CHAPTER 3

DEMAND FORECAST

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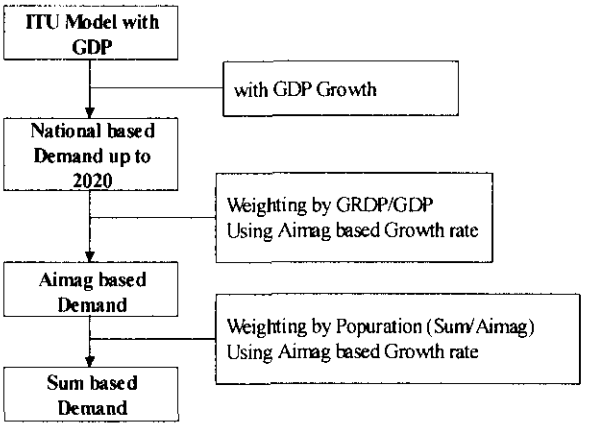
3.1 Telephone Demand

3.1.1 General

It is necessary to estimate more detail Telephone Demand in selected Sum Centres of FS Project for the preparation of the exact plan.

Although Telephone Demand of Sum Centres in Macroscopic demand forecast was estimated by weighting of RDGP and Population for National based Telephone Demand, Microscopic demand forecast should consider the detail condition related to telephone demand in each Sum centre.



(Macroscopic Demand Forecast)

In this study, the hearing on Telephone demand was executed for 300 households and 200 Public organizations and Business companies of 10 sampled Sum centres in Uvurkhangai, Selenge and Darkhan-Uul Aimags as the site survey. And the statistical Data on Economic activity, Population, Number of Household and Number of Public and Business organizations etc. were collected from the official office of the Sum Centres. (Ref. Attached Site Survey Report in Data Book)

The present Demand and the future demand up to the year of 2020 in the Sum Centres are estimated based on the above collected Data. Demand forecast result is shown in Table 3.7-3.

3.1.2 Concept of the microscopic demand forecast

(1) Area of Microscopic Demand Forecasts

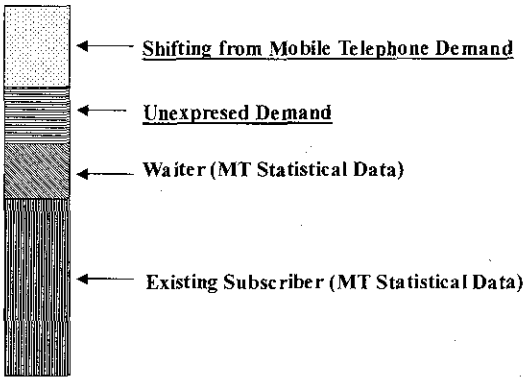
All Sum Centres in Uvurkhangai, Selenge and Darkhan-Uul are the object of the Microscopic Demand Forecast except Bag areas.

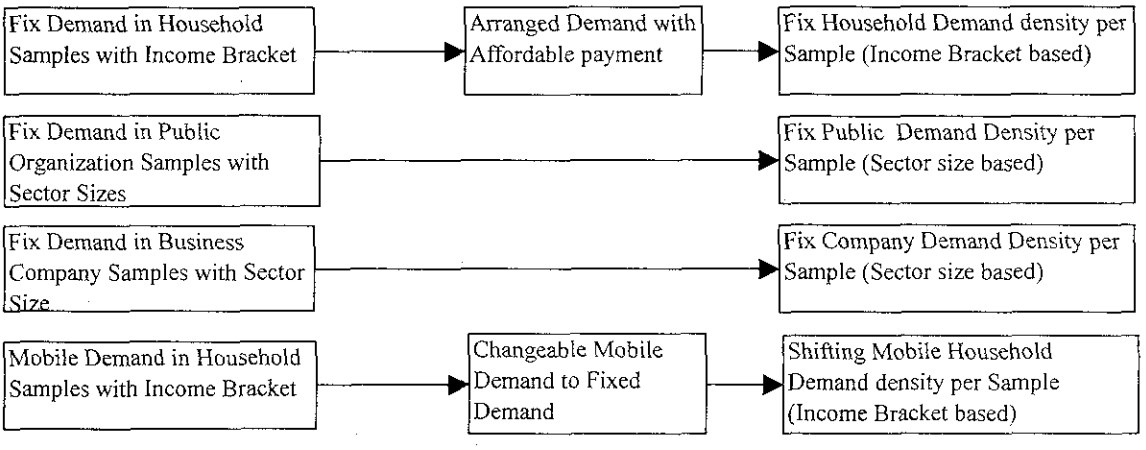
(2) Methodology of Microscopic Demand Forecast

The Microscopic Demand is forecasted based on the demands in the sample household, Public organizations and Business companies.

i) Fixed Telephone Present Demand in Samples

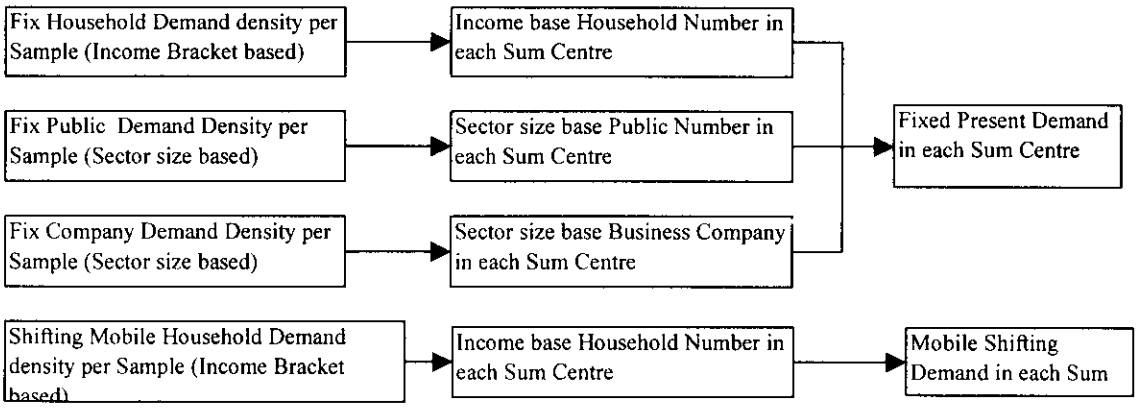
The Present Demand is composed of the number of Existing Subscriber, Waiter and Unexpressed Demand. The present Demand as the present demand density per Household, Public and Business organization have been collected from the Site survey. A part of Mobile Demand that will be shifted to Fixed Telephone Demand during un-available Mobile Service period is also counted as part of the present Demand.





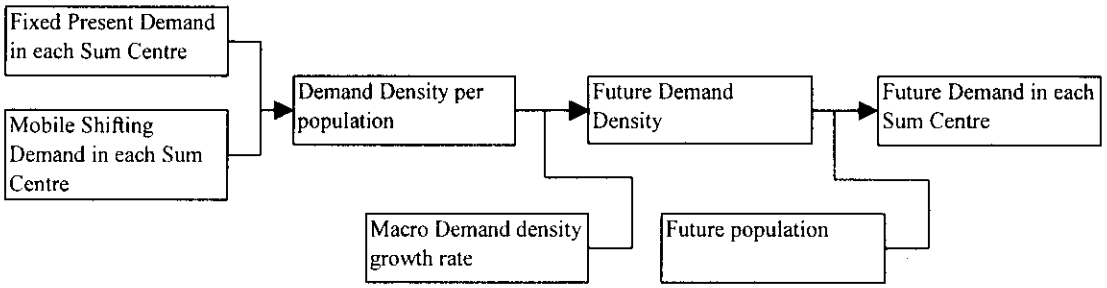
ii) Present Telephone Demand in Sum Centre

Demand in Sum Centre is estimated from the Demand density per Sample and Number of Household, Public organization and Business company in the Sum Centre.



iii) Fixed Telephone Future Demand

The growth of Fixed Telephone Demand for the present demand is estimated with the economic growth and Population growth of the Sum centres as the future demand. Estimation period is up to the year of 2020.



3.1.3 Data Collection

(1) Statistic Data

The following Data on all Sum Centres in the F/S Project are collected. (Detailed are stated in the Site Survey Report)

i) MT and Mobile Company

- Number of Existing Subscriber classified by Service categories (Public, Business and Private) for year of 1997 to 2002.
- Number of Waiter for year of 1997 to 2002.

ii) Mobile Company

- Number of Existing Subscriber and Waiter for year 1999 to 2002
- Service commencement plan for new service areas.

iii) Rail way Telecom

- Number of Existing Subscriber and Waiter for year 1999 to 2002

iv) Municipality (Aimag Centre or Sum Centre)

- Population (1997-2002)
- Number of Household classified by occupation (1997-2002)
- Number of Household classified by Income Bracket in each occupation categories (2001)
- Average Household Income (1997-2002)
- Number of Public Organization and Business Company classified by Sector (1997-2002)
- Number of Employee classified in the categories (Large, Medium, Small) in each sector (2001)
- GRDP (1997-2002)
- Budget and Expenditure of municipality (1997-2001)

(2) Spot Survey on Households and Companies

The following information is collected by the Spot survey for 30 household and 20 Public and Business organization per one sampled Sum centre. 10 Sum centres were selected as the sampled Sum Centres.

i) Questionnaire to Households

- Fixed Telephone related Data
  - Existing Subscriber, Application issued, willing to be Subscriber with timing
- Mobile Telephone related Data
  - Existing Subscriber, Application issued, willing to be Subscriber with timing

- Intention to be Fixed Telephone Subscriber in the period of unavailable Mobile Service.

