : Billion Baht.

CATEGORY	1966		1970 *		1966-1970 mean growth ratio
	AMOUNT	%	AMOUNT	%	
AGRICULTURE	30.785	34.5	35.224	29.6	5.6
MINING INDUSTRY	1.418	1.6	1.984	1.7	10.8
INDUSTRY	13.795	15.5	19.820	16.6	9.9
CONSTRUCTION	5.604	6.3	8.014	6.7	4.3
ELECTRICITY & WATER SUPPLY	809	0.9	1.681	1.4	21.9
TRANSPORTATION - COMMUNICATION	6.013	6.7	8.131	6.8	7.8
COMMERCE	14.133	15.8	19.514	16.4	8.8
FINANCIAL BUSINESS	2.620	2.9	4.749	4.0	17.3
HOUSEHOLD	1.931	2.2	2.304	1.9	4.4
ADMINISTRATION NATIONAL DEFENCE	3.542	4.0	5.366	4.5	9.3
SERVICE	8.539	9.6	12.305	10.3	9.7
TOTAL	89.190	100.0	119.101	100.0	9.5

* Estimated

SOURCE : Bank of Thailand

Appendix 1.5

NATIONAL DEVELOPMENT SCHEME

FIELD	1st Plan 1961 - 1966		2nd Plan 1967 - 1971		3rd Plan 1972 - 1976	
	Investment	%	Investment	%	Investment	%
Agriculture	3,900	13.9	12,767	17.2	13,695	13.7
Mining	2,340	8.3	838	1.1	2,350	2.3
Transportation & Communication	7,360	26.1	19,645	26.4	19,475	19.4
Power	4,700	16.8	6,658	9.0	7,875	7.9
Village Development	5,560	19.7	9,058	12.2	17,630	17.6
Public Welfare	1,060	3.8	4,658	6.3	6,340	6.3
Education	2,080	7.4	20,649	27.8	32,910	32.8
Others	1,140	4.0	-	-	-	-
TOTAL	28,140	100.0	74,273	100.0	100,275	100.0

Source : NEDB Business in Thailand 1971.10

Appendix 1.6

TELEPHONE SERVICE UNDER T.O.T.

	1966	1967	1968	1969	1970
A. Metropolitan Area					
1. No.of offices	8	8	8	13	13
2. Capacities	55,000	55,000	60,200	74,340	84,285
3. No.of lines	42,060	43,861	48,170	56,395	66,384
4. No.of telephone sets	65,650	74,818	87,422	103,988	118,809
B. Provincial Area					
1. No.of offices	62	66	73	76	76
2. Capacities	28,425	30,270	32,290	33,400	34,200
3. No.of lines	18,149	20,700	23,698	26,689	29,089
4. No.of telephone sets	20,358	23,572	26,997	30,675	34,150
C. Total (A + B)					
1. No.of offices	70	74	81	89	89
2. Capacities	83,425	85,270	92,490	107,740	118,485
3. No.of lines	60,209	64,561	71,868	83,084	95,473
4. No.of telephone sets	86,008	98,390	114,419	134,663	152,959
D. Toll lines					
1. Domestic	220	260	271	353	357
2. International (T.O.T.)	5	6	11	11	15

Appendix 1.7

DIFFUSION OF TELEPHONE

Name of Cities	No.of Telephone sets in 1968	Sets per Capita x 100
Melbourne	708,941	30.6
Sydney	904,458	34.2
Rangoon	16,043	0.9
Colombo	32,667	5.8
Taipei	126,010	7.9
Hong Kong	426,540	10.8
Calcutta	146,847	4.9
Bombay	150,611	2.8
Delhi	103,932	2.9
Djakarta	32,358	0.7
Madras	58,999	2.9
Tokyo	3,641,383	36.2
Osaka	1,820,076	24.9
Nagoya	601,506	29.8
Seoul	230,265	5.3
Kuala Lumpur	53,339	10.9
Oakland	273,146	44.9
Wellington	161,331	53.1
Karachi	57,500	1.9
Dacca	22,565	2.7
Manila	147,671	9.8
Bangkok*	87,422	2.9
Tehran	130,500	4.4
Singapore	119,184	5.95

*As of 1970

Appendix 1.8

Telephones per capita in ECAFE

Name of Countries	1969 No.of Telephone	No.of Population in Million	No.of telephones per capita
Afganistan	10,000	16.70	0.06
Brunei	2,681	0.11	2.35
Burma	22,080	29.70	0.08
Cambodia	7,315	6.665	0.11
Ceylon	57,146	12.00	0.48
Taiwan	280,192	13.70	2.05
Hong Kong	426,540	3.97	10.74
India	1,047,000	523.50	0.20
Indonesia	181.377	113.00	0.16
Iran	250,300	27.00	0.92
Korea	489,912	30.60	1.60
Laos	1,081	2.70	0.04
Malaysia	156,354	10.40	0.75
Mongolia	16,220	1.23	1.32
Nepal	5,400	10.80	0.05
Pakistan	184,498	115.00	0.16
Philippines	241,496	36.40	0.66
Singapore	119,184	2.00	5.95
Thailand	114,419	33.80	0.34
South Vietnam	30,964	17.20	0.18
West Samoa	1,800	0.14	1.29
Fuji Island	14,507	0.51	2.83
Australia	3,392,436	12.00	28.20
Japan	20,525,211	102.00	20.12
New Zealand	1,155,465	2.70	41.56

Appendix 1.9

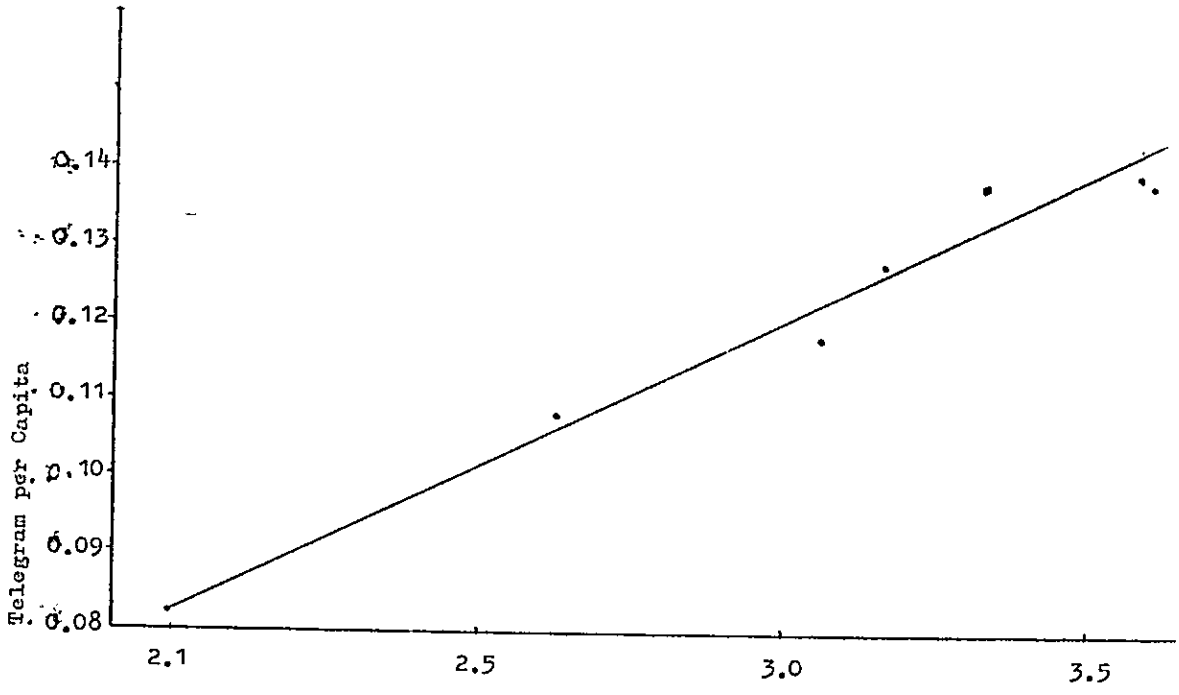
LONG DISTANCE CALL IN ECAFE

Country	No. of Toll lines	No. of Telephone sets	Long distance calls per one telephone
India	10,800	1,159,519	89
Ceylon	212	60,841	101
Taiwan	3,264	338,803	92
Korea	6,053	502,374	73
Philippines	465	282,166	9
Indonesia	1,002	182,319	42
Malaysia	3,046	168,826	117
Thailand	362	134,663	19
South Vietnam	119	33,996	17
Pakistan	3,466	193,493	220
New Zealand	3,378	1,202,590	56

As of June, 1970 Source : ECAFE

INCREMENT OF TELEGRAMS CORRESPOND WITH GDP/CAPITA

Appendix 1.10



G N P Per Capita ——————→ (1000 Baht)

Year	1960	1965	1966	1967	1968	1969	1970
GDP Per Capita	1,988.8	2,632.8	3,060.3	3,168.9	3,326.4	3,582.7	3,599.5
No.of Telegrams	8.24	10.80	11.80	12.70	13.70	13.80	13.70

Unit : G N P per Capita in Baht

Telegram per Capita X100

TELEGRAM PER CAPITA IN SOME COUNTRIES

ZONE	COUNTRIES	Telegrams in Million		No.of Telegram per Capita	No.of Telephone per Capita x 100
		1969	1970		
	India	47.9	50.5	0.09	0.20
E	Ceylon	3.9	4.5	0.35	0.48
C	Taiwan	1.77	1.92	0.14	2.05
A	Korea	0.89	1.01	0.32	1.60
F	Thailand	4.81	4.89	0.139	0.34
E	Philippines	-	-	0.16	0.66
*					
E	West Germany		17.7	0.31	17.21
U	East Germany		11.3	0.71	10.42
R	Netherlands		2.0	0.16	21.45
O	Italy		38.3	0.73	13.44
P	United Kingdom		98.4	1.81	21.87
E					

* : Domestic Telegram in 1965

SOURCE : overseas telecommunications 6.1971

Appendix 1.12

UTILIZATION OF TELEGRAM

USE \ NAME OF THE OFFICE	BANGKOK C.T.O.	CHIANGMAI	NAKHON SAWAN	NAKHON RATCHASIMA	NAKHON SITHAMMARAT
From Company to company	50.4	19.7	35.9	23.4	19.6
From company to individual	19.7	8.4	4.6	-	0.6
From individual to company	1.8	6.4	12.4	9.1	12.6
From individual to individual total	28.1	65.5	47.1	67.5	67.2
contents. - Travel -	(4.0)	(8.2)	(6.5)	(7.2)	(13.2)
- Sickness Death etc -	(1.6)	(1.6)	(3.3)	(1.9)	(4.6)
- Congratuiations -	(0.2)	-	-	-	(0.6)
- Others -	(22.3)	(55.7)	(37.3)	(58.4)	(42.5)
TOTAL	n = 1045 100.0	n = 240 100.0	n = 152 100.0	n = 134 100.0	n = 174 100.0

As of 5 Aug. 1971.

Appendix 1.13

INTERNATIONAL TELEGRAM SERVICE

YEAR	Sent To Foreign Countries		Received From Foreign Countries		TOTAL	
	No. of Telegrams	No.of Words In Thousands	No. of Telegrams	No.of Words In Thousands	No. of Telegrams	No.of Words in Thousands
1960	351,534	7,198	362,655	7,363	714,189	14,561
1961	374,421	7,923	405,682	8,186	780,103	16,109
1962	390,817	7,880	418,993	8,634	809,810	16,514
1963	385,972	7,527	405,040	8,438	791,012	15,965
1964	416,080	8,514	435,916	9,302	815,996	17,818
1965	430,470	8,880	448,822	9,673	879,292	18,553
1966	500,362	11,132	517,555	11,597	1,017,917	22,729
1967	510,917	10,940	545,982	12,437	1,056,899	23,377
1968	523,516	10,952	571,578	13,049	1,095,094	24,001
1969	531,469	10,871	584,947	13,706	1,116,416	24,577
1970	515,960	10,741	581,031	13,937	1,096,991	24,678
1971	507,713	10,683	565,842	13,927	1,073,555	24,610

Appendix 1.14

ORIGIN OF INTERNATIONAL TELEGRAMS

(INCLUDING SERVICE TGs)

1971

ORIGIN OR DESTINATION	INCOMING FROM FOREIGN		OUTGOING TO FOREIGN	
	DELIVERED TGs	%	ACCEPTED TGs	%
C.T.O	34,056	6,02	301,825**	59,44
METRO POLIS (BK1 - BK 12)	475,365*	84,01	108,857	21.44
[illegible] HOTEL, PRIVATE LINE (4)	-	-	34.202	6.73
5 unit Telex	4,082	0.72	-	-
PROVINCE (transit)	16,767	2.96	15,707	3.10
SERVICE TG. FROM/TO CENTRAL RADIO BUREAU	35,572	6.29	47,122	9.29
TOTAL	565,842	100	507,713	100
REMARKS ALL OF SERVICE TG INCLUDING C.R.B.	66,674	(11,81)	63,681	(12.54)

X TG DELIVERED BY 6 UNIT TELEX ARE INCLUDED.

XX ACCEPTED AT GTO COUNTER BY TELEX (5 AND 6 UNIT) ARE INCLUDED WHICH DETAIL IS DESCRIBED IN APPENDIX 1.20

Appendix 1.15

INTERNATIONAL TELEGRAMS IN 1971

MONTH	TO FOREIGN COUNTRIES			FROM FOREIGN COUNTRIES		
	TOTAL	FROM PROVINCE	FROM METROPOLIS	TOTAL	TO PROVINCE	TO METROPOLS
January	39,741	1164	38577	45,442	1241	44201
February	38,364	1147	37217	43,775	1183	42592
March	45,591	1580	44011	50,822	1703	49119
April	43,478	1432	42046	47,704	1590	46114
May	41,224	1603	39621	45,307	1438	43869
June	40,293	1286	39007	44,069	1279	42790
July	39,808	1126	38682	44,870	1270	43600
August	41,793	1298	40495	45,843	1235	44608
September	42,144	1250	40894	46,851	1373	45478
October	43,563	1229	42334	49,623	1395	48228
November	45,849	1204	44645	49,578	1338	48240
December	45,865	1388	44477	51,958	1722	50236
TOTAL	507,713	15707	492,006	565,842	16767	549,075

Appendix 1.16

TELEX EXCHANGE FACILITY

1. EXCHANGE

Office Location	Kind of Exchange	Unit	Office Numbering	Capacities	Number of Subscribers	Date Operated
BANGKOK	Manual (OKI) for International	5	3XX	80	57	1963
	Automatic (Lorentz)	5	2XX	100	4W:1 2W:87 =114	1964
	Automatic (OKI)	6	22XX 23XX	125	82	1967
NAKHONRAT-CHASIMA	Automatic (OKI)	6	52XX	100	3	1970
LAMPANG	Automatic (OKI)	6	42XX	50	4	1970
HAT YAI	Automatic (OKI)	6	32XX	100	*5	1970
TOTAL		-	-	555	265	-

As of March 6, 1972. Having accomodating Capacity insufficient for the 5 unit, 28 Subscribers are temporarily connected to 6 unit exchange facility. (5 unit exchange will be expanded within few months)

2. CONCENTRATOR

Office Location	Exchange Offices belong to	Office Numbering	Capacities	No. of Subscribers *	Date Operated
CHIANG MAI	LAMPANG	43XX	24	4	1970
NAKHON SAWAN	BANGKOK	24XX (2450 - 2473	24	0	1970
SARABURI	BANGKOK	24XX 2435 - 2449	24	8	1970
TOTAL			72	12	-

* No. of subscribers including OFFICIAL use.

