4. Telephone Traffic Forecast and Circuit Calculation

4.1 Methodology for Traffic Forecast & Circuit Calculation

(1) Determination of outgoing calling rate per subscriber

Actual traffic data of outgoing calls per subscriber at the busy hour was obtained from the data of the existing digital exchange, E-10B, in ATC-3 in September 1995. Basically, this outgoing calling rate is used for traffic forecast which are classified into two categories, i.e., administration/business and residential, by user type in this study. On the other hand, MOID has been considering to introduce the timed local call charge. In the consideration of the new tariff system introduced July 1, 1996, the Study Team assumed the expected change in outgoing calling rate, especially for residential subscribers.

(2) Determination of Outgoing Traffic Ratio by Destination

The intra-office traffic ratio, local traffic ratio, long distance traffic ratio, international traffic ratio and special service ratio are determined after acquiring the traffic data of the existing digital exchange, E-10B, in ATC-3, for respective destinations. However, the intra-office traffic of each exchange, i.e., the traffic between subscribers in the same exchange area, and the local traffic to other exchanges, i.e., i) from E-10B sub. to RSU's sub., ii) from RSU's sub. to E-10B sub., iii) from RSU's sub. to RSU's sub., in Ulaanbaatar city are combined into one traffic category as "Internal Traffic" in the traffic data acquired from the digital exchange, E-10B. In addition, the long distance traffic, i.e., the traffic to exchanges in other Aimags, and the international traffic to other countries, and the local traffic to other exchanges in Ulaanbaatar city except E-10B exchange and remote exchanges of E-10B (RSUs) are combined into one category as "Outgoing traffic". The Study Team divided "Internal Traffic" acquired by E-10B data into two categories, one is for the intra-office traffic and the other is for the local traffic and divided "Outgoing Traffic" into three categories, the local traffic, long distance traffic and international traffic.

(3) Presumption of traffic volume per each local exchange in the target years

The quantity of the traffic consists of the intra-office traffic, local traffic, long distance traffic and international traffic by switch unit in each local exchange are presumed based on the outgoing calling rate per subscriber by user type and the number of telephone subscribers by user type in each exchange in the target years.

(4) Preparing traffic matrix

The junction traffic matrix was prepared, based on the quantity of outgoing traffic by switch unit, and by applying the same ratio of community of interest to all the exchanges in Ulaanbaatar city, irrespective of the distance between exchanges. The traffic between 3 enclaves (Nalaih, Baganuur and Bagahangai) and Ulaanbaatar city and among 3 enclaves were classified as trunk traffic. In this process, a network plan (e.g., establishment of new exchanges and the type of exchanges to be established, etc.) was considered for each forecasting year. In addition to the junction traffic matrix, trunk traffic table and international traffic table were prepared for circuit calculation.

(5) Circuit calculation for junction/trunk network

Based on the junction/trunk traffic matrix, the number of junction/trunk circuits was calculated, by applying "loss probability of 0.01". The calculation was made by Erlang B formula as calls among exchanges are generated at random. In this calculation, the second trunk digital exchange equipped with local and trunk functions, to be installed in ATC-5 by 1995, was considered in this study.

(6) International circuit calculation (outgoing / incoming circuit)

The number of international circuits between Mongolia and other countries were obtainable from the data of international exchange, i.e., NEAX61-E. Based on these data and the results of preceding traffic forecasting, the number of circuits by country was calculated for the forecasting years.

4.2 Traffic Forecast

4.2.1 Determination of Outgoing Calling Rate per Subscriber

(1) Outgoing traffic measurement

To identify characteristics of busy hour traffic concentration and traffic distribution by route in the existing local telephone networks in Ulaanbaatar city, an analytical study was carried out based on the latest data collected from E-10B.

Figure 7-4-1 shows the traffic profile of E-10B during one week from 24 to 30 September 1995, and Figure 7-4-2 illustrates the type of outgoing traffic from subscribers accommodated in E-10B.

(2) Monthly traffic fluctuation measurement

Table 7-4-1 presents the monthly traffic fluctuation data during 5 years from 1985 to 1989, obtained from "Study and development of the optimization method of the basic telecommunication network structure of Mongolia" [N.Nansaljav, Ph.D.Thesis] published by the former MTC, based on their survey results.

Table 7-4-1 Domestic Traffic Volume in Ulaanbaatar City

Month	Monthly Traffic (thousand minutes)					Average	(%)
	1985	1986	1987	1988	1989	(round up)	
January	362.0	439.7	507.9	564.4	676.9	508	7.85
February	417.2	473.6	560.9	537.4	680.6	534	8.25
March	344.0	419.6	478.7	535.2	585.1	473	7.30
April	387.0	468.4	542.4	607.4	697.4	541	8.35
May	364.0	445.3	502.1	593.4	673.3	516	7.96
June	417.7	506.6	591.5	694.2	764.0	595	9.19
July	375.9	479.7	511.1	642.6	644.2	531	8.20
August	390.9	477.7	555.2	690.2	637.7	550	8.50
September	429.5	483.1	572.7	666.9	694.0	569	8.79
October	392.8	482.8	560.9	627.0	671.7	547	8.45
November	437.8	485.3	569.8	646.7	679.7	564	8.71
December	412.4	492.2	543.7	638.6	651.3	548	8.46
Total	4,731.2	5,644.0	6,496.9	7,444.0	8,055.9	6,476	

The Table 7-4-1 indicates that the heaviest traffic is observed in June every year, of which ratio to the traffic in September is 1.046 (9.91 / 8.79 = 1.0455) to 1 on an average.

(3) Weekly traffic fluctuation (one week) measurement :

Friday was a heavy traffic day.

(4) Daily traffic fluctuation measurement

The busy-hour in a day was one hour between 11 to 12 o'clock in the morning on the average. The average ratio of concentration to busy hour during a day was 7.73%. However, the busiest hour during one week was between 21 to 22 o'clock on Friday, of which concentration ratio was 7.69%.

(5) Traffic measurements of outgoing calls at the busy hour :

Monthly fluctuation ratio : 1.046 (June) : 1.000 (September)
Traffic of outgoing calls (Friday) : 21,726.99 erl x 1.046 = 22,726.43 erl
(Internal traffic + Outgoing traffic + Transit traffic)
Traffic in busiest hour : 1,670.33 erl x 1.046 = 1,747.17 erl
(7.69% of traffic on Friday, 21-22 o'clock)
Number of subscriber lines : 32,252 subscriber lines (in E-10B)
Coefficient of variation : 1.24
(Percentage of unsuccessful calls due to lines being busy : 24%)
Outgoing calling rate estimated from above data
: 1,747.17 erl / 32,252 x 1.24 = 0.067 erl per subscriber

The Study Team used the above outgoing calling rate for administration/business calls. But for residential calls, the rate less than the above by approximately 33% was assumed in view of the planned introduction of the local timed tariff system. That is, in our conservative assumption, the outgoing calling rate of residential calls was presumed to decrease in the initial stage after the introduction of the new tariff system and gradually recover during the forecasting year up to 2010, while the outgoing calling rate of business calls was presumed to increase gradually up to 2010 depending on the growth of economic activities in Mongolia. The results of estimation in this study are given in Table 7-4-2.

Table 7-4-2 Outgoing Calling rate per Subscriber in Ulaanbaatar city

User category	1995	2000	2005	2010
Business (erl)	0.067 erl	0.078 erl	0.089 erl	0.1 erl
Residential (erl)	0.045 erl	0.052 erl	0.059 erl	0.067 erl

Table 7-4-3 shows the basic data used for calculation of the outgoing traffic ratio in Ulaanbaatar city.

Table 7-4-3 Outgoing Traffic Data of E-10B (Internal Local + Service + Outgoing Traffic)

(ERL)

Day / Time	0:00	1:00	2:00	3:00	4:00	5:00	6:00	7:00	8:00	9:00	10:00	11:00
24 Sep. 1995	388.43	155.48	69.29	38.52	29.96	21.46	23.98	57.90	251.63	643.50	908.64	960.32
25 Sep. 1995	213.11	78.84	40.33	27.90	19.95	18.26	19.33	65.06	339.32	768.19	1,557.40	1,628.51
26 Sep. 1995	242.31	110.75	52.37	34.66	28.28	23.78	20.03	58.06	355.22	840.90	1,587.28	1,613.78
27 Sep. 1995	242.31	110.75	57.35	34.66	28.28	23.78	20.03	58.06	355.22	747.63	1,535.49	1,559.15
28 Sep. 1995	312.93	112.89	65.22	35.58	25.92	18.26	19.10	54.13	344.10	747.63	1,595.12	1,636.07
29 Sep. 1995	277.95	105.87	56.48	38.24	25.40	23.50	20.07	54.10	337.80	779.07	1,536.30	1,617.03
30 Sep. 1995	295.26	117.78	60.70	42.01	30.76	24.18	21.77	57.97	351.22	846.92	1,558.81	1,597.72
1 week total	1,972.30	792.36	401.74	251.57	188.55	153.22	144.31	405.28	2,334.51	5,373.84	10,279.04	10,612.58
Ratio (%)	1.44%	0.58%	0.29%	0.18%	0.14%	0.11%	0.11%	0.30%	1.70%	3.92%	7.49%	7.73%

Day / Time	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00	23:00	Total(day)
24 Sep. 1995	824.78	749.26	715.99	707.70	742.80	637.51	775.11	989.25	838.15	591.55	1,087.57	548.36	12,757
25 Sep. 1995	1,543.91	1,407.32	1,325.36	1,546.04	1,570.59	1,489.85	1,375.27	1,304.53	1,305.43	1,433.48	1,221.28	548.63	20,848
26 Sep. 1995	1,502.63	1,359.88	1,329.05	1,529.71	1,530.83	1,499.30	1,395.80	1,222.70	1,502.52	1,356.27	911.62	486.63	20,594
27 Sep. 1995	1,530.99	1,414.84	1,328.37	1,528.60	1,539.69	1,479.01	1,388.49	1,239.22	1,513.30	1,581.76	1,264.30	666.36	21,248
28 Sep. 1995	1,546.73	1,317.68	1,275.01	1,484.85	1,489.06	1,412.57	1,335.73	1,247.00	1,388.27	1,345.75	1,487.64	859.69	21,157
29 Sep. 1995	1,512.96	1,376.17	1,308.42	1,592.60	1,606.17	1,528.66	1,381.52	1,256.57	1,412.72	1,670.33	1,378.78	830.28	21,727
30 Sep. 1995	1,483.94	1,405.15	1,337.78	1,227.67	1,103.44	1,082.87	1,057.96	1,211.64	1,199.04	1,055.85	1,111.23	613.08	18,895
1 week total	9,945.94	9,030.30	8,619.98	9,617.17	9,582.58	9,129.77	8,709.88	8,470.91	9,159.43	9,034.99	8,462.42	4,553.03	137,226
Ratio (%)	7.25%	6.58%	6.28%	7.01%	6.98%	6.65%	6.35%	6.17%	6.67%	6.58%	6.17%	3.32%	

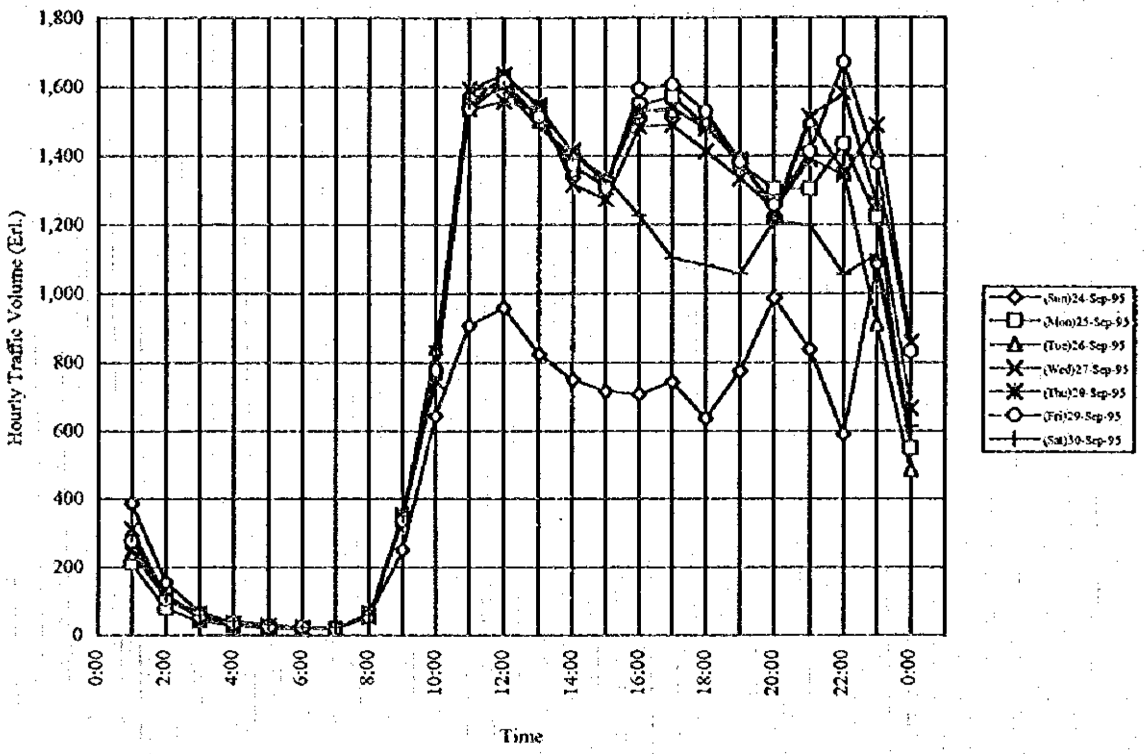


Figure 7-4-1 Hour Traffic Profile of E-10B in Ulaanbaatar city (Outgoing traffic)

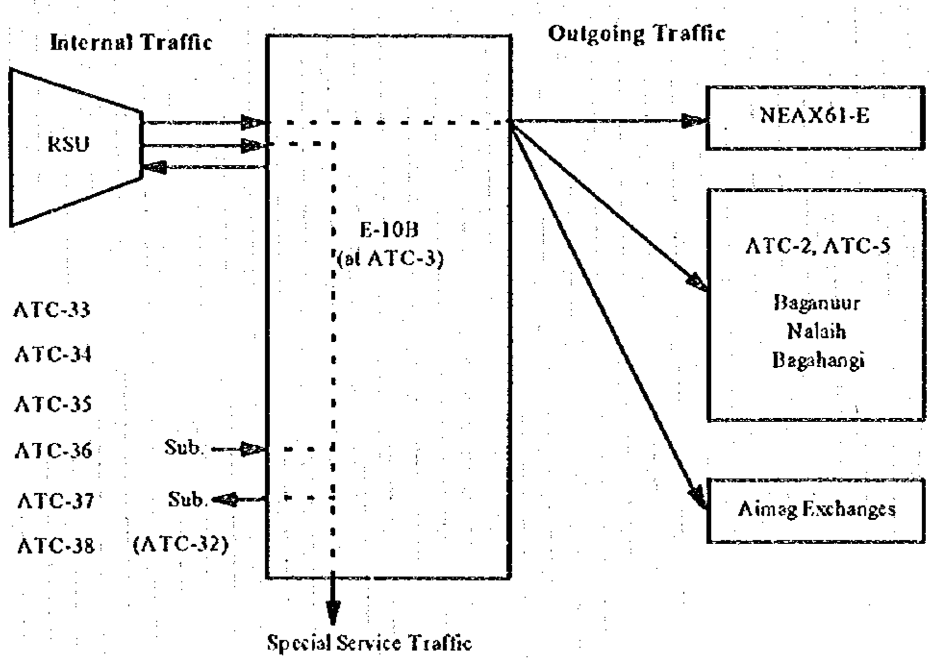


Figure 7-4-2 Type of Traffic Recording on E-10-B
(only illustrated the data used to estimate outgoing traffic per subscriber in this study)

4.2.2 Determination of Outgoing Traffic Ratio in Ulaanbaatar City

According to E-10B traffic data, outgoing traffic is classified mainly into three categories, i.e., outgoing traffic, special service traffic and internal traffic. Outgoing traffic further classified into three: (a) international traffic from E-10B to NEAX61-E, (b) trunk traffic to exchanges in other Aimags, and (c) local traffic to other local exchanges, i.e., ATC-2, ATC-5, Baganuur, Nalaih and Bagahangai. Special service traffic is the traffic of special service calls, such as emergency calls to police and fire stations, etc. Figure 7-4-3 presents the ratio of the volume of each type of traffic mentioned above to the total outgoing traffic from E-10B during one week from 24 to 30 September, 1995.

Outgoing Traffic 18%
Service Traffic 1%
Internal Traffic (Local Traffic and Intra-office 81%

<u>Outgoing Traffic</u>

(a) International outgoing traffic from E-10B to NEAX61-E

(b) Long distance outgoing traffic to exchanges in other Aimags

(c) Local traffic between E-10B/RSU to ATC-2, ATC-5, Baganuur, Nalaih and Bagahangai

<u>Service Traffic</u>

Fire station, police and ambulance, etc.: special traffic

(1% of total traffic was estimated as special traffic in this study)

Figure 7-4-3 Outgoing Traffic Ratio by Traffic Type of E-10B

According to E-10B data, local traffic is included in the outgoing traffic. This traffic, however , should be included in internal traffic which consists of local traffic and intra-office traffic. The study team divided the outgoing traffic into three categories, i.e., international outgoing traffic, long distance traffic and internal traffic, by the ratio of the trunk circuits of E-10B exchanges to NEAX61-E, each exchange in Aimags and each exchange in Ulaanbaatar city. Table 7-4-4 presents the number of trunk circuits to/from E-10B.

Table 7-4-4 Ratio of Trunk Circuits from/to E-10B

Note : ( ) both way circuit

	NEAX61-E	Long Distance (Trunk)				U.B. city		total
	(International)	Aimag exchanges	Baganuur	Nalaih	Bagahangai	ATC-2	ATC-5	
Outgoing	120	210	16	12	(1)	264	511	1,134
Incoming	120	210	16	12	(1)	356	504	1,219
Total	240	420	32	24	(2)	620	1,015	2,353
Ratio (%)	10%				20%		70%	100%

Figure 7-4-4 shows the three types of outgoing traffic.

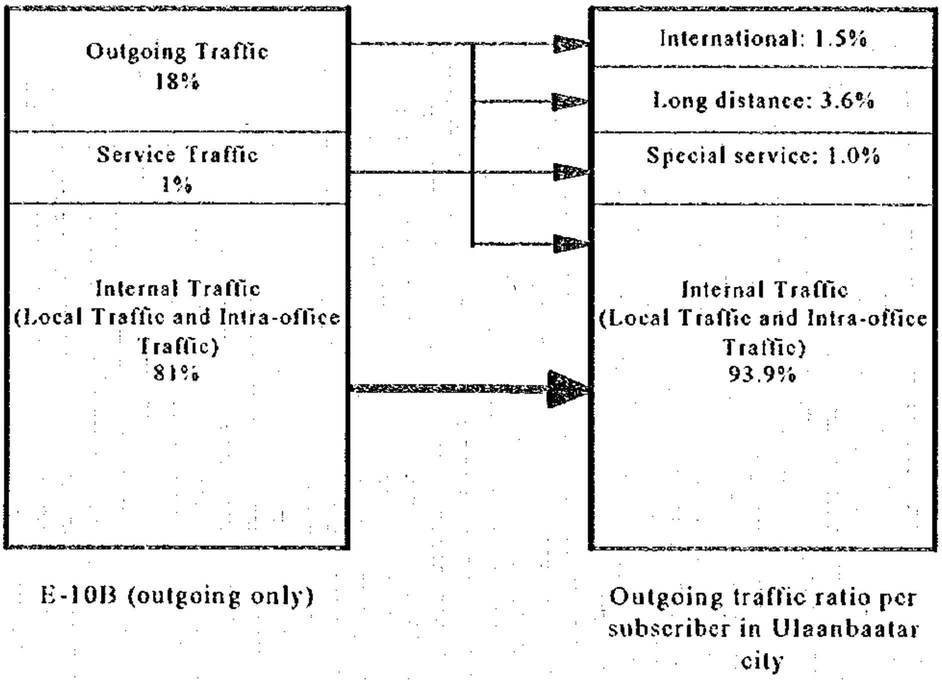


Figure 7-4-4 Outgoing Traffic Ratio by Traffic Type in This Study in 1995

4.2.3 Projection of Traffic Ratio by Type up to 2010 in Ulaanbaatar city

(1) International traffic ratio

There is just one international exchange, i.e., NEAX61-E, in Mongolia located in ATC-3 in Ulaanbaatar city which commenced services in 1993. The international traffic data is available and well compiled by MTC staff at present. The reported minutes for international calls (IDD 85% and operator assisted calls 15%) are shown in Table 7-4-5. This means that at least 85% of international calls are outgoing or incoming from/to E-10B subscribers in Ulaanbaatar city. In the future, international traffic will increase according as the number of subscriber lines in Ulaanbaatar city increases. MCAC/MTC introduced new international tariff in October 1995, however, from Japanese experience, the Study Team assumed that the gap between outgoing traffic and incoming traffic will remain until 2010 in this study.

Table 7-4-5 International Traffic Volume and Ratio in 1994 and 1995

(Million minutes)

Year	Item	Outgoing	Incoming
1994	International Traffic	1.226	3.208
	Ratio (%)	28%	72%
1995	International traffic		
	Jan.-June	0.875	2.158
	July-Sept.	0.511	1.189
	October	0.173	0.424
	Nov.-Dec.	0.345	0.849
	Total	1.904	4.620
	Ratio (%)	29%	71%

Note : Jan-Oct. 1995, actual minutes; Nov.-Dec. 1995, estimated minutes by ADB's project

The international traffic growth rate both in outgoing and incoming calls from 1994 to 1995 is shown in Table 7-4-6.

Table 7-4-6 International Traffic Growth Rates from 1994 to 1995

Items	Growth rate (%)
Outgoing	55%
Incoming	44%
Overall	47%

Table 7-4-7 shows new international tariff rates (for outgoing calls) reduced on 5 October, 1995.

Table 7-4-7 New International Tariffs (outgoing)

Destination	From (US$ per minute)	To (US$ per minute)	Decrease Rate (%)
Russian Federation	2.5	2.2	12%
China	2.5	2.2	12%
Japan, HK, Korea	5.0	4.0	20%
Rest of Asia	5.7	4.5	21%
Australia, N.Z.	6.0	5.0	16.7%
USA, Canada	7.0	5.0	28.6%
Europe	7.0	5.0	28.6%
S.America, Africa	8.0	6.0	25%

In 1995 the overall outgoing traffic increased by 47% in minute as compared with 1994. In line with the growth of business activities with foreign countries, international traffic volume will increase in coming years. Then, the ratio of the outgoing international traffic to the total outgoing traffic will increase gradually in the forecasting years because the business activities in Mongolia, especially in Ulaanbaatar as capital city, will need to communicate closely with economic activities in foreign countries. The assumption of outgoing international traffic ratio during the forecasting period is shown in Table 7-4-8.

Table 7-4-8 Assumption of the International Traffic Ratio

Items	1995	2000	2005	2010
Outgoing Traffic Ratio (%)	1.5%	1.7%	1.8%	2.0%

(2) Long distance traffic ratio

In Ulaanbaatar city, the number of outgoing long distance calls is very small, because all trunk calls between Ulaanbaatar city and each aimag centre have to be linked through operators with very long waiting time. At present, the quality of trunk links is very low due to use of open-wire in all links connecting aimag exchanges. According to the actual data of E-10B in 1995, the ratio of the outgoing long distance traffic to the total outgoing traffic is 3.6% during the period from 24 to 30 September, 1995. The traffic data on the long distance calls in Mongolia (both automatic and manual recordings) are shown in Table 7-4-9.