• Occupation and Economic related Data
- Number of Family (2002)
- Occupation (2002)
- Average Household Income (2002)
- Affordable Telephone charge (Fixed and Mobile)

ii) Questionnaire for Public and Business User

• Fixed Telephone related Data
- Existing Subscriber, Application issued, willing to be Subscriber with timing

• Mobile Telephone related Data
• Sector and Size of Organization related Data

3.1.4 Site Survey Result

(1) Telephone Demand in Sampled Households

According to the replay of Households in the questionnaire, the necessary Telephone Lines in the 300 sampled households are summarized with the household monthly income as follows;

i) Fixed Telephone and Mobile Demand based on the Questionnaire result. (Table 3.1.4-1)

The following is the necessary lines replied by the sampled household. The questionnaire asks the necessity of the telephone lines, Fixed Telephone or Mobile, independently regardless of the other service.

Table 3.1.4-1 Fixed Telephone and Mobile Demand in Sampled Household

Sample	Income (TG)	Fix Demand	Mobile Demand
14	18999	1	0
60	19000	32	12
164	41000	141	52
63	101000	58	28

The household monthly income "**Income (TG)**" is classified by Table 3.1.4-2 according to Mongolian Government Regulations.

Table 3.1.4 –2 Income Brackets

Income Bracket	Household Monthly Income (Tg)
18999	18999 or less
19000	19000 - 40999
41000	41000-109999
101000	101000 or more

ii) Selection of Telephone Service based on the questionnaire result. (Table 3.1.4-3)

This is the answer on the selection of the service if both services are available.

Table 3.1.4-3 Selection of Telephone in Sampled Household

Income (TG)	Sample	Both	Fixed	Mobile
18999	12	2	8	2
19000	55	15	17	23
41000	160	88	31	41
101000	63	43	1	19

However, the number of "Both" is arranged by the rate shown in Table 3.1.4-4 because of the affordability.

Table 3.1.4-4 Redistribution rate of Telephone Selection "Both"

Income (Tg)	Fixed Demand	Mobile Demand	Revised Rate of Both
18999	0.4	0.6	0%
19000	0.4	0.6	0%
41000	0.5	0.7	20%
101000	1	1	100%

iii) Shifting Demand from Mobile to Fixed in the unavailable Mobile Service period (Table 3.1.4-5)

The shifting demand means the number of lines which the household has intention to use Fixed telephone line in spite of Mobile line for the period.

Table 3.1.4-5 Shifting Mobile Demand to Fix Telephone Demand

Income (TG)	Mobile Demand	Shifting Demand	Shifting Rate
19000	12	6	50.00%
41000	52	29	55.77%
101000	28	19	67.86%

iv) Present Fixed Telephone Demand in Sampled Households without the consideration of Affordability (Table 3.1.4-6)

The present fixed telephone demand in sampled households is summarized in Table 3.1.5 -6 after the arrangement of Shifting Mobile demand and Selection of Both services.

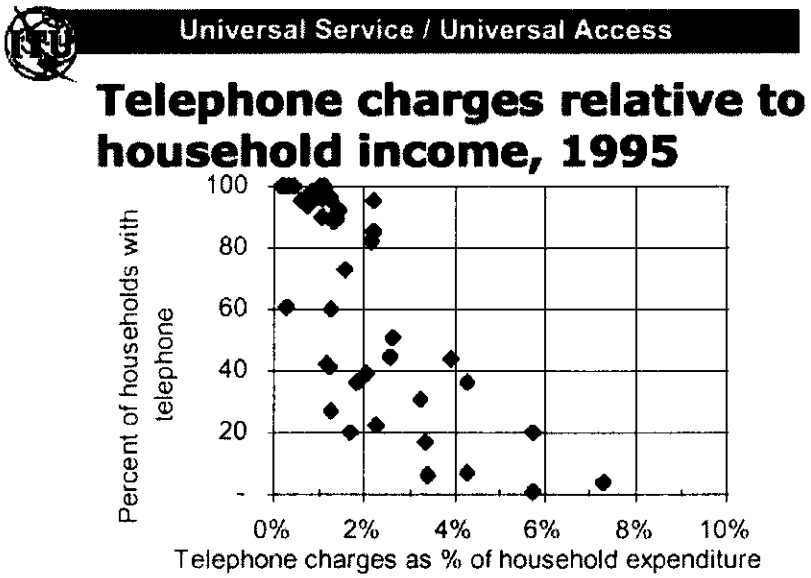
Table 3.1.4-6 Fixed demand without the consideration of Affordability

Income (TG)	Sample	Fixed Demand	Shifted Mobile Demand
18999	14	1	
19000	60	23	5
41000	164	89	23
101000	63	58	19
Total	301	171	47

(2) Affordable Demand

i) Affordable Payment for Household Income in ITU Report (Figure 3.1.4-1)

ITU Report states Affordable Payment for Household income is normally 3% and the necessary yearly payment is 64 US$ (5000Tg per Month equivalent) as minimum in International Statistic.



Note: *The annual telephone charge are a basket based on one tenth of the installation charge, annual subscription in the largest local network, 700 local calls and 130 long-distance calls. Taxes are included.*

Source: *TU World Telecommunication Development Report 1998, Universal Access*

Figure 3.1.4-1 Affordable Payment

ii) Affordable Payment with Income Brackets in Sample Household (Figure 3.1.4-2)

The Affordable payment for the monthly telephone charge is asked in the questionnaire (Ref. Annex 1, Table 1) and the average of the affordable payment with the income brackets is shown as Line 1 in Figure 2 (Ref. Annex 1, Table 2). On the other side, Line 2 is the Affordable payment that is assumed as 5% for the household income based on ITU Report and the consideration of the economic feature in the rural area of Mongolia. The affordable payment in answer is 5,500TG higher than 5% income.

According to the Lines, Affordable payment in Sample is 5500Tg higher than the real affordable payment and it means that the demand of Household was answered with 5500TG higher affordable payment condition. Therefore, Minimum 5,000Tg of necessary monthly payment stated in ITU Report is equal to 10,500Tg of necessary payment in Sample.

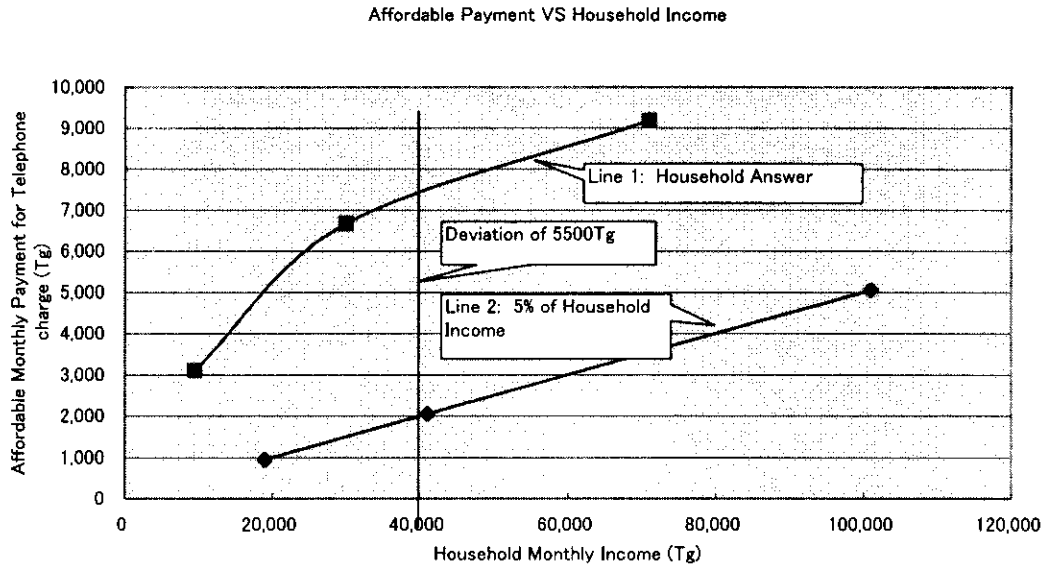


Figure 3.1.4-2 Deviation of Affordable Payment

iii) Arrangement of Telephone Demand in Sampled Household

The minimum monthly telephone charge is stated as 5000Tg in ITU Report. The payment available rate of each household income bracket is shown in Figure 3.1.4-3 that come from answer of affordable payment in the site survey.

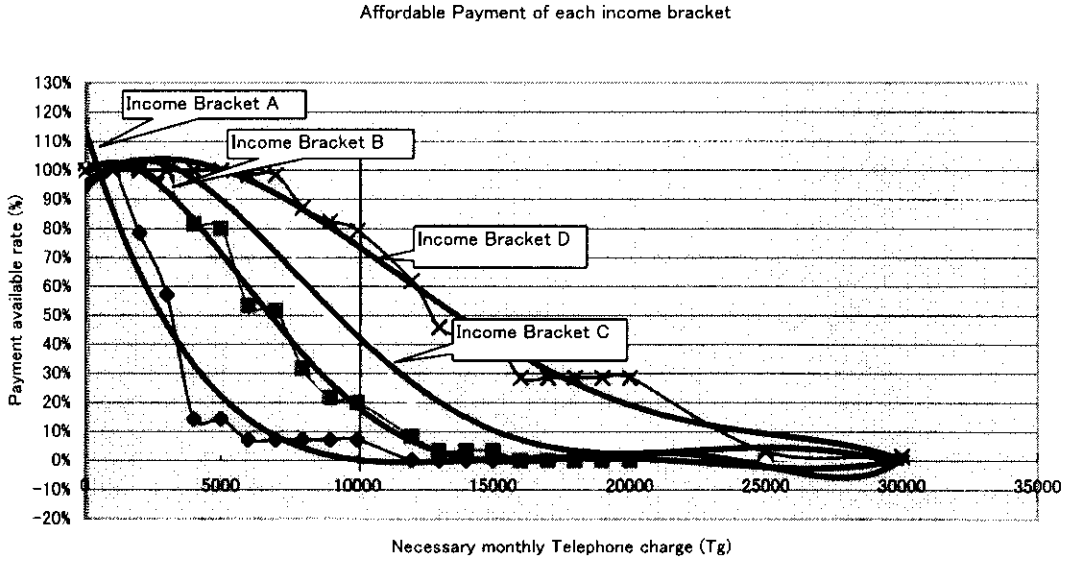


Figure 3.1.4-3 Affordable Payment with Income

The payment available rate for 5,000TG actual monthly charge is shown on the cross point between each income bracket line and line of 10,500 Tg monthly payment as stated in the previous paragraph. The payment available rate for 5,000Tg

Actual monthly charge equivalent is shown in Table 3.1.45-6.