As of March 6, 1972

6 March 1972

Appendix 1.17

BUSINESS CLASSIGICATION OF TELEX USERS (IN CLUDING OFFICIAL USE)

Users \ Exchange System	Manual 5 Unit		Automatic 5 Unit		Automatic 6 Unit		Located in Province (6 Unit)	
	No. of subscribers	per-cent	No. of subscribers	per-cent	No. of subscribers	per-cent	No. of subscribers	per-cent
Trade	32	56.0	8	7	9	11	4	16.7
Import	-	- -	22	19.3	17	20.7	-	-
Export	1	1.8	5	4.4	7	8.5	-	-
Import & Export	-	- -	19	16.7	5	6.1	5	20.8
Law Firms	2	3.5	1	0.9	-	- -	-	-
Sea transport	-	-	9	7.9	1	1.2	-	-
News	-	-	5	4.4	-	-	-	-
Banks	4	7.0	7	6.2	9	11	7	29.2
Hotels	-	-	4	3.5	6	7.3	-	-
Air transport	1	1.8	6	5.3	1	1.2	-	-
Embassies	6	10.5	6	5.3	2	2.5	-	-
Agents	1	1.8	7	6.2	8	9.8	-	-
Computer Co.	1	1.8	1	0.9	1	1.2	-	-
Machine Service	1	1.8	-	-	-	-	-	-
Oil Co.	4	7.0	2	1.7	1	1.2	-	-
Official Use	3	5.3	8	7	9	11	8	33.3
Others	2	3.5	4	3.5	6	7.3	-	-
TOTAL	57	100.0	114	100.2	82	100.0	24	100.0

Appendix 1.18.

NUMBER OF TELEX CALLS IN TYPICAL ONE DAY

AT. BANGKOK

KIND OF EXCHANGE	ORIGINATED OR OUTGOING			INCOMING FROM FOREIGN COUNTRIES
	INLAND CALL	FOREIGN CALL	TOTAL	
International 5 unit Manual	-	80	80	89
Domestic 5 unit Automatic	·X· 128	130	258	152
Domestic 6 unit Automatic	440	88	528	127
TOTAL	568	298	866	368

23 th Feb. 1972 AT BANGKOK CTD & INTERNATIONAL TELEX OFFICE

·X· Extimated from the record 640 unit/day

640 ÷ (5 unit/call : assumed) = 128

1 unit = 30 seconds.

CONTENTS OF 6 UNIT TELEX CALL

Appendix 1.18 Cont.

DESTINATED TO ORIGINATED FROM	OFFICIAL USE INCLUDING TELEGRAM SENT& REC.	TELEGRAM ACCEPTANCE (# 2203)	COMPLAINT POSITION (# 2200)	5 UNIT TELEX(21) BOOKING POSITION FOR OVERSEAS	BUSINESS FIRM (73 SUB)	TOTAL NUMBER OF CALLS
OFFICIAL USE (9 SUB.)	33 (7.26%)	0	0	0	Telegram Delivery 63 (13.88%)	96 (21.14%) 454
BUSINESS FIRMS *(110 SUB.)	19 (11.44%)	58 (12.80%)	14 (3.08%)	108 (23.78%)	159 (35.02%)	358 (78.86%) 100 %

AS OF 10th APRIL, 1972 AT BANGKOK CTO.

REMARKS : *

(1) 5 Unit Subscribers which are connected temporarily to 6 Unit exchange board are included.

(2) That is

6 Unit Subscribers	X	82
5 Unit Temporary Subscribers	X	28

Total Subscriber connected to 6 Unit board = 100

(3) These 5 Unit Subscribers are only able to have connection with Telex Booking Position to make overseas telex communication, no connection is available between 5 Unit Subscribers (See Appendix 1.16)

(4) Among 6 Unit Subscribers of business firms, those who accommodated to 6 Unit automatic exchange board, telex communication per day is about 2 times (∴ 159 times ÷ 73 SUB. = 2)

(5) If the 5 Unit Subscribers mentioned above are eliminated, total number of business telex occupies 46 % to all telex calls

$$\frac{159}{454 - 108} = 0.46$$

(6) Telegrams by means of telex occupy 45% to total telex calls by the following expression.

$$\frac{\text{Telegrams (Delivery + Acceptance + Sent \& Rec)}}{\text{Total No.of Telex calls except telex Booking due to 5 Unit}}$$

$$\simeq \frac{63 + 58 + 33}{454 - 108} = 0.45$$

Appendix 1.19

TELEGRAMS DELIVERED BY TELEX (JANUARY-DECEMBER 1971)

MONTH	TLGS SHOULD BE DELIVERED BY TELEX		TOTAL	TLGS. NOT DELIV. BY TELEX		TOTAL	TLGS.DELIVERED BY TELEX
	DOMESTIC	INTERNATIONAL	X	DOMESTIC	INTERNATIONAL	XX	
January	1309	676	1985	21	53	74	1911
February	1342	687	2029	63	118	181	1848
March	1158	689	1847	105	146	251	1596
April	1277	712	1989	66	64	130	1859
May	1073	757	1830	77	96	173	1657
June	797	678	1475	56	82	138	1337
July	1415	716	2131	10	73	83	2048
August	1327	599	1926	23	72	95	1831
September	1551	678	2029	45	76	121	2108
October	1276	724	2000	135	103	238	1762
November	1950	718	2668	107	96	203	2465
December	2221	707	2928	80	81	161	2767
TOTAL	16,696	8,341	25,037	788	1,060	1.848	23,189

X Telegrams appeared in this column were asked by the addressers to be delivered by Telex.

XX Telegrams could not be delivered by Telex because of Line failure, Machine failure of bysy. (As a rule,in order to watch the aiming subscriber stations operators used to try dialing more than three times within 20 minutes before avandonment).

Appendix 1.20

TELEGRAMS ACCEPTED BY TELEX

MONTH (1971)	GRAND TOTAL	DOMESTIC	INTERNATIONAL		
			TOTAL	ACCEPTED AT	
				COUNTER	MANUAL TELEX POS.
January	3694	1672	2022	1930	92
February	4055	1626	2429	2318	111
March	4596	1578	3018	2863	155
April	4232	1513	2719	2620	99
May	3974	1427	2547	2422	125
June	3960	1461	2499	2340	159
July	4659	2190	2469	2345	124
August	5196	1922	3274	2815	459
September	5404	2027	3377	2818	559
October	5361	2053	3308	2616	692
November	6342	2352	3990	3246	744
December	6446	2428	4018	3246	772
TOTAL	57919	22249	35670	31579	4091

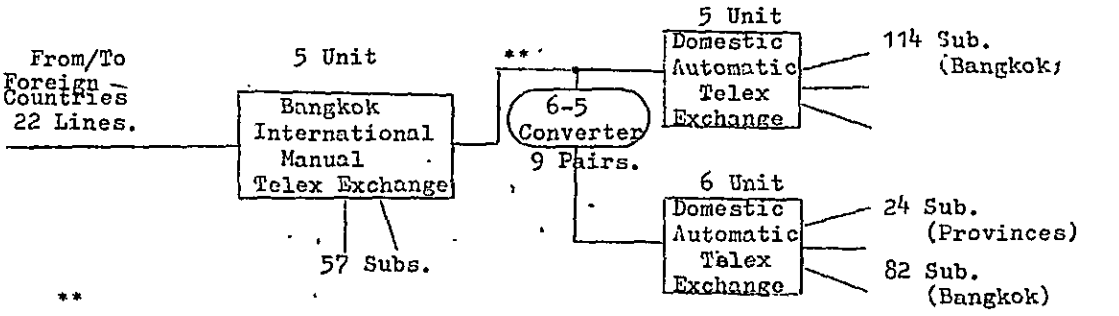
X Accepted at CTO counter by # 203, and # 2203 the former 15 provided for the telegrams from 5 unit telex users, the latter is for 6 unit telex users.

TELEX SERVICE IN 1971

MONTH	FROM FOREIGN COUNTRIES		TO FOREIGN COUNTRIES		BANGKOK AREA	
	CALLS	MINUTES	CALLS	MINUTES	* UNITS	MINUTES
January	5,733	27,907	5,063	26,577	40,395	22,032½
February	6,363	31,250	5,842	29,693	33,785	19,105
March	7,630	37,385	6,635	32,544	29,383	17,201½
April	7,170	33,237	5,645	27,459	35,011	19,519½
May	6,109	28,076	5,547	27,105	35,011	19,519½
June	7,299	32,687	5,954	28,404	34,797	18,854
July	7,421	33,092	5,994	27,476	39,584	22,293
August	7,602	34,564	6,244	30,135	50,623	28,339
September	7,767	34,159	6,240	29,315	40,740	22,717½
October	7,832	34,308	6,471	29,796	38,851	21,983
November	7,767	34,159	6,240	29,315	40,740	22,717½
December	9,003	41,704	7,169	35,220	38,398	22,365
Grand Total	88,488	406,005	94,198	358,416	456,790	257,330
Per day No. of messages	88,488 ÷300 = 295	406,005÷300 = 1,350	74,198÷ 300 = 347	358,416÷300 = 1,195	456,790÷300 = 1,520 *1,520 ÷ 5 = 304	257,330½ ÷ 300 = 858

* 30 sec. is one unit. Supposing that one call is 5 unit, communication would be 304 times.

Note : Both 5 and 6 unit telex are included together. The route of international telex communication is illustrated as follows (reference to appendix 1.15, 1.16 and 1.24).



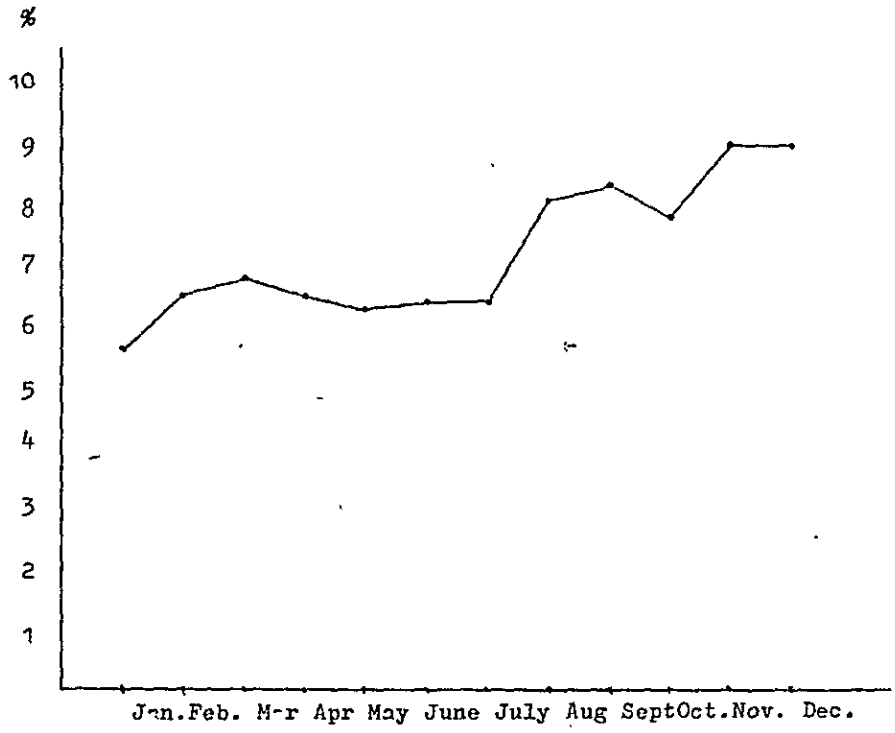
** No. of Trunk Lines between International Telex and 5 Unit Ex. are 9 channels, between International Telex and 6 Unit Ex. are 6 channels.

RATIO OF INTERNATIONAL TELEGRAMS ACCEPTED BY TELEX IN 1971

Appendix 1.22

Ratio of Telegram Acceptance by Telex

$$\% = \frac{\text{No.of Foreign Telegrams Accepted by Telex} \quad (2)}{\text{Total No.of Foreign Telegrams Despatched from Metropolis} \quad (1)}$$

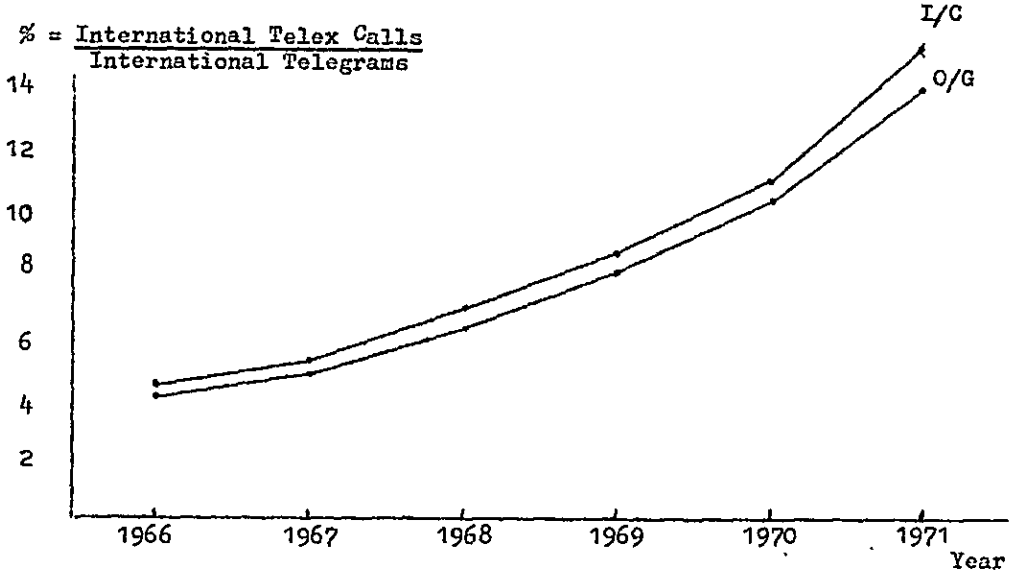


Month	Jan	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
(1)	35.6	37.2	44.0	42.0	39.6	39.0	38.7	40.5	40.9	42.3	44.6	44.5
(2)	2.0	2.4	3.0	2.7	2.5	2.5	2.5	3.3	3.4	3.3	4.0	4.0
Ratio(2)/(1)	5.6	6.5	6.8	6.5	6.3	6.4	6.4	8.1	8.3	7.8	9.0	9.0

Unit 1000

RATIO OF TELEX MESSAGES TO INTERNATIONAL TELEGRAMS

Appendix 1.23

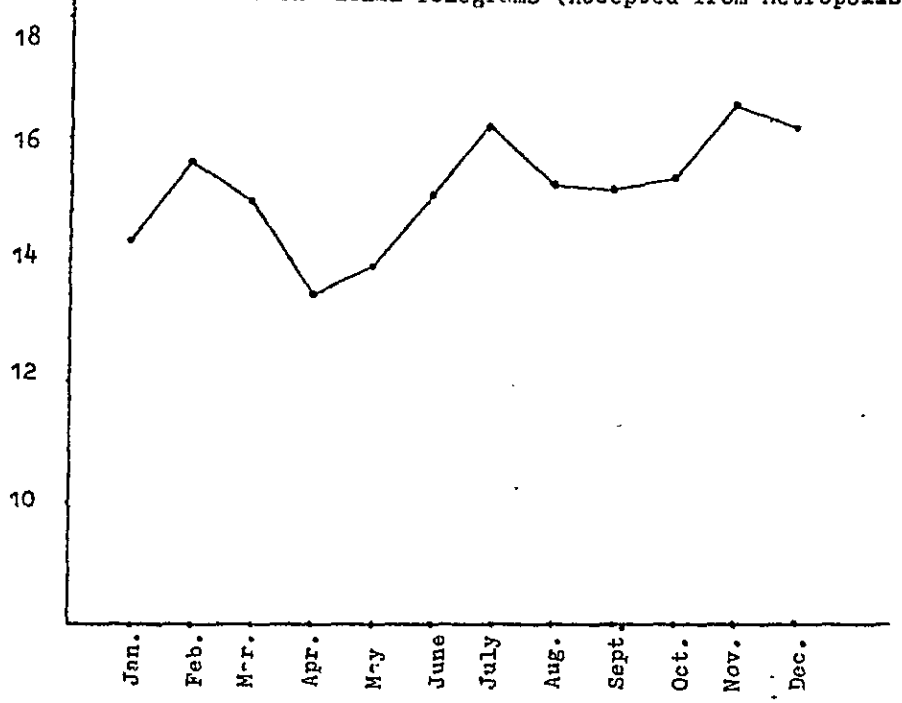


Ratio (5)=(2)/(4)	4.0	4.8	6.3	8.2	10.6	14.2
(5)=(1)/(3)	4.3	5.2	6.9	8.8	11.2	15.6
Telegram O/G(4)	500.4	510.9	523.5	531.5	516.0	507.7
I/C(3)	517.6	546.0.	571.6	584.9	581.0	565.8
Telex Call O/G(2)	20.1	24.7	33.0	44.2	55.0	74.2
I/C(1)	20.4	28.5	39.3	51.5	65.4	88.5
YEAR	1966	1967	1968	1969	1970	1971

RATIO OF TELEX MESSAGES TO INTERNATIONAL TELEGRAMS IN 1971

Appendix 1.23 Cont.