Table 7-4-9 Long Distance Traffic in Mongolia

(Million minutes)

Type of Exchange	1994 July-Dec.	1995 Jan-June	Growth Ratio per annum (%)
Automatic	0.889	1.099	24%
Manual	4.901	5.692	16%
Total	5.790	6.791	17%

From 1994 to 1995 Oct., the number of subscriber lines increased by approximately 11%, ((75,114 sub./67,700 sub.) - 1 x 100) , in Mongolia. It means that the growth rate of long distance traffic in minutes was higher than that of the number of subscriber lines last year. In an assumption that the digital network will be expanded among aimag exchanges during this study period, the Study Team projected that the growth of long distance traffic up to 2010 as shown in Table 7-4-10.

Table 7-4-10 Assumption of the Long Distance Traffic Ratio to the Total Outgoing Traffic in Ulaanbaatar city

Item	1995	2000	2005	2010
Outgoing Traffic Ratio (%)	3.6%	4.0%	5.0%	7.0%

(3) Special service traffic ratio

At present in Ulaanbaatar city, some emergency lines (Numbering : 1XX) are used. In this study, the traffic ratio of special service traffic is assumed to be 1% as illustrated in Figure 7-4-4. Special service traffic ratio is assumed to remain at 1% up to 2010 in spite of the growth of the number of subscriber lines in future.

(4) Intra-office and local traffic ratio (included in "Internal Traffic")

"Internal traffic" ratio is the remainder after subtraction of the international traffic ratio, long distance traffic ratio and special service traffic ratio from the total traffic. Remained "Internal Traffic" ratio should be divided into intra-office traffic ratio and local traffic ratio to make traffic matrix. This share is closely linking to the total traffic in each exchange in objective local area, that is, in Ulaanbaatar. The Study Team used the following gravity formula to separate "Internal Traffic" by exchange in the forecasting year.

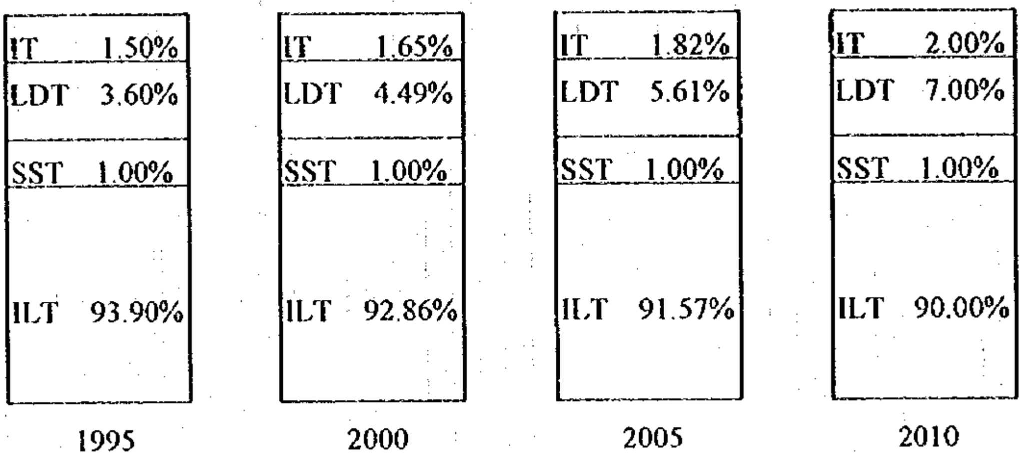
$$TTEt / TTUt \times ILTRt = IOTRt$$

$$ILTRt - IOTRt = LTRt$$

where,

TTEt	:	Total outgoing Traffic of objective Exchange in the period t
TTUt	:	Total outgoing Traffic in Ulaanbaatar city in the period t
ILTRt	:	Internal Traffic Ratio in Ulaanbaatar city in the period t
IOTRt	:	Intra-Office Traffic Ratio of objective exchange in the period t
LTRt	:	Local Traffic Ratio of objective exchange in the period t

The results of outgoing traffic ratio in Ulaanbaatar city up to 2010 is illustrated in Figure 7-4-5.



IT : International Traffic
LDT : Long Distance Traffic
SST : Special Service Traffic
ILT : Internal Traffic

Figure 7-4-5 Outgoing Traffic Ratio by Traffic Type in Ulaanbaatar city

4.2.4 Outgoing Calling Rate and Outgoing Traffic Ratio by Traffic Type in Each Exchange

Outgoing calling rate and outgoing traffic ratio traffic type in each exchange during the forecasting year are shown in Table 7-4-11, -12, and -13.

Table 7-4-11 Calling Rate and Outgoing Traffic Ratio by Traffic Type in Each Exchange (2000)

Exchange Name	Switch Unit	No. of Sub.	Outgoing Calling Rate (m Erlang)	Outgoing Traffic Ratio (%) Intra-office	Local	Long Distance	Special Service	International
ATC-3	H03A	14,300	63.20	28.80%	64.06%	4.49%	1.00%	1.65%
	H03B	3,997	63.20	28.80%	64.06%	4.49%	1.00%	1.65%
ATC-4	R04A	4,509	62.20	7.00%	85.86%	4.49%	1.00%	1.65%
	H04A	0	0	-	-	-	-	-
ATC-37A	R37A	823	64.20	1.30%	91.56%	4.49%	1.00%	1.65%
ATC-37Y	R37B	472	52.00	0.70%	92.16%	4.49%	1.00%	1.65%
ATC-7	H07A	3,730	55.30	5.10%	87.76%	4.49%	1.00%	1.65%
ATC-5	R05A	1,000	57.30	15.00%	77.86%	4.49%	1.00%	1.65%
	H05A	9,531	57.30	15.00%	77.86%	4.49%	1.00%	1.65%
ATC-51	R51A	0	0	-	-	-	-	-
ATC-52	R52A	0	0	-	-	-	-	-
ATC-6	H06A	13,839	56.30	19.40%	73.46%	4.49%	1.00%	1.65%
	H06B	0	0	-	-	-	-	-
ATC-2	R02A	4,864	63.30	7.60%	85.26%	4.49%	1.00%	1.65%
	H02A	0	0	-	-	-	-	-
ATC-38	R38A	4,608	52.80	6.00%	86.86%	4.49%	1.00%	1.65%
ATC-21	R21A	0	0	-	-	-	-	-
Jargalant	XJA	25	60.30	0.04%	92.82%	4.49%	1.00%	1.65%
	RJAA	0	0	-	-	-	-	-
Honhor	XHO	50	54.60	0.07%	92.79%	4.49%	1.00%	1.65%
	RHOA	0	0	-	-	-	-	-
Gachuurt	XGA	29	59.20	0.05%	92.81%	4.49%	1.00%	1.65%
	RGAA	0	0	-	-	-	-	-
Biokombinat	RBIA	219	69.20	0.38%	92.48%	4.49%	1.00%	1.65%
Shuvuun Fabric	RSFA	131	66.10	0.21%	92.65%	4.49%	1.00%	1.65%
Int. Children	PIC	30	78.00	0.06%	92.80%	4.49%	1.00%	1.65%
	RICA	0	0	-	-	-	-	-
MobiCom	MOBA	1,280	35.00	2.50%	90.36%	4.49%	1.00%	1.65%
Nalaih	HNAA	1,266	58.40		92.86%	4.49%	1.00%	1.65%
Baganuur	HBNA	1,927	56.40		92.86%	4.49%	1.00%	1.65%
Bagahangai	HBHA	174	61.30		92.86%	4.49%	1.00%	1.65%
TOTAL		66,804						

Note : "Total" includes the number of subscribers in MobiCom, Nalaih, Baganuur and Bagahangai.

[shaded] : Trunk Exchanges

Table 7-4-12 Calling Rate and Outgoing Traffic Ratio by Traffic Type in Each Exchange (2005)

Exchange Name	Switch Unit Unit	No. of Sub.	Outgoing Calling Rate (m Erlang)	Outgoing Traffic Ratio (%) Intra-office	Local	Long Distance	Special Service	International
ATC-3	H03A	14,300	71.40	25.40%	66.17%	5.61%	1.00%	1.82%
	H03B	10,794	71.40	25.40%	66.17%	5.61%	1.00%	1.82%
ATC-4	R04A	0	0	-	-	-	-	-
	H04A	6,876	69.40	6.80%	84.77%	5.61%	1.00%	1.82%
ATC-37A	R37A	1,237	71.50	1.30%	90.27%	5.61%	1.00%	1.82%
ATC-37Y	R37B	778	59.00	0.60%	90.97%	5.61%	1.00%	1.82%
ATC-7	H07A	5,994	62.10	5.30%	86.27%	5.61%	1.00%	1.82%
ATC-5	R05A	1,000	64.60	13.30%	78.27%	5.61%	1.00%	1.82%
	H05A	13,554	64.60	13.30%	78.27%	5.61%	1.00%	1.82%
ATC-51	R51A	493	59.90	0.50%	91.07%	5.61%	1.00%	1.82%
ATC-52	R52A	478	68.20	0.50%	91.07%	5.61%	1.00%	1.82%
ATC-6	H06A	20,315	63.50	18.30%	73.27%	5.61%	1.00%	1.82%
	H06B	0	0	-	-	-	-	-
ATC-2	R02A	0	0	-	-	-	-	-
	H02A	9,452	64.00	16.40%	75.17%	5.61%	1.00%	1.82%
ATC-22	R22A	8,608	64.00	16.40%	75.17%	5.61%	1.00%	1.82%
ATC-21	R21A	1,164	60.00	1.00%	90.57%	5.61%	1.00%	1.82%
Jargalant	XJA	0	0	-	-	-	-	-
	RJAA	42	69.00	0.04%	91.53%	5.61%	1.00%	1.82%
Honhor	XHO	0	0	-	-	-	-	-
	RHOA	69	62.50	0.06%	91.51%	5.61%	1.00%	1.82%
Gachuurt	XGA	0	0	-	-	-	-	-
	RGAA	41	69.20	0.04%	91.53%	5.61%	1.00%	1.82%
Biokombinat	RBIA	315	77.50	0.35%	91.22%	5.61%	1.00%	1.82%
Shuvuun Fabric	RSFA	193	73.80	0.20%	91.37%	5.61%	1.00%	1.82%
Int. Children	PIC	0	0	-	-	-	-	-
	RICA	50	89.00	0.06%	91.51%	5.61%	1.00%	1.82%
MobiCom	MOBA	3,372	35.00	2.50%	89.07%	5.61%	1.00%	1.82%
Nalaih	HNAA	2,179	64.80		91.57%	5.61%	1.00%	1.82%
Baganuur	HBNA	3,829	66.30		91.57%	5.61%	1.00%	1.82%
Bagahangai	HBHA	451	64.60		91.57%	5.61%	1.00%	1.82%
TOTAL		105,584						

Note : "Total" includes the number of subscribers in MobiCom, Nalaih, Baganuur and Bagahangai.

[shaded box] : Trunk Exchanges

Table 7-4-13 Calling Rate and Outgoing Traffic Ratio by Traffic Type in Each Exchange (2010)

Exchange Name	Switch Unit Unit	No. of Sub.	Outgoing Calling Rate (m Erlang)	Outgoing Traffic Ratio (%) Intra-office	Local	Long Distance	Special Service	International
ATC-3	H03A	14,300	78.90	23.80%	66.20%	7.00%	1.00%	2.00%
	H03B	24,067	78.90	23.80%	66.20%	7.00%	1.00%	2.00%
	H03C	6,820	78.80	27.60%	62.40%	7.00%	1.00%	2.00%
ATC-4	R04A	0	0	-	-	-	-	-
	H04A	10,669	76.80	6.40%	83.60%	7.00%	1.00%	2.00%
ATC-37A	R37A	1,889	79.10	1.20%	88.80%	7.00%	1.00%	2.00%
ATC-37Y	R37B	1,294	67.00	0.70%	89.30%	7.00%	1.00%	2.00%
ATC-7	H07A	9,854	69.80	5.40%	84.60%	7.00%	1.00%	2.00%
ATC-5	R05A	0	0	-	-	-	-	-
	H05A	23,534	72.10	13.30%	76.70%	7.00%	1.00%	2.00%
ATC-51	R51A	825	67.80	0.50%	89.50%	7.00%	1.00%	2.00%
ATC-52	R52A	754	75.60	0.50%	89.50%	7.00%	1.00%	2.00%
ATC-6	H06A	30,000	71.10	18.40%	71.60%	7.00%	1.00%	2.00%
	H06B	2,900	71.10	18.40%	71.60%	7.00%	1.00%	2.00%
ATC-2	R02A	0	0	-	-	-	-	-
	H02A	20,529	71.60	16.40%	73.60%	7.00%	1.00%	2.00%
ATC-22	R22A	8,608	71.60	16.40%	73.60%	7.00%	1.00%	2.00%
ATC-21	R21A	1,929	67.80	1.00%	89.00%	7.00%	1.00%	2.00%
Jargalant	XJA	0	0	-	-	-	-	-
	RJAA	65	76.60	0.04%	89.96%	7.00%	1.00%	2.00%
Honhor	XHO	0	0	-	-	-	-	-
	RHOA	113	70.20	0.06%	89.94%	7.00%	1.00%	2.00%
Gachuurt	XGA	0	0	-	-	-	-	-
	RGAA	64	76.80	0.04%	89.96%	7.00%	1.00%	2.00%
Biokombinat	RBIA	462	85.60	0.31%	89.69%	7.00%	1.00%	2.00%
Shuvuun Fabric	RSFA	290	81.50	0.19%	89.81%	7.00%	1.00%	2.00%
Int. Children	PIC	0	0	-	-	-	-	-
	RICA	60	100.00	0.05%	89.95%	7.00%	1.00%	2.00%
Mobicom	MOBA	7,179	35.00	2.50%	87.50%	7.00%	1.00%	2.00%
Nalaih	HNAA	4,429	71.20		90.00%	7.00%	1.00%	2.00%
Baganuur	HBNA	6,013	73.80		90.00%	7.00%	1.00%	2.00%
Bagahangai	HBHA	914	71.10		90.00%	7.00%	1.00%	2.00%
TOTAL		170,741						

Note :"Total" includes the number of subscribers in MobiCom, Nalaih, Baganuur and Bagahangai.

(shaded) : Trunk Exchanges

4.2.5 Junction Traffic Matrix

(1) Gravity Model

On the gravity model the intensity of traffic flow between any two switches in the target network is expressed in terms of a community factor or coefficient of affinity, and traffic is distributed on the basis of the magnitude of its value.

The intensity of traffic flow exhibits widely different values, depending on whether the distance is short or long, or the geographical characteristics of areas such as commercial and residential areas. It is generally known that the shorter the distance, the larger the community factor. However, equal distance and community factor between each exchange were adopted in this study due to a high-density large-city local network in Ulaanbaatar where the effects of distances in traffic flow are small.

(2) Algorithm

The gravity model uses the following equation to distribute traffic on the basis of the originating and terminating local traffic volumes at the individual switching units in the target network and the community factor indicating the intensity of traffic flow between switches.

$$Fij = Ai \times \frac{Cij \times Tj}{\sum_{j} Cij \times Tj}$$

Fij : Traffic demand from switch I to switch j
Ai : Originating local traffic volume of switch I
Tj : Terminating local traffic volume of switch j
Cij : Community factor of switch I to switch j traffic

(3) Other Condition

a) Intra-office traffic of RSU

All Intra-office traffic in RSU are linked through Host exchange of RSU in this study.

b) Local Traffic Distribution Ratio between Host Switching Units

To enhance the reliability of the local network in Ulaanbaatar city, the following traffic distribution percentage in logical link for local traffic between host switching units was adopted in this study as illustrated in Figure 7-4-6 and -7.

More than 40 erl in outgoing local traffic from LE A to LE B

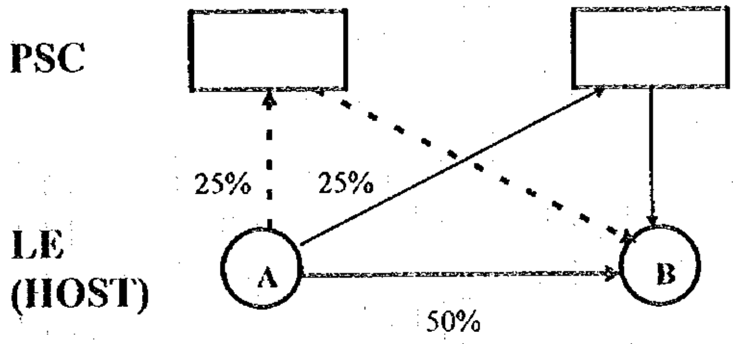


Figure 7-4-6 Local Traffic Distribution Ratio in Ulaanbaatar (More than 40 erlangs)

Less than 40 erl in outgoing local traffic LE A to LE B

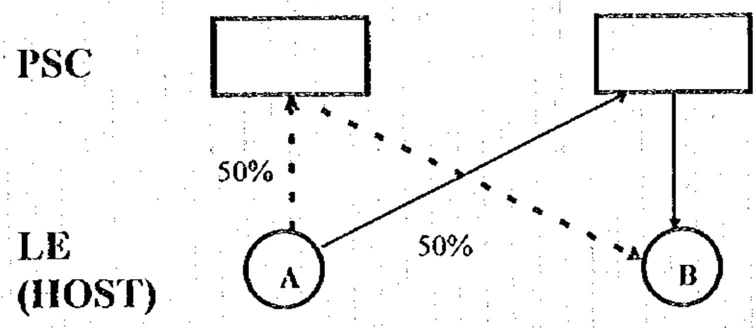


Figure 7-4-7 Local Traffic Distribution Ratio in Ulaanbaatar (Less than 40 erlangs)

The Study Team selected the lower threshold, such as 40 erlangs, to make logical link between host exchanges in this study because half of 40 erlangs, i.e., 20 erlangs, is carried by the minimum digital transmission system, that is, 2M bit (30 channels).

c) Trunk, Special service and International Traffic Distribution Ratio

There are two trunk switching units in Ulaanbaatar city, i.e., H03A and H05A, during the forecasting period. Half of calls on trunk, special service and international from each local exchange will be distributed to each trunk switching unit respectively, that is, 50%. In addition, it was assumed that the existing international traffic gap between outgoing and incoming will remain during the forecasting period, then the incoming traffic is calculated double of outgoing traffic. Junction Traffic Matrices in each forecasting year are shown in Table 7-4-14, -15 and -16. Table 7-4-17 presents trunk traffic and Table 7-4-18 presents international traffic in each forecasting year.

d) Traffic between MCAC/MTC and MobiCom

The traffic volume and distribution ratio was decided based on the data of MobiCom in this study.

In order for cellular system to interface with PSTN, it was assumed that the ratio of outgoing call is 47.5%, that of incoming call is 47.5% and cellular to cellular call is 5%, the grade of service (blocking ratio) is 1%, traffic load is 0.07 erlang in the busy hour and connection links for outgoing and incoming is designed to be separately prepared.

Total traffic volume between MCAC/MTC and MobiCom are given as follows:

(1) Total traffic = The number of subscribers x Calling rate (0.07 erl)
(2) Outgoing traffic = Total traffic x Outgoing ratio (47.5%)
(3) Incoming traffic = Total traffic x Incoming ratio (47.5%)
(4) Cellular to cellular traffic = Total traffic x Intra-Office ratio (OG + IC : 5%)

Table 7-4-14 Junction Traffic Matrix in 2000

(ERL)

No.	To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
	From	H03A	H03B	R04A	H04A	R37A	R37B	H07A	R05A	H05A	R51A	R52A	H06A	H06B	R02A	H02A	R38A	R21A	XJA	RJAA	XHO	RHOA	XGA	RGAA	RBIA	RSFA	PIC	RICA	MOBA	
1	H03A	1,086.55	108.92	285.10	0.00	53.72	24.95	105.55	58.23	332.27	0.00	0.00	362.75	0.00	312.97	0.00	247.30	0.00	1.53	0.00	2.79	0.00	1.74	0.00	0.00	0.00	2.40	0.00	22.22	3,008.99
2	H03B	106.66	75.18	0.00	0.00	0.00	0.00	0.00	0.00	73.26	0.00	0.00	21.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.42	8.82	0.00	0.00	0.00	300.76
3	R04A	280.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	280.55
4	H04A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	R37A	52.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.85
6	R37B	24.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.55
7	H07A	103.88	0.00	0.00	0.00	0.00	0.00	10.52	0.00	70.57	0.00	0.00	21.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	206.33
8	R05A	57.30	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.30
9	H05A	343.43	75.54	0.00	0.00	0.00	0.00	72.27	0.00	131.62	0.00	0.00	335.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	22.21	980.40
10	R51A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
11	R52A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
12	H06A	356.15	21.41	0.00	0.00	0.00	0.00	21.35	0.00	228.75	0.00	0.00	151.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	778.81
13	H06B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	R02A	308.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	308.02
15	H02A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
16	R38A	243.38	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	243.38
17	R21A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
18	XJA	1.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.51
19	RJAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
20	XHO	2.73	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.73
21	RHOA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22	XGA	1.77	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.77
23	RGAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
24	RBIA	0.00	15.16	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	15.16
25	RSFA	0.00	8.68	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	8.68
26	PIC	2.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.36
27	RICA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
28	MOBA	21.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	21.84	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1.12	44.81
	TOTAL	2,993.49	304.89	285.10	0.00	53.72	24.95	209.69	58.23	858.31	0.00	0.00	892.01	0.00	312.97	0.00	247.30	0.00	1.53	0.00	2.79	0.00	1.74	0.00	15.42	8.82	2.40	0.00	45.55	6,218.91

Table 7-4-15 Junction Traffic Matrix in 2005

(ERL)

No.	To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
	From	H03A	H03B	R04A	H04A	R37A	R37B	H07A	R05A	H05A	R51A	R52A	H06A	H06B	R02A	H02A	R22A	R21A	XJA	RJAA	XHO	RHOA	XCA	RCAA	RBIA	RSFA	PIC	RICA	WORA	
1	H03A	453.28	239.05	0.00	171.61	98.08	46.75	145.72	65.91	373.04	0.00	0.00	409.71	0.00	0.00	383.52	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	52.62	2,447.09
2	H03B	200.75	202.07	0.00	22.37	0.00	0.00	0.00	0.00	226.02	0.00	0.00	63.32	0.00	0.00	60.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.85	14.51	0.00	0.00	0.00	817.41
3	R04A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	H04A	145.07	73.37	0.00	32.45	0.00	0.00	0.00	0.00	163.45	0.00	0.00	46.56	0.00	0.00	44.35	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	455.17
5	R37A	99.48	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	99.48
6	R37B	45.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	45.92
7	H07A	125.05	0.00	0.00	0.00	0.00	0.00	12.77	0.00	139.40	0.00	0.00	36.29	0.00	0.00	34.56	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.00	355.93
8	R05A	64.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	64.62
9	H05A	329.47	233.87	0.00	167.74	0.00	0.00	142.79	0.00	279.70	30.09	33.19	309.50	0.00	0.00	382.70	0.00	0.00	0.00	0.00	0.00	4.40	0.00	2.89	0.00	0.00	0.00	0.00	59.61	2,025.94
10	R51A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	29.55
11	R52A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.60	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	32.60
12	H06A	337.22	63.27	0.00	45.51	0.00	0.00	36.25	0.00	387.52	0.00	0.00	226.07	0.00	0.00	121.21	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	1,228.65
13	H06B	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
14	R02A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	H02A	282.25	60.93	0.00	44.34	0.00	0.00	34.56	0.00	372.47	0.00	0.00	121.28	0.00	0.00	217.24	550.94	71.12	0.00	2.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.53	0.00	1,872.51
16	R22A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	550.91	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	550.91
17	R21A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	69.85
18	XJA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	RJAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.95
20	XHO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	RHOA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.32	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.32
22	XCA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	RCAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.83	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.83
24	RBIA	0.00	24.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	24.42
25	RSFA	0.00	14.25	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.25
26	PIC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	RICA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.45	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.45
28	WORA	57.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.95	118.04
	TOTAL	2,229.52	852.79	0.00	495.92	98.08	46.75	379.05	65.91	2,028.37	30.09	33.19	1,313.32	0.00	0.00	1,883.60	550.94	71.12	0.00	2.95	0.00	4.40	0.00	2.89	24.85	14.51	0.00	4.53	120.18	10,754.94