Table 3.1.4-7 Payment available rate in each Income bracket

18999(10000)	19000(10000)	41000(10000)	101000(10000)
0	0.19	0.43	0.75

Therefore, affordable Demand is calculated by answered Demand with Payment available rate (Table 3.1.4-7)

Table 3.1.4-8 Affordable Demand and Density per Household in Sampled Household

Income(TG)	Sample	Affordable Fix Demand	Affodable Mobile Demand	Affordable Change Demand	Fix Demand Density	Mobile Demand Density	Change Demand Density
18999	14	0.00	0.00	0.00	0.00	0.00	0.00
19000	60	4.37	1.92	0.96	0.07	0.03	0.02
41000	164	38.21	17.78	9.92	0.23	0.11	0.06
101000	63	43.50	21.00	14.25	0.69	0.33	0.23

(3) Telephone Demand in Sampled Public and Business Organization

i) Fixed Telephone Demand categorized with the size of Organization

Present Demand is calculated as Existing Subscriber line plus Expressed Demand in Sampled organization and classified with Size of organization. (Large size: more than 15 employees, Medium: 6-15, Small: less than 6). Demand and Density in sampled Public Organization and Business Company are shown in Table 3.1.4-8 and 3.1.4-9.

Table 3.1.4-9 Demand and Demand density in Sampled Business Company

Sample	CompanySector	Size	Existing Sub	Expressed Demand	Present Demand	Demand Density per Company
9	Agriculture/Stock	Large	29	3	32	3.56
10	Agriculture/Stock	Medium	6	5	11	1.10
6	Agriculture/Stock	Small	5	2	7	1.17
1	Fabric	Large	3	0	3	3.00
1	Fabric	Medium	0	1	1	1.00
7	Trade/Sells	Large	7	2	9	1.29
10	Trade/Sells	Medium	9	2	11	1.10
22	Trade/Sells	Small	19	8	27	1.23

Table 3.1.4-10 Demand and Demand density in Sampled Public Organization

Sample	PublicSector	Size	Existoing Subscriber	Expressed Demand	Present Demand	PresentDemand
10	Hospital	Large	20	7	27	2.70
7	Municipality	Large	41	2	43	6.14
7	Municipality	Medium	33	4	37	5.29
14	Municipality	Small	10	2	12	0.86
7	Other	Large	14	26	40	5.71
17	Other	Medium	15	4	19	1.12
59	Other	Small	34	11	45	0.76
11	School	Large	15	8	23	2.09
1	School	Medium	0	0	0	0.00

ii) Arranged Demand Density per Public and Business Organisation

The arranged Demand densities per Public and Business organisation are settled as the following Tables based on the Table 3.1.4-8 and 3.1.4-9.

Table 3.1.4-11 Arranged Demand Density per Public Organisation

Sector	Large	Medium	Small
Government	614%	529%	86%
Others	571%	112%	76%
School	209%	100%	100%
Hospital	270%	200%	100%

Table 3.1.4-12 Arranged Demand Density per Business Company

Sector	Large	Medium	Small
Agriculture/Sto	200%	100%	50%
Trade/Sells	200%	150%	100%
Fabric	200%	100%	50%
Others	200%	100%	50%

3.1.5 Present Demand Estimation

(1) Fixed Telephone Present Demand in Each Sum Centre

i) Residential

• Household Number with Income Bracket

Statistic Data on Number of Household categorized with the household Income is collected from Sum Centre Official Office (Ref. Annex 1, Table 3)

- Present Demand in Each Sum Centre (Table 3.1.5-1)
  Present Demand of each Sum Centre is calculated by the product of Demand Density per Household (Table 3.1.4-7, Affordable Fix Telephone Demand Density) and Household Number. Calculated result is shown in Table 3.1.5-1.

ii) Public

- Number of Public Organisation categorized with the size from Sum Centre Official Office Statistic Data (Ref. Annex 1, Table 4))
- Present Demand in each Sum Centre (Table 3.1.5-2).
- Demand of each sector is shown in Annex 1, Table 5.

iii) Business

- Number of Business Company categorized with the size from Sum Centre Official Office Statistic Data (Ref. Annex 1, Table 6)
- Present Demand in each Sum Centre (Table 3.1.5-3).
- Demand of each Sector is shown in Annex 1, Table 7.

(2) Mobile

Mobile Demand and Shifting Mobile Demand are calculated by the product of Mobile Demand Density per Household (Table 3.1.4-7, Affordable Mobile Demand Density and Affordable Changing Demand Density) and Number of Household (Annex 1, Table 3).

- Present Mobile Demand in Each Sum Centre (Table 3.1.5-4)
- Shifting Mobile Demand in Each Sum Centre (Table 3.1.5-5)

(3) Fixed Telephone Total Present Demand (Table 3.1.5-6)

Present total demand of Fixed telephone is the sum of Residential demand, Public Organisation demand and Business Company demand. If the present total demands are less than the existing subscribers, the number of present demand is considered as the same volume of existing subscriber. So, Fixed Telephone Total Demand is shown in the column of Arranged Present Fixed Demand in Table 3.1.5-6.

Shifting Mobile Demand is considered as the additional demand for the present demand, but the shifting demand is not counted for Sum Centres in Mobile service areas.

Table 3.1.5-1 Household Fix Present Demand

ID	Aimag ID	Sum ID	Aimag/Sum Name	Total	18999 and Under	19000-40999	41000-100999	101000 and above	Demand Density per Populatio
1	10	2	Bayan-Undur	38	0	7	13	17	0.07
2	10	3	Burd	38	0	7	13	17	0.06
3	10	4	Bat-Ulzii	39	0	12	14	14	0.02
4	10	5	BB-Ulaan	15	0	7	8	0	0.03
5	10	6	Bayangol	15	0	5	10	0	0.02
6	10	7	Guchin-Us	19	0	2	17	0	0.04
7	10	8	Esunzuil	14	0	7	7	0	0.01
8	10	9	Ulziit	8	0	3	3	1	0.01
9	10	10	ZB Ulaan	40	0	2	26	12	0.06
10	10	11	Bogd	110	0	2	16	92	0.11
11	10	12	Nariinteel	45	0	7	23	15	0.03
12	10	13	Sant	31	0	5	22	4	0.04
13	10	14	Taragt	11	0	6	5	0	0.02
14	10	15	Tugrug	36	0	6	27	3	0.06
15	10	16	Yanga	66	0	8	52	6	0.05
16	10	17	Khairkhandula	15	0	12	3	0	0.03
17	10	18	Khujirt	153	0	24	60	68	0.06
18	10	19	Kharkhorin	736	0	27	708	0	0.09
19	10	20	Bayanteeg	3	0	2	0	0	0.00
20	13	2	Altanbulag	74	0	15	53	6	0.02
21	13	3	Eruu	205	0	5	44	155	0.08
22	13	4	Zuunburen	24	0	12	12	0	0.01
23	13	5	Khushaat	53	0	1	53	0	0.06
24	13	6	Orkhon	89	0	1	89	0	0.07
25	13	7	Sant	79	0	4	75	0	0.05
26	13	8	Khuder	72	0	1	70	0	0.05
27	13	9	Tsagaannuur	154	0	2	151	0	0.05
28	13	10	Bugant	0	0	0	0	0	0.00
29	13	11	Orkhontuul	146	0	4	142	0	0.04
30	13	12	Baruunburen	74	0	2	72	0	0.05
31	13	13	Dulaankhaan	0	0	0	0	0	0.00
32	13	14	Javkhlant	40	0	1	39	0	0.04
33	13	15	Shaamar	147	0	13	134	0	0.04
34	13	16	Tushig	61	0	4	57	0	0.05
35	13	17	Saikhan	0	0	0	0	0	0.00
36	13	18	Khutul	405	0	30	375	0	0.06
37	13	19	Zuunkharaa	988	0	13	975	0	0.05
38	13	20	Bayangol	182	0	2	180	0	0.05
39	13	21	Tunkhel	159	0	2	157	0	0.05
40	19	2	Shariin gol	501	0	46	173	281	0.06
41	19	3	Khongor	92	0	8	66	19	0.04
42	19	4	Orkhon	41	0	21	19	0	0.01