% = (2) No.of Telex calls to Foreign Countries / (1) No.of International Telegrams (Accepted from Metropolis)



		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.
	Ratio(2)/(1)	14.3	15.6	15.0	13.4	13.9	15.1	16.2	15.3	15.2	15.4	16.6	16.2
unit 1000	(2)No.of calls	5.1	5.8	6.6	5.6	5.5	5.9	6.0	6.2	6.2	6.5	7.4	7.2
	(1)Accepted	35.6	37.2	44.0	42.0	39.6	39.0	38.7	40.5	40.9	42.3	44.6	44.5
	Month	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept	Oct.	Nov.	Dec.

Appendix 1.24

NUMBER OF TELEGRAMS ORIGINATED IN EACH PROVINCE

RG	Province		Year 1970	Year 1979	Year 1987
1	1 + 2	BANGKOK	1,055,597 113,900+ 1,169,497	2,017,649	2,739,770
	3	NONTHA BURI	18,559	48,981	62,043
	4	PATHUM THANI	6,876	13,818	17,377
	5	SAMUT PRAKAN	21,676	46,511	61,699
		TOTAL	1,216,608	2,126,959	2,880,889
2	6	AYUTTHAYA	40,239	69,600	77,832
	7	SUPHAN BURI	38,145	73,359	87,355
	8	ANGTHONG	22,628	45,102	50,042
	9	SING BURI	19,616	36,842	40,878
	10	LOP BURI	51,580	74,235	97,763
	11	SARA BURI	36,409	59,294	71,133
		TOTAL	208,617	358,432	425,003
3	12	CHACHOENGSAO	31,664	64,878	75,390
	13	NAKHON NAYOK	16,098	32,779	37,510
	14	PRACHIN BURI	45,449	85,850	108,744
	15	TRAT	15,903	24,247	31,185
	16	CHANTHABURI	34,799	50,636	68,227
	17	RAYONG	22,691	43,025	64,029
	18	CHON BURI	77,218	145,914	196,603
		TOTAL	243,822	447,329	581,688
4	19	RATCHABURI	60,989	109,497	132,405
	20	KANCHANABURI	21,137	63,182	87,835
	21	NAKHON PATHOM	34,231	70,083	82,105
	22	SAMUT SAKHON	10,777	21,409	25,684
	23	SAMUT SONGKHRAM	13,575	30,025	33,576
	24	PHETCHABURI	31,649	60,905	73,066
	25	PRACHUAP	43,004	119,150	73,373
		TOTAL	215,362	474,251	608,044

RG	Province		Year 1970	Year 1979	Year 1987
5	26	NAKHON SAWAN	121,045	193,317	230,199
	27	TAK	35,437	50,665	65,162
	28	KAMPHAENG PHET	21,543	64,293	77,590
	29	UTHAI THANI	20,353	34,901	38,111
	30	CHAI NAT	33,723	52,706	56,778
		TOTAL	232,103	395,882	467,840
6	31	CHIANG MAI	160,228	292,773	340,209
	32	MAEHONG SON	11,295	18,202	21,325
	33	LAMPHUN	18,126	37,635	42,409
	34	LAMPANG	80,914	142,434	164,272
		TOTAL	210,563	491,044	568,215
7	35	UTTARADIT	38,562	64,475	77,349
	36	CHIANG RAI	101,933	219,925	280,755
	37	NAN	25,913	53,918	64,684
	38	PHRAE	56,631	101,802	118,297
		TOTAL	223,039	440,120	541,085
8	39	PHITSANULOK	73,005	116,974	165,099
	40	SUKHOTHAI	41,395	51,925	64,765
	41	PHETCHABUN	41,757	84,203	124,432
	42	PHICHIT	56,933	88,853	107,442
		TOTAL	213,090	341,955	461,738
9	43	UDON THANI	93,015	178,288	224,204
	44	LOEI	31,239	75,241	113,525
	45	NONG KHAI	37,780	65,727	102,401
	46	KHON KAEN	117,233	183,179	223,217
		TOTAL	279,267	502,435	663,347
10	47	SAKON NAKHON	48,052	95,485	125,749
	48	NAKHON PHANOM	67,600	156,757	201,612
	49	KALASIN	31,217	69,759	88,361
	50	MAHA SARAKHAM	37,842	92,616	113,712
		TOTAL	184,711	414,617	529,434

RG	Province		Year 1970	Year 1979	Year 1987
11	51	UBON RATCHATHANI	126,255	237,729	305,754
	52	SISAKET	31,793	61,674	77,557
	53	SURIN	38,352	76,950	97,470
	54	ROI ET	55,453	122,417	148,028
		TOTAL	251,853	498,770	628,809
12	55	NAKHON RATCHASIMA	145,194	283,886	370,879
	56	CHAIYAPHUM	40,896	82,202	104,260
	57	BURI RAM	41,315	70,546	94,350
		TOTAL	227,405	436,634	569,489
13	58	CHUMPHON	61,544	87,396	115,935
	59	RANONG	32,133	57,844	84,811
	60	PHANGNGA	29,345	53,786	71,935
	61	KRABI	18,433	38,346	54,949
	62	PHUKET	53,882	57,645	73,589
		TOTAL	195,337	295,017	401,219
14	63	NAKHON SITHAMMARAT	153,694	283,034	353,020
		THUNG SONG			
	64	SURAT THANI	90,197	169,627	223,390
	65	PHATTHALUNG	25,190	45,946	57,779
	66	TRANG	79,122	115,227	150,537
		TOTAL	348,203	613,834	784,726
15	67	SONG KHLA	184,571	308,056	381,252
		HAT YAI			
	68	PATTANI	41,327	63,313	74,758
	69	NARATHIWAT	62,072	105,315	128,334
	70	YALA	62,689	114,183	155,050
	71	SATUN	14,592	33,679	52,471
		TOTAL	365,251	624,546	791,865
		GRAND TOTAL	4,675,231	8,461,825	10,903,391

ORIGINATION AND DESTINATION OF DOMESTIC TELEGRAM IN THAILAND

#	FROM \ TO	1,2	3	4	5	TOTAL
	(CTO COUNTER ONLY)	[illegible]	33	21	35	10575
1,2	BANGKOK & THONBURI	944	72	33	73	23753
3	NONTHA BURI	94	13	3	4	722
4	PATHUM THANI	72	3	11	5	295
5	SAMUT PRAKAN	90	1	2	9	634
6	AYUTTHAYA	397	15	2	14	1074
7	SUPHAN BURI	658	11	4	17	1335
8	ANG THONG	275	11	-	10	722
9	SING BURI	269	22	1	13	582
10	LOP BURI	4053	9	5	15	4779
11	SARA BURI	427	27	3	8	1103
12	CHACHOENGSAO	412	2	1	14	925
13	NAKHON NAYOK	199	3	3	12	497
14	PRACHIN BURI	694	6	10	23	1514
15	TRAT	234	2	2	5	482
16	CHANTHA BURI	986	9	4	16	999
17	RAYONG	408	4	2	42	781
18	CHON BURI	988	25	3	41	2447
19	RATCHA BURI	831	10	6	23	2,61
20	KANCHANA BURI	181	6	2	7	486
21	NAKHON PATHOM	329	6	6	10	1034
22	SAMUT SAKHON	110	2	4	6	351
23	SAMUT SONGKHRAM	194	2	-	10	423
24	PHETCHA BURI	187	21	1	7	782
25	PRACHUAP	643	12	3	16	1423
26	NAKHON SAWAN	1745	46	6	23	3796
27	TAK	772	7	1	13	1233
28	KAMPHAENG PHET	252	4	3	10	756
29	U THAI THANI	349	7	1	7	692
30	CHAI NAT	497	13	4	12	1116
31	CHIANG MAI	3687	46	8	33	6594
32	MAE HONG SON	155	4	-	-	409
33	LAMPHUN	384	9	4	12	749
34	LAMPANG	1381	25	1	23	2753
35	UTTARADIT	619	13	2	12	1316
36	CHIANG RAI	1586	24	2	32	3595
37	NAN	371	7	2	7	894
38	PHRAE	959	10	6	12	2764
39	PHITSANULOK	1152	11	7	18	2354
40	SUKHOTHAI	679	9	3	17	1292
41	PHETCHABUN	721	12	3	12	1433
42	PHICHIT	885	26	2	14	1353
43	UDON THANI	1461	25	4	16	3139
44	LOEI	172	14	3	6	647
45	NONGKHAI	459	6	3	5	971
46	KHON KAEN	1528	30	9	42	3253
47	SAKON NAKHON	486	18	1	7	1258
48	NAKHON PHANOM	672	8	2	10	1743
49	KALASIN	448	9		10	953
50	MAHA SARAKHAM	410	3	2	4	1113
51	UBON RATCHATHANI	1944	44	11	39	4287
52	SISAKET	481	6	1	9	1063
53	SURIN	587	13	3	16	1239
54	ROI ET	884	16	2	28	1953
55	NAKHON RATCHASIMA	1985	26	5	60	4026
56	CHAIYAPHUM	315	15	-	9	1274
57	BURI RAM	531	47	1	14	1304
58	CHUMPHON	1019	17	1	33	1953
59	RANONG	484	5	-	10	923
60	PHANG NGA	472	10	-	7	933
61	KRABI	246	4	-	2	373
62	PHUKET	969	1	-	9	1649
63	NAKHON SI THAMMARAT	1768	16	5	26	3443
*	THUNG SONG	410	7	-	4	1056
64	SURAT THANI	1282	3	2	34	2640
65	PHATTHALUNG	422	10	-	2	873
66	TRANG	1147	9	-	25	2236
67	SONGKHLA	1145	9	3	12	1776
*	HAT YAI	1670	26	7	12	2432
68	PATTANI	761	5	-	8	1335
69	NARATHIWAT	904	11	1	5	1727
70	YALA	975	25	1	20	1855
71	SATUN	197	9	-	10	453
—	TOTAL	56009	1002	235	1134	138143

TO	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34
TOTAL	933	807	409	502	1343	924	722	309	1054	320	628	672	2641	1556	581	1057	355	309	752	1006	2745	789	439	402	663	4462	323	530	2069

TO	68	69	70	71
TOTAL	790	1032	1133	360

NOTES : (1) BY THE SURVEY OF DOMESTIC TELEGRAMS DESPATCHED WITHIN WHOLE COUNTRY DURING 1st TO 10th OF APRIL IN 1971.

(2) FIGURES SHOWN IN PARENTHESIS AT THE FIRST COLUMN ARE THE TELEGRAMS ACCEPTED AT CTO. COUNTER INCLUDING OFFICIAL USE.

(3) BESIDES; THIS AMOUNT OF TELEGRAMS, DOMESTIC TELEGRAMS ACCEPTED AT THE LICENSED POST OFFICES, WHICH OCCUPIES ABOUT 4% OF WHOLE DOMESTIC TELEGRAMS ARE NOT SURVEYED.

: PROVINCIAL NUMBER

Appendix 2.1

SURVEY OF DESTINATION ON DOMESTIC TELEGRAM

RG	Province	Name of the Offices	No.of Telegrams Originated	within the same Province	Ratio %	Destinated to Bangkok Thonburi	Ratio
1	1 + 2	BANGKOK	23753	944	3.97	944	3.97
	3	NONTHA BURI	722	15	2.07	94	13.02
	4	PATHUM THANI	295	11	3.72	79	26.78
	5	SAMUT PRAKAN	694	9	1.29	90	12.97
		TOTAL	25464	979	3.84	1207	4.74
2	6	AYUTTHAYA	1074	33	3.07	397	36.97
	7	SUPHAN BURI	1338	80	5.97	658	49.18
	8	ANGTHONG	722	27	3.73	275	38.09
	9	SING BURI	582	35	6.01	269	46.22
	10	LOP BURI	4779	37	0.77	4053	84.81
	11	SARA BURI	1103	24	2.17	427	38.71
		TOTAL	9598	236	2.45	6079	63.33
3	12	CHACHOENGSAO	925	65	7.03	412	44.54
	13	NAKHON NAYOK	497	29	5.84	199	40.04
	14	PRACHIN BURI	1514	257	16.31	694	45.84
	15	TRAT	482	11	2.28	284	58.92
	16	CHANTHABURI	999	30	3.00	586	58.66
	17	RAYONG	781	22	2.82	408	52.24
	18	CHON BURI	2449	152	6.21	988	40.34
		TOTAL	7647	566	7.40	3571	46.70
4	19	RATCHABURI	2061	105	5.10	831	40.32
	20	KANCHANABURI	486	9	1.85	181	37.24
	21	NAKHON PATHOM	1034	31	3.00	329	31.82
	22	SAMUT SAKHON	361	2	.55	110	30.47
	23	SAMUT SONGKHRAM	423	17	4.02	194	45.86
	24	PHETCHABURI	782	13	1.66	187	23.91
	25	PRACHUAP	1423	84	5.90	643	45.19
		TOTAL	6570	261	3.97	2475	37.67

RG	Province	Name of the Offices	No.of Telegrams Originated	within the same Province	Ratio %	Destinated to Bangkok Thonburi	Ratio
5	26	NAKHON SAWAN	3865	308	7.97	1748	45.22
	27	TAK	1288	40	3.11	772	59.94
	28	KAMPHAENG PHET	756	12	1.59	252	33.33
	29	UTHAI THANI	692	7	1.01	345	49.86
	30	CHAI NAT	1136	42	3.70	497	43.75
		TOTAL	7737	409	5.29	3614	46.71
6	31	CHIANG MAI	6594	185	2.81	3687	55.91
	32	MAEHONG SON	403	46	11.41	155	38.46
	33	LAMPHUN	740	2	.27	384	51.89
	34	LAMPANG	2753	63	2.29	1381	50.16
		TOTAL	10490	296	2.82	5607	53.45
7	35	UTTARADIT	1306	29	2.22	619	47.40
	36	CHIANG RAI	3595	367	10.21	1586	44.12
	37	NAN	894	28	3.13	371	41.50
	38	PHRAE	2064	45	2.18	989	47.92
		TOTAL	7859	469	5.97	3565	45.36
8	39	PHITSANULOK	2354	18	.77	1152	48.94
	40	SUKHOTHAI	1292	11	.85	679	52.55
	41	PHETCHABUN	1435	64	4.46	721	50.24
	42	PHICHIT	1855	54	2.91	885	47.71
		TOTAL	6936	147	2.12	3437	49.55
9	43	UDON THANI	3139	110	3.50	1461	46.54
	44	LOEI	647	40	6.18	172	26.58
	45	NONG KHAI	972	48	4.94	459	47.22
	46	KHON KAEN	3253	130	4.00	1528	46.97
		TOTAL	8011	328	4.09	3620	45.19
10	47	SAKON NAKHON	1298	220	16.95	486	37.44
	48	NAKHON PHANOM	1743	349	20.02	672	38.55
	49	KALASIN	965	49	5.08	448	46.43
	50	MAHA SARAKHAM	1015	71	7.00	410	40.39
		TOTAL	5021	689	13.72	2016	40.15