Note : NO.16, R22A (Old switching unit name : R38A)

Table 7-4-16 Junction Traffic Matrix in 2010

(EPL)

No.	To / From	1 H03A	2 H03B	3 R04A	4 H04A	5 R37A	6 R37B	7 H07A	8 R05A	9 H05A	10 R51A	11 R52A	12 H06A	13 H06B	14 R02A	15 H02A	16 R22A	17 R21A	18 XJA	19 RJAA	20 XHO	21 RHOA	22 XCA	23 RCAA	24 RBIA	25 RSFA	26 PIC	27 RICA	28 NOBA	TOTAL
1	H03A	381.52	537.07	0.00	285.99	152.42	88.45	224.97	0.00	641.55	0.00	0.00	625.12	52.83	0.00	661.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	125.91	3,898.40
2	H03B	469.50	450.27	0.00	57.61	0.00	0.00	42.30	0.00	555.70	0.00	0.00	146.89	0.00	0.00	157.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	40.35	24.10	0.00	0.00	0.00	1,959.59
3	R04A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	H04A	225.38	57.50	0.00	52.46	0.00	0.00	23.30	0.00	281.42	0.00	0.00	70.84	0.00	0.00	76.13	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	787.11
5	R37A	149.43	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	149.43
6	R37B	85.72	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	85.72
7	H07A	109.90	48.30	0.00	33.30	0.00	0.00	57.14	0.00	277.99	0.00	0.00	59.40	0.00	0.00	53.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	660.77
8	R05A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
9	H05A	552.57	548.09	0.00	239.59	0.00	0.00	244.75	0.00	500.65	57.06	58.15	625.03	88.61	0.00	726.24	0.00	0.00	0.00	0.00	0.00	8.10	0.00	5.03	0.00	0.00	0.00	0.00	125.91	3,928.16
10	R51A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	55.95
11	R52A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	57.01
12	H06A	522.52	108.22	0.00	70.82	0.00	0.00	59.28	0.00	865.34	0.00	0.00	392.47	0.00	0.00	134.95	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2,052.90
13	H06B	66.36	0.00	0.00	0.00	0.00	0.00	0.00	0.00	96.54	0.00	0.00	0.00	37.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	190.93
14	R02A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	H02A	654.54	157.78	0.00	78.10	0.00	0.00	63.81	0.00	703.77	0.00	0.00	154.05	0.00	0.00	292.97	524.65	133.42	0.00	5.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	6.09	0.00	3,216.18
16	R22A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	516.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	516.33
17	R21A	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	130.82	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	130.82
18	XJA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
19	RJAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.09	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.09
20	XHO	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	RHOA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.94	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	7.94
22	XCA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
23	RCAA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.93	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.93
24	RBIA	0.00	39.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	39.55
25	RSFA	0.00	23.62	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	23.62
26	PIC	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
27	RICA	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.57	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.57
28	NOBA	122.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	122.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	5.74	251.29
	TOTAL	2,582.34	2,057.53	0.00	875.85	152.42	88.45	781.65	0.00	3,931.19	57.06	58.15	2,175.65	219.33	0.00	3,039.65	524.65	133.42	0.00	5.09	0.00	8.10	0.00	5.03	40.35	24.10	0.00	6.09	256.30	17,918.48

Note : NO.16. R22A (Old switching unit name : R38A)

Table 7-4-17 Trunk Traffic ATC-3(H03A)/ATC-5(H05A) to/from Other Aimag Center (including Baganuur, Nalaih and Bagahangai)

No.	Aimag Center (PSC)	ABBR.	1996 (Jan.) No. of Traffic		2000 Trunk Traffic (erl)			2005 Trunk Traffic (erl)			2010 Trunk Traffic (erl)		
			Minute	(%)	OG	IC	OG+IC	OG	IC	OG+IC	OG	IC	OG+IC
1	BAGANUUR	BGNR	731,485	4%	3.32	3.32	6.64	7.19	7.19	14.38	15.93	15.93	31.86
2	NALAIH (*1)	NLH	309,683	2%	1.41	1.41	2.82	3.05	3.05	6.10	6.75	6.75	13.50
3	ERDENET	EDNT	1,629,357	9%	7.40	7.40	14.80	16.02	16.02	32.04	35.49	35.49	70.98
4	DARKHAN	DRHN	2,421,342	13%	11.00	11.00	22.00	23.81	23.81	47.62	52.74	52.74	105.48
5	KHENTII	HNTI	729,819	4%	3.32	3.32	6.64	7.18	7.18	14.36	15.90	15.90	31.80
6	KHUVSGUL	HVS	651,660	4%	2.96	2.96	5.92	6.41	6.41	12.82	14.19	14.19	28.38
7	KHOVD	HVD	1,043,059	6%	4.74	4.74	9.48	10.26	10.26	20.52	22.72	22.72	45.44
8	UVS	UVS	831,243	5%	3.78	3.78	7.56	8.18	8.18	16.36	18.10	18.10	36.20
9	TUV	TUV	603,756	3%	2.74	2.74	5.48	5.94	5.94	11.88	13.15	13.15	26.30
10	SELENGE	SLNG	814,007	4%	3.70	3.70	7.40	8.01	8.01	16.02	17.73	17.73	35.46
11	SUKHBAATAR	SHBR	388,046	2%	1.76	1.76	3.52	3.82	3.82	7.64	8.45	8.45	16.90
12	OMNUGOBI	UMGV	564,238	3%	2.56	2.56	5.12	5.55	5.55	11.10	12.29	12.29	24.58
13	OVURHANGAI	UVHG	930,714	5%	4.23	4.23	8.46	9.15	9.15	18.30	20.27	20.27	40.54
14	ZAVKHAN	ZVHM	1,046,669	6%	4.75	4.75	9.50	10.29	10.29	20.58	22.80	22.80	45.60
15	DUNOGOBI	DDGV	574,831	3%	2.61	2.61	5.22	5.65	5.65	11.30	12.52	12.52	25.04
16	DORNOD	DRND	938,781	5%	4.26	4.26	8.52	9.23	9.23	18.46	20.45	20.45	40.90
17	DORNOGOBI	DNGV	811,833	4%	3.69	3.69	7.38	7.98	7.98	15.96	17.68	17.68	35.36
18	CHOIR	CHIR	131,363	1%	0.60	0.60	1.20	1.29	1.29	2.58	2.86	2.86	5.72
19	GOBI-ALTAI	GVAT	1,013,691	5%	4.60	4.60	9.20	9.97	9.97	19.94	22.08	22.08	44.16
20	BULAN	BLGN	526,688	3%	2.39	2.39	4.78	5.18	5.18	10.36	11.47	11.47	22.94
21	BAYANKONGOR	BNHG	745,522	4%	3.39	3.39	6.78	7.33	7.33	14.66	16.24	16.24	32.48
22	BAYAN OLGII	BNUG	429,369	2%	1.95	1.95	3.90	4.22	4.22	8.44	9.35	9.35	18.70
23	ARKHANGAI	ARHM	572,117	3%	2.60	2.60	5.20	5.63	5.63	11.26	12.46	12.46	24.92
	Total				83.76	83.76	167.52	181.34	181.34	362.68	401.62	401.62	803.24

Note *1 : The traffic of Nalaih includes that of Bagahangai.

Table 7-4-18 International Traffic to/from Other Countries (by Destination)

No.	Destination	ABBR.	Route	19 95 No of International Trunk Circuits				2000 Traffic (erl)			2005 Traffic (erl)			2010 Traffic (erl)		
				OG	IC	B/W	(%)	OG	IC	B/W	OG	IC	B/W	OG	IC	B/W
1	TOKYO	TOKS	INTELSAT	0	0	18	15.65%	10.60	21.20	31.80	20.25	40.51	60.76	39.51	79.02	118.53
2	SEOUL	SELS	INTELSAT	0	0	5	4.35%	2.95	5.89	8.84	5.63	11.26	16.89	10.98	21.96	32.94
3	USA(AT&T)	SACS	INTELSAT	0	0	9	7.83%	5.30	10.60	15.90	10.13	20.27	30.40	19.77	39.54	59.31
4	SINGAPORE	SNGS	INTELSAT	0	0	15	13.04%	8.83	17.66	26.49	16.88	33.75	50.63	32.92	65.84	98.76
5	UK(MERCURY)	VXHS	INTELSAT	0	0	8	6.96%	4.71	9.43	14.14	9.01	18.02	27.03	17.57	35.14	52.71
6	BEIJING	PEKS	INTELSAT	0	0	20	17.39%	11.78	23.55	35.33	22.51	45.02	67.53	43.90	87.81	131.71
7	HONG KONG	HKGS	INTERSAT	0	0	8	6.96%	4.71	9.43	14.14	9.01	18.02	27.03	17.57	35.14	52.71
8	MOSCOW	MCSO/MCSI	INTERSPUTNIK	6	6	12	10.43%	7.06	14.13	21.19	13.50	27.00	40.50	26.33	52.66	78.99
9	MOSCOW	MCMO/MCMI	MICROWAVE	10	10	20	17.39%	11.78	23.55	35.33	22.51	45.01	67.52	43.91	87.81	131.72
	TOTAL					115	100.00%	67.72	135.44	203.16	129.43	258.86	388.29	252.46	504.92	757.38

90% from Ulaanbaatar

10% from other Aimags

4.3 Circuit Calculation

The calculation is carried out by Erlang's B formula as the calls among exchanges are generated at random. In this Erlang's B formula, loss probability (En) is the function of traffic (in erl) and numbers of circuits required in channel. Loss probability indicates probability of call connections to fail. In this study, as loss probability, En = 0.01 is used.

4.3.1 The Results of Circuit Calculation for Ulaanbaatar junction network

Based on the junction traffic matrices in Table 7-4-14, -15 and -16, calculation results for the number of the junction circuits required were made as shown in Table 7-4-19, -20 and -21. Digital modularity adopted in this calculation is 30 Ch.

4.3.2 The Results of Circuit Calculation for Trunk Network to/from Ulaanbaatar city

Based on the junction traffic tables in Table 7-4-17, calculation results for the number of the junction circuits required to/from Ulaanbaatar city are in Table 7-4-22. Digital modularity adopted in this calculation is 30 Ch. Traffic distribution to Aimag Centers (PSCs) were made based on the number of trunk circuits ratio to/from Ulaanbaatar city at present.

4.3.3 The Results of Circuit Calculation for International Network to/from Ulaanbaatar city

Based on the junction traffic tables in Table 7-4-18, calculation results for the number of the junction circuits required to/from Ulaanbaatar city are in Table 7-4-23. Digital modularity adopted in this calculation is 30 Ch. Traffic distribution to countries were made based on the number of trunk circuits ratio to/from Mongolia at present.

Table 7-4-19 Junction Circuits Matrix in 2000

(30ch Modularity)

No.	To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
	From	H03A	H03B	R04A	H04A	R37A	R37B	H07A	R05A	H05A	R51A	R52A	H06A	H06B	R02A	H02A	R38A	R21A	XJA	RJAA	XHO	RHOA	XGA	RGAA	RB1A	RSFA	PIC	RICA	WOBA	
1	H03A	38	5	11		3	2	5	3	12			13		12		9		1		1		1				1		2	119
2	H03B	5	4							3			2												1	1				16
3	R04A	11																												11
4	H04A																													0
5	R37A	3																												3
6	R37B	2																												2
7	H07A	5						1		3			2																	11
8	R05A	3																												3
9	H05A	13	4					3		6			9																2	37
10	R51A																													0
11	R52A																													0
12	H06A	13	2					2		9			6																	32
13	H06B																													0
14	R02A	12																												12
15	H02A																													0
16	R38A	9																												9
17	R21A																													0
18	XJA	1																												1
19	RJAA																													0
20	XHO	1																												1
21	RHOA																													0
22	XGA	1																												1
23	RGAA																													0
24	RB1A		1																											1
25	RSFA		1																											1
26	PIC	1																												1
27	RICA																													0
28	WOBA	2								2																			1	5
	TOTAL	120	17	11	0	3	2	11	3	35	0	0	32	0	12	0	9	0	1	0	1	0	1	0	1	1	1	0	5	266

Table 7-4-20 Junction Circuits Matrix in 2005

(30ch Modularity)

No.	To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
	From	H03A	H03B	R04A	H04A	R37A	R37B	H07A	R05A	H05A	R51A	R52A	H06A	H06B	R02A	H02A	R22A	R21A	XJA	RJAA	XHO	RHOA	XGA	RGAA	RBIA	RSFA	PIC	RICA	MOBA	
1	H03A	16	9		7	4	2	6	3	14			15			14													3	93
2	H03B	8	8		2					9			3			3									2	1				36
3	R04A																													0
4	H04A	6	2		2					7			2			2														21
5	R37A	4																												4
6	R37B	2																												2
7	H07A	5						1		6			2			2														16
8	R05A	3																												3
9	H05A	12	9		7			6		9	2	2	15			14						1		1					3	81
10	R51A									2																				2
11	R52A									2																				2
12	H06A	13	3		2			2		14			9			5														48
13	H06B																													0
14	R02A																													0
15	H02A	14	3		2			2		14			5			8	20	3		1								1		73
16	R22A															20														20
17	R21A															3														3
18	XJA																													0
19	RJAA															1														1
20	XHO																													0
21	RHOA									1																				1
22	XGA																													0
23	RGAA									1																				1
24	RBIA		2																											2
25	RSFA		1																											1
26	PIC																													0
27	RICA															1														1
28	MOBA	3								3																			1	7
	TOTAL	86	37	0	22	4	2	17	3	82	2	2	51	0	0	73	20	3	0	1	0	1	0	1	2	1	0	1	7	418

Note : NO.16, R22A (Old switching unit name : R38A)

Table 7-4-21 Junction Circuits Matrix in 2010

(30ch Modularity)

No.	To	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	TOTAL
	From	H03A	H03B	R04A	H04A	R37A	R37B	H07A	R05A	H05A	R51A	R52A	H06A	H06B	R02A	H02A	R22A	R21A	XJA	RJAA	XHO	RHOA	XGA	RGAA	RBIA	RSFA	PIC	RICA	WOBA	
1	H03A	17	19		10	6	4	3		22			22	4		23													5	142
2	H03B	16	17		3			3		20			6			6									2	2				75
3	R04A																													0
4	H04A	9	3		3			2		11			3			4														35
5	R37A	6																												6
6	R37B	4																												4
7	H07A	8	3		2			2		9			3			3														30
8	R05A																													0
9	H05A	20	21		11			9		18	3	3	24	4		26						1		1					5	146
10	R51A									3																				3
11	R52A									3																				3
12	H06A	19	6		3			3		24			14			8														77
13	H06B	3								4				2																9
14	R02A																													0
15	H02A	23	6		4			3		25			8			14	22	6		1								1		113
16	R22A															22														22
17	R21A															5														5
18	XJA																													0
19	RJAA															1														1
20	XHO																													0
21	RHOA									1																				1
22	XGA																													0
23	RGAA									1																				1
24	RBIA		2																											2
25	RSFA		2																											2
26	PIC																													0
27	RICA															1														1
28	WOBA	5								5																			1	11
	TOTAL	130	79	0	36	6	4	31	0	147	3	3	80	10	0	113	22	6	0	1	0	1	0	1	2	2	0	1	11	689

Note : NO.16, R22A (Old switching unit name : R38A)

Table 7-4-22 The Number of Trunk Circuit ATC-3(H03A)/ATC-5(H05A)to/from Other Aimag Center (including Baganuur, Nalaih and Bagahangai)

No.	Aimag Center (PSC)	ABBR.	1996 (Jan.) No. of Traffic Minute	1996 (Jan.) No. of Traffic (%)	2000 No. of Trunk CCTS OG	2000 IC	2000 OG+IC	2005 No. of Trunk CCTS OG	2005 IC	2005 OG+IC	2010 No. of Trunk CCTS OG	2010 IC	2010 OG+IC
1	BAGANUUR	BGNR	731,485	4%	9	9	18	14	14	28	25	25	50
2	NALAIH (*1)	NLH	309,683	2%	6	6	12	8	8	16	14	14	28
3	ERDENET	EDNT	1,629,357	9%	15	15	30	25	25	50	48	48	96
4	DARKHAN	DRHN	2,421,342	13%	19	19	38	35	35	70	67	67	134
5	KHENTII	HNTI	729,819	4%	9	9	18	14	14	28	25	25	50
6	KHUVSGUL	HVS	651,660	4%	8	8	16	13	13	26	23	23	46
7	KHOVD	HVD	1,043,059	6%	11	11	22	18	18	36	33	33	66
8	UVS	UVS	831,243	5%	9	9	18	16	16	32	28	28	56
9	TUV	TUV	603,756	3%	8	8	16	13	13	26	22	22	44
10	SELENGE	SLNG	814,007	4%	9	9	18	15	15	30	27	27	54
11	SUKHBAATAR	SHBR	388,046	2%	6	6	12	10	10	20	16	16	32
12	OMNUGOBI	UMGV	564,238	3%	8	8	16	12	12	24	21	21	42
13	OVURHANGAI	UVHG	930,714	5%	10	10	20	17	17	34	30	30	60
14	ZAVKHAN	ZVHM	1,046,669	6%	11	11	22	18	18	36	33	33	66
15	DUNOGOBI	DDGV	574,831	3%	8	8	16	12	12	24	21	21	42
16	DORNOD	DRND	938,781	5%	10	10	20	17	17	34	31	31	62
17	DORNOGOBI	DNGV	811,833	4%	9	9	18	15	15	30	27	27	54
18	CHOIR	CHIR	131,363	1%	4	4	8	5	5	10	8	8	16
19	GOBI-ALTAI	GVAT	1,013,691	5%	11	11	22	18	18	36	33	33	66
20	BULAN	BLGN	526,688	3%	7	7	14	12	12	24	20	20	40
21	BAYANKONGOR	BNHG	745,522	4%	9	9	18	14	14	28	26	26	52
22	BAYAN OLGII	BNUG	429,369	2%	7	7	14	10	10	20	17	17	34
23	ARKHANGAI	ARHM	572,117	3%	8	8	16	12	12	24	21	21	42
	Total				211	211	422	343	343	686	616	616	1,232

Note *1 : The traffic of Nalaih includes that of Bagahangai.

Table 7-4-23 International Circuits to/from Other Countries (by Destination)

No.	Destination	ABBR.	Route	1995 No. of Trunk Circuits				2000 No. of Trunk Circuits			2005 No. of Trunk Circuits			2010 No. of Trunk Circuits		
				OG	IC	B/W	(%)	OG	IC	B/W	OG	IC	B/W	OG	IC	B/W
1	TOKYO	TOKS	INTELSAT	0	0	18	15.65%	19	32	51	30	53	83	52	95	147
2	SEOUL	SELS	INTELSAT	0	0	5	4.35%	8	13	21	12	20	32	19	32	51
3	USA(AT&T)	SACS	INTELSAT	0	0	9	7.83%	12	19	31	18	30	48	30	52	82
4	SINGAPORE	SNGS	INTELSAT	0	0	15	13.04%	16	27	43	26	46	72	45	81	126
5	UK(MERCURY)	VXHS	INTELSAT	0	0	8	6.96%	11	17	28	17	28	45	27	47	74
6	BEIJING	PEKS	INTELSAT	0	0	20	17.39%	20	34	54	33	58	91	57	104	161
7	HONG KONG	HKGS	INTERSAT	0	0	8	6.96%	11	17	28	17	28	45	27	47	74
8	MOSCOW	MCSO/MCSI	INTERSPUTNIK	6	6	12	10.43%	14	23	37	22	38	60	37	67	104
9	MOSCOW	MCMO/MCMI	MICROWAVE	10	10	20	17.39%	20	34	54	33	58	91	57	104	161
	TOTAL					115	100.00%	131	216	347	208	359	567	351	629	980

90% from Ulaanbaatar

10% from other Aimags

5. Switching System and Its Facility Plan

5.1 Telephone Switching System Introduction Policy

Telephone switching system will be introduced under the following policies in principle. In this paragraph, the word "switching system" is used as defined in CCITT Rec. Q.9 and used as an element to form an exchange.

The switching system demarcation hereto is in line with the guideline of MCAC and close to the actual situation found in MCAC network. This switching system demarcation by size is for building up the telephone network plan, which should be reviewed and decided in consideration of price and performance on the occasion of purchase.

5.1.1 Local Exchange

(1) The telephone switching systems to be introduced under this Basic Plan should be of digital type compatible with Integrated Service Digital Network (ISDN).

(2) The telephone switching systems will be introduced or extended to meet duly the demand forecast in Chapter 5. The capacity of the switching system will be designed to meet the supply plan for five (5) years after installation and its expansion project is planned every five (5) years. See Figure 7-5-1.

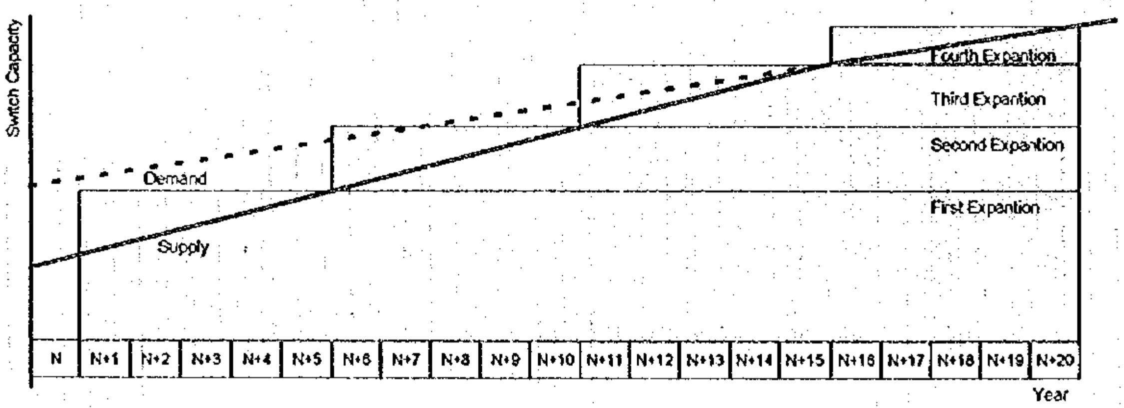


Figure 7-5-1 Supply Plan and Switching System Capacity

(3) Study team decides the priority placing for introduction of the switching system based on the following viewpoints on general principles.

- From the area that has more waiting applicants
- The balance of construction work

(4) The nominal life of the exchange is twenty (20) years in accordance with GAS.3 CCITT.