Table 3.1.5-2 Present Public Demand in Each Sum Centre

ID	Aimag ID	Sum ID	Aimag/Sum Name	Municipality	Hospital	School	Other	Total
1	10	2	Bayan-Undur	25	3	2	7	36
2	10	3	Burd	25	3	2	12	41
3	10	4	Bat-Ulzii	25	3	4	7	38
4	10	5	BB-Ulaan	25	3	2	3	33
5	10	6	Bayangol	6	3	2	12	23
6	10	7	Guchin-Us	25	3	2	4	33
7	10	8	Esunzuil	14	3	2	11	30
8	10	9	Ulziit	25	3	2	4	33
9	10	10	ZB Ulaan	25	3	6	9	42
10	10	11	Bogd	25	3	2	10	40
11	10	12	Nariinteel	25	3	2	9	38
12	10	13	Sant	21	3	2	6	32
13	10	14	Taragt	25	3	4	7	38
14	10	15	Tugrug	25	3	2	3	33
15	10	16	Yanga	18	5	5	25	53
16	10	17	Khairkhandula	25	3	2	6	35
17	10	18	Khujirt	27	3	2	0	32
18	10	19	Kharkhorin	12	3	6	19	41
19	10	20	Bayanteeg	18	5	2	0	25
20	13	2	Altanbulag	5	2	2	6	15
21	13	3	Eruu	6	2	2	1	11
22	13	4	Zuunburen	6	2	2	2	12
23	13	5	Khushaat	5	2	1	1	9
24	13	6	Orkhon	5	2	1	1	9
25	13	7	Sant	5	2	1	6	15
26	13	8	Khuder	5	2	1	11	20
27	13	9	Tsagaannuur	5	2	1	8	16
28	13	10	Bugant	5	2	1	17	25
29	13	11	Orkhontuul	5	2	1	6	15
30	13	12	Baruunburen	5	2	1	1	9
31	13	13	Dulaankhaan	5	2	1	2	10
32	13	14	Javkhlant	5	2	1	1	9
33	13	15	Shaamar	5	2	1	1	9
34	13	16	Tushig	5	2	1	1	9
35	13	17	Saikhan	0	0	0	0	0
36	13	18	Khutul	11	3	3	18	35
37	13	19	Zuunkharaa	11	3	10	38	63
38	13	20	Bayangol	5	3	2	2	12
39	13	21	Tunkhel	5	0	2	1	8
40	19	2	Shariin gol	6	3	2	25	36
41	19	3	Khongor	7	3	2	115	127
42	19	4	Orkhon	5	2	2	19	28

Table 3.1.5-3 Present Business Demand in each Sum Centre

ID	Aimag ID	Sum ID	Aimag/Sum Name	Agricul-ture/Stock	Fabric	Trade/ Sales	Others	Total
1	10	2	Bayan-Undur	0	0	2	0	2
2	10	3	Burd	0	0	3	0	3
3	10	4	Bat-Ulzii	0	0	3	0	3
4	10	5	BB-Ulaan	0	0	2	0	2
5	10	6	Bayangol	0	2	4	0	6
6	10	7	Guchin-Us	0	0	2	0	2
7	10	8	Esunzuil	0	1	9	0	10
8	10	9	Ulziit	0	0	5	0	5
9	10	10	ZB Ulaan	0	0	5	0	5
10	10	11	Bogd	0	0	5	0	5
11	10	12	Nariinteel	8	19	19	0	46
12	10	13	Sant	0	0	2	3	4
13	10	14	Taragt	0	0	3	0	3
14	10	15	Tugrug	1	0	6	0	7
15	10	16	Yanga	0	1	15	3	19
16	10	17	Khairkhandulaan	0	0	3	0	3
17	10	18	Khujirt	0	6	2	12	19
18	10	19	Kharkhorin	2	28	1	20	51
19	10	20	Bayanteeg	0	0	0	0	0
20	13	2	Altanbulag	7	1	1	1	10
21	13	3	Eruu	11	0	0	0	11
22	13	4	Zuunburen	17	0	4	3	24
23	13	5	Khushaat	29	0	2	1	32
24	13	6	Orkhon	23	0	2	1	26
25	13	7	Sant	8	0	6	1	15
26	13	8	Khuder	9	2	2	1	14
27	13	9	Tsagaannuur	23	0	5	1	29
28	13	10	Bugant	0	0	0	0	0
29	13	11	Orkhontuul	26	3	4	2	34
30	13	12	Baruunburen	18	0	2	1	21
31	13	13	Dulaankhaan	0	0	0	0	0
32	13	14	Javkhlant	21	0	2	1	24
33	13	15	Shaamar	7	2	3	6	17
34	13	16	Tushig	6	2	2	2	12
35	13	17	Saikhan	10	0	0	0	10
36	13	18	Khutul	10	7	10	4	31
37	13	19	Zuunkharaa Bayangol	27	25	85	28	164
38	13	20	(Baruunharaa)	15	9	9	5	37
39	13	21	Tunkhel	0	4	5	8	17
40	19	2	Shariin gol	0	15	44	10	68
41	19	3	Khongor	21	11	14	6	51
42	19	4	Orkhon	7	5	0	2	13

Table 3.1.5-4 Present Mobile Demand in Each Sum Centre

ID	Aimag ID	Sum ID	Aimag/Sum Name	Existing Sub-scriber	Demand Total	18999 and Under	19000-40999	41000-100999	101000 and above	Demand Density per Population
1	10	2	Bayan-Undur	0	18	0	3	6	8	0.03
2	10	3	Burd	0	18	0	3	6	8	0.03
3	10	4	Bat-Ulzii	0	18	0	5	6	7	0.01
4	10	5	BB-Ulaan	0	7	0	3	4	0	0.01
5	10	6	Bayangol	0	7	0	2	5	0	0.01
6	10	7	Guchin-Us	0	9	0	1	8	0	0.02
7	10	8	Esunzuil	0	6	0	3	3	0	0.01
8	10	9	Ulziit	0	4	0	1	2	1	0.01
9	10	10	ZB Ulaan	0	19	0	1	12	6	0.03
10	10	11	Bogd	0	53	0	1	7	44	0.05
11	10	12	Nariinteel	0	21	0	3	11	7	0.02
12	10	13	Sant	0	14	0	2	10	2	0.02
13	10	14	Taragt	0	5	0	2	2	0	0.01
14	10	15	Tugrug	0	17	0	3	12	2	0.03
15	10	16	Yanga Khairkhandul	0	31	0	4	24	3	0.02
16	10	17	aan	0	7	0	5	1	0	0.01
17	10	18	Khujirt	0	72	0	11	28	33	0.03
18	10	19	Kharkhorin	297	639	0	12	330	0	0.07
19	10	20	Bayanteeg	0	1	0	1	0	0	0.00
20	13	2	Altanbulag	1,339	1,373	0	7	24	3	0.43
21	13	3	Eruu	0	98	0	2	21	75	0.04
22	13	4	Zuunburen	70	81	0	5	5	0	0.04
23	13	5	Khushaat	0	25	0	0	24	0	0.03
24	13	6	Orkhon	0	42	0	0	41	0	0.03
25	13	7	Sant	0	37	0	2	35	0	0.02
26	13	8	Khuder	0	33	0	0	33	0	0.02
27	13	9	Tsagaannuur	0	72	0	1	70	0	0.02
28	13	10	Bugant	0	0	0	0	0	0	0.00
29	13	11	Orkhontuul	0	68	0	2	66	0	0.02
30	13	12	Baruunburen	0	34	0	1	34	0	0.02
31	13	13	Dulaankhaan	0	0	0	0	0	0	0.00
32	13	14	Javkhlant	0	19	0	0	18	0	0.02
33	13	15	Shaamar	100	168	0	6	62	0	0.05
34	13	16	Tushig	0	28	0	2	27	0	0.02
35	13	17	Saikhan	0	0	0	0	0	0	
36	13	18	Khutul	115	303	0	13	174	0	0.05
37	13	19	Zuunkharaa Bayangol	1,203	1,662	0	6	454	0	0.09
38	13	20	(Baruunharaa)	0	85	0	1	84	0	0.02
39	13	21	Tunkhel	0	74	0	1	73	0	0.02
40	19	2	Shariin gol	0	237	0	20	81	136	0.03
41	19	3	Khongor	0	43	0	3	31	9	0.02
42	19	4	Orkhon	0	18	0	9	9	0	0.01

Table 3.1.5-5 Shifting Mobile Demand in Each Sum Centre

ID	Aimag ID	Sum ID	Aimag/Sum Name	Total	18999 and Under	19000-40999	41000-100999	101000 and above	Demand Density per Population
1	10	2	Bayan-Undur	6	0	1	2	3	0.01
2	10	3	Burd	0	0	0	0	0	0.00
3	10	4	Bat-Ulzii	9	0	3	3	3	0.01
4	10	5	BB-Ulaan	4	0	2	2	0	0.01
5	10	6	Bayangol	4	0	1	3	0	0.00
6	10	7	Guchin-Us	4	0	0	4	0	0.01
7	10	8	Esunzuil	3	0	2	2	0	0.00
8	10	9	Ulziit	2	0	1	1	0	0.00
9	10	10	ZB Ulaan	10	0	0	6	3	0.01
10	10	11	Bogd	27	0	0	4	23	0.03
11	10	12	Nariinteel	11	0	1	6	4	0.01
12	10	13	Sant	7	0	1	5	1	0.01
13	10	14	Taragt	3	0	1	1	0	0.00
14	10	15	Tugrug	9	0	1	6	1	0.01
15	10	16	Yanga	16	0	2	13	1	0.01
16	10	17	Khairkhandula	3	0	3	1	0	0.01
17	10	18	Khujirt	8	0	4	4	0	0.00
18	10	19	Kharkhorin	178	0	6	171	0	0.02
19	10	20	Bayanteeg	1	0	0	0	0	0.00
20	13	2	Altanbulag	18	0	4	13	2	0.01
21	13	3	Eruu	51	0	1	11	39	0.02
22	13	4	Zuunburen	6	0	3	3	0	0.00
23	13	5	Khushaat	13	0	0	13	0	0.01
24	13	6	Orkhon	22	0	0	21	0	0.02
25	13	7	Sant	19	0	1	18	0	0.01
26	13	8	Khuder	17	0	0	17	0	0.01
27	13	9	Tsagaannuur	37	0	1	37	0	0.01
28	13	10	Bugant	0	0	0	0	0	0.00
29	13	11	Orkhontuul	35	0	1	34	0	0.01
30	13	12	Baruunburen	18	0	0	18	0	0.01
31	13	13	Dulaankhaan	0	0	0	0	0	0.00
32	13	14	Javkhlant	10	0	0	9	0	0.01
33	13	15	Shaamar	35	0	3	32	0	0.01
34	13	16	Tushig	15	0	1	14	0	0.01
35	13	17	Saikhan	0	0	0	0	0	
36	13	18	Khutul	33	0	2	31	0	0.01
37	13	19	Zuunkharaa	192	0	2	190	0	0.01
38	13	20	Bayangol	44	0	0	44	0	0.01
39	13	21	Tunkhel	3	0	0	3	0	0.01
40	19	2	Shariin gol	123	0	11	42	71	0.02
41	19	3	Khongor	22	0	2	16	5	0.01
42	19	4	Orkhon	10	0	5	5	0	0.00