RG	Province	Name of the Offices	No.of Telegrams Originated	within the same Province	Ratio %	Destinated to Bangkok Thonburi	Ratio
11	51	UBON RATCHATHA NI	4287	501	11.69	1944	45.35
	52	SISAKET	1069	32	2.99	481	44.99
	53	SURIN	1299	50	3.85	587	45.19
	54	ROI ET	1869	95	5.08	884	47.30
		TOTAL	8524	678	7.95	3896	45.71
12	55	NAKHON RATCHASIMA	4926	440	8.93	1985	40.30
	56	CHAIYAPHUM	1274	64	5.02	515	40.42
	57	BURI RAM	1304	105	8.05	551	42.26
		TOTAL	7504	609	8.11	3051	40.66
13	58	CHUMPHON	1860	82	4.41	1019	54.79
	59	RANONG	928	20	2.16	484	52.16
	60	PHANGNGA	933	16	1.72	472	50.59
	61	KRABI	573	-	-	246	42.93
	62	PHUKET	1659	1	.06	969	58.41
		TOTAL	5953	119	2.00	3190	53.59
14	63	NAKHON SITHAMMARAT	3443	236	6.85	1768	51.35
		THUNG SONG	1056	-	-	410	38.83
	64	SURAT THANI	2640	103	3.90	1282	48.56
	65	PHATTHALUNG	873	9	1.03	422	48.34
	66	TRANG	2236	58	2.59	1147	51.30
		TOTAL	10248	406	3.96	5029	49.07
15	67	SONG KHLA	1776	54	3.04	1145	64.47
		HAT YAI	3432	9	.26	1670	48.66
	68	PATTANI	1338	24	1.79	761	56.88
	69	NARATHIWAT	1727	61	3.53	904	52.35
	70	YALA	1855	56	3.02	975	52.56
	71	SATUN	453	9	1.99	197	43.49
		TOTAL	10581	213	2.01	5652	53.42
		GRAND TOTAL	138143	6405	4.63	53891	39.01

Duration: 1st - 10th on APRIL in 1971

ESTIMATED DOMESTIC TRAFFIC FLOW IN 1979

Appendix 2.2

Origination \ Destination		Central					North					North-East					South				Grand Total
		1	2	3	4	Total	5	6	7	8	Total	9	10	11	12	Total	13	14	15	Total	
Central	1	52.22	57.41	76.47	58.93	245.53	49.62	100.25	59.46	54.99	264.32	65.32	36.20	54.41	49.12	205.05	53.29	102.48	102.97	258.74	973.64
	2	87.74	20.57	7.18	7.48	122.97	8.67	3.95	3.02	4.61	20.25	4.32	1.92	2.76	4.96	13.96	1.12	2.11	1.58	4.81	161.99
	3	99.92	8.28	47.18	7.42	162.80	3.56	5.38	3.73	2.90	15.57	4.38	2.64	3.74	5.71	16.47	1.98	3.47	2.80	8.25	203.09
	4	87.42	8.28	9.95	43.04	148.69	4.60	5.73	3.09	4.26	17.68	4.28	1.84	2.61	4.51	13,24	13.52	10.61	11.40	35.53	215.14
	Total	327.80	94.54	140.78	116.87	679.99	66.45	115.31	69.30	66.76	317.82	78.30	42.60	63.52	64.30	248.72	69.91	118.67	118.75	307.33	1553.86
North	5	85.97	10.85	4.70	3.21	104.73	33.23	16.37	5.83	11.69	61.12	3.06	1.17	1.77	2.62	8.62	0.72	1.23	3.58	5.53	180.00
	6	123.42	3.48	4.73	4.24	135.87	7.96	24.43	24.12	9.20	65.71	4.53	1.96	2.98	3.87	13.34	1.58	3.02	4.42	9.02	223.94
	7	94.32	4.36	4.34	3.61	106.63	6.32	34.55	31.59	9.43	81.89	3.61	1.38	1.14	2.56	8.69	0.82	1.23	1.59	3,64	200.85
	8	80.51	5.79	3.59	3.16	93.05	11.58	11.30	8.28	18.67	49.83	2.85	1.20	1.74	2.77	8.56	0.37	2.44	1.41	4.22	155.66
	Total	384.22	24.48	17.36	14.22	440.28	59.09	80.65	69.82	48.99	258.55	14.05	5.71	7.63	11.82	39.21	3.49	7.92	11.00	22.41	760.45
North-East	9	105.38	6.72	6.78	4.81	123.69	3.87	4.34	4.13	4.94	17.28	37.69	15.46	13.93	16.36	83.44	0.85	1:81	1.67	4.33	228.74
	10	78.70	3.09	3.01	1.80	86.60	1.87	2.34	1.81	1.53	7.55	24.63	41.69	15.43	11.71	93.46	0.43	0.60	0.43	1.46	189.07
	11	109.58	4.92	6.65	3.14	124.29	2.90	3.31	1.74	2.50	10.45	18.17	11.76	39.87	17.19	86.99	1.50	2.30	2.07	5.87	227.60
	12	85.91	7.68	8.37	4.46	106.42	3.79	3.89	3.09	3.97	14.74	17.63	8.00	13.62	32.84	72.09	1.13	2.96	1.73	5.82	199.07
	Total	379.57	22.41	24.81	14.21	441.00	12.43	13.88	10.77	12.94	50.02	98.12	76.91	82.85	78.10	335.98	3.91	7.67	5.90	17.48	844.48
South	13	73.78	1.50	1.59	5.28	82.15	0.46	1.56	0.69	0.75	3.46	0.76	0.06	0.87	0.64	2.33	17.25	16.67	12.07	45.99	133.93
	14	141.57	2.10	4.01	11.20	158.88	1.31	3.24	1.64	1.88	8.07	1.74	0.37	1.10	2.57	5.78	20.03	48.00	40.93	108.96	281.69
	15	156.60	2.38	3.35	13.28	175.61	1.09	3.96	1.83	2.18	9.06	1.22	0.27	0.86	1.20	3.55	15.23	35.85	45.53	96.61	284.83
	Total	371.95	5.98	8.95	29.76	416.64	2.86	8.76	4.16	4.81	20.59	3.72	0.70	2.83	4.41	11.66	52.51	100.52	98.53	251.56	700.45
GRAND TOTAL		1463.54	147.41	191.90	175.06	1977.91	140.83	218.60	154.05	133.50	646.98	194.19	125.92	156.83	158.63	635.57	129.82	234.78	234.18	598.78	3859.24

No.of Telegrams in each Region $\times \frac{1^{*}}{299} \times \frac{1^{**}}{8} \times 1.1^{***}$

* Usual week day's traffic = No.of Telegrams in one year $\times \frac{1}{299}$ (Based on Traffic Survey At CTO)

** Busy hour traffic = one day traffic $\times \frac{1}{8}$

*** Variation coefficient of season

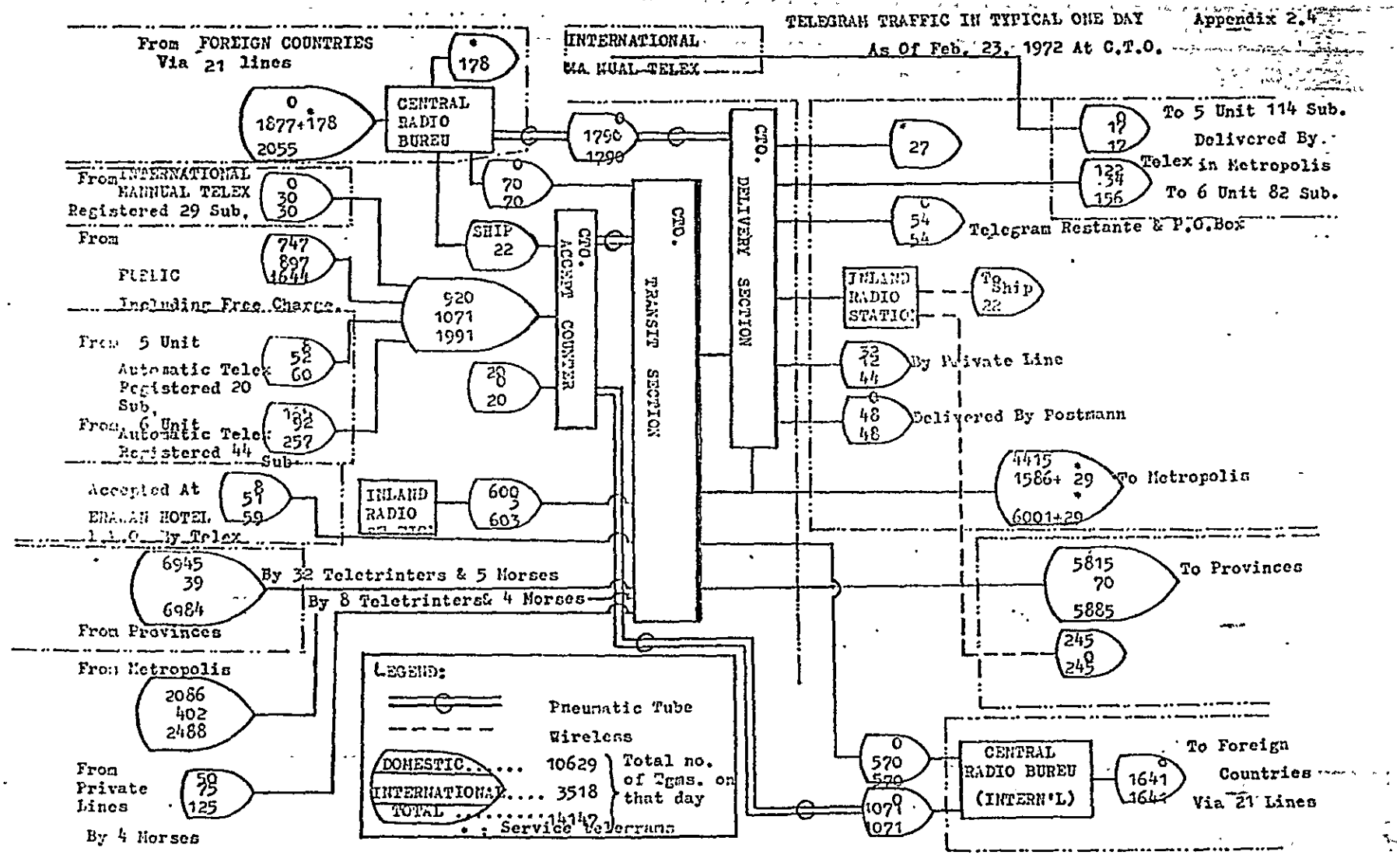
ESTIMATED DOMESTIC TRAFFIC FLOW IN 1987

Appendix 2.3

Origination \ Destination		Central					North					North-East					South				Grand Total
		1	2	3	4	Total	5	6	7	8	Total	9	10	11	12	Total	13	14	15	Total	
Central	1	71.50	77.86	103.70	79.92	332.98	67.29	135.95	80.64	74.57	358.45	88.58	49.09	73.79	66.62	278.08	72.27	88.98	139.64	350.89	1320.40
	2	105.51	24.73	8.63	8.99	147.86	10.43	4.75	3.63	5.54	24.35	5.19	2.31	3.32	5.96	16.78	1.35	2.54	1.90	5.79	194.78
	3	131.17	10.86	61.93	9.74	213.70	4.67	7.06	4.89	3.80	20.42	5.74	3.46	4.90	7.49	21.59	2.59	4.55	3.67	10.81	266.52
	4	113.24	10.73	12.89	55.75	192.61	5.96	7.42	4.00	5.52	22.90	5.54	2.38	3.38	5.84	17.14	17.51	13.74	14.77	46.02	278.67
	Total	421.42	124.18	187.15	154.40	887.15	88.35	155.18	93.16	89.43	436.12	105.05	57.24	85.39	85.91	333.59	93.72	159.81	159.98	413.51	2060.37
North	5	102.41	12.92	5.59	3.82	124.74	39.58	12.35	6.94	13.92	72.79	3.64	1.39	2.10	3.12	10.25	0.85	1.46	4.26	6.57	214.35
	6	143.53	4.04	5.50	4.93	158.00	9.25	28.41	28.05	10.69	76.40	5.26	2.27	3.46	4.50	15.49	1.83	3.51	5.14	10.48	260.37
	7	116.46	5.38	5.35	4.45	131.64	7.80	42.66	39.00	11.64	101.10	4.45	1.70	1.40	3.16	10.71	1.01	1.51	1.96	4.48	247.93
	8	109.45	7.87	4.88	4.29	126.49	15.74	15.36	11.25	25.38	67.73	3.87	1.63	2.36	3.76	11.62	0.50	3.31	1.91	5.72	211.56
	Total	471.85	30.21	21.32	17.49	540.87	72.37	98.78	85.24	61.63	318.02	17.22	6.99	9.32	14.54	48.07	4.19	9.79	13.27	27.25	934.21
North-East	9	140.07	8.93	9.01	6.39	164.40	5.14	5.77	5.49	6.57	22.97	50.10	20.55	18.52	21.74	110.91	1.13	2.41	2.22	5.76	304.04
	10	101.01	3.97	3.86	2.31	111.15	2.40	3.00	2.32	1.96	9.68	31.61	53.51	19.80	15.03	119.95	0.55	0.77	0.55	1.87	242.65
	11	138.76	6.23	8.42	3.98	157.39	3.67	4.19	2.20	3.17	13.23	23.01	14.89	50.49	21.77	110.16	1.90	2.91	2.62	7.43	288.21
	12	112.64	10.06	10.97	5.84	139.51	4.96	5.10	4.05	5.20	19.31	23.11	10.48	17.85	43.05	94.49	1.48	3.88	2.26	7.62	260.93
	Total	492.48	29.19	32.26	18.52	572.45	16.17	18.06	14.06	16.90	65.19	127.83	99.43	106.66	101.59	435.51	5.06	9.97	7.65	22.68	1095.83
South	13	101.30	2.05	2.18	7.24	112.77	0.63	2.14	0.94	1.02	4.73	1.04	0.08	1.19	0.87	3.18	23.68	22.68	16.57	63.13	183.81
	14	180.75	2.68	5.11	14.30	202.84	1.67	4.13	2.09	2.40	10.29	2.22	0.47	1.40	3.28	7.37	25.57	61.28	52.25	139.10	359.60
	15	199.53	3.03	4.26	16.92	223.74	1.38	5.04	2.33	2.77	11.52	1.55	0.34	1.09	1.52	4.50	19.40	45.67	58.01	123.08	362.84
	Total	481.58	7.76	11.55	38.46	539.35	3.68	11.31	5.36	6.19	26.54	4.81	0.89	3.68	5.67	15.05	68.65	129.83	126.83	325.31	906.25
GRAND TOTAL		1867.33	191.34	252.29	228.87	2539.82	180.57	283.33	197.82	174.15	835.87	254.91	164.55	205.05	207.71	832.22	171.65	309.40	307.73	788.75	4996.66

TELEGRAM TRAFFIC IN TYPICAL ONE DAY Appendix 2.4

As Of Feb. 23, 1972 At C.T.O.



DISTRIBUTION CHART OF "TRANSITTING-PROCESS TIME " AT CTO.

Appendix 2.5

ITEM	LESS THAN 1 HOUR	BETWEEN							MORE THAN 8 HOURS	TOTAL
		1-2	2-3	3-4	4-5	5-6	6-7	7-8		
Number of Transit Telegrams	115	366	136	238	94	60	28	20	15	1,072
%	10.7	34.1	12.7	22.2	8.8	5.6	2.6	1.9	1.4	100

Data taken during busy hour (16:00 PM. to 17:00 PM)

As of March 1, 1971

From Above table. The average value of "Transitting process time (elapsing time of cross - office telegram Transit) is counted as 2 hours and 50 minutes.

Appendix 2.6

NO. OF TELEGRAMS DEALT IN C.T.O.