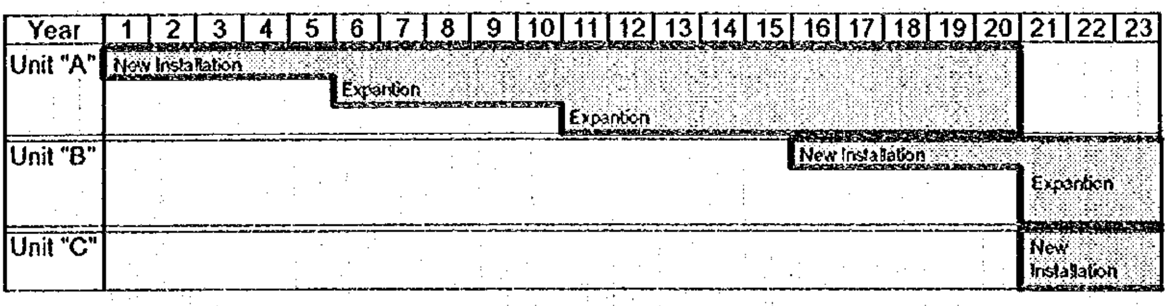


Figure 7-5-2 Switching System Life

(5) Limit of the capacity of installing exchange should be approximately 35,000 lines (including RSU) considering the security of the network and calling rate. If the demand is over 35,000, new unit will be introduced.

(6) In general, all of the local exchanges will be host exchanges, but RSU will be installed to the areas where demand is considerably small and economically efficient. Figure 7-5-3 shows the application domain of host exchange and RSU. Remote terminal is not considered to be introduced from the viewpoint of reliability, that is, when the circuits between a remote terminal and the host exchange are cut, calls from subscribers can not be handled.

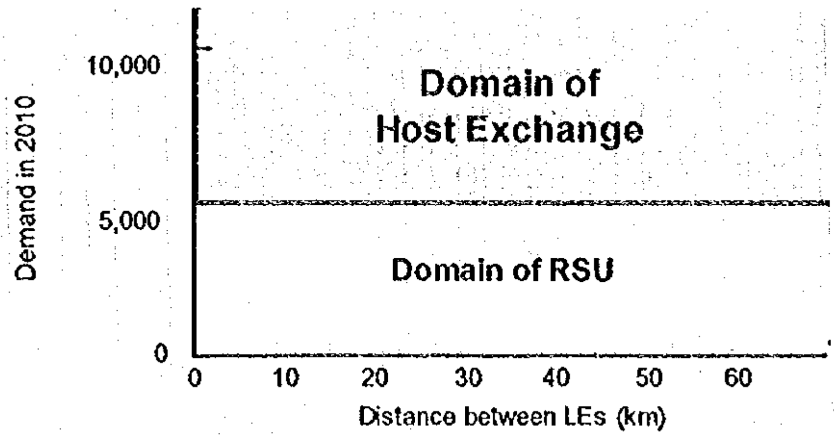


Figure 7-5-3 Application Domain of Host Exchange and RSU

(7) In the central area of Ulaanbaatar city, RSUs are installed in some areas whose demand is over 5,000 at present. Some of them will remain in order to reuse RSUs in other areas, but they will be replaced by Host Exchanges one by one afterwards.

(8) For the purpose of digitalization of the network, the replacement of analogue exchange with digital one is carried out as fast as possible (completion of digitalization by 2002).

5.1.2 ISC, SSC and PSC

(1) SSC is planned as transit-local combined exchange, in consideration of the fact that the total demand in subscriber line number and the number of inter-exchange trunk circuits remains in the capacity of ordinary combined switching system. See Table 7-5-1.

Table 7-5-1 Required Exchange Capacity and Inter-Exchange Trunk Circuit

Year / ATC/RSU	2000	2005	2010	2000	2005	2010
	Subscriber Line Capacity Required			Inter-Exchange Circuit Required		
HO2A	0	23,000	29,000	0	2,700	4,620
R22A	0	8,608	8,608	0	1,140	1,260
R21A	0	2,500	3,000	0	180	330
RJAA	0	100	100	0	60	60
RICA	0	100	100	0	60	60
H03A	14,336	14,336	14,336	4,890	4,410	7,140
R02A	4,864	0	0	720	0	0
R04A	7,328	7,328	0	660	0	0
R05A	1,024	1,024	0	180	180	0
R37A	2,512	2,512	2,512	180	240	420
R37B	1,512	1,512	1,512	120	120	240
R38A	8,608	0	0	540	0	0
H03B	18,000	29,000	33,000	780	1,710	3,600
RBIA	500	500	700	60	120	120
RSFA	300	400	500	60	60	120
H04A	0	0	13,000	0	0	1,950
H05A	19,300	19,300	29,300	1,800	4,350	7,710
R51A	0	1,000	1,000	0	120	180
R52A	0	1,000	1,000	0	120	180
RGAA	0	100	100	0	60	60
RHOA	100	100	200	60	60	60
H06A	23,000	30,000	35,000	1,560	2,430	3,870
H06B	0	0	5,000	0	0	450
H07A	8,000	10,000	13,500	600	930	1,710
HNAA	2,500	4,000	6,500	360	450	840
RBHA	0	700	1,200	0	120	180
HBNA	0	5,500	7,000	0	840	1,500
XBN	3,000	0	0			
PBN1	32	0	0			
PBN2	48	0	0			
XJA	200	0	0			
XGA	50	0	0			
PIC	32	0	0			
XBH	200	0	0			
Total	115,446	162,620	206,168	12,570	20,460	36,660

5.2 Exchange Functions

The exchanges to be provided under this Basic Plan should be digital exchanges which are in line with CCITT Rec. Q.500 series for making up an ISDN in Mongolia. Details should be stipulated on the occasion of purchase.

The switching system to be provided under this Basic Plan and applied to ISC, SSC and PSC should be equipped with CCITT CCS No.7 TUP and ISUP.

5.3 Telephone Switching System Capacity to be Provided

5.3.1 Local Exchange Capacity

The existing local exchange capacity is supposed to increase up to approximately 54,644 in the year 1997, according to on-going projects as of November 1995. The local exchange capacity to be provided during this Basic Plan period is calculated based on the telephone switching system introduction policy stated in Paragraph 1 in this Chapter. It will be increased up to approximately 210,560 in the year 2010. Local exchange capacity is shown in Table 5-5-1, Volume V - Chapter 5.

Table 7-5-2 shows local exchange installation plan.

Table 7-5-2 Local Exchange Installation Plan

Year	Exchange		Install			
	Host	RSU	New	Expansion	Transfer	Total
1998	H06A		16,000			16,000
1999	H05A			3,000		
	H07A		6,000			
		R34A			4,000	
		R37A			2,000	
		R37B			1,000	
		R38A			4,000	
	HNAA		2,000			
		RBHA		700		22,700
2000	H03B		13,000			
		RBIA	500			
		RSFA	300			13,800
2001	H02A		20,000			
		R21A	1,500			
		RJAA	100			
		RICA	100			21,700
2002	H05A			4,000		
		R51A	1,000			
		R52A	1,000			
		RGAA	100			
		RHOA	100			
	HBNA		5,000			11,200
2003	H06A			11,000		
	HNAA			2,000		13,000
2004	H03B			10,000		
		RSFA		100		10,100
2005	H04A			11,000		
	H07A			4,000		15,000
2006	H02A			11,000		
		R21A		500		11,500
2007	H05A			11,000		
		RHOA		100		
	HBNA			2,000		13,100
2008	H06A			8,000		
	H06B		5,000			
	HNAA			2,500		
		RBHA		500		16,000
2009	H03B			12,000		
		RBIA		200		
		RSFA		100		12,300
2010	H04A			4,000		
	H07A			4,000		8,000
Total						184,400

5.3.2 ISC, SSC and PSC Capacity

The capacity of ISC, SSCs and PSC is calculated based on the circuit calculation result discussed in Paragraph 4, Chapter 7. Table 7-5-3 shows the Trunk circuit capacity of SSC and PSC to be provided. Table 7-5-4 shows ISC capacity to be provided.

Table 7-5-3 Trunk Capacity of SSC and PSC

	2000	2005	2010
H03A	5,700	5,700	5,700
H05A	1,500	3,000	4,500

Table 7-5-4 ISC Capacity

	1995	2000	2005	2010
Domestic	420	570	570	990
International	420	570	570	990
Total	840	1,140	1,140	1,980

Table 7-5-5 shows SSC expansion plan to fulfill the required capacity shown in Table 7-5-3. Expansion of inter-exchange circuits of PSC will be done as part of transit-local combined exchange. Table 7-5-6 shows ISC expansion plan to fulfill the required capacity shown in Table 7-5-4.

Table 7-5-5 SSC Expansion Plan

	1995	2000	2005	2010
H03A	0	0	0	0
H05A	0	0	1,500	1,500
Total	0	0	1,500	1,500

Table 7-5-6 ISC Expansion Plan

	1995	2000	2005	2010
Domestic	0	150	420	270
International	0	150	420	270
Total	0	300	840	540

5.3.3 ISDN Switching Center Capacity

ISDN Switching Center capacity is designed 500 in the year 2003.

5.4 Integrated Services Digital Network (ISDN)

5.4.1 Introduction of ISDN

Many industrialized advanced countries have introduced ISDN. Such countries have introduced the ISDN for providing services on voice communication, facsimile communication, elementary video communication, data transmission, etc. That ISDN is capable to transmit signals of a speed up to 2 Mb/s and is called N-ISDN.

It is expected that the demand on video conference, video telephone, data communication between LANs, high speed broad band data communication will come out in future, which require a transmission speed up to several hundred Mega-bits per second. The terminals may have multi-functions. That ISDN is called B-ISDN.

Mongolia is in the development stage of individual network era, where the ordinary telephone network, cellular telephone networks, data communication networks and telex network coexist by means of individual network. The existing networks should grow up to an ISDN gradually. MCAC/MTC should introduce an N-ISDN after the year 1998 to offer ISDN services in major 3 cities in order to achieve the target on ISDN. The N-ISDN will be expanded gradually to provide such services to all district capitals. Figure 7-5-4 shows a network integration steps to N-ISDN.

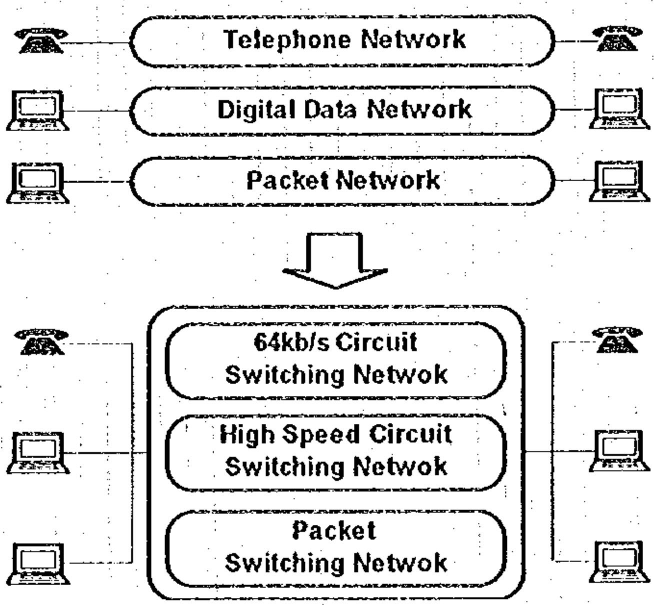


Figure 7-5-4 Network Integration Steps to N-ISDN

5.4.2 Essential Technologies for ISDN

The essential technologies to establish an integrated services digital network are digital exchange, Signaling System No.7.

MCAC/MTC is going to purchase digital exchanges equipped with integrated services digital network user part (ISUP) of Signaling System No. 7 through the on-going projects in Ulaanbaatar. The ISUP being introduced is intended to offer telephonic services by the standard specifications defined by CCITT Blue books. Study team recommends MCAC/MTC to adopt the standard specifications by CCITT through variations are provided by manufacturers.

5.4.3 ISDN Expansion

This Basic Plan suggests that a digital exchange with ISDN function be introduced in Ulaanbaatar by the year 2005. Introduction of another small size ISDN exchange is planned to another major cities after the year 2005. ISDN Center in Ulaanbaatar shall offer services in Ulaanbaatar and major cities. Figure 7-5-5 shows a proposed ISDN network for Mongolia in 2010. Since the ISDN service is the first time in Mongolia telecommunications service history, the ISDN Center size and its traffic routing should be reviewed on the occasion of purchase and even after introduction.

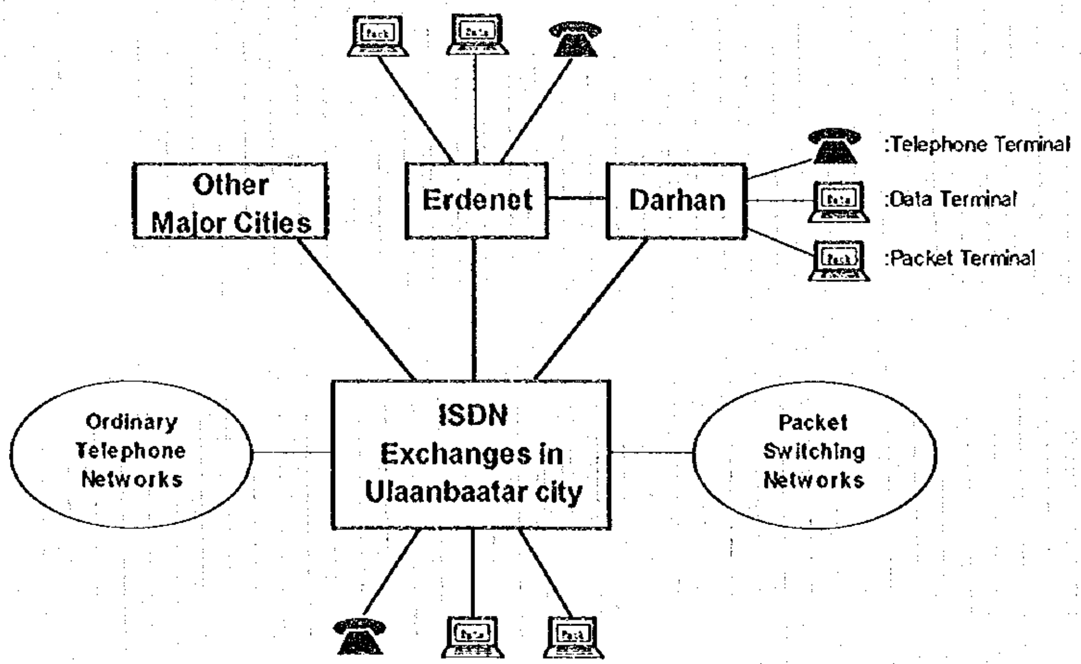


Figure 7-5-5 Proposed ISDN Network for MCAC in 2010

5.4.4 ISDN Interface and Service Features

The ISDN to be introduced should have, as ISDN user network interface, the Basic Access Interface of 2B+D and Primary Rate Access Interface of 30B+D, which are in conformity with CCITT Recommendations. The ISDN should have also ISDN Network Node Interface including X.75 for Packet Switched Data Network and Signaling System No.7 ISDN User Part (ISUP) for Common Channel Signaling Network. Volume V Chapter 5.3 shows examples of circuit switched call connection, B-channel Packet Call connection, and D-channel Packet Call connection, respectively, which may be realized by the ISDN suggested in this Basic Plan.

CCITT Recommendations define three (3) types of ISDN services, that is, Bearer services, Teleservices and Supplementary services. The Bearer services provide the means to convey information between users. Teleservices combine the transportation and the information processing functions, employing bearer service. The supplementary service may be used with one or more of the bearer or teleservices to enhance services.

Bearer services include;

- Circuit mode 64 Kbps voice bearer service;
  A service suitable for speech information;
- Circuit mode 64 Kbps unrestricted bearer service;
  A service suitable for telephone, facsimile of Group 4 and video telephone;
- Circuit mode 64 Kbps 3.1 KHz Audio bearer service;
  A service providing the transfer of speech and 3.1 KHz bandwidth information such as voice-band data via modems and facsimile G2/G3.
- Packet mode (Virtual circuit);
  A service providing the unrestricted transfer of user information in the packet mode over virtual circuit.

Teleservices include;

- Telephone call
- Telex
- Facsimile
- Videotex

Supplementary services include;

- Direct Inward Dialing (PBX-DID);
  A service which enables direct calling from a user to another user on a PBX without the assistance of attendant;
- Multiple/subscriber Number;
  A service which assigns multiple ISDN Numbers to a single subscriber line;
- Calling Line Identification Presentation;
  A service which restricts presentation of the calling party's ISDN number, possibly along with the sub-address;
- Calling Line Identification Restriction;
  A service which restricts presentation of the calling party's ISDN Number and sub-address;
- Malicious Call Trace;
  A service which traces a malicious call to the source;
- Sub addressing;
  A service which addresses a particular terminal on an ISDN Number by using; 20-digit identification number (sub-address) in addition to the ISDN Number;
- Call Forwarding Busy Line;
  A service which forwards calls for an ISDN Number to the pre-registered directory number when the called Number is busy.
- Call Forwarding Don't Answer (Call Forwarding No Reply);
  A service which forwards calls for an ISDN Number to the pre-registered directory number when the call meets no reply at the ISDN Number;
- Call Forwarding Unconditional;
  A service which forwards all calls for an ISDN Number to the pre-registered directory number regardless of the condition of the called terminal;
- Call Waiting;
  A service which audibly notifies a user that another call is incoming while the user is already active on a call. Then the user can answer the incoming call by "hook flash", placing the outgoing call on hold;
- Three-way Calling (Three Party service);
  A service which enables a three-way conversation without assistance of attendant. That is, the user who is already active on a call holds that call, makes an additional call to a third party, and then joins the two calls together into a three-way call;

- Closed User Group (CUG);

  A service which enables users to form groups, to and from which access may be restricted. Three types of CUG services are available;

  Closed User Group (CUG), which permits intra-group communications. Outgoing/incoming calls to/from the group are restricted.

  CUG with Outgoing Access, which permits outgoing access to the group and restricts incoming access to the group. User terminals can individually be registered for this service.

- User-to-User Signaling;

  A service which allows a user to send/receive information to/from another ISDN user over the signaling channel.

6. Transmission System and Its Facilities Plan

Transmission network in Mongolia is categorized into 3 types by system, i.e. , National backbone, International, and Ulaanbaatar junction networks. Based on the results of the traffic and circuit calculations up to 2010, the facility expansion plans are prepared up as described in the following paragraph. In these plans, an attention has been focused on digitalization of the existing radio transmission system.

Recently, Synchronous Digital Hierarchy (SDH) technology has been standardized by ITU and has been popular instead of conventional Plesochrous Digital Hierarchy (PDH) technology. By applying SDH system, the international telecommunications network can be easily connected each other.

Table 7-6-1 shows the type, bit rate and number of channels for SDH.

Table 7-6-1 Hierarchy of SDH

Type	Bit Rate	No of Channels
STM-0	51.84 Mbps	672 Ch
STM-1	155.52 Mbps	2016 Ch
STM-4	622.08 Mbps	8064 Ch
STM-16	2488.32 Mbps	32256 Ch

STM : Synchronous Transport Module

The adoption of SDH technology has the following advantages:

(1) World-wide standardized network node interface.
(2) Multi-media and ISDN services.
(3) Enhanced O&M capability and high performance network.

At present, SDH equipment is still more expensive than PDH one. However, many countries have already introduced SDH system, and it is no doubt that SDH is dominant system in near future. Considering the recent tendency of technical innovation, the adoption of the latest SDH technology for this basic plan will be reasonable.

6.1 National Backbone System

Since the facilities of the existing backbone network are considerably obsolete and the transmission capacity is insufficient in order to carry the increasing demand, it is seriously required to install a new backbone system immediately. The exiting backbone network is illustrated in Figures 4-6-3 and 7-6-1.

The installation works of a backbone system should be carried out in accordance with Basic Plan and keeping pace with progress of installation schedule with the both projects of outside plant and switching equipment.

This Basic Plan covers the network expansion plan in the Ulaanbaatar administrative area, and the capacity of the backbone system has to be expanded to carry the increasing traffic in the city. The required transmission types of SDH system are in Table 7-6-2.

Table 7-6-2 New Digital Radio Link until 2010

No.	Radio Section	Inst. Year	Capacity
1	Ulaanbaatar (ATC-5) - 3K	1999	M/W STM-1
2	3K - Nalaih	1999	M/W STM-0
3	Ulaanbaatar (ATC-5) - MV-294	1999	M/W STM-1
4	MV-204 - Bagahangai	1999	M/W STM-0
5	3K - MV-204	2002	M/W STM-1
6	MV-204 - Baganuur	2002	M/W STM-0

As for the digitalization of the national backbone network, the existing network will be digitized by 2002 and all Aimags will have been connected by digital radio links by 2010.

6.2 International Transmission System

The international communication services in Mongolia started with Russian and China. Since the introduction of INTELSAT terminal in Naran station in 1993, direct access to UK, Japan, Singapore, Hongkong, China and Korea has become possible. The configuration of the Naran satellite station is shown in Figure 7-6-2. Required number of international circuits is summarized in Table 7-6-3.