Table 3.1.5-6 Fixed Telephone Total Present

ID	AimagID	SumID	Aimag/Sum Name	Existing Fix Sub	Household Demand	Pubblic Demand	Business Demand	Present Fix Demand	Less than Existing Sub	Arranged Present Fix Demand	Macro Demand 2001	Density per Population	Existing Mobile Sub	Mobile Present Demand	Shifting Mobilee Demand
1	10	2	Bayan-Undur	1	38	36	2	76	0	76	22	0.14	0	18	11
2	10	3	Burd	12	38	41	3	82	0	82	37	0.14	0	18	11
3	10	4	Bat-Ulzii	19	39	38	3	81	0	81	94	0.04	0	18	11
4	10	5	BB-Ulaan	0	15	33	2	49	0	49	21	0.10	0	7	4
5	10	6	Bayangol	49	15	23	6	44	-5	49	56	0.05	0	7	4
6	10	7	Guchin-Us	0	19	33	2	53	0	53	53	0.11	0	9	5
7	10	8	Esunzuil	60	14	30	10	54	-6	60	80	0.06	0	6	3
8	10	9	Ulziit	8	8	33	5	46	0	46	32	0.08	0	4	2
9	10	10	ZB Ulaan	29	40	42	5	86	0	86	57	0.13	0	19	11
10	10	11	Bogd	0	110	40	5	155	0	155	50	0.16	0	53	35
11	10	12	Nariinteel	0	45	38	46	128	0	128	62	0.09	0	21	12
12	10	13	Sant	75	31	32	4	67	-8	75	43	0.10	0	14	8
13	10	14	Taragt	29	11	38	3	52	0	52	43	0.09	0	5	3
14	10	15	Tugrug	5	36	33	7	76	0	76	36	0.12	0	17	9
15	10	16	Yanga	120	66	53	19	138	0	138	145	0.10	0	31	17
16	10	17	Khairkhandulaan	0	15	35	3	53	0	53	27	0.09	0	7	3
17	10	18	Khujirt	155	153	32	19	204	0	204	298	0.08	0	72	43
18	10	19	Kharkhorin	711	736	41	51	827	0	827	849	0.10	297	639	0
19	10	20	Bayanteeg	1	3	25	0	28	0	28	9	0.02	0	1	1
20	13	2	Altanbulag	72	74	15	10	100	0	100	157	0.03	1,339	1,373	0
21	13	3	Eruu	63	205	11	11	227	0	227	126	0.09	0	98	63
22	13	4	Zuunburen	5	24	12	24	60	0	60	65	0.03	70	81	0
23	13	5	Khushaat	10	53	9	32	94	0	94	35	0.10	0	25	14
24	13	6	Orkhon	11	89	9	26	124	0	124	53	0.10	0	42	23
25	13	7	Sant	19	79	15	15	108	0	108	74	0.07	0	37	20
26	13	8	Khuder	12	72	20	14	105	0	105	46	0.07	0	33	19
27	13	9	Tsagaannuur	21	154	16	29	198	0	198	128	0.06	0	72	40
28	13	10	Bugant	13	0	25	0	25	0	25	95	0.01	0	0	0
29	13	11	Orkhontuul	93	146	15	34	195	0	195	106	0.06	0	68	38
30	13	12	Baruunburen	36	74	9	21	104	0	104	104	0.07	0	34	19
31	13	13	Dulaankhaan	7	0	10	0	10	0	10	35	0.01	0	0	0
32	13	14	Javkhlant	14	40	9	24	73	0	73	42	0.08	0	19	10
33	13	15	Shaamar	64	147	9	17	173	0	173	170	0.05	100	168	0
34	13	16	Tushig	10	61	9	12	82	0	82	48	0.06	0	28	16
35	13	17	Saikhan	11	0	0	10	10	-1	11	209		0	0	0
36	13	18	Khutul	521	405	35	31	470	-51	521	508	0.08	115	303	0
37	13	19	Zuunkharaa	1,237	988	63	164	1,214	-23	1,237	1,167	0.07	1,203	1,662	0
38	13	20	Bayangol	127	182	12	37	231	0	231	228	0.06	0	85	47
39	13	21	Tunkhel	51	159	8	17	185	0	185	14	0.05	0	74	41
40	19	2	Shariin gol	326	501	36	68	604	0	604	651	0.08	0	237	147
41	19	3	Khongor	270	92	127	51	270	0	270	176	0.10	0	43	25
42	19	4	Orkhon	140	41	28	13	82	-58	140	118	0.05	0	18	10

3.1.6 Future Demand Estimation

(1) Estimation Method

The growth of the future demand is basically depending on the two factors, one is the increase of telephone necessity due to economical activity etc. (growth of demand density) and the other is the growth of population. In this study, the growth of the demand density is estimated by the growth of the economical activity. The future demand is calculated by the following formula.

Future Demand = Future Demand Density *Future Population

(2) Present Demand Density per Population

The Present demand density is shown in Annex 1, Table 9 based on the Present Demand (Table 3.1.5-6) and the population of Sum centre (Annex 1, Table 8).

(3) Future Population

Transition of Sum centre population from 1997 to 2001 and the growth rate per year during the period is shown in Annex 1, Table 8. Future Population is calculated by:

(Future Population) = (Present Population) x (Population Growth Rate)$^{N(\text{Period by year})}$.

(4) Estimation of future Telephone demand density

Sum Centre GRDP and Sum Centre Official Office yearly Budget and Expenditure were examined for future Economical growth estimation. However, the trend of statistic data during last several years is fluctuated much every year because of outside factor such as Sodo etc. and it is difficult to use for the estimation of future growth trend. Therefore, the growth of GRDP in Aimags used in the Macro demand forecast is applied to Micro demand forecast also and the actual Growth rate is calculated by the growth rate of Macro demand density for each Sum centre.

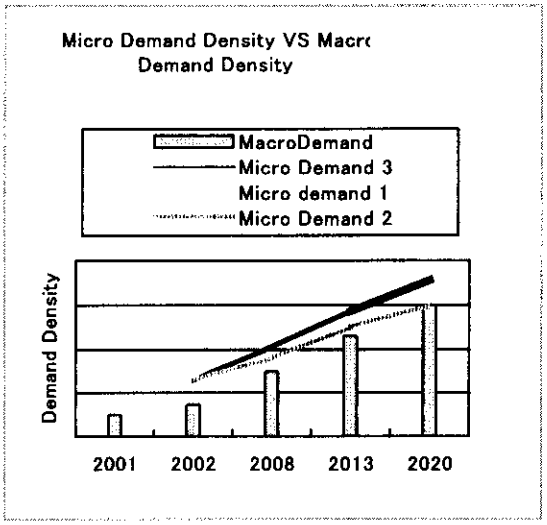


Fig 3.1.6-1 Apply of Growth rate of Macro Demand Density

Since there are three options listed at the below and shown in Fig 3.1.6-1 to apply the growth rate of Macro demand density, the case of Micro demand 1 that means the Micro demand density increases by Macro demand density growth rate, is reasonable and applied for the calculation.

- ✧ Micro Demand1: Using Macro Demand Density Growth Rate
- ✧ Micro Demand2 :Adjusting the Micro Demand (2020) to Macro Demand (2020)
- ✧ Micro Demand3: Adding the Deviation between Micro and Macro in 2002 to Future Macro Demand

(5) Estimation of Future Telephone Demand Calculation Results

The estimation results are shown in the following Tables.

- Fixed Telephone Demand (2002 to 2020) (Table 3.1.6-1)
- Shifting Mobile Demand (2002 to 2020) (Table 3.1.6-2)
- Total Fixed Telephone Demand (2002 to 2020) (Table 3.1.6-3) that is Fixed telephone Demand (2002 -2020) plus Shifted Mobile Demand (2002-2008)

Table 3.1.6-1 Fixed Telephone Demand (2002 to 2020)

ID	Aimag ID	Sum ID	Aimag/Sum Name	Arranged Present Fix Demand	Micro 2008	Micro 2013	Micro 2020	Macro 2020
1	10	2	Bayan-Undur	76	96	119	162	49
2	10	3	Burd	82	102	126	175	82
3	10	4	Bat-Ulzii	81	101	125	172	208
4	10	5	BB-Ulaan	49	63	77	106	47
5	10	6	Bayangol	49	62	76	104	123
6	10	7	Guchin-Us	53	66	82	112	116
7	10	8	Zyil	60	75	93	128	177
8	10	9	Ulziit	46	57	71	98	70
9	10	10	ZB Ulaan	86	107	133	183	125
10	10	11	Bogd	155	194	239	328	110
11	10	12	Nariinteel	128	161	199	275	138
12	10	13	Sant	75	93	116	158	94
13	10	14	Taragt	52	64	81	110	94
14	10	15	Tugrug	76	93	116	160	79
15	10	16	Yanga	138	172	213	293	320
16	10	17	Kharkhandulaa	53	65	82	113	59
17	10	18	Khuzirt	204	255	316	433	657
18	10	19	Kharkhorin	827	1,034	1,283	1,759	1,875
19	10	20	Bayanteeg	28	35	44	62	21
Uvurkhangai Total				**2,318**	**2,895**	**3,591**	**4,931**	**4,444**
20	13	2	Altanbulag	100	102	126	173	274
21	13	3	Eruu	227	233	288	396	221
22	13	4	Zuunburen	60	62	77	105	114
23	13	5	Khushaat	94	96	118	163	61
24	13	6	Orkhon	124	126	157	215	92
25	13	7	Sant	108	110	137	187	128
26	13	8	Khuder	105	107	132	182	80
27	13	9	Tsagaannuur	198	202	250	344	223
28	13	10	Bugant	0	0	0	0	165
29	13	11	Orkhontuul	195	199	247	339	185
30	13	12	Baruunburen	104	106	131	179	181
31	13	13	Dulaankhaan	0	0	0	0	62
32	13	14	Javkhlant	73	74	93	128	74
33	13	15	Shaamar	173	176	218	299	296
34	13	16	Tushig	82	83	103	141	83
35	13	17	Saikhan	0	0	0	0	365
36	13	18	Khutul	521	533	661	906	887
37	13	19	Zuunkharaa	1,237	1,265	1,569	2,153	2,039
38	13	20	Bayangol	231	236	293	401	397
39	13	21	Tunkhel	185	185	225	317	24
Selenge Total				**3,815**	**3,895**	**4,824**	**6,628**	**5,951**
40	19	2	Shariin gol	604	671	821	1,109	1,216
41	19	3	Khongor	270	300	366	496	329
42	19	4	Orkhon	140	155	190	257	220
Darkhan-Uul Total				**1,014**	**1,127**	**1,378**	**1,862**	**1,765**
Total				**7,147**	**7,917**	**9,793**	**13,420**	**12,160**