INCLUDING SERVICE TELEGRAMS

Category / Year / Month	ACCEPTED AT CTO.		TRANSITTED		DELIVERED TO METROPOLIS		TOTAL		SHIP TELEGRAM		TOTAL PIECES OF TELEGRAMS
	Domestic	International	Domestic	International	Domestic	International	Domestic	International	CASH PAYMENT	DEPOSIT ACCOUNT	
1971 Jan.	25,712	28,229	135,730	15,270	136,829	41,656	298,271	80,755	85	346	379,457
Feb.	26,325	23,175	136,301	14,490	141,299	39,964	303,925	77,629	81	299	381,934
Mar.	30,206	27,116	176,231	17,443	177,670	46,173	384,107	90,732	72	336	475,247
Apr.	30,863	26,757	175,591	16,465	162,469	43,103	368,923	86,325	73	282	455,603
May.	29,370	24,349	178,022	15,528	166,809	41,216	374,201	81,095	71	300	455,667
Jun.	27,085	23,763	152,274	15,130	153,439	40,316	332,798	79,209	70	252	412,329
Jul.	25,269	23,996	125,898	14,481	128,869	40,834	280,036	79,311	89	342	359,778
Aug.	23,447	24,663	122,147	15,402	124,919	41,293	270,513	81,358	91	342	352,304
Sep.	23,971	24,896	116,628	15,604	116,369	41,716	256,968	82,216	88	274	339,546
Oct.	22,500	25,549	119,199	15,739	114,786	43,307	256,485	84,595	92	373	341,543
Nov.	23,209	26,722	116,563	16,364	111,308	43,294	251,080	86,380	111	382	337,953
Dec.	24,140	27,010	119,580	16,523	110,030	45,547	253,750	89,080	104	387	343,321
TOTAL 1971	312,097	301,825	1,674,164	188,439	1,644,796	508,421	3,631,057	998,685	1,027	3,915	4,634,684
* TOTAL/DAY	1,044	943	5,599	589	5,501	1,589	12,144	3,121	34	13	15,281.4
1970	346,987	307,994	1,664,545	195,643	1,728,991	525,981	3,740,523	1,029,618	906	3,324	4,774,371
1969	358,766	320,952	1,576,080	203,028	1,742,287	531,576	3,677,133	1,055,556	3,585	1,133	4,737,407

* Domestic : TOTAL÷ 299
International : TOTAL÷ 320

Note : As for the Category of Service Message refer to Table 2

Appendix 2.7

RATIO OF SERVICE MESSAGES

OFFICE / CONTENTS	BANGKOK CENTRAL	CHIANG MAI	NAKHON-SAWAN	NAKHON-RATCHASIMA	HATYAI
TELEGRAMS DEALT TOTAL (1)	1,113	5,595	4,483	4,892	4,871
ACCEPTED FROM PUBLIC	1,006	5,178	4,194	4,704	4,712
ORIGINATED FROM OFFICE	107	417	289	188	159
PROTOCOL	(26)	(100)	(42)	(5)	(8)
FINANCE	0	(40)	(74)	(34)	(30)
MONEYORDER	(8)	(72)	(19)	(22)	(15)
OTHERS	(73)	(205)	(154)	(127)	(120)
ENQUIRIES & CONFIRMATION ABOUT TELEGRAMS (2)	67	279	682	651	279
Ratio (2)/(1)	6.0	5.0	15,2	13,3	5,7
Date As Of	16 th August 1971	One month During July, 1971			

Service Telegrams appear in this column are not counted in the above column (*1)

Note : Service messages listed in column (*) are included in every kind of statistics quoted in this report.

Appendix 2.8

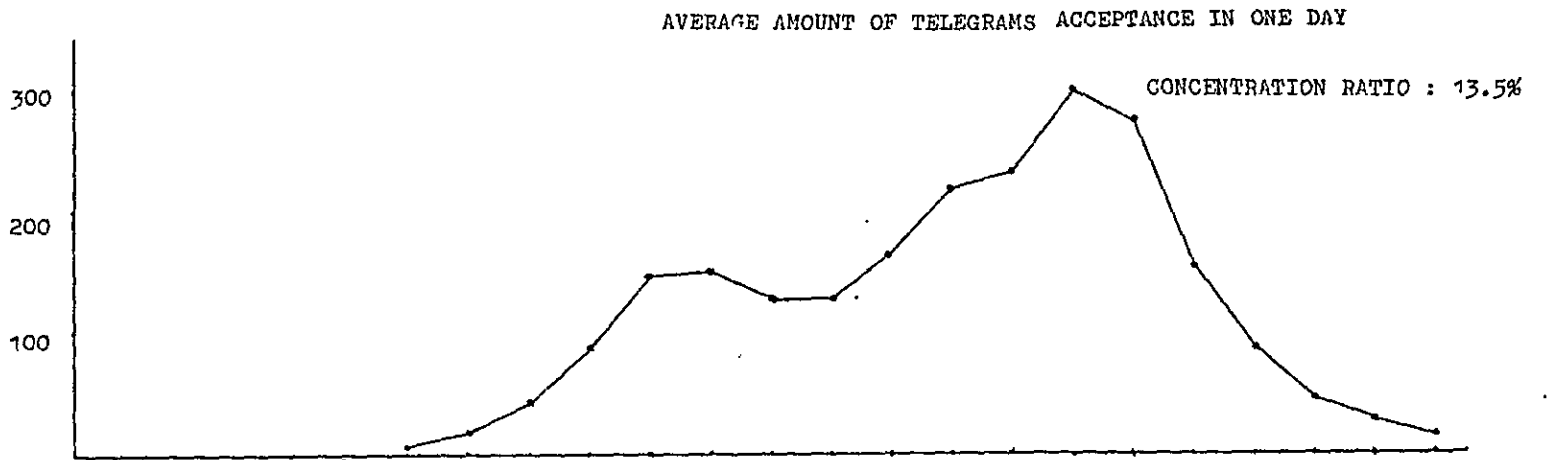
SEASONAL VARRIATIONS OF TELEGRAM ACCEPTANCE

Name of the Offices	TOTAL Acceptance (1)	Average per month (2)=(1)÷(12)	Month of the peak traffic and their acceptance (3)	variation (4)=(3)-(2)
NAKHONSAWAN	78,819	6568	June 7304	11.2
CHIANG MAI	88,603	7384	May 8829	19.5
LAMPANG	57,756	4813	May 5336	10.9
UTTARADIT	35,162	2930	Aug 3160	7.9
UDONTHANI	85,733	7144	Oct 10065	14.1
KHONKAEN	68,867	5738	Mar. 6535	13.9
UBON	69,964	5830	Mar 6496	11.4
NAKHON RATCHASHIMA	98,614	8218	June 9045	10.1
CHUMPHON	30,660	2555	Mar 3109	10.1
THUNGSONG	34,100	2841	Mar 3290	15.8
SURATTHANI	45,464	3788	Mar 4443	11.7
HAT YAI	86,442	7203	Mar 8109	12.6
Mean Value	-	-	-	12.4

DIURNAL TRAFFIC VARIATION OF DOMESTIC TELEGRAM ACCEPTED AT CTO.COUNTER

Appendix 2.9

Survey : From 1st to 19th April 1971 except Sunday
and Saturday



Duration	(0 - 6)*	7-8	8-9	9-10	10-11	11-12	12-13	13-14	14-15	15-16	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	Total
No.of Telegrams/Day	9.7	17.5	42.9	85.2	146.3	150.6	126.1	122.0	163.5	227.1	230.9	300.3	275.1	154.8	85.0	45.1	25.9	15.6	2223.5

* No.of Tlg. from 00.00 - 06.00 is 6.3 altogether.

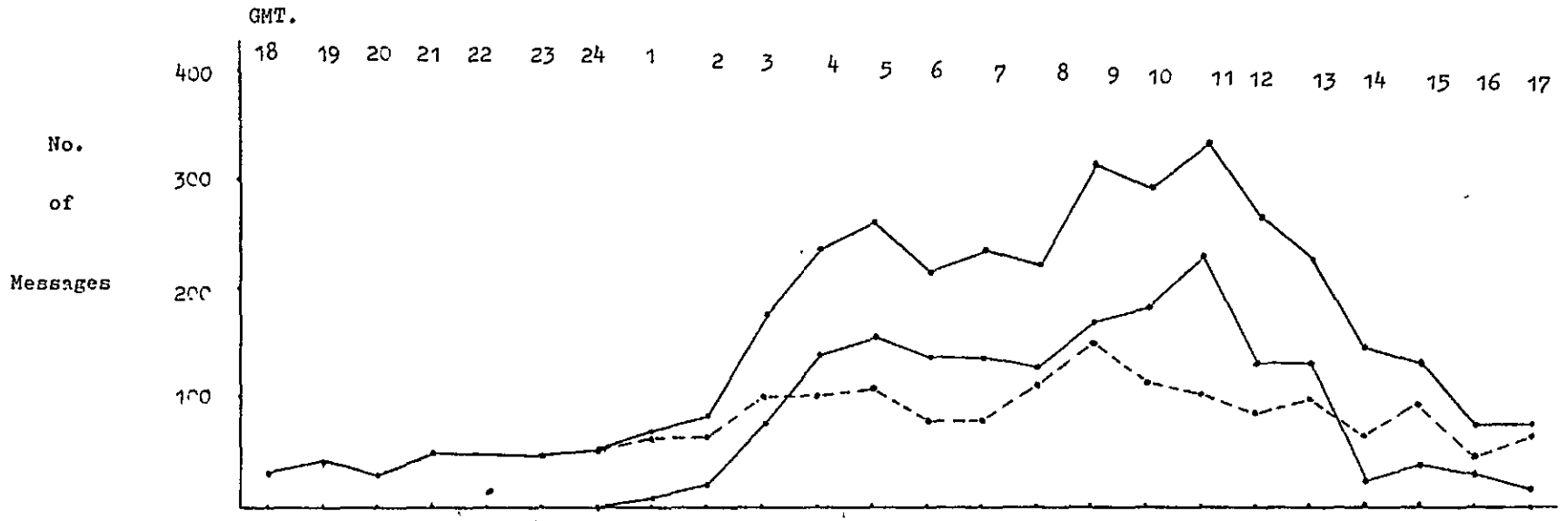
DIURNAL TRAFFIC VARIATION OF INTERNATIONAL TELEGRAM INCLUDING SERVICE MESSAGES

(BANGKOK TIME = GMT + 7)

Appendix 2.10

26 Oct., 1971

-2 Nov.



O/G	29	38	30	49	12	46	51	61	62	99	99	107	79	78	111	148	112	103	85	98	65	93	45	63	1782
I/C	55	5	0	0	0	1	0	7	20	75	138	155	137	136	127	170	184	231	132	133	23	39	31	15	1876
Total Traffic	34	43	30	49	12	47	51	68	82	174	237	262	216	234	223	318	296	334	267	231	148	132	76	78	3658
Concentration %	0.9	1.2	0.8	1.3	0.3	1.3	1.4	1.9	2.2	4.8	6.5	7.2	5.9	6.4	6.5	8.7	8.1	9.1	7.3	6.3	4.0	3.6	2.1	2.1	

TRAFFIC CONCENTRATION RATIO

Name of the offices	No. of Telegrams Accepted (1)	Busy hour and their traffic (2)		Concentration ratio (2) ÷ (1)
TUNG SONG	1,825	10 - 11	258	14.14
KHON KAEN	3,545	10 - 11	386	10.89
PHITSANULOK	3,433	15 - 16	472	13.75
SURATTHANI	2,374	9 - 10	302	12.72
LAMPANG	2,984	9 - 10	377	12.63
UTTARADIT	1,887	15 - 16	297	15.74
UBON RATCHATHANI	3,902	15 - 16	453	11.61
CHUM PHON	1,671	9 - 10	214	12.81
UDON THANI	4,259	10 - 11	491	11.53
NAKHON SAWAN	3,538	9 - 10	429	12.13
HATYAI	4,429	17 - 18	515	11.63
CHIANG MAI	4,213	9 - 10	444	10.54
TOTAL	38,060	9 - 10	4,195	11.02
Bangkok Central C.T.O.	154,946	14 - 15	16,033	10.35 *

* In CTO, all of the transit telegrams are included as of 27 April - 14 May 1971 excluding Saturday and Sunday

REMARK : The average concentration ratio of telegrams in Thailand is assumed to be 12.5% which is $\frac{1}{8}$ of the number of telegrams in a day. This figure is not much difference from figures in Appendix 2.9 and Appendix 2.11

Appendix 2.12

TABLE OF TRIBUTARY OFFICES

Center	Satellite office (Having no subscriber set)
1. BANGKOK CTO.	
2. INTERNATIONAL GATE	
3. BK. 1	
4. 2	
5. 3	
6. 4	
7. 5	
8. 6	Taladplu, Bang Khae
9. 7	Bang Plad
10. 8	
11. 9	
12. 10	Khlong Jun
13. 11	Khlong Toei (newly opened)
14. 12	
15. WAT LIAP	
16. NAPHRA LAN	
17. HUA LAM PHONG	
18. BANGLAMPHU-BON	
19. BANGKRABUE	
20. POM PRAP	
21. PATHUM WAN	
22. SANTITHAM	
23. DON MUANG	
24. WONGWIEN YAI	
25. DON MUANG AIR PORT	
26. NONTHABURI	BANGBUATHONG,PAKKRET,BANGKRUAI,BANGYAI.
27. PATHUMTHANI	THANYABURI,RANGSIT.
28. SAMUT PRAKAN	PHRAPRADAENG,BANGPHLI,KHLONGDAN.
29. AYUTTHAYA	PHAKHAI,SENA,THARUA,PHACHI,MAHARAT,BANGPA-IN.
30. SUPHANBURI	SONGPHINONG,DOEMBANG NANGBUAT,SAMCHUK,SIPRACHAN,BANGPLAMA, U-THONG.

31. ANG THONG	WISETCHAICHAN,PHOTHONG,PAMOK,CHAIYO.
32. SING BURI	INBURI,PHROMBURI,BANGRACHAN.
33. LOP BURI	BANMI,KHOKSAMRONG,CHAIBADAN.
34. SARA BURI	KAENGKHOI,PHRAPHUTTABAT,BANMO,SARABURI 1,WIHANDAENG,NONGKHAE.
35. CHACHOENGSAO	BANGKHLA,PHANOM SARAKHAM,BANGPAKONG.
36. NAKHON NAYOK	BANNA,ONGKHARAK.
37. PRACHIN BURI	PRACHANTAKHAM,KABINBURI,ARAYAPRATHET,SIMAHAPHOT,BANSAENG, WATTANA NAKHON,SAKAEO.
38. TRAT	KHLONG YAI.
39. CHANTHA BURI	KHLUNG,THAMAI,
40. RAYONG	KLANG,BANKHAI.
41. CHONBURI	KO SICHANG,PHANAT NIKHOM,BANGLAMUNG,PHANTHONG,BAN BUNG.
42. SIRACHA	BANGSAEN.
43. SATTA HIP	-
44. RATCHA BURI	DAMNOEN SADUAK,PAKTHO,CHOMBUNG.
45. BAN PONG	PHOTHARAM.
46. KANCHANABURI	THAMAKA,THAMUANG.
47. NAKHON P ATHOM	SAMPHRAN,NAKHONCHAISI,BANGLEN,KAMPHAENG SEAN.
48. SAMUT SAKHON	KRATHUM BAEN,BANPHAEO.
49. SAMUTSONGKHRAM	AMPHAWA,BANGKHONTHI.
50. PHETCHABURI	BANLAEN,CHA-AM,THAYANG.
51. PRACHUAPKHIRIKHAN	KUIBURI.
52. THAP SAKAE	BANGSAPHAN.
53. HUA HIN	PRANBURI.
54. NAKHON SAWAN	CHUMSAENG,PHAYUHAKHIRI,LATYAO,THATAKO,KROKPHRA,BANPHOT PHISAI,NAKHONSAWAN 1,NONGBUALAMPHU.
55. TAKHLI	TAKFA.
56. TAK	MAESOT,BANTAK.
57. KAMPHAENGPHET	PHRANKRATAI,KHLONG KHLUNG,KHANU WORALAKSABURI.
58. UTHAITHANI	NONGCHANG,THAPTHAN,NONGKHAYANG.
59. CHAI NAT	WATSING,MANOROM, HANKHA,SANPHAYA,SANKHABURI.
60. CHIANG MAI	FANG,SANPATONG,SANKAMPHAENG,SARAPHI,MAETAENG,CHOMTHONG, CHIANGMAI 2, and 3, CHIANGDAO.
61. " " 1	

62. MAEHONGSON	MAESARIANG.
63. LAMPHUN	LI,PASANG,BANHONG,MAETHA.
64. LAMPANG	THOEN,NGAO,CHAEHOM,HANGCHAT,KO KHA,LAMPANG 1,WANGNUA.
65. UTTARADIT	NAMPAT,PHICHAI,LAPLAE.
66. CHIANG RAI	MAECHAN,PHAN,MAESAI,CHIANGKHONG,CHIANGSAEN,WIANGPAPAO, THOENG
67. PHA YAO	CHIANGKHAM,DOKKHAMTAI.
68. NAN	SA,PUA,THUNGCHANG.
69. PHRAE	SONG,DENCHAI,SUNGMEN,RONGKWANG,LONG.
70. PHITSANULOK	BANGKRATHUM,WANGTHONG,NAKHONTHAI.
71. SUKHO THAI	SAWANKHALOK,SISAMRONG,SISATCHANALAI,BANDANLANHOI.
72. PHETCHA BUN	WICHIANBURI,NONGPHAI,CHONDAEN.
73. LOMSAK	LOM KAO.
74. PHICHIT	PHOTHALE,SAMNGAM,TAP KHLO.
75. TAPHAN HIN	BANGMUNNAK.
76. UDON THANI	KUMPHAWAPI,NONGBUALAMPHU,NONGHAN,NONGSAENG,PHEN,BANPHU.
77. " " 1	-
78. LOEI	CHIANGKHAN,DANSAI,WANGSAPHUNG,THALI.
79. NONG KHAI	THABO,PHONPHISAI,SI CHIANGMAI,BUNG KAN.
80. KHON KAEN	CHUMPHAE,NAMPHONG,PHUWIANG,KRANUAN,NONGSONGHONG.
81. BAN PHAI	PHON,MANCHA KHIRI,CHONNABOT.
82. SAKHON NAKHON	SAWANGDAENDIN,WANONNIWAT,PHANNANIKHOM,WARITCHAPHUM,PHANGKHON.
83. NAKHON PHANOM	THA-UTHEN,THATPHANOM,BANPHAENG,SISONGKHRAM.
84. MUKDAHAN	NAKHAE,KHAM-CHA-I.
85. KALASIN	KUCHINARAI,YANGTALAT,KAMALASAI.
86. MAHA SARAKHAM	WAPIPATHUM,KOSUMPHISAI,BORABU,KANTARAWITHAI,PHAYAKHAPHUMPISAI.
87. UBON	PHIBUNMANGSAHAN,TRAKAN PHUTPHON,KHUANGNA,MUANGSAMSIP,DETUDOM, PHANA,WARINCHAMRAP,BANDAN.
88. YASO THON	AMNATCHAROEN,KHAMKHUNKAEO,LOENGNOKTHA,KHEMARAT,MAHACHANACHAI, CHANUMAN.
89. SISAKET	KANTHARALAK,KANTHARAROM,KHUKHAN,UTHUMPHONPHISAI.
90. SURIN	SIKHORAPHUM,THATUM,RATANABURI,PRASAT,SANGKHA,SAMRONGTHAP.
91. ROIET	PHONTHONG,SELAPHUM,SUWANNAPHUM,PHANOMPHRAI,ATSAMAT,KASETWISAI THAWATCHABURI,CHATURAPHAKPHIMAN.