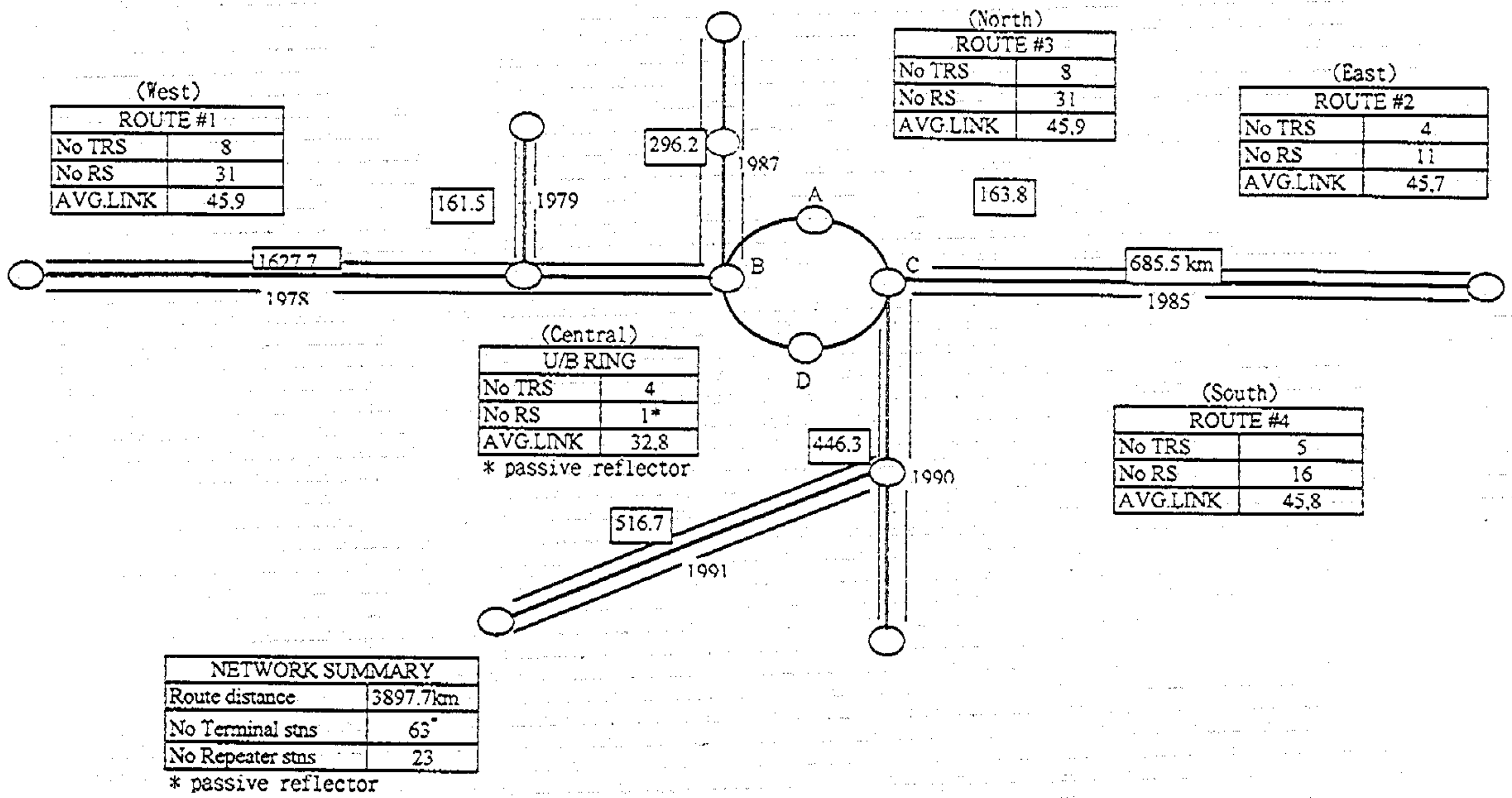


Figure 7-6-1 The Existing Backbone Network

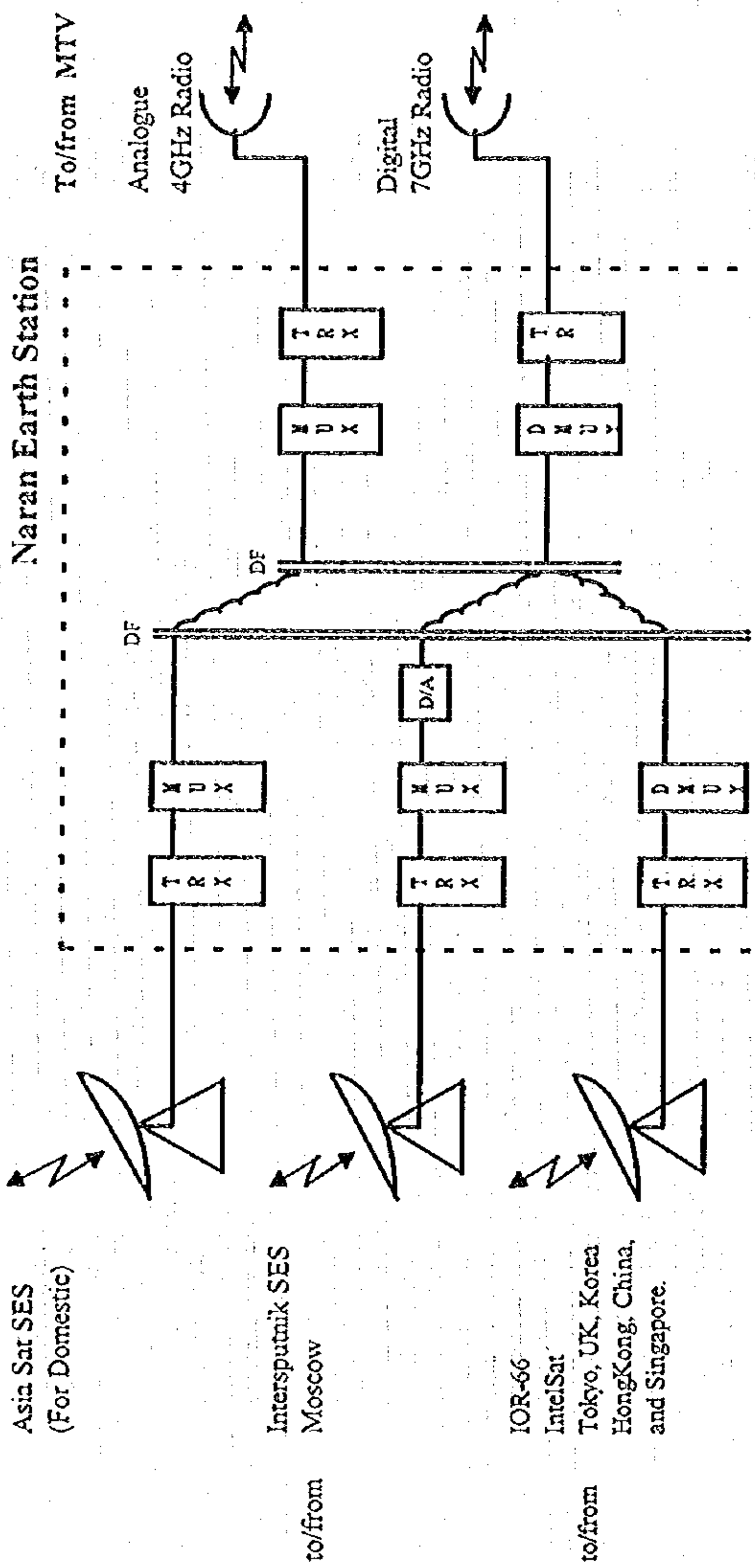


Figure 7-6-2 Satellite System Configuration in Naran Station

Table 7-6-3 Number of International Circuits

(Unit : Ch)

Type of Circuit	Y 2000	Y 2005	Y 2010
I.C. Circuit	216	359	629
O.G. Circuit	131	208	351
Total	347	567	980

6.3 Ulaanbaatar City Network

6.3.1 Ulaanbaatar Junction Network

The junction network in Ulaanbaatar city consisting of optical fiber system will be expanded to cope with increasing demand and traffic between the digital exchanges.
For application of SDH fiber optic cable system to the basic plan, there are two physical link structures , i.e. Ring structure and Point to point structure to be employed. High route security of SHD system is achieved at its best in case of the Ring route configuration.

According to the Basic plan, Ulaanbaatar Junction network is scheduled to complete the SDH Ring configuration by 2005., and final Ring configuration is shown in Figure 7-6-3.

Table 7-6-4 shows transmission capacities in Ulaanbaatar SDH Ring Structure.

Table 7-6-4 Transmission Capacity Types in Ulaanbaatar Junction Network

No.	Optical Fiber Section	Installation Year	Transmission Capacity Type	
1	ATC-5 ~ ATC-7	1999	STM-4 x 1	-
2	ATC-7 ~ ATC-6	1999	STM-4 x 1	-
3	ATC-6 ~ ATC-2	2001	STM-4 x 1	-
4	ATC-2 ~ ATC-3	2001	STM-4 x 1	-
5	ATC-3 ~ ATC-4	2005	STM-4 x 1	-
6	ATC-4 ~ ATC-5	2005	STM-4 x 1	-

Introduction of a microwave system in Ulaanbaatar junction network is conceivable.

However, a number of high (10 m or more storied) building have been, or are being, constructed in Ulaanbaatar city and there is a fear that construction of an antenna tower having sufficient height for radio path will be difficult. Therefore, the adoption of the optical fiber cable system is preferable in the central part of Ulaanbaatar city.

6.3.2 Digital Radio Concentration System

In order to improve the poor telephone services in Ulaanbaatar city including Ger area, the following 3 types of subscriber access systems are considered to be effective and efficient:

- Metallic cable network.
- Cellular system.
- Digital radio concentration system (DRCS).

It is generally difficult to say which method is the best for subscriber access system, as they all have merits and demerits.

However, the DRCS system project was selected as one of the Feasibility Study Projects, because DRCS system will be in a better position to other methods in some part area of Ulaanbaatar city. Further study and detail explanations of the DRCS system are made in Feasibility Study Report of the Volume III. Chapter 3 in this report.

The typical DRCS system configuration is illustrated in Figure 7-6-4.

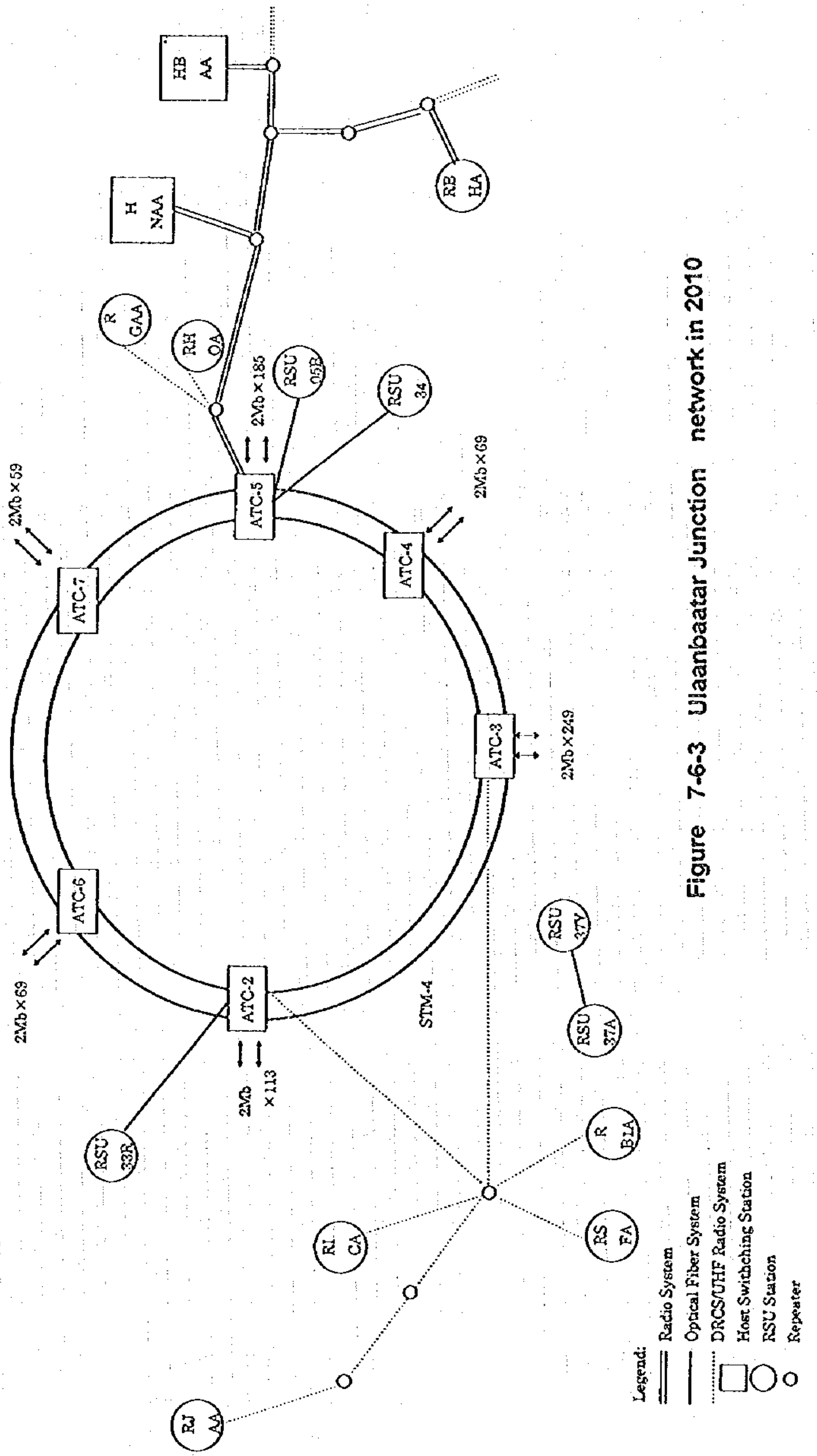


Figure 7-6-3 Ulaanbaatar Junction network in 2010

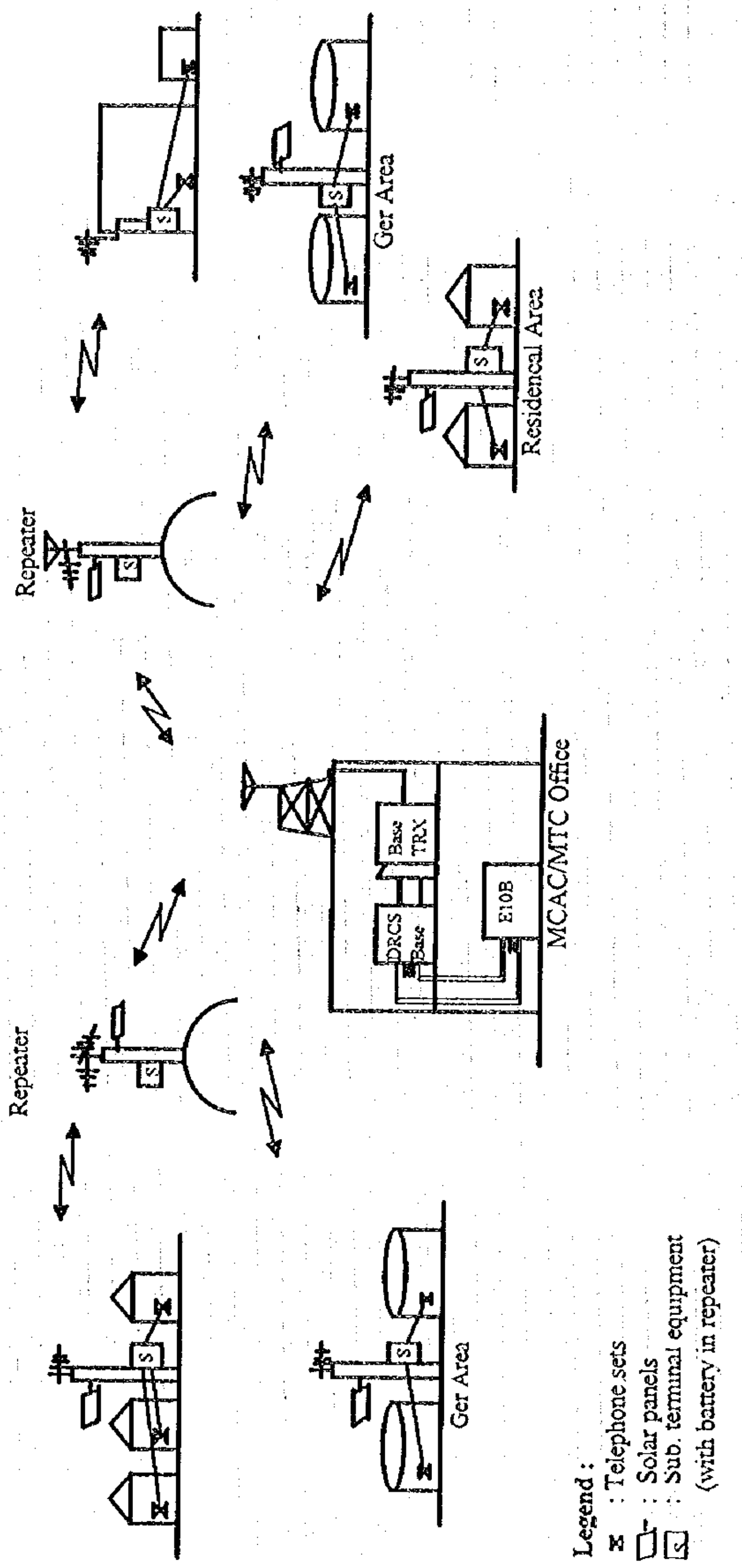


Figure 7-6-4 DRCS System Configuration

6.4 Frequency Allocation Plan

Radio frequencies are limited resources of the world and, pertaining to their allocation, regulations have been established by ITU/ITU-R. In most countries, frequency allocations is controlled by governmental organizations, in accordance with these regulations.

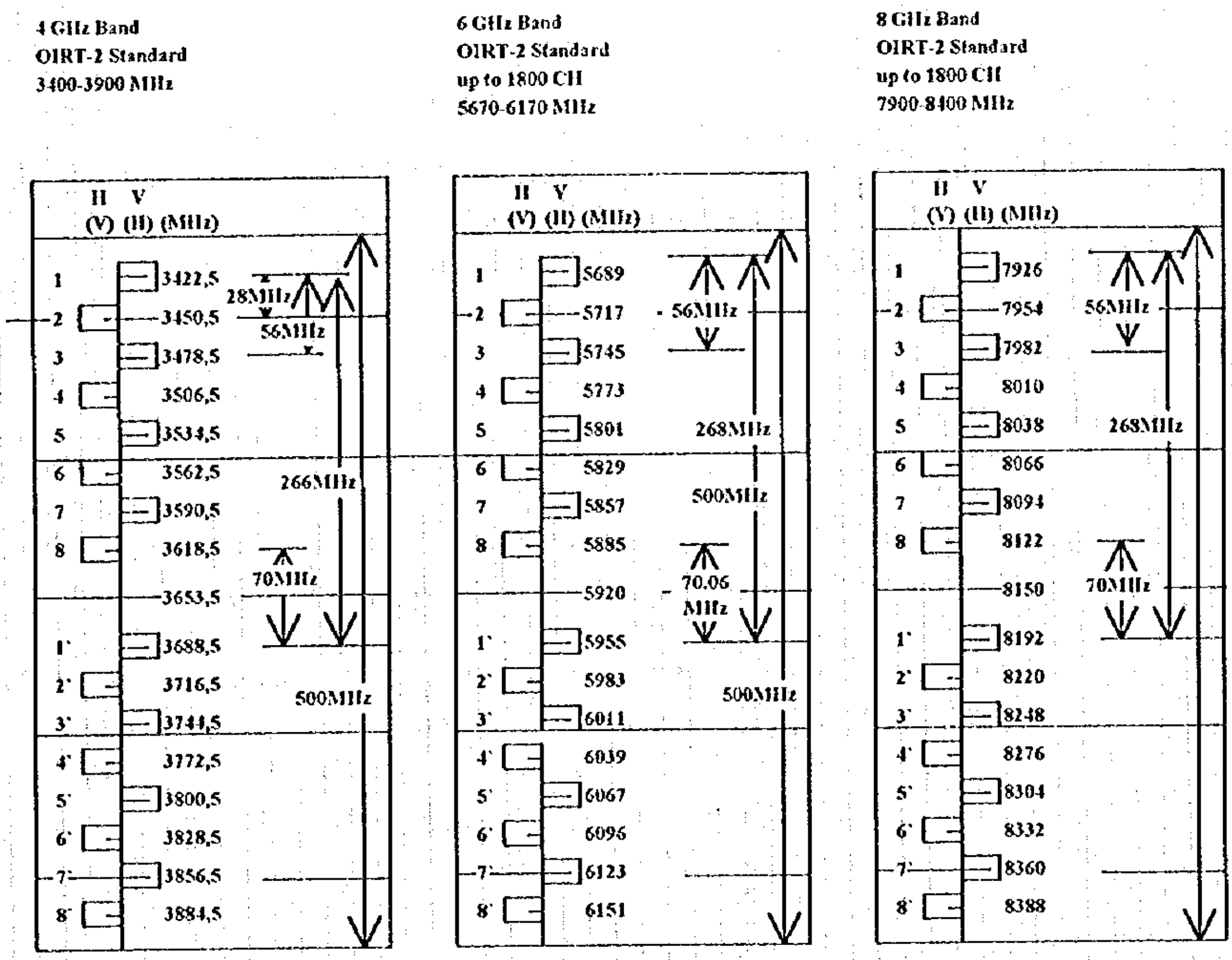
In Mongolia, the frequency allocation was introduced through the former USSR, together with the introduction of radio equipment. This plan is in compliance with the ITU/CCITT-R regulations but generally adopted only in communist countries. Figure 7-6-5 presents the current frequency allocation.

In view of the expansion of international communications with countries over the world in coming years, the plan should preferably be changed to universally acceptable one in consideration of the following, though the current plan itself has no problem.

- Higher frequency can carry larger traffic, while the propagation loss is bigger. and the radio path length can be shorter.
- Lower frequency has less capacity, but the loss is smaller, so that the radio path distance can be longer (number of stations can be reduced).

Therefore, 4~7 Hz frequency bands are preferable to be adopted for main backbone systems, and VHF and UHF bands are to be adopted for spur and rural systems which required smaller capacity. In the ADB project now being executed , the radio links for main route are established over 6 G Hz frequency band.

For frequency allocation principle, the further study which is formulated "Mongolia Standard Procedure" will be required.



Plan No.1 Plan No.3
CH 1:3422.5MHz CH 1:3688.5MHz
CH 3:3478.5MHz CH 3:3744.5MHz
CH 5:3534.5MHz CH 5:3800.5MHz
CH 7:3590.5MHz CH 7:3856.5MHz

Plan No.1 Plan No.3
CH 2:3450.5MHz CH 2:3716.5MHz
CH 4:3506.5MHz CH 4:3772.5MHz
CH 6:3562.5MHz CH 6:3828.5MHz
CH 8:3618.5MHz CH 8:3884.5MHz

Plan No.1
CH 1:5689MHz
CH 3:5745MHz
CH 5:5801MHz
CH 7:5857MHz

Plan No.1
CH 2:5955MHz
CH 4:6011MHz
CH 6:6067MHz
CH 8:6013MHz

Plan No.1
CH 1:7926MHz
CH 2:7982MHz
CH 3:8038MHz
CH 4:8094MHz

Plan No.1
CH 1:8122MHz
CH 2:8178MHz
CH 3:8324MHz
CH 4:8290MHz

Figure 7-6-5 The Existing Frequency Allocation Plan

7. Outside Plant and Its Facility Plan

In order to assess the subscriber's loop conditions accurately, survey visits were made to all of ATCs in Ulaanbaatar city and remote districts which are designated in this study.

As the result of the survey, the rehabilitation and expansion of the subscriber access network in this Basic Plan are designed taking into account the following;

7.1 Take-off from The Deteriorated Existing Cable Network

The existing cable network are comprised of paper-insulated lead-sheathed cables and cross-connection cabinets which have been introduced for many years from Russian technique.

In recent years, China-made plastic cables are seen to be introduced gradually. But still large portion of the existing cables are predominantly paper-insulated lead-sheathed cables. These cables and cross-connection cabinets have been badly deteriorated due mainly to the lack of appropriate maintenance practice and inappropriate method of repair for many years.

Statistics show that the number of faults per 100 lines per month as of August 1995 stands at an average 39%, varying from 11.2% to 78% by ATCs, and of the total faults within the period, the percent of faults in the cables stands at nearly 70% in Ulaanbaatar city. In addition, a pair checking made in Ulaanbaatar on 30 cross-connection cabinets fed by 3,000 primary pairs shows a rate of 8.2% of faulty pairs and an occupation rate of 61.3% in primary cables.

- 246 faulty pairs
- about 500 pairs in unspecified status
- 1,839 occupied by customer lines

According to the PIU optimization plan, the rates of the faulty cables concerning primary cables by ATCs are as a whole assumed to be as follows:

ATC-32	45%
ATC-33	80%
ATC-34	50%
ATC-35	30%
ATC-36	20%
ATC-37	50%
ATC-38	20%

The local loop has a significant affect on overall network quality. Generally saying, the modern network should be simple in design, reliable, and within transmission design parameters of the digital switch.

It is clear that digital switches generally are less tolerant of poor local line standards than are electromagnetic switches. Therefore, it is necessary to determine and improve the quality of the existing network before a digital switch is installed or further expanded in order to ensure that the customer will continue to receive service after changeover.

The on-going projects being funded by ADB, etc., for outside plant network expansion and rehabilitation up to year 2000 stated as follows;

* The urgent program will initially focus on outside plant in Ulaanbaatar.
* To replace some of the obsolete outside plant in Ulaanbaatar.
* To expand outside plant lines in Ulaanbaatar.