Table 3.1.6-2 Shifting Mobile Demand (2002 to 2020)

ID	Aimag ID	Sum ID	Aimag/Sum Name	Shiting Mobile Present	2008	2013	2020
1	10	2	Bayan-Undur	11	14	17	23
2	10	3	Burd	11	13	17	23
3	10	4	Bat-Ulzii	11	13	17	23
4	10	5	BB-Ulaan	4	5	6	8
5	10	6	Bayangol	4	5	6	8
6	10	7	Guchin-Us	5	6	7	10
7	10	8	Esunzuil	3	4	5	7
8	10	9	Ulziit	2	3	3	4
9	10	10	ZB Ulaan	11	14	17	23
10	10	11	Bogd	35	43	54	74
11	10	12	Nariinteel	12	16	19	26
12	10	13	Sant	8	10	12	17
13	10	14	Taragt	3	3	4	6
14	10	15	Tugrug	9	12	14	20
15	10	16	Yanga	17	22	27	37
16	10	17	Khairkhandula	3	4	5	7
17	10	18	Khujirt	43	54	67	92
18	10	19	Kharkhorin	0	0	0	0
19	10	20	Bayanteeg	1	1	1	1
Uvurkhangai Total				**193**	**240**	**298**	**409**
20	13	2	Altanbulag	0	0	0	0
21	13	3	Eruu	63	65	81	111
22	13	4	Zuunburen	0	0	0	0
23	13	5	Khushaat	14	14	17	24
24	13	6	Orkhon	23	24	29	40
25	13	7	Sant	20	21	26	35
26	13	8	Khuder	19	19	23	32
27	13	9	Tsagaannuur	40	41	50	69
28	13	10	Bugant	0	0	0	0
29	13	11	Orkhontuul	38	39	48	66
30	13	12	Baruunburen	19	20	24	33
31	13	13	Dulaankhaan	0	0	0	0
32	13	14	Javkhlant	10	11	13	18
33	13	15	Shaamar	0	0	0	0
34	13	16	Tushig	16	16	20	27
35	13	17	Saikhan	0	0	0	0
36	13	18	Khutul	0	0	0	0
37	13	19	Zuunkharaa	0	0	0	0
38	13	20	Bayangol	47	48	60	82
39	13	21	Tunkhel	41	41	50	71
Selenge Total				**350**	**357**	**441**	**608**
40	19	2	Shariin gol	147	164	200	270
41	19	3	Khongor	25	28	34	46
42	19	4	Orkhon	10	11	13	18
Darkhan-Uul Total				**182**	**202**	**247**	**334**
Total				**725**	**800**	**986**	**1,351**

Table 3.1.6-3 Fixed Telephone Micro Demand including Shifted Mobile Demand

ID	AimagID	SumID	Aimag/Sum Name	2002	2008	2013	2020
1	10	2	Bayan-Undur	86	109	119	162
2	10	3	Burd	93	116	126	175
3	10	4	Bat-Ulzii	91	114	125	172
4	10	5	BB-Ulaan	53	68	77	106
5	10	6	Bayangol	53	66	76	104
6	10	7	Guchin-Us	58	72	82	112
7	10	8	Esunzuil	63	79	93	128
8	10	9	Ulziit	48	60	71	98
9	10	10	ZB Ulaan	97	120	133	183
10	10	11	Bogd	190	237	239	328
11	10	12	Nariinteel	141	177	199	275
12	10	13	Sant	83	103	116	158
13	10	14	Taragt	55	67	81	110
14	10	15	Tugrug	85	105	116	160
15	10	16	Yanga	155	194	213	293
16	10	17	Khairkhandulaan	57	69	82	113
17	10	18	Khujirt	247	309	316	433
18	10	19	Kharkhorin	827	1,034	1,283	1,759
19	10	20	Bayanteeg	28	36	44	62
Uvurkhangai Total				**2,510**	**3,136**	**3,591**	**4,931**
20	13	2	Altanbulag	100	102	126	173
21	13	3	Eruu	290	298	288	396
22	13	4	Zuunburen	60	62	77	105
23	13	5	Khushaat	108	110	118	163
24	13	6	Orkhon	147	150	157	215
25	13	7	Sant	129	130	137	187
26	13	8	Khuder	123	126	132	182
27	13	9	Tsagaannuur	238	243	250	344
28	13	10	Bugant	0	0	0	0
29	13	11	Orkhontuul	232	238	247	339
30	13	12	Baruunburen	123	126	131	179
31	13	13	Dulaankhaan	0	0	0	0
32	13	14	Javkhlant	83	85	93	128
33	13	15	Shaamar	173	176	218	299
34	13	16	Tushig	97	99	103	141
35	13	17	Saikhan	0	0	0	0
36	13	18	Khutul	521	533	661	906
37	13	19	Zuunkharaa	1,237	1,265	1,569	2,153
38	13	20	Bayangol	278	284	293	401
39	13	21	Tunkhel	226	226	225	317
Selenge Total				**4,165**	**4,253**	**4,824**	**6,628**
40	19	2	Shariin gol	752	835	821	1,109
41	19	3	Khongor	295	328	366	496
42	19	4	Orkhon	150	166	190	257
Darkhan-Uul Total				**1,196**	**1,329**	**1,378**	**1,862**
Total				**7,872**	**8,717**	**9,793**	**13,420**

3.1.7 Fulfilment Plan of the Forecasted Sum Demand

Based on the Implementation Plan of FS Project in Chapter 6 and Facility Plan in Chapter 5, the forecasted demand in Sums will be fulfilled as described in the followings:

(1) Priority Sum Centre in Rural Development Project (FS Project)

Priority Sum Centres and those service inauguration are planed under the discussion between PTA , Mongolia and JICA Telecom study Team as follows:

Table 3.1.7-1 Priority Sum Centre in Uvurkhangai Aimag

Aimag ID No	Sum ID No	Aimag/Sum Name	Inauguration
10	3	Burd	01-Jan-06
10	4	Bat-Ulzii	01-Jan-06
10	6	Bayangol	01-Jan-06
10	8	Esunzuil	01-Jan-06
10	10	ZB Ulaan	01-Jan-06
10	12	Nariinteel	01-Jan-06
10	13	Sant	01-Jan-06
10	16	Yanga	01-Jan-06
10	18	Khujirt	01-Jan-06
10	19	Kharkhorin	01-Jan-06

Table 3.1.7 –2 Priority Sum Centre in Selenge Aimag

Aimag ID No	Sum ID No	Aimag/Sum Name	Inauguration
13	2	Altanbulag	01-Jan-06
13	3	Eruu	01-Jan-06
13	4	Zuunburen	01-Jan-06
13	7	Sant	01-Jan-06
13	9	Tsagaannuur	01-Jan-06
13	11	Orkhontuul	01-Jan-06
13	15	Shaamar	01-Jan-06
13	18	Khutul	01-Jan-06
13	19	Zuunkharaa	01-Jan-06
13	20	Bayangol	01-Jan-06
13	21	Tunkhel	01-Jan-06

Table 3.1.7-3 Priority Sum Centre in Darkhan-Uul Aimag

Aimag ID No	Sum ID No	Aimag/Sum Name	Inauguration
19	2	Shariin gol	01-Jan-06

(2) Fulfilment Plan

According to the priority of Sums, Inauguration year and also Design Period of Network (Switching facility is designed for the demand of year 2010), Fulfilments Plan of the Sum demand is shown in Table 3.8-4.

Table 3.1.7-4 Fulfilment Plan

Year	2002	2003	2004	2005	2006	2007	2008	2009	2010
Demand	6,086	6,189	6,292	6,395	6,498	6,601	6,704	6,882	7,060
Existing	3,829								
New Connection	0	0	0	0	2,667	102	96	183	183
Working Lines	3,829	3,829	3,829	3,829	6,496	6,598	6,694	6,876	7,059
Fulfillment Ratio	63%	62%	61%	60%	100%	100%	100%	100%	100%

Demand Estimation in FS Project Sum Centre and New connection Plan are described in Table 3.1.7-5 and Table 3.1.7-6 by year and by areas.