92. NAKHONRATCHASIMA	BUAYAI,PHIMAI,SIKHIU,PAKTHONGCHAI,NONSUNG,SUNGNOEN,PRATHAI, CHOKCHAI,DANKHUNTHOT,NONTHAI,CHAKKARAT.
93. " " 1	-
94. PAKCHONG	-
95. CHAIYA PHUM	PHUKHIEO,KASETSOMBUN,CHATURAT,KHONSAWAN,KAENGKLO,BAMNETNA-RONG.
96. BURI RAM	NANGRONG,PHUTTHAISONG,LAMPLAIMAT,SATUK,PHAKHONCHAI.
97. CHUM PHON	LANGSUAN,PAKNAM-CHUMPHON,SAWI,THASAE,PAKNAM-LANGSUAN,PATHIU.
98. RANONG	KRABURI.
99. PHANGNGA	THAIMUANG,TAKUATHUNG,KOK-KLOI.
100. TAKUAPA	-
101. KRABI	AO-LUK.
102. PHUKET	THALUNG.
103. NAKONSITHAMARAT	SICHON,THASALA,HUASAI,CHIANYAI,KHANOM,NABON.
104. PAKPHANANG	-
105. THUNG SONG	RONPHIBUN,CHAWANG,CHA-UAT.
106. SURATTHANI	CHAIYA,BANNASAN,KO-SAMUI,THACHANG,KANCHANADIT,THACHANA, KHIRIRATTHANANIKHOM.
107. PHUN PHIN	-
108. PHATTALUNG	KHUAN-KHANUN,PAKPHAYUN.
109. TRANG	KANTANG,PALIAN,HUAYYOT,YANTAKHAO,KAOCHAISON.
110. SONG KHLA	SADAO,CHANA,RANOD,THEPHA,NATHAWI,KHLONG-NGAE,RATHAPHUM.
111. HAT YAI	-
112. " " 2	-
113. PATTANI	SAIBURI, KHOKPHO,MAYO,PANARE.
114. NARATHIWAT	TAKBAI,TANYONGMAT,RUSO,WAENG,BACHO,YI-NGO.
115. SUNGAI-KOLOK	SUNGAI-PADI.
116. YALA	BETONG,YAHA,BANNANGSTAR,RAMAN.
117. SATUN	LA-NGU.

NUMBER OF DOMESTIC TELEGRAMS

PER DAY IN EACH OFFICE

Appendix 2.13

Name of Toll Centers	ACCEPTANCE			DELIVERY		
	1970	1979	1987	1970	1979	1987
1. BANGKOK CTO.	1165	2016	2587	-	-	-
2. INTERNATIONAL GATE	-	-	-	-	-	-
3. BK. 1	106	184	249	1270	2244	2893
4. BK. 2	223	385	523	664	1173	1512
5. BK. 3	145	250	340	320	566	730
6. BK. 4	246	426	578	535	946	1219
7. BK. 5	159	275	373	829	1465	1889
8. BK. 6	105	182	247	502	887	1144
9. BK. 7	168	290	396	228	403	520
10. BK. 8	72	124	169	126	223	287
11. BK. 9	65	112	217	171	301	388
12. BK. 10	39	67	91	144	254	328
13. BK. 11	201	347	471	425	751	968
14. BK. 12	62	107	146	250	443	571
15. WAT LIAP	123	213	287	-	-	-
16. NAPHRA LAN	110	189	257	-	-	-
17. HUA LAM PHONG	143	247	335	-	-	-
18. BANGLAMPHU-BON	162	280	380	-	-	-
19. BANGKRABUE	72	125	170	-	-	-
20. POM PRAP	219	379	515	-	-	-
21. PATHUM WAN	118	204	278	-	-	-
22. SANTITHAM	65	113	154	-	-	-
23. DON MUANG	22	39	51	67	118	152
24. WONGWIEN YAI	107	185	251	-	-	-
25. DON MUANG AIR PORT	5	9	12	-	-	-
26. NONTHABURI	62	164	163	92	122	157
27. PATHUMTHANI	23	46	100	22	78	100
28. SAMUT PRAKAN	73	155	206	119	211	273
TOTAL	4060	7113	9546	5765	10186	13131

Name of Toll Centers	ACCEPTANCE			DELIVERY		
	1970	1979	1987	1970	1979	1987
29. AYUTTHAYA	135	233	260	126	222	286
30. SUPHANBURI	127	245	292	97	171	221
31. ANG THONG	76	151	167	51	92	118
32. SING BURI	66	123	137	59	104	134
33. LOP BURI	172	248	327	159	282	363
34. SARA BURI	121	198	238	114	201	260
TOTAL	697	1198	1421	606	1072	1382
35. CHACHOENGSAO	106	217	252	101	178	230
36. NAKHON NAYOK	54	110	125	38	67	86
37. PRACHIN BURI	152	287	364	130	230	296
38. TRAT	53	81	104	39	69	89
39. CHANTHA BURI	116	169	228	107	190	245
40. RAYONG	76	144	214	66	117	151
41. CHONBURI	135	256	345	140	247	319
42. SIRACHA	59	111	150	70	123	159
43. SATTA HIP	64	121	163	109	194	250
TOTAL	815	1496	1945	800	1415	1825
44. RATCHA BURI	126	272	275	134	237	306
45. BAN PONG	78	94	168	71	125	161
46. KANCHANABURI	71	211	294	81	143	184
47. NAKHONPATHOM	114	234	275	110	195	252
48. SAMUT SAKHON	36	72	86	40	70	90
49. SAMUTSONGKHRAM	45	100	112	48	85	110
50. PHETCHABURI	106	204	244	97	171	221
51. PRACHUAPKHIRIKHAN	47	132	191	49	87	112
52. THAP SAKAE	40	109	159	37	65	84
53. HUA HIN	57	158	230	52	93	118
TOTAL	720	1586	2034	719	1270	1638
TOTAL NUMBER OF RG 1 - 4	6692	11393	14946	7890	13943	17976

Name of Toll Centers	ACCEPTANCE			DELIVERY		
	1970	1979	1987	1970	1979	1987
54. NAKHON SAWAN	329	526	627	278	492	635
55. TAKHLI	75	120	143	69	122	157
56. TAK	119	169	218	91	161	207
57. KAMPHAENGPHET	72	215	259	60	107	138
58. UTHAITHANI	68	117	127	55	97	125
59. CHAI NAT	113	176	190	90	158	204
TOTAL	776	1323	1564	643	1137	1466
60. CHIANG MAI	359	655	762	453	801	1033
61. " " 1	177	324	376	-	-	-
62. MAEHONGSON	38	60	71	29	51	66
63. LAMPHUN	60	126	142	64	113	145
64. LAMPANG	270	476	549	230	407	525
TOTAL	904	1641	1900	776	1372	1769
65. UTTARADIT	129	216	259	111	197	254
66. CHIANG RAI	261	543	719	210	371	479
67. PHA YAO	80	192	220	63	112	144
68. NAN	87	180	216	69	122	157
69. PHRAE	189	340	396	149	263	339
TOTAL	746	1471	1810	602	1065	1373
70. PHITSANULOK	244	391	552	201	356	459
71. SUKHO THAI	138	174	217	112	198	255
72. PHETCHA BUN	89	179	264	67	118	153
73. LOMSAK	51	103	152	48	84	108
74. PHICHIT	73	113	138	61	108	139
75. TAPHAN HIN	117	183	222	95	168	217
TOTAL	712	1143	1545	584	1032	1331
TOTAL NUMBER OF REG.5 -8	3138	5578	6819	2605	4606	5939
76. UDON THANI	268	513	646	288	509	656
77. " " 1	43	83	104	1	2	3
78. LOEI	105	252	379	86	151	195
79. NONG KHAI	126	220	342	115	204	263
80. KHON KAEN	285	445	542	207	446	575

Name of Toll Centers	ACCEPTANCE			DELIVERY		
	1970	1979	1987	1970	1979	1987
81. BAN PHAI	107	167	204	131	151	195
TOTAL	934	1680	2217	828	1463	1887
82. SAKHON NAKHON	161	319	421	162	285	368
83. NAKHON PHANOM	155	359	462	138	245	316
84. MUKDAHAN	71	165	212	55	97	125
85. KALASIN	104	233	296	89	158	204
86. MAHA SARAKHAM	126	310	380	96	170	219
TOTAL	617	1386	1771	540	955	1232
87. UBON	321	604	777	311	574	740
88. YASO THON	101	191	245	86	151	195
89. SISAKET	106	206	259	92	162	209
90. SURIN	128	257	326	100	177	228
91. ROIET	186	409	495	139	247	318
TOTAL	842	1667	2102	728	1311	1690
92. NAKHONRATCHASIMA	388	759	992	409	721	930
93. " " 1	55	109	142	-	-	-
94. PAKCHONG	42	81	106	44	78	101
95. CHAIYA PHUM	137	275	349	105	186	240
96. BURI RAM	138	236	316	104	185	238
TOTAL	760	1460	1905	662	1170	1509
TOTAL NUMBER OF REG.9-12	3153	6193	7995	2758	4899	6318
97. CHUM PHON	206	292	388	228	403	519
98. RANONG	107	193	284	97	171	220
99. PHANGNGA	52	96	129	62	110	142
100. TAKUAPA	46	84	112	40	70	91
101. KRABI	62	128	184	67	108	139
102. PHUKET	180	193	246	140	247	319
TOTAL	653	986	1343	634	1109	1430
103. NAKHONSITHAMMARAT	291	536	669	289	510	657
104. PAKPHANANG	53	97	121	61	107	138
105. THUNG SONG	170	313	391	135	239	308

Name of Toll Centers	ACCEPTANCE			DELIVERY		
	1970	1979	1987	1970	1979	1987
106. SURATTHANI	259	487	747	249	441	568
107. PHUN PHIN	42	80	105	40	71	92
108. PHATTALUNG	84	154	193	74	131	169
109. TRANG	265	385	503	240	423	546
TOTAL	1164	2052	2729	1088	1922	2478
110. SONG KHLA	223	372	368	193	260	336
111. HAT YAI	259	432	626	337	675	871
112. " " 2	136	227	281	-	-	-
113. PATTANI	138	212	250	115	204	263
114. NARATHIWAT	129	220	268	104	184	237
115. SUNGAI-KOLOK	78	132	162	65	114	148
116. YALA	209	382	519	166	293	378
117. SATUN	49	113	175	47	83	107
TOTAL	1221	2090	2649	1027	1813	2340
TOTAL NUMBER OF REG.13-15	3038	5128	6721	2749	4844	6248
TOTAL NUMBER OF REG.9-12	3153	6193	7995	2758	4899	6318
TOTAL NUMBER OF REG.5-8	3138	5578	6819	2605	4606	5939
TOTAL NUMBER OF REG.1-4	6292	11393	14946	7890	13943	17976
GRAND TOTAL	15621	28292	36481	16002	28292	36481

No.of International - Telegrams per year in each office.	1971		1979		1987	
	Acceptance	Delivery	Acceptance	Delivery	Acoeptnce	Dolivery
(Including Service - Telegrams)						
BANGKOK CTO.	301,825	34,056	362,190	39,730	507,066	52,972
INTERNATIONAL GATE	47,122	35,572	56,546	41,498	79,164	55,329
BK.1	11,260	111,314	13,512	129,859	18,917	173,141
BK.2	12,903	43,765	15,484	51,056	21,678	68,073
BK.3	2,072	3,170	2,486	3,698	3,480	4,931
BK.4	5,775	34,178	6,930	39,872	9,702	53,161
BK.5	11,318	191,730	13,582	223,672	19,015	298,222
BK.6	870	9,214	1,044	10,749	1,462	14,332
BK.7	720	854	864	996	1,210	1,328
BK.8	870	1,830	1,044	2,135	1,462	2,847
BK.9	994	4,823	1,193	5,627	1,670	7,502
BK.10	288	9,028	346	10,532	484	14,042
BK.11	1,824	40,226	2,189	46,928	3,065	62,569
BK.12	14,361	23,927	17,233	27,913	24,126	37,216
WAT LIAP	1,546	-	1,855	-	2,597	-
NAPHRA LAN	756	-	907	-	1,270	-
HUA LAM PHONG	2,477	-	2,973	-	4,162	-
BANGLAMPHU-BON	1,671	-	2,005	-	2,807	-
BANGKRABUE	587	-	705	-	987	-
POM PRAP	23,434	-	28,121	-	39,370	-
PATHUM WAN	7,492	-	8,991	-	12,587	-
SANTITHAM	4,547	-	5,457	-	7,640	-
DON MUANG	286	1,306	343	1,523	480	2,031
WONGWIEN YAI	395	-	474	-	664	-
DON MUANG AIR PORT	2,065	-	2,478	-	3,469	-
TALAD PHLU	57	-	68	-	95	-
BANG PLAD	203	-	244	-	342	-
KELONG CHAN	80	-	96	-	134	-
LAT KRABANG	-	-	-	-	-	-
NONG CHOK	-	-	-	-	-	-
MIN BURI	6	-	8	-	11	-
KRUNGTHAI BANK(LPO)	3,586	-	4,303	-	6,024	-
THAI DEVELOPMENT BANK(LPO)	1,384	-	1,661	-	2,325	-
BANGKOK BANK (LPO)	10,226	-	12,271	-	17,179	-
EAST ASIATIC COMPANY(LPO)	2,127	-	2,552	-	3,573	-
ERAWAN HOTEL (LPO)	16,879	-	20,255	-	28,357	-
TOTAL NUMBER IN THE - METROPOLITAN AREA.	492,006	544,993	590,410	635,788	826,574	847,696