The scope of the above mentioned projects is summarized below;

* The main aim of the project is to rehabilitate key parts of the network in Ulaanbaatar and to re-balance the network by bringing outside plant capacity closer to a level that is technically consistent with existing and planned digital switching capacity.
In addition, the project will enable a modest expansion telephone lines.
* In Ulaanbaatar, 43,400 outside plant lines (MDF pairs) will be installed.
About 21,360 of these outside plant lines will replace obsolete cables and about 22,040 will expand outside plant capacity.
After the implementation of this component, about 38,800 obsolete outside plant lines will remain.
* Spare parts and tools for emergency maintenance of the outside plant network will be procured and utilized.

The major milestones in the PIU's forecast implementation schedule are shown in table 7.7.1

Table 7-7-1 ADB's Implementation Schedule

Year	Contents
1996	* First priority installation of 16,800 OSP lines in three ATC's in Ulaanbaatar. 5,000 lines in ATC 33, of which 2,800 are replacement and 2,200 expansion: 3,400 lines in ATC 38, of which 600 are replacement and 2,800 are expansion: and 8,400 lines in ATC 36, of which 3,900 are replacement and 4,500 expansion * Utilization of emergency spare parts for OSP maintenance in Ulaanbaatar.
1997	*Installation of OSP 26,600 lines in Ulaanbaatar, of which 14,060 are replacement and 12,540 expansion.

In ADB project, the primary cable system is not rehabilitated so much, but the fault cables only are to be replaced. In short, it is planned to replace around 37% of existing lead-sheathed or damaged cables as well as around 34% of cross-connection cabinets. But this still remain insufficient and therefore after completion of ADB project, it should be planned to replace persistently the remaining deteriorated cables, cross-connection cabinets and other defective facilities.

In line with the replacement of these deteriorated facilities, new type of cable or jelly-filled cable which is nothing but maintenance free, and its related improved splicing method should be employed.

7.2 Meet of The Telephone Demand in Local Loop Capacity

The expansion of local loop network tends to be delayed due to the shortage of funds and materials against the expansion of the telephone demand which arise from residents of apartments and ever expanding gers. For that reason, the quantitative imbalances between local loop capacity and telephone demand are found at many ATC areas and therefore the effort has to be made not only to meet the telephone demand but also not to make further imbalances in future. (Refer to Volume V, Chapter 1, page 1-3)

Based on ADB program, the switching capacity, MDF pairs and demand in Ulaanbaatar at the end of 1997 is forecast to be shown in Table 7-7-2.

Table 7-7-2 Switching capacity, MDF pairs and Demand

As of end of 1997

Name of ATC	Switching Capacity	MDF Pairs	Demand	Waiting List
ATC 3	14,336	23,400	21,276	7,144
ATC 5	8,024	16,100	11,995	3,855
ATC 33	4,864	5,000	4,941	0
ATC 34	3,328	6,300	5,042	1,191
ATC 36	11,000	19,800	16,179	5,382
ATC 37	1,024	2,400	1,502	1,191
ATC 38	4,608	7,800	6,613	1,974
ATC 73	0	1,400	4,718	
Total	47,184	82,200	72,266	19,764

7.3 Introduction of the Latest and Economical Network System

In recent years, the various systems for the application of optical fiber system and radio system to subscriber access network have been researched, developed and introduced in many countries.

Mongolia has already adopted the optical fiber cables as a junction circuits which link RSUs to ATC32 in Ulaanbaatar city. But taking a look at other sections between Ulaanbaatar city and remote districts, there are no optical fiber cable links. These sections are still relying on the outdated open wire systems that are highly vulnerable to the weather condition, environment and other disturbance.

These new systems should be employed not only for the reason of economic aspects but also for the improvement of the services available or to catch up with the new services like ISDN, or PHS (Personal Handy-phone System) and the like. It is important to select the most appropriate system(s) to the demands and requirements in consideration of the future trends.

7.4 Optical Fiber Subscriber Line Network

7.4.1 General

Optical fiber cables are being introduced to the subscriber network in various developed countries mainly to urban areas keeping step with the introduction of multiplex transmission systems (CT/RT : central terminal/remote terminal)which provide telephones ISDN services, etc.

In order to meet future demand for various telecommunications services in Mongolia, it will be necessary to introduce optical fiber cables to the subscriber network positively and efficiency restructuring it to higher level.

Subscriber cables can be used for over 10 years. It is the chance to introduce optical fiber subscriber network when the existing cables are deteriorated.

Optical fiber cables (single mode fiber) are capable of transmitting more than 1,000 times of signals than metallic cables. Existing metallic subscriber cables can transmit only some 100 kb/s, but optical fiber ones have the capacity of Mb/s to Gb/s. Then, if optical fiber cables are installed from exchanges to subscribers, the network can meet any demand for telecommunications services in the future by changing transmission equipment only without replacing outside plant system.

The distribution method for optical fiber subscriber system is as follows:
Introduction of optical fiber cables to the subscriber network is actively going on mainly in North America, Europe and Japan. They aim at, by the middle of 21st century, installing optical fiber cables not only to offices but also to each home, and providing multimedia telecommunication services.

In these countries, such systems as mentioned below are already provided partially. They are provision of telephone service through multiplex transmission system, provision of video distributing service like CATV and telecommunication service simultaneously through optical fiber cable to homes, etc. Such application of optical fiber cables from exchanges to homes is called FTTH (fiber to the home). FTTH is the ultimate network using optical fiber cables. On the way to that ultimate network, there are FTTO (fiber to the office) and FTTZ (fiber to the zone).

Figure 7-7-1 shows deployment process for fiber optic system.
Figure 7-7-2 shows optical fiber subscriber network configuration.
Figure 7-7-3 shows RT system application.

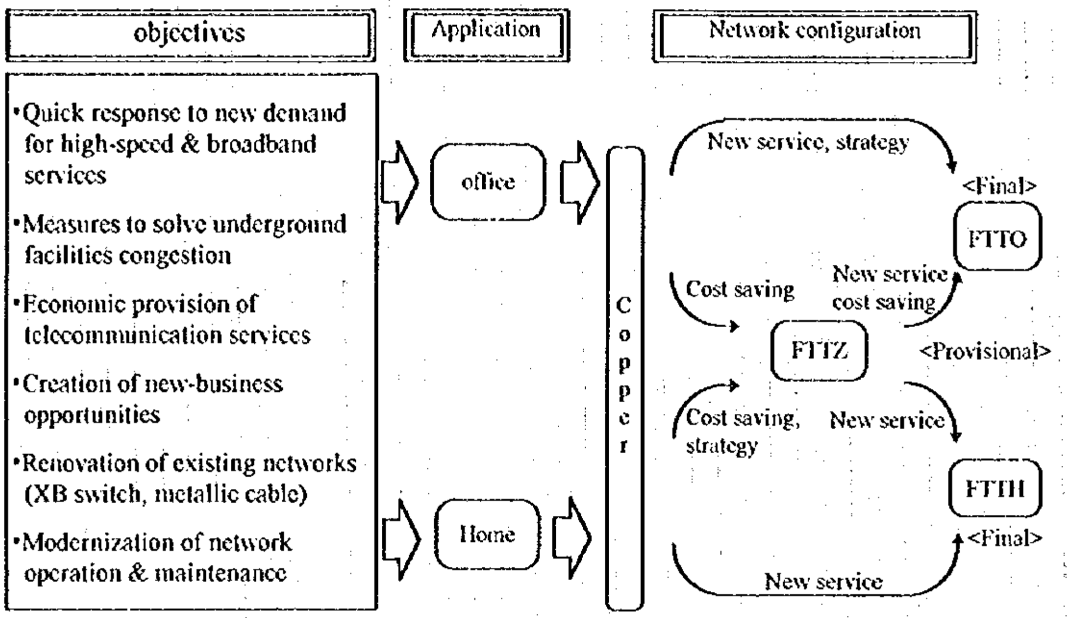


Figure 7-7-1 Development Process for Fiber Optic System

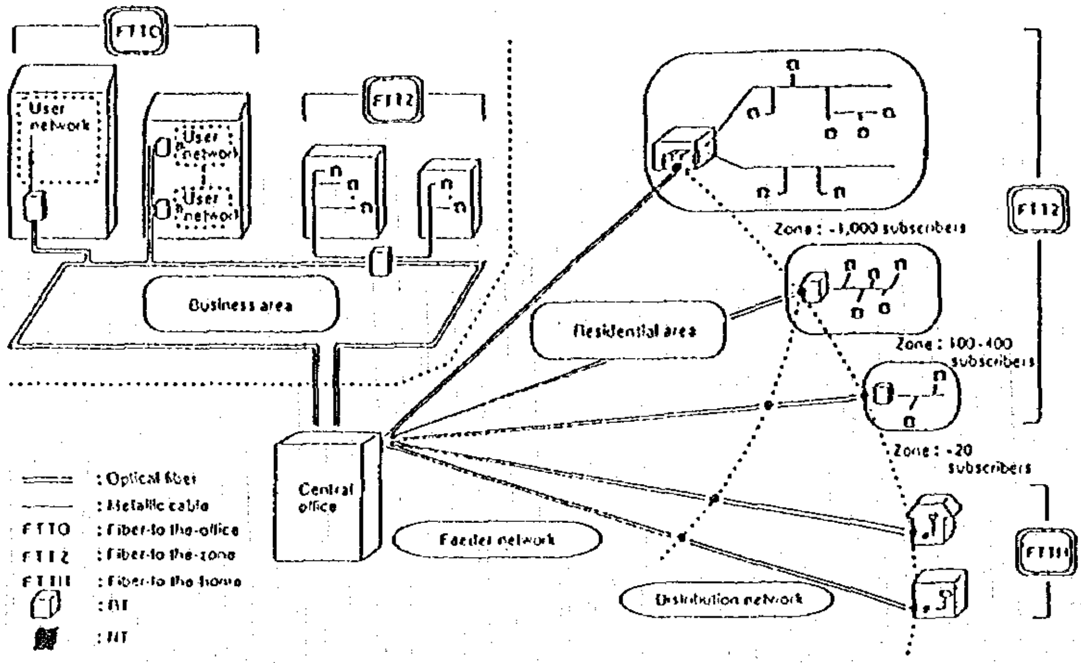


Figure 7-7-2 Optical Fiber Subscriber Network Configuration

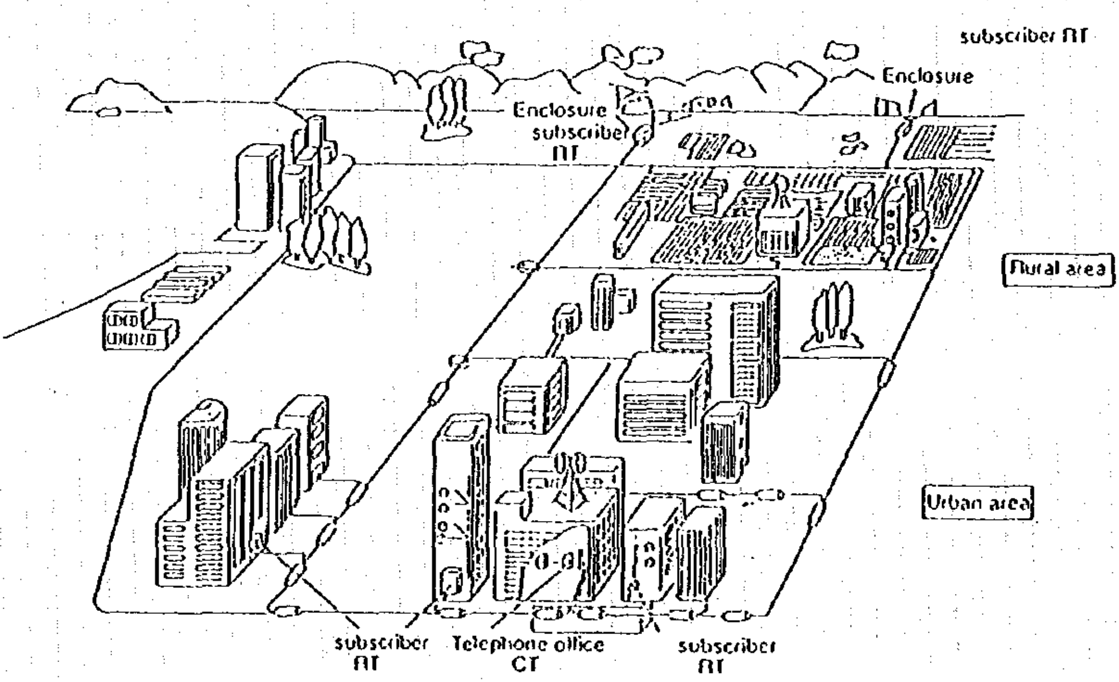


Figure 7-7-3 RT System Application

7.4.2 Steps of introducing optical fiber subscriber network to Ulaanbaatar

At present, no optical fiber cable has not been introduced yet to the subscriber network in Mongolia. Now is the best chance to introduce optical fiber cables to subscriber network when old existing metallic cables have to be replaced because of their obsoleteness. This should be the first step.

(1) Business area

It is appropriate to introduce optical fiber subscriber network in the type of FTTO (fiber to the office) for the business area and the governmental organizations taking into consideration the following:

a) flexibility for the future high speed and broad band service demand in the business field;

b) countermeasures against underground duct condition and deteriorated existing metallic cables.

(2) Other than business area

In these areas, telephone demand will be mainly of apartments and gers. At present we do not see any services which require optical fiber cables in the near future. FTTZ (fiber to the zone) will be available where economically feasible. In this system, metallic cables will be used from optical fiber cable terminals to subscribers.

7.4.3 Application of CT/RT(Central Terminal/Remote Terminal) System

Application of CT/RT system with optical fiber cable could be considered instead of deteriorated primary cable rehabilitation. This system is able to meet flexibly demand increase/change, and as the cost of remote interfacing equipment, standardized transmission equipment and supporting system is decreasing rapidly, it will be profitable to utilize the system.

Technical and economic advantage of the system is as follows:

a) CT/RT system can cope with demand increase/change more flexibly without major modification of basic facilities.

b) CT/RT system is more feasible for the demand in remote areas from the exchange. It is more effective for the urban areas where ducts are fully used and not available.

7.5 Introduction of OSP Facility Management System

Assessment of the maintenance operational performance can not be accurately judged because of the critical shortage of the materials and the staff for repairing the cable faults. The operation practice is seen on a subsistence level.

All the ATC's operations are in some ways affected by the company's inability to meet the operation and maintenance requirements.

For the latest few years, MTC has been surviving on the existing stocks for maintenance which are now on the point of exhaustion.

There is a danger that with MTC, having severe difficulties in supporting the operation and maintenance, the network will deteriorate toward the point of collapse. To avert this, the support of the current operation and maintenance practice by using computerized OSP facility management system is required as a matter of urgency if the network is to remain in an operational condition, sufficient to form the basic network for the modernisation and expansion programme.

The so called Computerized OSP Facility Management System in general comprises the following systems as a whole;

(1) Demand forecast system

(2) Telecommunications facility design system

(3) information control system (Plant record, Facility data, etc.)

The recent progress in computer technologies have achieved an amazing increase in data processing speed and data storage volume.

Due to such technology innovation, this system has accomplished integrated control of geographical and facility information data. Also the progress in software development technology has contributed to this system by enabling an advanced man-machine interface.

Figure 7.7.4 shows the concept of OSP facility management system.

It is preferable that the computerized OSP facility management system shall be housed in the Outside Plant Maintenance Center(OPMC) reflecting man-power.

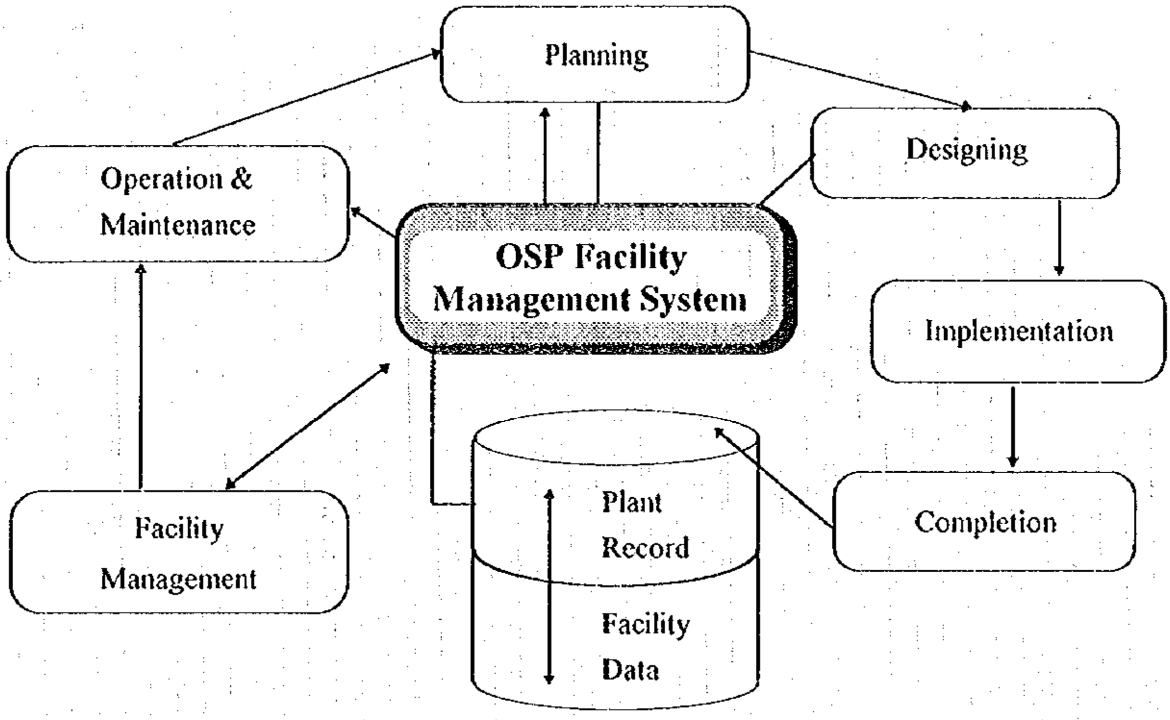


Figure 7-7-4 Concept of OSP Facility Management System

7.6 Installation of OPMC(Outside Plant Maintenance Center)

7.6.1 Necessity of OPMC

It is recommended that so called OPMC should be set up in place inside Ulaanbaatar, which is expected to deal with collectively a series of the maintenance practices and methods as a way of improving the outside plant systems and cable networks as well as training program at one organization.

It should be noted that OPMCs have so far been introduced in some Asian countries with the aid of Japan.

The set-up of the OPMC should be considered as a matter of importance..

Figure 7-7-5 shows the concept of OPMC.

7.6.2 Benefits from Introducing OPMC

By utilizing the cost effective OPMC system, MCAC/MTC can both lower its fault rate and enhance the customer services. The following are benefits that can be derived from the introducing OPMC.

(1) Improvement of the Working Environment

(i) Improvement of the Working Environment

(a) Better Analysis of Data and More Effective Maintenance Action
Centralization provides for effective data analysis; computers can quickly analyze the data and prepare the maintenance programs.

(b) Shorter Preparation
Time Having all the required materials available at one work site reduces preparation time and enables more efficient maintenance work.

(c) Better Safety Control
With OPMC, it is easier to teach safe maintenance methods and provide training in the use of related tools and equipment. OPMC also makes it easier to monitor old equipment and facilities.

(d) Efficient Training
OPMC enables employees and equipment to be placed in a central location, which facilitates the dissemination of new methods and technologies and the carrying out of on-the-job training.

(e) Raising Morale
OPMC raises employee morale and gives employees a sense of responsibility by providing them with effective facilities and new technologies to work with. This kind of employee productivity can not be expressed in figures alone.

(ii) Large-scale Repair Work and Construction
Centralization increases available manpower, allowing large maintenance teams to be assembled quickly to perform large-scale repair work or to construct outside plants.

Such large-scale repair and construction work provides employees with on-the-job training and opportunities to use new technologies and the latest equipment.

(2) Results Obtainable through OPMC

Through OPMC implementation, (i) increased revenue can be obtained by reducing downtime and fault claims will decrease, and (ii) manpower will be saved by lowering the fault rate and raising productivity.

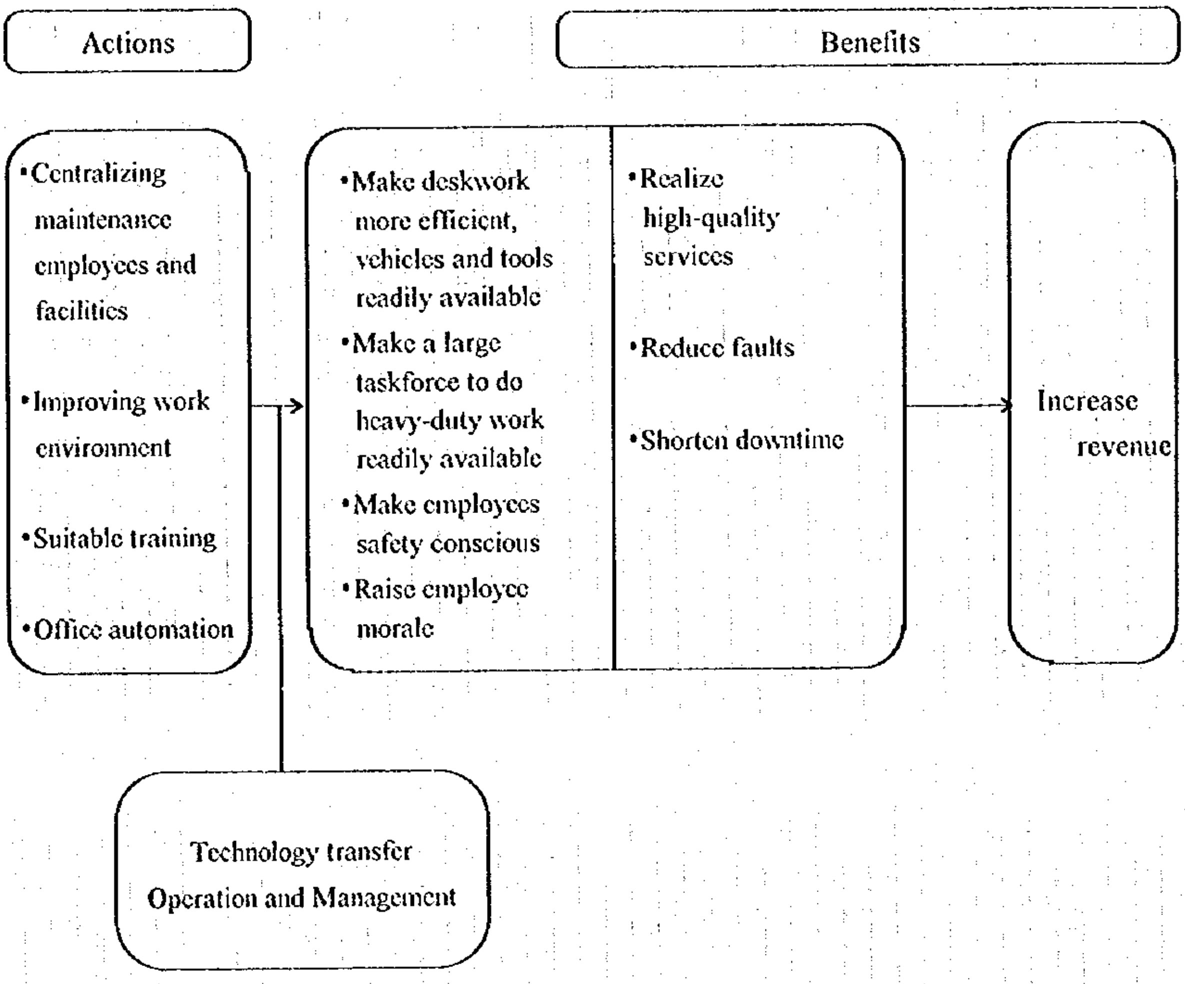


Figure 7.7.5 Concept of OPMC

8. Governmental Network Plan

8.1 General

The Governmental Network is operated by the Communication Office of the Government. The Network includes ministerial buildings, guest house, and other public organization buildings in Ulaanbaatar city as well as the governmental offices situated in Aimags of whole Mongolia. The exchanges, installed in 1973, made in East Germany, are old and obsolete with few spare parts. Its outside plants are also old and obsolete. Operation of the network has many problems and difficulties.