Table 3.1.7-5 Microscopic Demand Forecast in FS Project Areas

ID	Aimag ID	Sum ID	Aimag/Sum Name	Existing Sub	Railway Existing Lines	2002	2003	2004	2005	2006	2007	2008	2009	2010
2	10	3	Burd	12	0	93	97	100	104	108	112	116	118	120
3	10	4	Bat-Ulzii	19	0	91	95	99	103	106	110	114	116	119
5	10	6	Bayangol	49	0	53	55	57	60	62	64	66	68	70
7	10	8	Esunzuil	60	0	63	66	69	71	74	77	79	82	85
9	10	10	ZB Ulaan	29	0	97	101	105	109	113	116	120	123	125
11	10	12	Nariinteel	0	0	141	147	153	159	165	171	177	181	186
12	10	13	Sant	75	0	83	86	90	93	96	99	103	105	108
15	10	16	Yanga	120	0	155	162	168	174	181	187	194	198	202
17	10	18	Khujirt	155	0	247	258	268	278	288	299	309	310	312
18	10	19	Kharkhorin	711	0	827	861	896	930	965	999	1,034	1,084	1,133
Uvurkhangai Total				1,230	0	1,850	1,927	2,004	2,081	2,158	2,235	2,312	2,386	2,459
20	13	2	Altanbulag	72	0	100	100	100	101	101	101	102	106	111
21	13	3	Eruu	63	0	290	291	293	294	295	297	298	296	294
22	13	4	Zuunburen	5	0	60	60	61	61	61	61	62	65	68
25	13	7	Sant	19	0	129	129	129	130	130	130	130	132	133
27	13	9	Tsagaannuur	21	0	238	239	240	240	241	242	243	244	246
29	13	11	Orkhontuul	93	73	232	233	234	235	236	237	238	240	242
33	13	15	Shaamar	64	0	173	173	174	174	175	175	176	184	193
36	13	18	Khutul	521	59	521	523	525	527	529	531	533	559	584
37	13	19	Zuunkharaa	1,237	656	1,237	1,242	1,246	1,251	1,256	1,260	1,265	1,326	1,387
38	13	20	Bayangol	127	0	278	279	280	281	282	283	284	286	288
39	13	21	Tunkhel	51	46	226	226	226	226	226	226	226	226	226
Selenge Total				2,273	834	3,484	3,496	3,509	3,521	3,533	3,545	3,558	3,664	3,771
40	19	2	Shariin gol	326	0	752	766	779	793	807	821	835	832	829
Darkhan-Uul Total				326	0	752	766	779	793	807	821	835	832	829
Total				3,829	834	6,086	6,189	6,292	6,395	6,498	6,601	6,704	6,882	7,060

Table 3.1.7-6 New Subscriber Connection Plan

ID	AimagID	SumID	Aimag/Sum Name	Inauguration	Existing Sub Total	2002	2003	2004	2005	2006	2007	2008	2009	2010
2	10	3	Burd	01-Jan-06	12	0	0	0	0	96	4	4	2	2
3	10	4	Bat-Ulzii	01-Jan-06	19	0	0	0	0	87	4	4	2	2
5	10	6	Bayangol	01-Jan-06	49	0	0	0	0	13	2	2	2	2
7	10	8	Esunzuil	01-Jan-06	60	0	0	0	0	14	3	3	3	3
9	10	10	ZB Ulaan	01-Jan-06	29	0	0	0	0	84	4	4	3	3
11	10	12	Nariinteel	01-Jan-06	0	0	0	0	0	165	6	6	4	4
12	10	13	Sant	01-Jan-06	75	0	0	0	0	21	3	3	3	3
15	10	16	Yanga	01-Jan-06	120	0	0	0	0	61	6	6	4	4
17	10	18	Khujirt	01-Jan-06	155	0	0	0	0	133	10	10	1	1
18	10	19	Kharkhorin	01-Jan-06	711	0	0	0	0	254	35	35	50	50
	Uvurkhangai Total				1,230	0	0	0	0	928	77	77	74	74
20	13	2	Altanbulag	01-Jan-06	72	0	0	0	0	29	0	0	5	5
21	13	3	Eruu	01-Jan-06	63	0	0	0	0	230	0	0	0	0
22	13	4	Zuunburen	01-Jan-06	5	0	0	0	0	56	0	0	3	3
25	13	7	Sant	01-Jan-06	19	0	0	0	0	111	0	0	1	1
27	13	9	Tsagaannuur	01-Jan-06	21	0	0	0	0	220	1	1	1	1
29	13	11	Orkhontuul	01-Jan-06	93	0	0	0	0	143	1	1	2	2
33	13	15	Shaamar	01-Jan-06	64	0	0	0	0	111	1	1	8	8
36	13	18	Khutul	01-Jan-06	521	0	0	0	0	8	2	2	26	26
37	13	19	Zuunkharaa	01-Jan-06	1,237	0	0	0	0	19	5	5	61	61
38	13	20	Bayangol	01-Jan-06	127	0	0	0	0	155	1	1	2	2
39	13	21	Tunkhel	01-Jan-06	51	0	0	0	0	175	0	0	0	0
	Selenge Total				2,273	0	0	0	0	1,258	11	11	109	109
40	19	2	Shariin gol	01-Jan-06	326	0	0	0	0	481	14	8	0	0
	Darkhan-Uul Total				326	0	0	0	0	481	14	8	0	0
	Total				3,829	0	0	0	0	2,667	102	96	183	183

3.1.8 Estimation Result

(1) Comparison with Master Plan Macro Demand Estimation

The nature of the Micro demand forecast result is reasonable in comparison with Macro Demand, as example, the deviation between Micro Demand and Macro demand in 2020 is not so much (Micro demand is 16% higher than Macro demand and the Demand Density is 10% for the population as total)

Table 3.1.8-1 Comparison of Micro Demand and Macro Demand

Aimag	Macro2020	Macro2020 Demand Density	Micro2020	Micro2020 Demand Density	Rate of Micor for Macro
Uvurkhangai Total	4,444	0.18	4,931	0.19	1.11
Selenge Total	5,359	0.06	6,628	0.08	1.24
Darkhan-Uul Total	1,765	0.10	1,862	0.10	1.05
Total	11,568	0.09	13,420	0.10	1.16

(2) Relation with Household Income

Relation of Average Income and Household Demand density per population of each Sum Centre is shown in the following Figure. Most of Average Incomes of Sum Centre are less than 70,000Tg and Demand Densities are lower than 6%.

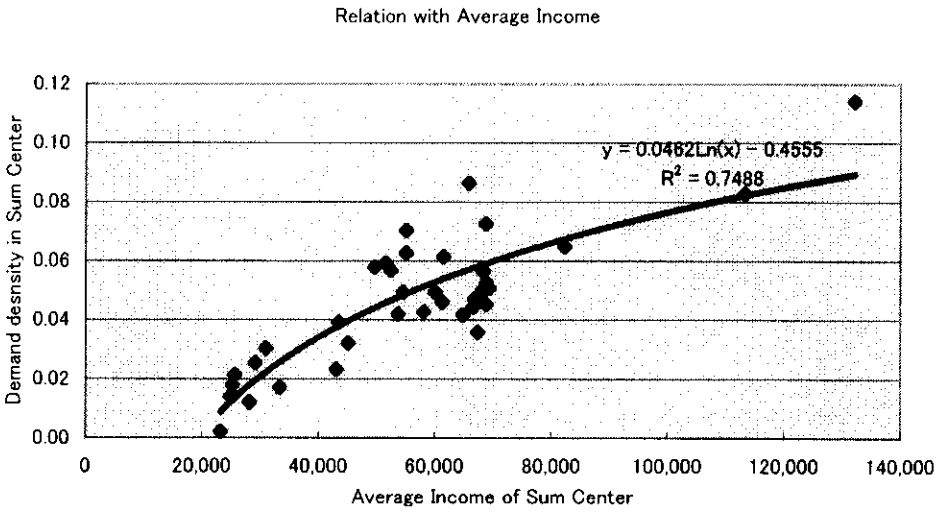


Figure 3.1.8-1 Relation of Average Income and Household Demand Density per Population

(3) Relation with Public and Business organisation

Relation between Demand Density per Population in each Sum Centre and the Population is shown in the following Figure. Smaller Sum Centre has higher Demand density.

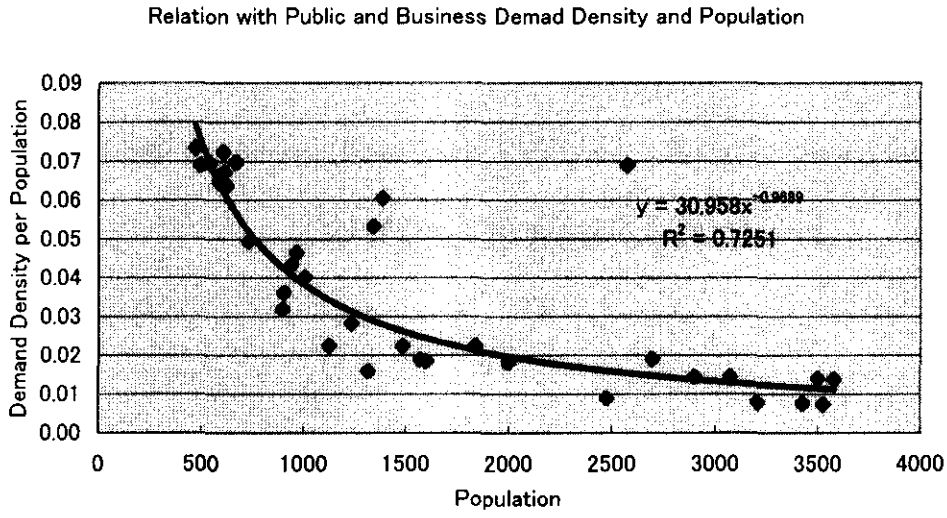


Figure 3.1.8-2 Relation of Public and Business Organisation Demand Density and Population of Sum Centres

3.2. IT Demand

3.2.1. Method of Demand Forecast

Figure 3.2-1 shows the flow of demand forecast of Internet at target Sum of the Feasibility Study. Basis of this forecasting method is the same as macro study in the master plan, i.e., features of households and their GRDP.