No.of International - Telegrams per year in each office.	1971		1979		1987	
	Acceptance	Delivery	Acceptance	Delivery	Acceptance	Delivery
(Including Service - Telegrams)						
NONTHABURI	499	834	599	973	699	1,112
PATHUMTHANI	15	16	18	19	21	21
SAMUT PRAKAN	973	931	1,167	1,086	1,362	1,241
TOTAL	1,487	1,781	1,784	2,078	2,082	2,374
AYUTTHAYA	37	49	44	57	52	65
SUPHANBURI	8	17	10	20	11	23
ANG THONG	1	9	2	10	2	12
SING BURI	1	8	2	9	2	11
LOP BURI	37	70	44	82	51	93
SARA BURI	44	151	52	176	61	201
TOTAL	128	304	154	354	179	405
CHACHOENGSAO	5	9	6	10	7	12
NAKHON NAYOK	5	22	6	26	7	29
PRACHIN BURI	18	17	22	20	25	23
TRAT	13	16	16	19	18	21
CHANTHA BURI	22	23	26	27	31	31
RAYONG	168	164	201	191	235	219
CHONBURI	1,321	1,467	1,585	1,711	1,849	1,956
SIRACHA	-	-	-	-	-	-
SATTA HIP	-	-	-	-	-	-
TOTAL	1,552	1,718	1,862	2,004	2,172	2,391
RATCHA BURI	126	146	151	170	176	195
BAN PONG	-	-	-	-	-	-
KANCHANABURI	23	48	28	56	32	64
NAKHON PATHOM	37	112	44	131	52	149
SAMUT SAKHON	11	61	13	71	15	81
SAMUTSONGKHRAM	-	6	-	7	-	8
PHETCHABURI	64	103	77	120	90	137
PRACHUAPKHIRIKHAN	76	65	91	76	106	87
THAP SAKAE	-	-	-	-	-	-
HUA HIN	-	-	-	-	-	-
TOTAL	337	541	404	631	471	721
TOTAL NUMBER OF REG.1-4	495,510	549,337	594,614	640,855	831,478	853,487

No.of International Telegrams per year in each office)	1971		1979		1987	
	Acceptance	Delivery	Acceptance	Delivery	Acceptance	Delivery
(Including Service Telegrams)						
NAKHON SAWAN	82	99	98	115	115	132
TAKHLI	-	-	-	-	-	-
TAK	10	14	12	16	14	19
KAMPHAENGPHET	1	4	2	5	2	5
UTHAITHANI	5	9	6	10	7	12
CHAI NAT	27	30	:	35	37	40
TOTAL	125	156	150	181	175	208
CHIANG MAI	1,517	1,660	1,820	1,936	2,124	2, 213
" " 1	-	-	-	-	-	-
MAEHONGSON	15	11	18	13	21	15
LAMPHUN	106	38	127	44	148	51
LAMPANG	185	186	222	217	259	248
TOTAL	1,823	1,895	2,187	2,210	2,552	2,527
UTTARADIT	264	207	317	241	370	276
CHIANG RAI	116	72	139	84	162	96
PHA YAO	-	-	-	-	-	-
NAN	7	9	8	10	10	12
PHRAE	18	34	22	40	25	45
TOTAL	405	322	486	375	567	429
PHITSANULOK	31	31	37	36	43	41
SUKHO THAI	10	14	12	16	14	19
PHETCHA BUN	256	150	307	175	358	200
LOMSAK	-	-	-	-	-	-
PHICHIT	3	3	4	4	4	4
TAPHAN HIN	-	-	-	-	-	-
TOTAL	300	198	360	231	419	264
TOTAL NUMBER OF REG.1-4	2,653	2,571	3,183	2,997	3,713	3,428
UDON THANI	1,203	1,284	1,444	1,498	1,684	1,712
" " 1	-	-	-	-	-	-
LOEI	9	10	11	12	13	13
NONG KHAI	83	41	99	48	116	55
KHON KAEN	145	163	174	190	203	217
BAN PHAI	-	-	-	-	-	-
TOTAL	1,440	1,498	1,728	1,748	2,016	1,997

No.of International - Telegrams per year in each office)	1971		1979		1987	
	Acceptance	Delivery	Acceptance	Delivery	Acceptance	Delivery
(Including Service-Telegrams)						
SAKHON NAKHON	39	24	47	28	55	32
NAKHON PHANOM	140	309	168	360	196	412
MUKDAHAN	-	-	-	-	-	-
KALASIN	15	12	18	14	21	16
MAHA SARAKHAM	111	70	133	82	155	93
TOTAL	305	415	366	484	427	553
UBON	303	530	364	618	424	707
YASO THON	-	-	-	-	-	-
SISAKET	4	4	5	5	6	5
SURIN	9	18	11	21	13	24
ROIET	37	25	44	29	51	33
TOTAL	353	577	424	673	494	769
NAKHONRATCHASIMA	367	676	440	788	514	901
" " 1	-	-	-	-	-	-
PAKCHONG	-	-	-	-	-	-
CHAIYA PHUM	-	4	-	5	-	5
BURI RAM	2	3	3	4	3	4
TOTAL	369	683	443	797	517	910
TOTAL NUMBER OF REG.9-12	2,467	3,173	2,961	3,702	3,454	4,231
CHUM PHON	10	8	12	9	14	11
RANONG	191	296	229	345	267	395
PHANGNGA	24	41	29	48	34	55
TAKUAPA	-	-	-	-	-	-
KRABI	28	15	34	18	39	20
PHUKET	2,394	1,945	2,872	2,269	3,351	2,593
TOTAL	2,647	2,305	3,176	2,689	3,705	3,074
NAKHONSITHAMMARAT	253	308	304	359	354	411
PAKPHANANG	-	-	-	-	-	-
THUNG SONG	-	-	-	-	-	-
SURATTHANI	80	81	96	94	112	108
PHUN PHIN	-	-	-	-	-	-
PHATTALUNG	2	7	3	8	3	9
TRANG	1,123	910	1,347	1,062	1,572	1,213
TOTAL	1,458	1,306	1,750	1,523	2,041	1,741

No.of International Telegrams per year in each office.)	1971		1979		1987	
	Acceptance	Delivery	Acceptance	Delivery	Acceptance	Delivery
(Including Service Telegrams)						
SONG KHLA	2,561	2,552	3,073	2,977	3,585	3,403
HAT YAI	-	-	-	-	-	-
" " 2	-	-	-	-	-	-
PATTANI	140	148	168	173	196	197
NARATHIWAT	113	102	136	119	158	136
SUNGAI-KOLOK	-	-	-	-	-	-
YALA	124	233	149	272	174	331
SATUN	22	31	26	36	31	41
TOTAL	2,960	3,066	3,552	3,577	4,144	4,088
TOTAL NUMBER OF REG. 13 - 15	7,065	6,677	8,478	7,789	9,890	10,565
TOTAL NUMBER OF REG. 9 - 12	2,467	3,173	2,961	3,702	3,454	4,231
TOTAL NUMBER OF REG. 5 - 8	2,653	2,571	3,183	2,997	3,713	3,428
TOTAL NUMBER OF REG. 1 - 4	495,510	549,337	594,614	640,855	831,478	853,487
GRAND TOTAL	507,695	561,758	609,236	655,343	848,535	871,711

NO. OF CHARACTERS IN A TELEGRAM

(Domestic)

Function Code *2	Identification	Reception Date, Time	Kind	Delivery office	Address *2	Text *1	Coltation	Total
14	23	11	3	20	42.8	109.9	30.2	253.9

CONTENTS OF TEXT

*1

Characters / Kind of TGM	Total	Sentence	Space	Shift	CR	LF
Domestic	109.9	75.6	6.4	13.3	5.8	8.8
International	277.2	121.2	25	4	10	17

*2 Function Code is composed of the following.

1) Space x 2 characters
2) Initial code x 1 characters
3) Message Number x 3 digits. (characters)
4) Hetter Shif x 1
5) Address code x 3 characters (2 or 3)
6) Space x 2

(Text)

7) Space x 1
8) End of Message Code x 1

Appendix 2.15

PUNCHING STROKE OF

KEYBOARD PERFORATOR

Stroke Per minute	No. of Operators
271 - 290	8
251 - 270	24
231 - 250	85
211 - 230	74
191 - 210	21
171 - 190	9
151 - 170	3
131 - 150	11
111 - 130	5
Total	240

AVERAGE 224.3 Stroke/min.

Standard deviation 14.8

Variation 0.06

Measured at CTO.

July, 1971

NUMBER OF LINES REQUIRED IN MESSAGE SWITCHING

Appendix 2.16

Item	Name of the office	No. of Lines				No. of Domestic Telegrams Per Day			
		Send		Receive		Send		Receive	
		Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light
1.	BANGKOK GTO.	4		1		2,650			
2.	INTERNATIONAL GATE	4	1	2	1				
3.	BK.1		1	6			249	2,893	
4.	2	1		3		523		1,512	
5.	3	1		2		340		730	
6.	4	1		3		578		1,219	
7.	5	1		4		373		1,889	
8.	6		1	2			247	1,144	
9.	7	1		1		396		520	
10.	8		1		1		169		287
11.	9		1	1			217	388	
12.	10		1	1			91	328	
13.	11	1		2		471		968	
14.	12		1	2			146	571	
15.	WET LLAP		1				287		
16.	NAPHRA LAN		1				257		
17.	HUA LAM PHONG	1				335			
18.	BANGLAMPHU-BON	1				380			
19.	BANGKRABUE						170		
20.	POM PRAP	1				515			
21.	PATHUM WAN		1				278		
22.	SANTITHAM		1				154		
23.	DON MUANG		1		1				152
24.	WONGWIEN YAI		1		1		251		1
25.	DON MUANG AIR PORT								
26.	NONTHABURI		1		1		163		156
27.	PATHUMTHANI		1		1		100		100
28.	SAMUT PRAKAN		1		1		206		273
	TOTAL	17	17	30	7	5,889	2,987	12,162	969
						(9546)		(13131)	
29.	AYUTTHAYA		1		1		260		286
30.	SUPHANBURI		1		1		292		221
31.	ANG THONG		1		1		167		118

Item	Name of the office	No. of Lines				No. of Domestic Telegrams Per Day			
		Send		Receive		Send		Receive	
		Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light
32.	SING BURI		1		1		137		134
33.	LOP BURI	1		1		327		363	
34.	SARA BURI		1		1		238		260
	TOTAL	1	5	1	5	327	1,094	363	1,019
						(1421)		(1382)	
35.	CHACHOENGSAO		1		1		252		230
36.	NAKHON NAYOK		1		1		125		86
37.	PRACHIN BURI	1			1	364			296
38.	TRAT		1		1		104		89
39.	CHANTHA BURI		1		1		228		245
40.	RAYONG		1		1		214		151
41.	CHONBURI	1			1	345			319
42.	SIRACHA		1		1		150		159
43.	SATTA HIP		1		1		163		250
						709	1236		1825
	TOTAL	2	7		9	(1945)			
44.	RATCHA BURI		1		1		275		306
45.	BAN PONG		1		1		168		161
46.	KANCHANABURI		1		1		294		184
47.	NAKHONPATHOM		1		1		275		252
48.	SAMUT SAKHON		1		1		86		90
49.	SAMUTSONGKHRAM		1		1		112		110
50.	PHETCHABURI		1		1		244		221
51.	PRACHUAPKHIRIKHAN		1		1		191		112
52.	THAP SAKAE		1		1		159		84
53.	HUA HIN		1		1		230		118
	TOTAL		10		10		2034		1638
	TOTAL NO. of RG 1-4	20	39	31	31	7595	7351	12525	5451
						(14946)		(17776)	
54.	NAKHON SAWAN	2		2		627		635	
55.	TAKHLI		1		1		143		157
56.	TAK		1		1		218		207
57.	KAMPHAENGPHET		1		1		259		138
58.	UTHAITHANI		1		1		127		125

Item	Name of the office	No. of Lines				No. of Domestic Telegrams Per Day			
		Send		Receive		Send		Receive	
		Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light
59.	CHAI NAT		1		1		190		204
						627	934	635	831
	TOTAL	2	5	2	5	(1564)		(1466)	
60.	CHIANG MAI	2		2		762		1033	
61.	" " 1	1				376			
62.	MAEHONGSON		1		1		71		66
63.	LAMPHUN		1		1		142		145
64.	LAMPANG	1		1		549		525	
						1687	213	1558	211
	TOTAL	4	2	3	2	(1900)		(1769)	
65.	UTTARADIT		1		1		259		254
66.	CHIANG RAI	1		1		719		479	
67.	PHA YAO		1		1		220		144
68.	NAN		1		1		216		157
69.	PHRAE	1		1		396		339	
						1115	695	818	555
	TOTAL	2	3	2	3	(1810)		(1373)	
70.	PHITSANULOK	1		1		552		459	
71.	SUKHO THAI		1		1		217		255
72.	PHETCHA BUN		1		1		264		153
73.	LOMSAK		1		1		152		108
74.	PHICHIT		1		1		138		139
75.	TAPHAN HIN		1		1		222		217
	TOTAL	1	5	1	5	552	993	459	872
	TOTAL NUMBER OF REG.5 - 8					(6819)		(5929)	
76.	UDON THANI	2		2		646		659	
77.	" " 1		1		1		104		-
78.	LOEI	1			1	379			195
79.	NONG KHAI	1			1	342			263
80.	KHON KAEN	1		1		542		575	
81.	BAN PHAI		1		1		204		195
						1909	308	1234	653
	TOTAL	5	2	3	4	(2217)		(1887)	
82.	SAKHON NAKHON	1		1		421		368	
83.	NAKHON PHANOM	1		1		462		316	

Item	Name of the office	No. of Lines				No. of Domestic Telegrams Per Day			
		Send		Receive		Send		Receive	
		Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light
84.	MUKDAHAN		1		1		212		125
85.	KALASIN		1		1		296		204
86.	MAHA SARAKHAM	1			1	380			219
						1263	508	684	548
	TOTAL	3	2	2	3	(1771)		(1232)	
87.	UBON	2		2		777		710	
88.	YASO THON		1		1		245		195
89.	SISAKET		1		1		259		209
90.	SURIN		1		1		326		228
91.	ROIET	1		1		495		318	
						1272	830	1058	632
	TOTAL	3	3	3	3	(2102)		(1690)	
92.	NAKHONRATCHASIMA	2		2		992		930	
93.	" " 1		1				142		
94.	PAKCHONG		1		1		106		101
95.	CHAIYA PHUM	1			1	349			240
96.	BURI RAM		1		1		316		238
						1341	564	930	579
	TOTAL	3	3	2	3	(1905)		(1509)	
						5785	2210	3903	2415
TOTAL	NUMBER OF REG. 9-12	14	10	10	13	(7995)		(6318)	
97.	CHUM PHON	1		1		388		519	
98.	RANONG		1		1		284		220
99.	PHANGNGA		1		1		129		142
100.	TAKUAPA		1		1		112		91
101.	KRABI		1		1		184		139
102.	PHUKET		1		1		246		319
						388	955	519	911
	TOTAL	1	5	1	5	(1343)		(1430)	
103.	NAKHONSITHAMARAT	2		2		669		657	
104.	PAKPHANANG		1		1		121		138
105.	THUNG SONG	1		1		391		308	
106.	SURATTHANI	2		1		747		568	
107.	PHUN PHIN		1		1		105		92

Item	Name of the office	No. of Lines				No. of Domestic Telegrams Per Day			
		Send		Receive		Send		Receive	
		Heavy	Light	Heavy	Light	Heavy	Light	Heavy	Light
108.	PHATTALUNG		1		1		193		169
109.	TRANG	1		1		503		546	
						2510	419	2079	399
	TOTAL	6	3	5	3	(2729)		(2478)	
110.	SONG KHLA	1		1		368		336	
111.	HAT YAI	2		2	626		871		
112.	" " 2		1				281		
113.	PATTANI		1		1		250		263
114.	NARATHIWAT		1		1		268		237
115.	SUNGAI-KOLOK		1		1		162		148
116.	YALA	1		1		519		378	
117.	SATUN		1		1		175		107
						1513	1136	1585	755
	TOTAL	4	5	4	4	(2649)		(2340)	
						4211	2510	4183	2065
	TOTAL NUMBER OF REG. 13-15	11	13	10	12	(6721)		6248	
						5785	2210	3903	2415
	TOTAL NUMBER OF REG. 9-12	14	10	10	13	(7995)		(6318)	
						3981	2838	3470	2469
	TOTAL NUMBER OF REG. 5-8	9	15	8	15	(1819)		(5939)	
						7595	7351	12525	5451
	TOTAL NUMBER OF REG. 1-4	20	39	31	31	(14946)		(17976)	
						21572	14909	24081	12400
	GRAND TOTAL	54	77	59	71	(36481)		(36481)	

Note : The office which has the Telegrams more than 300 messages per day is accommodated into heavy loaded position.