In keeping with the global tendency, the usage of computers are growing in various central and province governmental organizations including the offices of Mongolian President, Mongolian Parliament and Prime minister. During these years, computerized systems using LANs have been introduced in a few ministerial and other governmental organizations.

At the same time, those LANs and expecting ones are becoming more complex, with increasingly complex of differences of the hardware platform, operating systems and protocols in connection with their compatibility. Putting together a network strategy and satisfying growing needs of exchange, large amount of information between those organizations as well as information exchange confidentiality are essential. Organizing governmental data network using advanced technology will bring success of these tasks.

In this connection, the Governmental Network has to have large scale data processing capability in future. In this Basic Plan, as the first step, it is designed to introduce ISDN exchange which has capability of data processing.

8.2 Concept of Network Rehabilitation

It is assumed that the telephone traffic will not have much change as it is now, while data traffic will increase as the number of terminals increase.

8.3 Contents of Network Rehabilitation

(1) The existing exchange in ATC-65, which is the center of this network, will be replaced with a new exchange enabling to introduce ISDN (ISDN exchange).

(2) Cables between the new exchange and other governmental building terminals will be new jelly-filled plastic cables. Old cables connecting the old exchange and governmental building terminals will be removed.

(3) The new PBX of the guest house at Ih Tenger will be connected to the new exchange in ATC-65 by optical fiber cables.

(4) Terminals of each governmental building will include terminal equipment for ISDN as well as ordinary telephone sets, facsimile machines and personal computers.

(5) The ISDN exchange will be connected to governmental offices in Aimags by dedicated circuits owned by MCAC. (The costs of dedicated circuits are not included in this project.)

(6) In order to access to MCAC network, ATC-65 will be connected ATC-3. These circuits will be optical fiber cables which will be supplied by MCAC.

8.3 Network Configuration

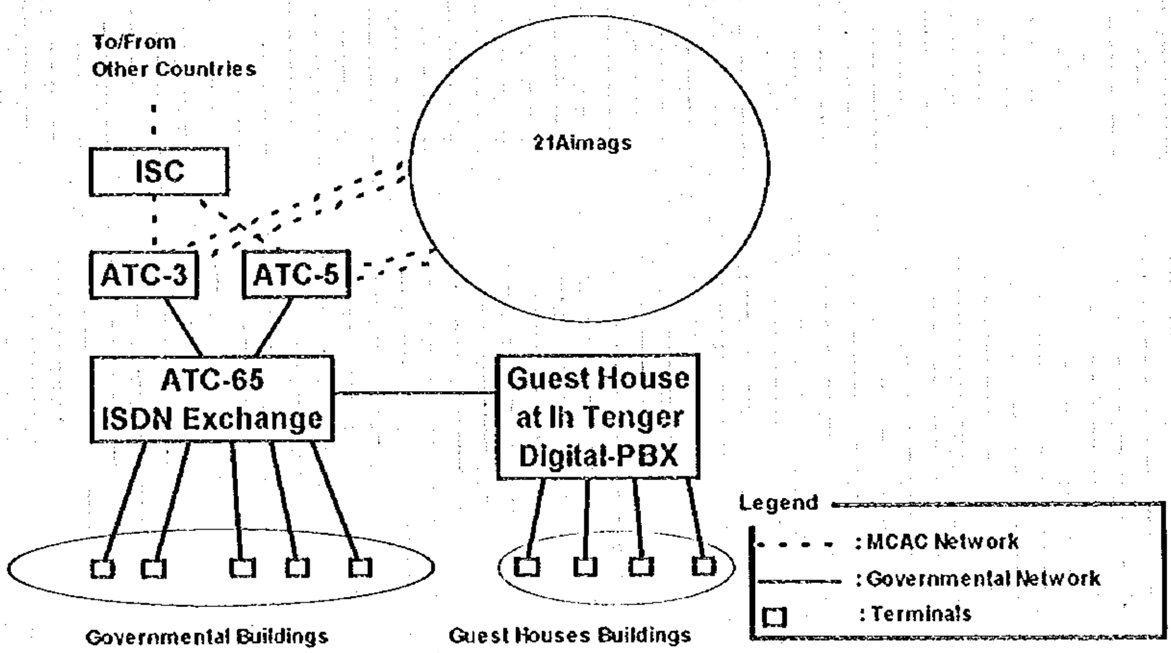


Figure 7-8-1 Network Configuration of Governmental Network

Table 7-8-1 Network Components

Network Component		Quantity
Item	Specification	
ISDN Exchange	Digital exchange with capacity of 1,400 installed in ATC-65	1
PBX exchange	Digital exchange with capacity of 200 installed at the Guest House (Ih Tenger)	1
Outside Plant	Rehabilitation of cables between ATC-65 and governmental buildings in the central part of Ulaanbaatar city	3,200
Optical Fiber Cables and MUX	Capacity of 8Mbps. Installed between ATC-65 and the Guest House (Ih Tenger). Capacity of 16Mbps, installed ATC-65 and ATC-3. Optical Fiber Cables and MUX has multiplied for ordinary and emergency use, respectively.	2
Digital Terminals	Digital Telephone,	1,600
	G4-Facsimile,	30
	Personal Computer (include Camera),	15
	Computer Terminal,	65
	Network Terminal	1,600

CHAPTER 8

PROJECT IMPLEMENTATION PLAN

CHAPTER 8

PROJECT IMPLEMENTATION PLAN

1. Concept for Project Formation and Cost Estimation

The on-going projects in Ulaanbaatar city will continue until the year 1997. However there will remain a lot of waiters in that area at that time. In order to meet the target to fulfill all the application of basic telephone service within one year after their registration in 2010, the switching, transmission and outside plant engineering works should be implemented with reasonable constant pace to form the network shown in Fig 7-2-3 by the year 2010.

Project implementation plan consists of short-term plan by the year 2000, medium-term plan by the year 2005 and long-term plan by the year 2010.

In the short-term plan and the medium-term plan, main works for the switching system are the introduction of new telephone offices to heighten the reliability of the network, for the transmission system, the formation of junction circuits between telephone offices and for the outside plant system, cable rehabilitation and cable installation with new exchanges.

In order to meet the target of fulfilling all demand by the year 2010, facilities to cope with the increasing demand will be installed in the long-term plan.

1.1 Switching System

1.1.1 Implementation Plan

In accordance with "Telephone Switching System Introduction Policy" in Chapter 7 the implementation plan is formed.

Figure 8-1-1 shows the implementation plan of switching system (1995 - 2010) and Volume V Chapter 5 shows the implementation plan in each telephone office and the changes of capacity.

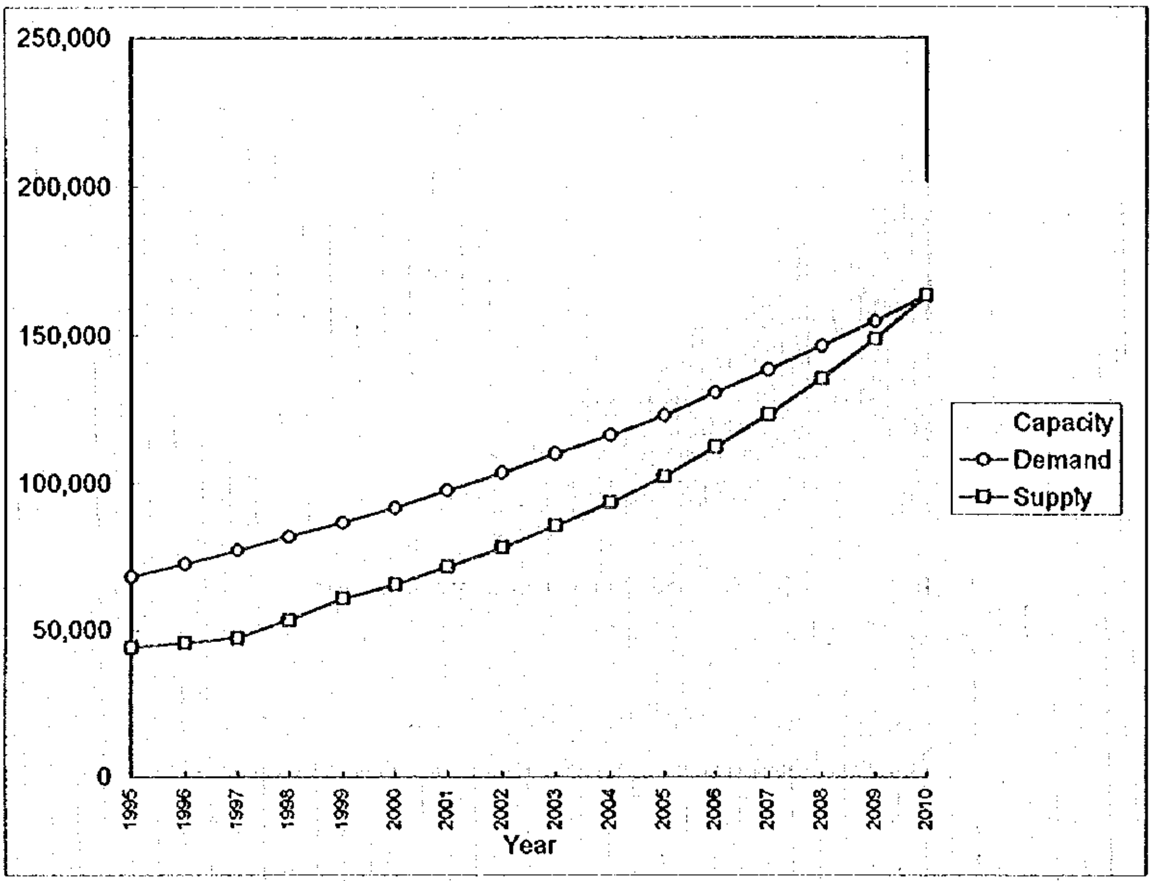


Figure 8-1-1 The Implementation Plan of Switching System (1995 - 2010)

1.1.2 Conditions for Cost Estimation

(1) Precondition

The cost using for calculation, is not included consultancy, tax and contingency. Training cost is included in equipment cost.

The proportion of consultancy, tax and contingency are as follows;

	Proportion
Consultancy	(Turn key Cost) x 0.05
Tax	(Equipment Cost) x 0.1825
Contingency	(Turn key Cost) x 0.1

(2) Exchange Cost

(Unit:US$)

Host	RSU	ISDN Module	Governmental Network	
			ISDN Exchange	Digital PBX
245	195	1,352	1,690	2,430

(2) ISDN Terminal Cost
- US$ 1,438,000

(3) Transfer Cost (In case to divert subscriber module of existing RSU per Line Unit)
- US$ 6

(4) Building Cost (In case building is newly constructed)
- US$ 700,000 for Host (200 m^2),
- US$ 5,000 for RSU(15 m^2)

1.1.3 Investment Plan

Switching system investment plan is make based on the switching system implementation plan. Table 8-1-1 shows the switching system investment plan.

A total amount of investment is approximately <u>US$61,157,000</u>.

Table 8-1-1 Switching System Investment Plan

No.	Site Name	Unit		1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	Total
1	ATC-33 (ATC-2)	H02A	Install				20,000					11,000					31,000
			Cost(MUS$)				6.286					3.457					9.744
2	ATC-3	H03A	Install														0
			Cost(MUS$)														0
3	ATC-3	H03B	Install			13,000				10,000					12,000		35,000
			Cost(MUS$)			4.086				3.143					3.772		11.001
4	ATC-34 (ATC-4)	H04A	Install								11,000					4,000	15,000
			Cost(MUS$)								3.457					1.257	4.715
5	ATC-5	H05A	Install		3,000			4,000					11,000				18,000
			Cost(MUS$)		0.943			1.257					3.457				5.658
6	ATC-36 (ATC-6)	H06A	Install	16,000					11,000					8,000			35,000
			Cost(MUS$)	5.029					3.457					2.515			11.001
7	ATC-6	H06B	Install											5,000			5,000
			Cost(MUS$)											1.572			1.572
8	ATC-73 (ATC-7)	H07A	Install		6,000						4,000					4,000	14,000
			Cost(MUS$)		1.886						1.257					1.257	4.400
9	ATC-21 (Bayan Hoshuu)	R21A	Install				1,500					500					2,000
			Cost(MUS$)				0.386					0.129					0.514
10	ATC-34 (ATC-4)	R04A	Transfer		4,000												4,000
			Cost(MUS$)		0.024												0.024
11	ATC-51 (Shamad)	R51A	Install					1,000									1,000
			Cost(MUS$)					0.257									0.257
12	ATC-52 (Amgalan)	R52A	Install					1,000									1,000
			Cost(MUS$)					0.257									0.257
13	ATC-37A (Airport)	R37A	Transfer		2,000												2,000
			Cost(MUS$)		0.012												0.012
14	ATC-37Y (Yarmag)	R37B	Transfer		1,000												1,000
			Cost(MUS$)		0.006												0.006
15	ATC-38	R38A	Transfer		4,000												4,000
			Cost(MUS$)		0.024												0.024
16	Nalaih	HNAA	Install		2,000				2,000					2,500			6,500
			Cost(MUS$)		0.629				0.629					0.786			2.043
17	Baganuur	HBNA	Install					5,000					2,000				7,000
			Cost(MUS$)					1.572					0.629				2.200
18	Biokombinato (ATC-76)	RBIA	Install			500									200		700
			Cost(MUS$)			0.129									0.051		0.180
19	Shuvuun Fabric	RSFA	Install			300				100					100		500
			Cost(MUS$)			0.077				0.026					0.026		0.129
20	Jargalant	RJAA	Install				100										100
			Cost(MUS$)				0.026										0.026
21	International Children Camp	RICA	Install				100										100
			Cost(MUS$)				0.026										0.026
22	Gachuurt	RGAA	Install					100									100
			Cost(MUS$)					0.026									0.026
23	Honhol	RHOA	Install					100					100				200
			Cost(MUS$)					0.026					0.026				0.051
24	Bagahangai	RBHA	Install		700									500			1,200
			Cost(MUS$)		0.180									0.129			0.309
25	ATC-3	ISC	Install		300						840						1,140
			Cost(MUS$)		0.212						0.357						0.569
26	Government Network		Install	1,600													1,600
			Cost(MUS$)	5.549													5.549
27	ISDN (ATC-3)		Install								500						500
			Cost(MUS$)								0.866						0.866
	Total		Install	16,000	11,700	13,800	21,700	11,200	13,000	10,100	15,000	11,500	13,100	16,000	12,300	8,000	173,400
			Cost(MUS$)	10.578	3.916	4.292	6.723	3.395	4.086	3.169	5.938	3.586	4.112	5.000	3.849	2.515	61.157

1.2 Transmission System

1.2.1 Implementation

The implementation of the transmission facilities should be developed in accordance with the " Basic Telecommunications Network Plan" in Chapter 7 of this Report. A special attention should be paid to closed co-ordination between switching and subscriber development situations when the installation of transmission system will be commenced. Table 8-1-2 shows the implementation schedule with each project cost until 2010.

1.2.2 Cost Estimation

The following prices in each type of station are as a reference value to calculate the Project cost.

a) SDH/PDH Digital Radio System

- STM-1 M/W radio terminal	$	59,200
- STM-1 M/W radio repeater (for new site)	$	163,400
- STM-1 M/W radio repeater (for existing site)	$	118,400
- STM-0 M/W radio terminal	$	42,600
-UHF radio terminal	$	45,400
- UHF radio Repeater (for new site)	$	127,800

b) SDH/PDH Optical Fiber System

- 140Mb/s Optical terminal	$	69,000
- STM-4 Add/drop station	$	123,200
- 34Mb/s Optical RSU station	$	49,000

c) Installation cost of Optical Fiber Cable : $6,000 / Km

Note 1 : For the new radio repeater site, additional facilities such as antenna and power supply should be considered.

Note 2 : Investment costs are calculated under the following condition ;

Transportation cost	: 12 % of equipment cost	Tax	: 18.25 % of equipment cost
Installation cost	: 30 % of equipment cost	Consultancy	: 8 % of turn key cost
Turn key cost	: 142 % of equipment cost	Contingency	: 10 % of turn key cost

1.2.3 Investment Plan

The transmission plan by 2010 is presented in Figure 8-1-2. The investment plan is covering the all Ulaanbaatar administrative area including enclaves.

A total amount of the investment cost is approximately **US $ 13,239,000.**

Table 8-1-2 Installation Plan and Project Cost

Year	Project and Installation	Cost(US Mil$)
1998	(Govermental Network) New Optical Fiber System:ATC3-ATC65-Ih tenger New Optical Fiber Cable 10 Km	0.348
	(Digital radio subscriber system) Feasibility study project	3.586
1999	(New Digital SW at ATC-7) New SDH links : ATC5-ATC7-ATC6 SDH add/drop X 3 stations New Optical Fiber Cable (OFC) 11.2 Km	1.194
	(New Digital SW at Nalaih, Bagahangai) Digital Microwave radio system X 6 links	2.331
2000	(New Digital SW at Biokom, Shuvuun Fab) Digital UHF radio X 3 links	0.337
	(New master clock) High precious cecium clock	1.914
2001	(New Digital SW at ATC-2) New SDH links : ATC6-ATC2-ATC3 SDH add/drop X 3 stations, RSU X 1 station New Optical Fiber Cable 20.3 Km	0.707
2002	(New Digital SW at ATC-5) New 34 Mbps Optical Fiber System ATC5 - RSU 2 stations New Optical Fiber Cable 8.7 Km	1.032
	(New Digital SW at Baganuur) Digital Microwave radio X 3 links	1.315
2005	(New Digital SW at ATC-4) New SDH links : ATC3-ATC4-ATC5 SDH add/drop X 3 stations New Optical Fiber Cable 7.9 Km	0.475
	Grand Total	13,239

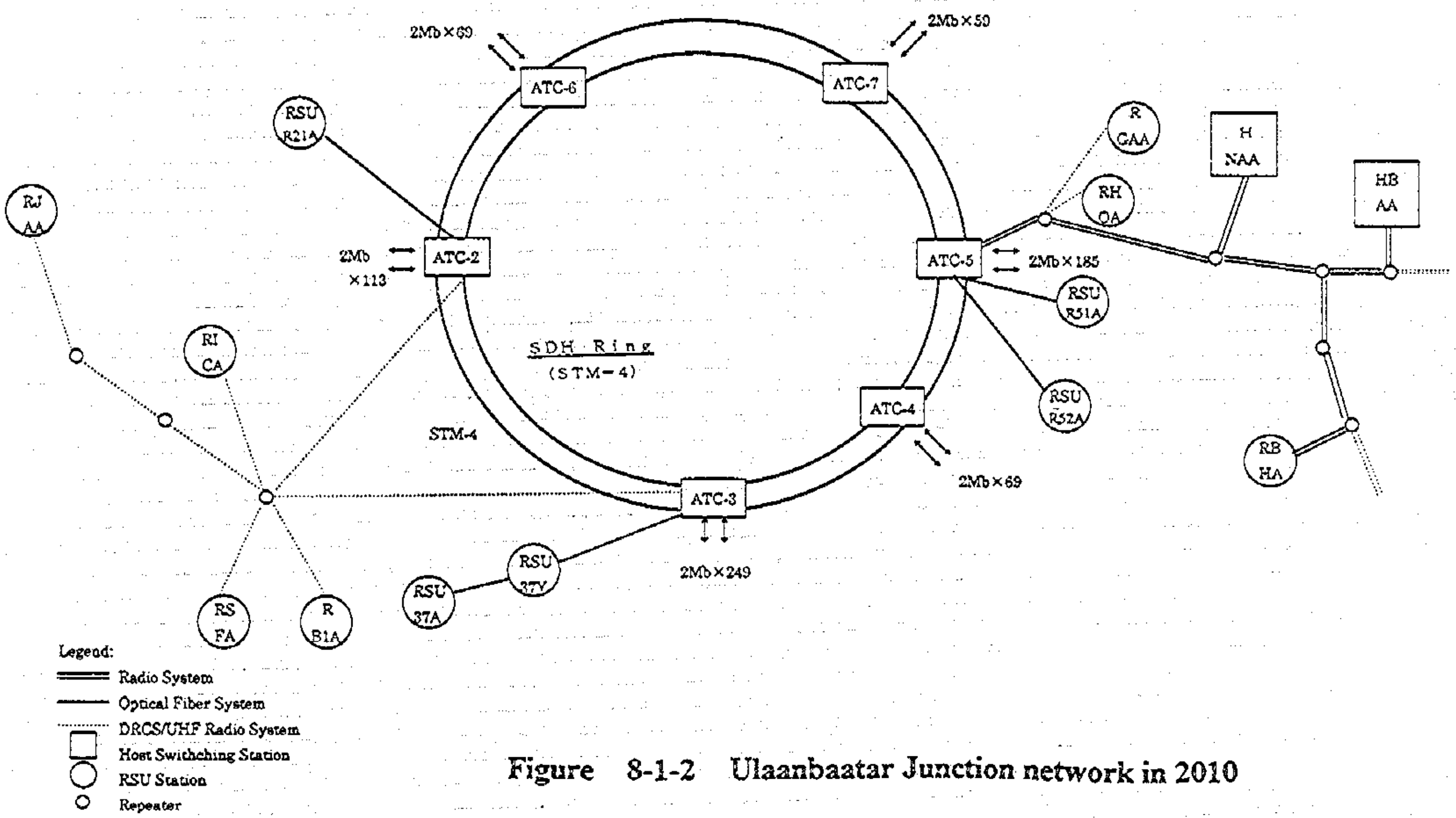


Figure 8-1-2 Ulaanbaatar Junction network in 2010

1.3 Outside Plant System

1.3.1 Installation Principle of Outside Plant

1). Expansion

a) Number of expansion cable pairs are assumed to be 1.3 times of demand in the stage of Master Plan.
b) Cable installation is to be planned so that it will be completed when expected demand reaches to the existing cable capacity.
c) When cable installation finishes, cable capacity can cover demand for the next 5 years.
d) Cable installation is to be planned so that installation period is two years. As for remote area, in case demand is less than 1,000 by the year 2010, cable pairs necessary for demand of the year 2010 are to be installed when expected demand reaches to the existing cable capacity.
e) Cable installation planning period is from 1998 to 2010.
f) Cable installation includes subscriber drop wire works.

General concept of cable planning is shown in figure 8.1.3

2). Rehabilitation

a) To replace remaining lead sheathed cables which are left "After ADB " with Jelly Filled Cables.
b) To replace some of obsolete outside plant, i.e. distribution boxes, cross-connection cabinets, underground facilities, customer wiring, etc.
c) Rehabilitation time is to be planned to coincide with expansion project.

3). Total Cost Estimation

Expansion cost:	US$ 63.17 Million
Rehabilitation cost:	US$ 22.19 Million
Government Network cost: (Rehabilitation)	US$ 1.54 Million
OPMC cost :	US$ 2.14 Million

a) underground facilities, customer wiring, etc.

Installation cost of cable per one pair is estimated to be as follows :

for Expansion	US$ 360
for Rehabilitation	US$ 360

* Rehabilitation work is assumed to be the same as expansion work.

4) Training Cost

Training cost is included in Total Cost Estimation.

1.3.2 Cost estimation of OPMC

Establishment costs of OPMC are as follows:

1)	Measurement equipment	US$ 0.44 Million
2)	Tools	US$ 0.20 Million
3)	Vehicles	US$ 0.50 Million
4)	Business equipment	US$ 0.20 Million
5)	Office automation	US$ 0.30 Million
6)	Building	US$ 0.50 Million
	Total	US$ 2.14 Million

1.3.3 Precondition of Cost Estimation

Tax	:	18.25% (of FOB)
Consultant Fee	:	10% (of Turn-key)
Contingency	:	10% (of Turn-key)

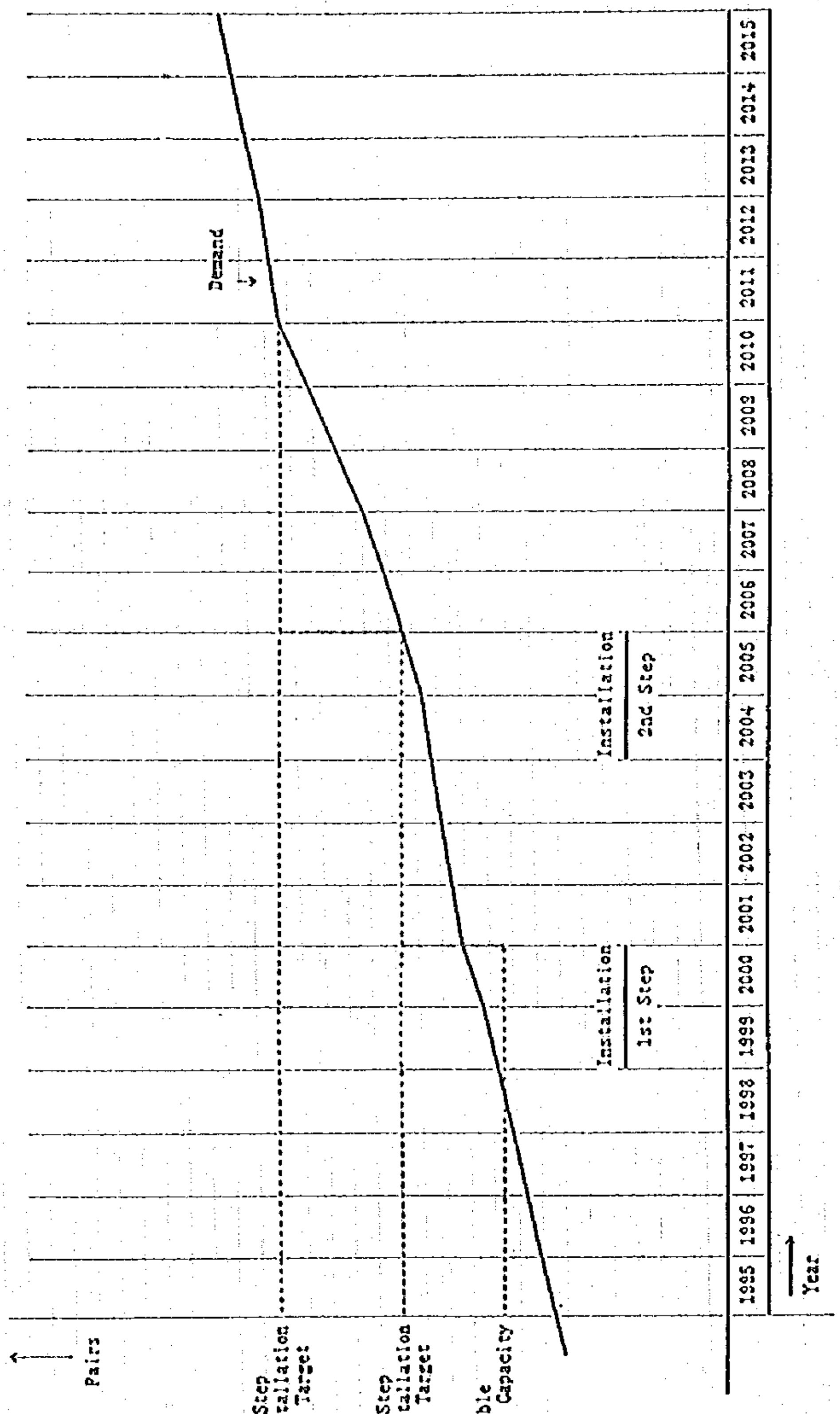


Figure 8-1-3 General Concept of Cable Planning

1.4 Project Formation Policy

The projects of this Basic Plan are formed on the following policy ;

(1) The demand of Ulaanbaatar city in the year 2010 is 163,000.

(2) It is aimed that the demand in the year 2010 will be fulfilled.

(3) In principle, existing ATC areas remain unchanged. However, some of them will be changed: ATC-3's area is extremely large. Therefore, the area of ATC-73, which has now no exchange, will be renamed as ATC-7, and an exchange will be installed.

Bayan Hoshuu area will be connected to the nearest host exchange ATC-2.

Then, the names of existing ATC areas will be renamed as follow:

Present area name	Area name of the Basic Plan
ATC－31, 32 RSU－37A,Y	ATC－3
RSU－33 , RSU - 38	ATC－2
RSU－34	ATC－4
ATC－73	ATC－7
RSU－36	ATC－6
RSU－35	ATC－5
Nalaih	ATC－Nalaih
Baganuur	ATC－Baganuur

When a host exchange will be installed in ATC-2, all subscribers of RSU-38 will be connected to the host exchange in ATC-2 instead of ATC-3. At that time, the usage of RSU-38 exchange should be decided after economical calculation. In this case, the name of "RSU-38" will be changed to "RSU-22".

(4) Host exchanges will be installed at the ATCs mentioned above. A host exchange will be installed in an ATC area where the number of subscribers will be more than 10,000 by the year 2010. Although the demand in ATC-Nalaih and ATC-Baganuur , which are distant from the central part of Ulaanbaatar city, will be less than 10,000 by the year 2010, host exchange will be installed considering the difficulties of maintenance.

RSU (Remote Switching Unit) will be installed for subscribers who are far from host exchanges. Whether RSU is installed or not will be decided from the view points of transmission loss and cost.

(5) Priority of implementation

It should be taken into account the following:

(a) Number of waiters in the year 1995.

(b) Political, economic, and social importance.

(c) To make even of works as possible.

(6) Implementation plan in each ATC area

In order to fulfill telephone demand of each ATC in the year 2010, installation of new and additional exchanges, trunk circuits, and rehabilitation and installation of additional outside plants are planned, taking into account of existing equipment of the work commencing year, and the demand in the year 2010 in each area. In principle, installation quantity of the facilities are planned to cover the supply schedule of the following five years.

In addition, the time of new RSU installation or its expansion is planned as close as possible to the time of its host exchange installation or expansion.

2. Projects Description and its Investment Cost Estimation

This basic plan has twenty nine projects to be implemented by the year 2010. These projects except the number 2 and 3 aims directly to meet the demand growth and to prepare no waiter status up to 2010. Full digitalization of the network and expansion of the network to whole of Ulaanbaatar city will be achieved in this term.

2.1 Project Description

The projects decided on the project formation policy of the preceding section are described as follows ;

Project-1 :

At ATC-6, new exchange (capacity ; 16,000 LU) and new cables (11,600 L) with rehabilitation cables (10,800 L) will be installed.

Project-2 :

In order to rehabilitate and develop the governmental network,

(1) Installation of new ISDN exchange (1,400 LU) at ATC-65 and new DPBX (200LU) at Ih Tenger.

(2) Installation of new optical fiber transmission systems for two (2) sections (ATC65 - Ih Tenger and ATC-65 - ATC-3).

(3) Cable rehabilitation (3,200 L).

(4) Digital Terminals arrangement.

Project-3 :

Introduction of radio subscriber system for Ger areas and remote areas as urgent measures.

A DRCS radio base station with omni-antenna will be installed at ATC-3, and many radio subscriber terminal equipment with directional antenna and its supporting pole which can supply several telephone lines will be put in Ger area sites and important subscriber sites located far from telephone exchange.

Project-4 :

New telephone office ATC-7 will be built in ATC-7 area which is separated from ATC-3 area. The new exchange (capacity ; 6,000 LU) and new cables (8,500 L) will be installed at this ATC-7.

And to form high reliable network in the city, three optical fiber systems will be constructed from ATC-7 to ATC-3, ATC-5 and ATC-6.

Project-5 :

The 4,000 line units (LU) of the suspended RSU-36 in ATC-6 will be transferred to RSU-34, 2,000 LU to RSU-37A, 1,000 LU to RSU-37Y and 4,000 LU to RSU-38. New cables (3,000 L) and rehabilitation cables (1,400 L) will be installed for RSU-37Y, and new cables (4,500 L) and rehabilitation cables (3,600 L) will be installed for RSU-34.

Project-6 :

(1) At ATC-Nalaih, a new exchange (capacity ; 2,000 LU) and new cables (2,000 L) with rehabilitation cables (1,600 L) will be installed. At the same time, the transmission link of radio system between this ATC and ATC-5 will be constructed.

(2) New RSU (RBHA capacity : 700 LU) and new cables (1,000 L) with rehabilitation cables (90 L) will be installed in Bagahangai. This RBHA and its host exchange in Nalaih will be connected by a radio link.

Project-7 :

Expansion of existing exchange capacity (3,000 LU) and new cables (7,000 L) with rehabilitation cables (8,400 L) will be installed in ATC-5.

Project-8 :

Existing international exchange will be expanded by 300 trunk units in International Switching Center (ISC).

Project-9 :

Change to high precision clock equipment (accuracy : 10^{-11}) at secondary switching centre of ATC-3 and a new standby clock will be installed at secondary switching center of ATC-5. Even for new services, these clocks will serve as master clocks of the network in Mongolia.

Project-10 :

(1) At ATC-3, the second unit exchange (capacity ; 13,000 LU) and new cables (21,000 L) with rehabilitation cables (11,000 L) will be installed.

(2) New RSU (RBIA; capacity : 500 LU) in Biokombinat (ATC-76) and new cables (400 L) with rehabilitation cables (200 L) will be installed, and this RBIA and ATC-3 (host exchange of RBIA) will be connected by a radio system.

(3) New RSU (RSFA ; capacity : 300 LU) and new cables (200 L) with rehabilitation cables (200 L) will be installed in Shuvuun Fabric, and this RSFA and ATC-3 (host exchange of RSFA) will be connected by a radio system.

Project-11 :

Outside Plant Maintenance Center will be introduced.

Project-12 :

(1) At ATC-2 (old ATC-33), new exchange (capacity ; 20,000 LU) and new cables (17,000 L) with rehabilitation cables (4,400 L) will be installed. At the same time, subscribers of RSU-38 will be transferred to the host exchange of ATC-2 from the host exchange ATC-3. The junction circuit capacity between ATC-2 and ATC-3 will be expanded, and one optical fiber system will be constructed from ATC-2 to ATC-6 in order to form high reliable local network in the city.

(2) At the same time, new RSU (R21A ; capacity :1,500 LU) and new cables (2,000 L) will be installed in Bayan hoshuu which is separated from ATC-6 area, and a optical fiber system is constructed to connect between this RSU and host exchange in ATC-2.

(3) A new RSU (RICA; capacity : 100 LU) and rehabilitation cables (100 L) will be installed in the International Children ATC, and this RSU and the host exchange at ATC-2 will be connected by radio system.

(4) A new RSU (RJAA ; capacity :100 LU) and rehabilitation cables (200 L) will be installed, and this RJAA and its host exchange in ATC-2 will be connected by a radio system.

Project-13 :

(1) Expansion of existing exchange capacity (4,000 LU) will be installed in ATC-5, and junction circuit capacity between ATC-5 and ATC-3 will be expanded.

(2) New RSU (R51A ; capacity : 1,000 LU) and new cables (1,500 L) in Sharhad of ATC-5 area and new RSU (R52A ; capacity : 1,000 LU) and new cables (1,000 L) in Amgalan of ATC-5 area will be installed. Two optical fiber systems will be constructed from the host exchange of ATC-5 to R51A and R52A.

(3) At the same time, new RSU (RHOA ; capacity : 100 LU) in Honhor and new cables (100 L) with rehabilitation cables (50 L) will be installed and this RHOA and ATC-5 will be connected by radio system

(4) A new RSU (RGAA ; capacity : 100 LU) and new cables (100 L) with rehabilitation cables (50 L) will be installed, and this RGAA and its host exchange H05A in ATC-5 will be connected by a radio system.

Project-14 :

At ATC-Baganuur, a new exchange (capacity ; 5,000 LU) and new cables (4,000 L) with rehabilitation cables (2,400 L) will be installed. At the same time, a radio transmission link will connect between this exchange HBNA and ATC-5.

Project-15 :

Existing exchange H06A will be expanded by (11,000 LU) and new cables (11,000 L) will be installed in ATC-6.

Project-16 :

Existing exchange HNAA will be expanded by (2,000 LU) and new cables (2,500 L) will be installed in ATC-Nalaih.

Project-17 :

(1) Existing exchange H03B will be expanded by (10,000 LU) and new cables (14,000 L) will be installed in ATC-3

(2) Existing RSU exchange RSFA will be expanded by (100 LU) in Shuvvun Fabric.

Project-18 :

Existing exchange H07A will be expanded by (4,000 LU) in ATC-7.

Project-19 :

Existing international exchange will be expanded by 840 trunk units in International Switching Center (ISC).

project-20 :

ISDN exchange (capacity ; 500 LU) and its related facilities will be introduced in ATC-3.

Project-21 :

A new host exchange H04A (capacity ; 11,000 LU) and new cables (3,500L) in ATC-4 (old ATC-34) will be installed. The junction circuit capacity between ATC-4 and ATC-3 will be expanded, and one optical fiber system will be constructed from ATC-4 to ATC-5 in order to form high reliable local network in the city.

Project-22 :

(1) Existing exchange H02A will be expanded by (11,000 LU) in ATC-2.

(2) Existing RSU exchange R21A will be expanded by (500 LU) in ATC-2.

Project-23 :

(1) Existing exchange H05A will be expanded by (11,000 LU) and new cables (7,500 L) will be installed in ATC-5.

(2) Existing RSU exchange RHOA will be expanded by (100 LU) in Honhor.

Project-24 :

Existing exchange HBNA will be expanded by (2,000 LU) and new cables (1,500 L) will be installed in ATC-Baganuur.

Project-25 :

Existing exchange H06A will be expanded by (8,000 LU) and furthermore new exchange unit H06B (5,000 LU) will be installed in ATC-6.

Project-26 :

(1) Existing exchange HNAA will be expanded by (2,500 LU) will be in ATC-Nalaih.

(2) Existing RSU exchange RBHA will be expanded by (500 LU) in Bagahangai.

Project-27 :

(1) Existing exchange H03B will be expanded by (12,000 LU) will be installed in ATC-3.

(2) Existing RSU exchange RFSA will be expanded by (100 LU) in Shuvuun Fabric.

(3) Existing RSU exchange RBIA will be expanded by (200 LU) in ATC-76.

Project-28 :

Existing exchange H07A will be expanded by (4,000 LU) in ATC-7.

Project-29:

Existing exchange H04A will be expanded by (4,000 LU) in ATC-4.

2.2 Investment Cost Estimation for Projects

Table 8-2-1 and Table 8-2-2 of the next pages show the cost estimation of the projects.

Table 8-2-1 Project Implementation Plan

(Mil.US$)

Number	Year	Project Name	Cost
1	1998	New exchange unit and its related facilities installation in ATC-6 (Bayangol district phase 1 project)	15.309
2	1998	Governmental network rehabilitation in Ulaanbaatar city	7.437
3	1998	Radio subscriber system installation for Ger area and remote areas (DRCS for ger area and remote areas project)	3.586
4	1999	New exchange unit and its related facilities installation in ATC-7 (Chingeltey/Sukhbaatar district phase 1 project)	7.170
5	1999	Reuse of the suspended RSU-36 exchange components to RSU-34, 37A,37Y	6.036
6	1999	New exchange unit and its related facilities installation in ATC-Nalaih and Bagahangai(Nalaih and Bagahangai district project)	5.40
7	1999	Expansion work of the existing exchange LU and its related facilities in ATC-5 (Bayanzurch ger area phase 1 project)	8.353
8	1999	Trunk unit expansion work-1 in international switching center (Expansion of ITC phase 1 project)	0.212
9	2000	Change to high precision master clock at the secondary switching center of ATC-3 and installation of a standby clock at ATC-5	1.914
10	2000	New exchange units and its related facilities installation in ATC-3, Biokombinat and Shuvuun Fabric (Tov Shoodan, Biokombibat, Shuvuun Fabric pro.)	20.509
11	2000	Outside plant maintenance center establishment	2.140
12	2001	New exchange units and its related facilities installation in ATC-2, Bayan Hoshuu, Int.Chidren and Jargalant (Songinohairhan dist. pro.)	18.841
13	2002	New exchange units and its related facilities installation in Sharhad, Amgalan, Honhor and Gachuurt, and expansion works in ATC-5 (Bayanzurch dist. pro.)	4.195
14	2002	New exchange unit and its related facilities installation in ATC-Baganuur (Baganur district project)	5.967
15	2003	Expansion works of the existing exchange LU and its related facilities in ATC-6 (Bayangol district project)	8.747
16	2003	Expansion works of the existing exchange LU and its related facilities in ATC-Nalaih (Nalaih district project)	1.829
17	2004	Expansion works of the existing exchange LU and its related facilities in ATC-3 and Shuvuun Fabric (Tov Shoodan dist. ph.2 pro.)	9.909
18	2005	Expansion works-1 of the existing exchange LU in ATC-7 (Chingeltey/Sukhbaatar district ph.2 project)	1.257
19	2005	Trunk unit expansion work-2 in international switching center	0.357
20	2005	New ISDN exchange unit and its related facilities installation in ATC-3 (Tov Shoodan ISDN project)	0.866
21	2005	New exchange unit and its related facilities installation in ATC-4 (Bogd Khan area phase 1 project)	5.612
22	2006	Expansion works of the existing exchange LU and its related facilities in ATC-2 and Bayan Hoshuu (Songinohairhan dist.ph.2 pro.)	7.436
23	2007	Expansion works of the existing exchange LU and its related facilities in ATC-5 and Honhor (Bayanzurch district ph.2 pro.)	7.093
24	2007	Expansion works of the existing exchange LU and its related facilities in ATC-Baganuur (Baganuur dist. ph.2 project)	1.349
25	2008	Expansion works of the existing exchange LU and installation of a new exchange unit in ATC-6 (Bayangol dist. ph.3 pro.)	4.087
26	2008	Expansion works of the existing exchange LU in ATC-Nalaih and Bagahangai (Nalaih ph.3 and Bagahangai ph.2 project)	0.915
27	2009	Expansion works of the existing exchange LU in ATC-3, Shuvuun Fabric and Biokombinat (Tov Shoodan, Biokombinat, Shuvuun Fabric pro.)	3.849
28	2010	Expansion works-2 of the existing exchange LU in ATC-7 (Chingeltey/Sukhbaatar dist. phase 2 project)	1.257
29	2010	Expansion works of the existing exchange LU in ATC-4 (Bagd Khan area phase 2 project)	1.257
		Total Cost	163.439

Table 8-2-2 Project Implementation Plan

(Unit : Mil. US$)

No.	Year	Switching system	Cost	Transmission system	Cost	Outside plant	Cost	Total
1	1998	H06A:N/16,000	5.029			N/11,600 R/10,800	10.780	15,809
2	1998	Goverment :R/1,600	5.549	ATC3/ATC65/ATC lh tenger:N/OF	0.348	R/3,200	1.540	7.437
3	1998			Radio subscriber system	3.586			3.586
4	1999	H07A:N/6,000	1.886	ATC7/ATC5,6:N/OF ATC3/ATC5:N/OF	1.194	N/8,500	4.090	7.170
5	1999	R04A:T/4,000	0.024			N/4,500 R/3,600	3.900	6.086
		R38A:T/4,000	0.024					
		R37A:T/2,000	0.012					
		R37B:T/1,000	0.006			N/3,000 R/1,400	2.120	
6	1999	HNAA:N/2,000	0.629	HNAA/ATC5:N/RADIO	2.331	N/2,000 R/1,600	1.730	5.400
		RBHA:N/700	0.180	RBHA/HNAA:N/RADIO		N/1,000 R/90	0.530	
7	1999	H05A:E/3,000	0.943			N/7,000 R/8,400	7.410	8.353
8	1999	ISC:E/ 300 TU	0.212					0.212
9	2000			SSC:Change of Clock	1.914			1.914
10	2000	H03B:N/13,000	4.086			N/21,000 R/11,000	15.400	20.509
		RBIA:N/500	0.129	RBIA/ATC3:N/RADIO	0.337	N/400 R/200	0.290	
		RSFA:N/300	0.077	RSFA/ATC3:N/RADIO		N/200 R/200	0.190	
11	2000					OPMC	2.140	2.140
12	2001	H02A:N/20,000	6.286	ATC2/ATC3,6:N/OF	0.707	N/17,000 R/4,400	10.300	18.841
		R21A:N/1,500	0.386	R21A/ATC2:N/OF		N/2,000	0.960	
		RICA:N/100	0.026			R/100	0.050	
		RJAA:N/100	0.026			R/200	0.100	
13	2002	H05A:E/4,000	1.257	ATC5/ATC3:E/OF	1.032		0.000	4.195
		R51A:N/1,000	0.257	R51A/ATC5:N/OF		N/1,500	0.720	
		R52A:N/1,000	0.257	R52A/ATC5:N/OF		N/1,000	0.480	
		RHOA:N/100	0.026			N/100 R/50	0.070	
		RGAA:N/100	0.026			N/100 R/50	0.070	
14	2002	HBNA:N/5,000	1.572	HBNA/ATC5:N/RADIO	1.315	N/4,000 R/2,400	3.060	5.967
15	2003	H06A:E/11,000	3.457			N/11,000	5.290	8.747
16	2003	HNAA:E/2,000	0.629			N/2,500	1.200	1.829
17	2004	H03B:E/10,000	3.143			N/14,000	6.740	9.909
		RSFA:E/100	0.026					
18	2005	H07A:E/4,000	1.257					1.257
19	2005	ISC:E/ 840 TU	0.357					0.357
20	2005	ISDN:N/500	0.666					0.866
21	2005	H04A:N/11,000	3.457	ATC4/ATC3,5:N/OF	0.475	N/3,500	1.680	5.612
22	2006	H02A:E/11,000	3.457			N/7,000	3.370	7.436
		R21A:E/500	0.129			N/1,000	0.480	
23	2007	H05A:E/11,000	3.457			N/7,500	3.610	7.093
		RHOA:E/100	0.026					
24	2007	HBNA:E/2,000	0.629			N/1,500	0.720	1.349
25	2008	H06A:E/8,000	2.515					4.087
		H06B:N/5,000	1.572					
26	2008	HNAA:E/2,500	0.786					0.915
		RBHA:E/500	0.129					
27	2009	H03B:E/12,000	3.772					3.849
		RSFA:E/100	0.026					
		RBIA:E/200	0.051					
28	2010	H07A:E/4,000	1.257					1.257
29	2010	H04A:E/4,000	1.257					1.257
		Total	61.160		13.239		89.040	163.439

Legend :

N : New Installation of Facilities

E : Expansion of Facilities

R : Rehabilitation Work for Outside Plant Cables

T : Transference of RSU Exchange Components

OPMC : Outside Plant Maintenance Center

OF : Optical Fiber Junction Circuits

TU : Trunk Unit