NUMBER OF LINES REQUIRED IN LINE SWITCHING

Appendix 2.17

NAME OF OFFICE	Sent		Received	
	Traffic (erl)	No.of Pos.	Traffic (erl)	No.of Pos.
1. BANGKOK CTO.	11.230	12	6,188	11
2. INTERNATIONAL GATE	8,475	9	6.563	12
3. BK.1	*0,170 1,055	2	*1,476 10,849	19
4: 2	0,193 2,216	3	0,579 5,670	11
5: 3	1,441	2	2,738	7
6: 4	0,088 2,449	3	0,453 4,571	10
7. 5	0,170 1,581	3	2,541 7,084	15
8. 6	1,047	2	4,290	9
9. 7	1,678	3	1,950	6
10. 8	0.716	2	1,076	4
11. 9	0,920	2	1,455	5
12. 10	0.386	1	1,230	4
13. 11	0,027 1,996	3	0,534 3,630	9
14. 12	0,210 0,619	2	0,318 2,141	6
15. WAT LIAP	1,216	2	-	-
16. NAPHRA LAN	1,089	2	-	-
17. HUA LAM PHONG	1,420	3	-	-
18. BANGLAMPHU-BON	1,610	3	-	-
19. BANGKRABUE	0,720	2	-	-
20. POM PRAP	2,182	3	-	-
21. PATHUM WAN	1,178	2	-	-
22. SANTITHAM	0,653	1	-	-
23. DON MUANG	-	-	0,570	3
24. WONGWIEN YAI	1,064	2	0,004	1
25. DON MUANG AIR PORT	-	-	-	-
26. NONTHABURI	0.691	1	0,585	3
27. PATHUMTHANI	0.424	1	0,375	3
28. SAMUT PRAKAN	0,873	2	1.024	4
TOTAL	49,787	73	67,894	142

NAME OF OFFICE	Sent		Received	
	Traffic (erl)	No.of Pos.	Traffic (erl)	No.of Pos.
29. AYUTTHAYA	1.102	2	1,073	4
30. SUPHANBURI	1.237	2	0,829	4
31. ANG THONG	0,708	1	0,443	3
32. SING BURI	0,581	1	0,503	3
33. LOP BURI	1,386	2	1,361	5
34. SARA BURI	1,009	2	0.975	4
TOTAL	6,023	10	5,184	23
35. CHACHOENGSAO	1,068	2	0,863	4
36. NAKHON NAYOK	0.530	1	0,323	3
37. PRACHIN BURI	1,542	3	1,110	4
38. TRAT	0,441	1	0.334	3
39. CHANTHA BURI	0,966	2	0.919	4
40. RAYONG	0.907	2	0.566	3
41. CHONBURI	1,462	3	1,196	4
42. SIRACHA	0.636	1	0.596	3
43. SATTA HIP	0,686	1	0.938	4
TOTAL	8.238	16	6,845	32
44. RATCHA BURI	1.165	2	1,148	5
45. BAN PONG	0,712	2	0.604	3
46. KANCHANABURI	1,246	2	0,690	3
47. NAKHONPATHOM	1.165	2	0.945	4
48. SAMUT SAKHON	0.364	1	0.338	3
49. SAMUTSONGKHRAM	0.475	1	0.413	3
50. PHETCHABURI	1,034	2	0.829	4
51. PRACHUAPKHIRIKHAN'	0.809	2	0.420	3
52. THAP SAKAE	0,674	1	0.315	3
53. HUA HIN	0,975	2	0.443	3
TOTAL	8,619	17	6,145	34
TOTAL NUMBER OF REG.1 - 4	72.667	116	86,068	231
54. NAKHON SAWAN	2.657	3	2.381	6
55. TAKHLI	0,606	1	0.589	3
56. TAK	0,924	2	0,776	4
57. KAMPHAENGPHET	1,098	2	0.518	3
58. UTHAITHANI	0.538	1	0.469	3
59. CHAI NAT	0.805	2	0.765	4
TOTAL	6,628	11	5.498	23

NAME OF OFFICE	Sent		Received	
	Traffic (erl)	No.of Pos.	Traffic (erl)	No.of Pos.
60. CHIANG MAI	3,229	4	3,874	8
61. " " 1	1.593	3	-	-
62. MAEHONGSON	0,301	1	0,248	2
63. LAMPHUN	0,602	1	0,544	3
64. LAMPANG	2.326	3	1.969	6
TOTAL	8,051	12	6.635	19
65. UTTARADIT	1,098	2	0.953	4
66. CHIANG RAI	3.047	4	1,796	5
67. PHA YAO	0.932	2	0.540	3
68. NAN	0,915	2	0.589	3
69. PHRAE	1,678	3	1.271	5
TOTAL	7.670	13	5,150	20
70. PHITSANULOK	2.339	3	1,721	5
71. SUKHO THAI	0,920	2	0,956	4
72. PHETCHA BUN	1.119	2	0.574	3
73. LOMSAK	0,644	1	0.405	3
74. PHICHIT	0,585	1	0.521	3
75. TAPHAN HIN	0.941	2	0.814	4
TOTAL	6.548	11	4.991	22
TOTAL NUMBER OF REG.5 - 8	28.897	47	22.274	84
76. UDON THANI	2.737	4	2,471	6
77. " " 1	0,441	1	-	-
78. LOEI	1,606	3	0.731	4
79. NONG KHAI	1,449	3	0,986	4
80. KHON KAEN	2,297	3	2,156	6
81. BAN PHAI	0,864	2	0.731	4
TOTAL	9,394	16	7.075	24
82. SAKHON NAKHON	1,784	3	1.380	5
83. NAKHON PHANOM	1,958	3	1.185	4
84. MUKDAHAN	0.898	2	0.469	3
85. KALASIN	1,254	2	0.765	4
86. MAHA SARAKHAM	1.610	3	0,821	4
TOTAL	7.504	13	4.620	20
87. UBON	3,293	4	2,663	7
88. YASO THON	1,038	2	0.731	4
89. SISAKET	1,098	2	0.784	4
90. SURIN	1.381	2	0.855	4
91. ROIET	2.[illegible]8	3	1,193	4
TOTAL	8,908	13	6,226	23

NAME OF OFFICE	Sent		Received	
	Traffic (erl)	No.of Pos.	Traffic (erl)	No.of Pos.
92. NAKHONRATCHASIMA	4.204	5	3.488	8
93. " " " 1	0,602	1	-	-
94. PAKCHONG	0,449	1	0,379	3
95. CHAIYA PHUM	1.479	3	0,900	4
96. BURI RAM	1,339	2	0.893	4
TOTAL	8,073	12	5.660	19
TOTAL NUMBER OF REG.9 - 12	33,879	54	23,581	86
97. CHUM PHON	1,644	3	1,946	6
98. RANONG	1,203	2	0,825	4
99. PHANGNGA	0.547	1	0,533	3
100.TAKUAPA	0.475	1	0.341	3
101,KRABI	0,780	2	0,521	3
102. PHUKET	1,042	2	1,196	4
TOTAL	5,691	11	5,362	23
103.NAKHONSITHAMMARAT	2,834	4	2,464	6
104.PAKPHANANG	0.513	1	0.518	3
105.THUNG SONG	1.657	3	1,155	4
106.SURATTHANI	3.165	4	2,130	6
107.PHUN PHIN	0.445	1	0.345	3
108.PHATTALUNG	0.818	2	0.634	3
109.TRANG	2,131	3	2,048	6
TOTAL	11,564	18	9,294	31
110.SONG KHLA	1,559	3	1,260	4
111.HAT YAI	2,653	3	3,266	8
112. " " 2	1,190	2	-	-
113.PATTANI	1,059	2	0,986	4
114.NARATHIWAT	1,136	2	0,889	4
115.SUNGAI-KOLOK	0,686	1	0,555	3
116.YALA	2.199	3	1,418	5
117.SATUN	0.742	2	0,401	3
TOTAL	11,225	18	8,775	31
TOTAL NUMBER OF REG.13 - 15	28,480	47	23,431	85
TOTAL NUMBER OF REG. 9 - 12	33-879	54	23,581	86
TOTAL NUMBER OF REG. 5 - 8	28.897	47	22.274	84
TOTAL NUMBER OF REG. 1 - 4	72.667	116	86,068	231
GRAND TOTAL	163,923	264	155.354	486

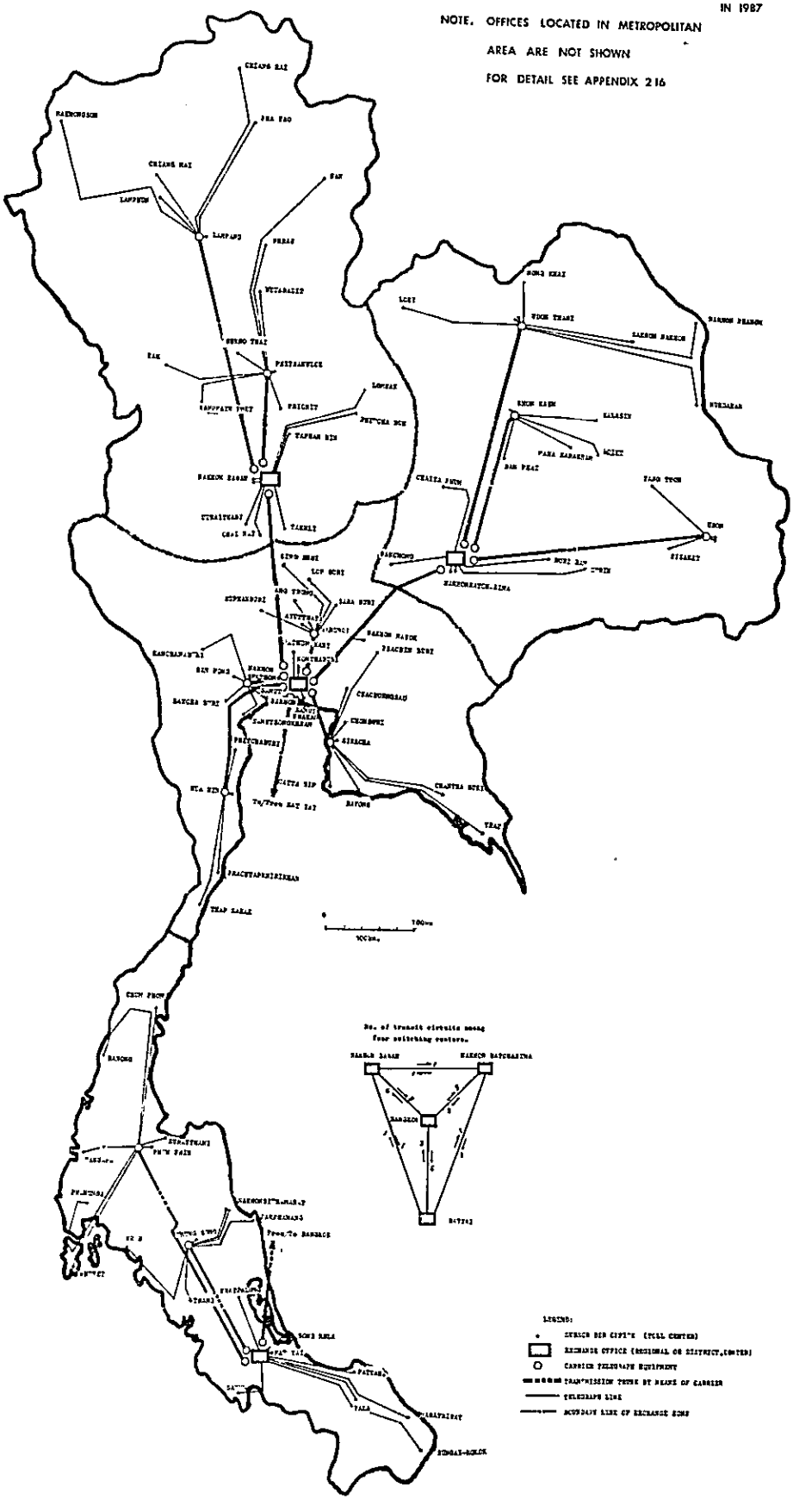
* : International traffic (Except main offices. International traffic ignored from the calculation)

APPENDIX 218
AUTOMATIC TELEGRAPH SWITCHING NETWORK IN THAILAND

IN 1987

NOTE. OFFICES LOCATED IN METROPOLITAN AREA ARE NOT SHOWN

FOR DETAIL SEE APPENDIX 216



ERRATA

PAGE	LINE	ERROR	CORRECTION
5	17		(insert) 1.13 Cont Number of International Telegrams Per Year In Each Office.
7	9	futute	future
7	11	1972	1979
8	5	Table 1.2	Appendix 1.2
8	10	(insert)	Forecasted values by this method are resulted in Appendix 1.24
8	21	$Y_t = \frac{K}{1 + Ae^{-\beta t}}$	$Y_t = \frac{K}{1 + Me^{-at}}$
8	29	A = Constant	M = Constant
10	12	fourty	forty
14	23	since	(delete)
14	24	9 %	6 %
14	4 from - Bottom	outgoing messages	outgoing messages are handled (Appendix 1.14)
17	4	(cf 1.4)	(cf 1.3)
17	6	in fifteen years	in fifteen years (See Table 1.1)
17	7	11,747	10,903
17	10	7,778	8,462
18	2	Table 1.23	Table 1.1
18	7	$Y = Y.(1 + a)^n$	$Y_t = Y\cdot(1 + a)^n$
18	13	$Y = \frac{K}{1 + Ae^{-\beta t}}$	$Y_t = \frac{K}{1 + Ae^{-\beta t}}$
18	22	$Y = \sum_{n=0}^{71} P.T.$	$Y_t = \sum_{n=1}^{71} P.T.$
18	22	10,810	10,903
19	5	whole country	whole country (Appendix 2.1)
19	8	(Appendix 2.1)	(Appendix 2.1 Cont)
19	11	region	zone
20,21,22		WITHIN THE REGION (T)/(G)	WITHIN THE ZONE (T)/(G)
24	2	Appendix 2.8	Appendix 2.13

PAGE	LINE	ERROR	CORRECTION
24	4 from - Bottom	is like a telex - exchange, is	like a telex exchange is
25	12	in Thailand. The delay	in Thailand, the delay
27	Bottom	Step	Set
31	formula 2.2.2	(unclear)	$+\gamma$
36	10	Table 2-2-2-2	Table 2.5.2.2
36	17	Table 2-2-3	Table 2.5.3
36	22	when n = 2,that is 440 telegrams	(delete)
	23	when n = 3, that is 456 telegrams	(delete)
47	10	$X\ 0.07(1 + \frac{240}{3600} + 2)$	$X\ 0.07 \left\{ (1 + \frac{240}{3600} + 2) \right.$
61	Table2.7.4	33.83	353.83
64	6	4	3
65	6	Regional	Switching
82	3 from - Bottom	tape	type
84	2	of this tape	of this type
86			Drawing 3.3 SCHEMATIC DIAGRAM OF MESSAGE SWITCHING SYSTEM(BANGKOK CENTER)
96	5	Send only X3 Cont	Send only X 0 cct
99	Bottom	END CODE	END CODE .Signal (B)
107	6	(SUITCHING.....)	(SWITCHING .....)
108	4	3.3	3.2
108	5	3.5	3.4
108	8	100 POS	82 POS
108	10	250 Sets	170 Sets
111	5 from- Bottom	: 2,256	2,356

PAGE	LINE	ERROR	CORRECTION
114	. . .	RATIO (4) (1)+(2) / (5) (1)+(5) 2.4% / 6.9%	RATIO (4) (1)+(2) / (5) (1)+(5) 2.4% / 6.9%
115	12	circuit switching	circuit switching(or line switching)
119	4	OPERA : NAL COST	OPERA TIO NAL COST
131	2	whle	while
131	3	apportunities	opportunities
149		MW W	M⎍ ⎍