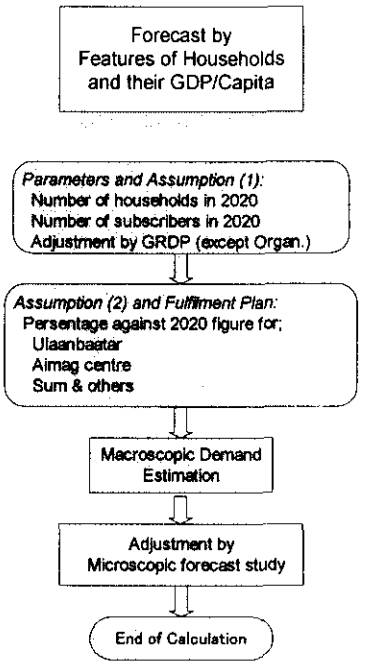


Figure 3.2-1 Flow of Demand Forecast of Internet

Following assumptions are applied for the calculation:

- Number of family members (for households' estimation)
  Sum & Others: 4.2 persons in a family

- Number of subscribers in 2020
  Sum Centre: 0.1 subscribers per total households of Sum centre
  Other rural: 0.05 subscribers per total households of the rural area

- Fulfilment plan (100% demand will be fulfilled by following scenario/ratio)
  Sum & Others: in 2008, 40% of 2020 figure
  in 2013, 70% of 2020 figure

- Adjustment by GRDP
  The demand of each district is to be adjusted by Aimag's GRDP/Capita from the national GDP/Capita.

- Adjustment by the results of microscopic study.
  The number of organization such as public organizations and private firms are more than the figures of previous study. Table 3.2-1 shows number of those organizations in target Sum of F/S. This portion's figures are to be adjusted.

Table 3.2-1 Number of Organisations in the Target Sums of F/S

Name of Sum	Public Organisation*	School**	Hospital	Private Firm*	Total
Uvurkhangai					
Burd	15	1	1	3	20
Bat-Ulzii	10	2	1	2	15
Bavangol	14	1	1	5	21
Esonzuil	15	1	1	5	22
ZB Ulaan	12	2	1	3	18
Nariinteel	13	2	1	2	18
Sant	16	1	1	2	20
Uvanga	29	2	2	19	52
Khuiirt	10	1	1	14	26
Kharkhorin	8	3	1	55	67
Sub-total	142	16	11	110	279
Selenge					
Shariin gol	9	1	1	84	95
Altanbulag	12	1	1	11	25
Eruu	8	2	1	14	25
Zuunburen	10	1	1	25	37
Sant	3	1	1	18	23
Tsagaannuur	4	1	1	31	37
Orkhontuul	3	2	1	35	41
Shaamar	2	2	1	10	15
Khutul	8	2	1	40	51
Zuunkharaa	16	6	1	172	195
Bavangol (Baruunkharaa)	4	1	1	42	48
Tunkhel	2	1	-	23	26
Sub-total	81	21	11	505	618
Total	223	37	22	615	897

Note: * More reliable figure is stated among the data from Sum, Aimag, questionnaire survey in September or hearing survey in June 2002.
** Data from Ministry of Science, Technology, Education and Calture in 2002.

(**Reference**: from the Questionnaire Survey)

Almost all families (98 %) have not their own PC. 78.9 % of respondents have not experience of PC operation and 97.3 % have not experience of Internet.

But, 83 % of them intend to access Internet, and 84 % of Uvurkhangai or 91 % of Selenge peoples want to use Internet café when the café opens in their Sums. That means; Sum inhabitant's intention to use IT is extremely high, and this characteristic is observed throughout the age groups.

3.2.2. Results of IT Demand Forecast

Based on the above consideration, Internet demands in the target Sums of F/S are

estimated as shown in Table 3.2-2

Table 3.2-2 Internet Demand in the Target Sums of F/S

	Population (2020) (Except Rural)	Population (2020) (Rural)	Number of HH (2020) (Except Rural)	Number of HH (2020) (Rural)	Number of Sub. (2008) (Sum & Other)	Number of Sub. (2013) (Sum & Other)	Number of Sub. (2020) (Sum & Other)	Number of Sub. For (Organization)
UVURKHANGAI							GRDP Adjust:	0.5297
Burd	639	4,085	152.2	972.5	22	38	34	20
Bat-Ulzii	2,277	4,642	542.1	1,105.2	29	51	58	15
Bayangol	828	4,954	197.2	1,179.5	25	44	42	21
Esonzuil	1,146	3,380	272.8	804.7	23	40	36	22
ZB Ulaan	1,020	5,557	242.8	1,323.1	26	46	48	18
Nariinteel	1,469	3,781	349.7	900.2	24	42	42	18
Sant	1,040	4,201	247.7	1,000.2	24	42	40	20
Uyanga	1,640	7,502	390.4	1,786.2	48	84	68	52
Khuzirt	4,782	4,680	1,138.6	1,114.4	46	81	90	26
Kharkhorin	10,522	6,206	2,505.3	1,477.7	96	167	172	67
Total	25,363	48,987	6,039	11,664	363	635	629	279
		74,350		**17,702**				**908**
SELENGE (DARKHAN-UUL)							GRDP Adjust:	0.4622
Shariin gol	11,449	1,218	2,726.0	290.1	91	159	133	95
Total	11,449	1,218	2,726	290	91	159	133	95
		12,668		**3,016**				**228**
SELENGE							GRDP Adjust:	0.5853
Altanbulag	3,667	820	873.1	195.3	33	57	57	25
Eruu	3,022	4,346	719.5	1,034.7	39	68	72	25
Zuunburen	2,492	733	593.3	174.6	31	54	40	37
Sant	2,032	588	483.7	139.9	22	39	32	23
Tsagaannuur	3,970	1,349	945.3	321.3	41	71	65	37
Orkhontuul	3,505	1,501	834.5	357.5	40	70	59	41
Shaamar	4,842	854	1,152.7	203.2	35	62	73	15
Khutul	3,775	0	898.7	0.0	41	73	53	51
Zuunkharaa	28,166	460	6,706.2	109.5	236	414	396	195
Bayangol (Baruunkharaa)	4,798	2,158	1,142.4	513.8	52	91	82	48
Tunkhel	256	1,022	60.8	243.4	15	26	11	26
Total	60,523	13,832	14,410	3,293	585	1,024	940	523
		74,355		**17,704**				**1,463**
FS Aimag's ALL		**161,373**		**38,422**	**1,039**	**1,819**		**2,598**

The detailed calculation results are shown in Annex 6.2.

CHAPTER 4

TECHNICAL PLAN

CHAPTER 4

TECHNICAL PLAN

4.1 General

The fundamental technical plan to be applied to the network development under the Feasibility Study should be in conformity with the ITU recommendations, be within the framework of the existing rules and be compatible with the existing MT network. The MT's existing technical plan has been a standard in Mongolia and approved by CRC. The Mongolian telecommunications network has been developed in keeping with the MT's technical plan.

4.2 Switching Network Plan

4.2.1 Basic Concept

The switching network under the Feasibility Study is designed as an expansion of the existing MT network.

The switching network in target Aimags will be structured stick to the existing one in principle. However, the links between Aimag centre and Sum centres in Selenge and Darkhan-Uul is modified in keeping with new (proposed) transmission links.

4.2.2 Existing Switching Network

Switching network plan of Uvurkahngai is a star type connection where all the Sum/Bag centres are connected directly to Arbaikheer Aimag centre switch. The links between them are all distant subscriber lines, not the inter-exchange circuits.

The switching network plan of Selenge and Darkhan-Uul is consisted of two (2) centres, that is, SDE switch of Sukhbaatar (Selenge) and EWSD switch of Darkhan-Uul. Five (5) Sum/Bag centre switches of Selenge Aimag and one (1) Sum centre switch of Tuv Aimag are assigned, respectively, a directory number of Darkhan-Uul EWSD. See Figure 4.2.2-1 (1/2) and (2/2)

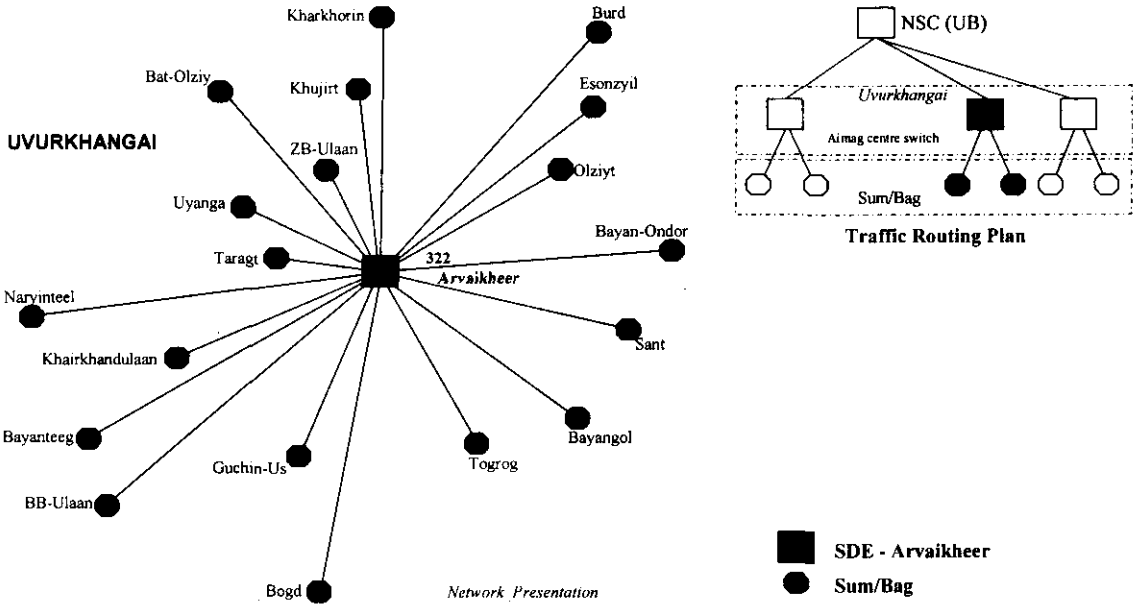


Figure 4.2.2-1 (1/2) Existing Switch Network - Uvurkhangai

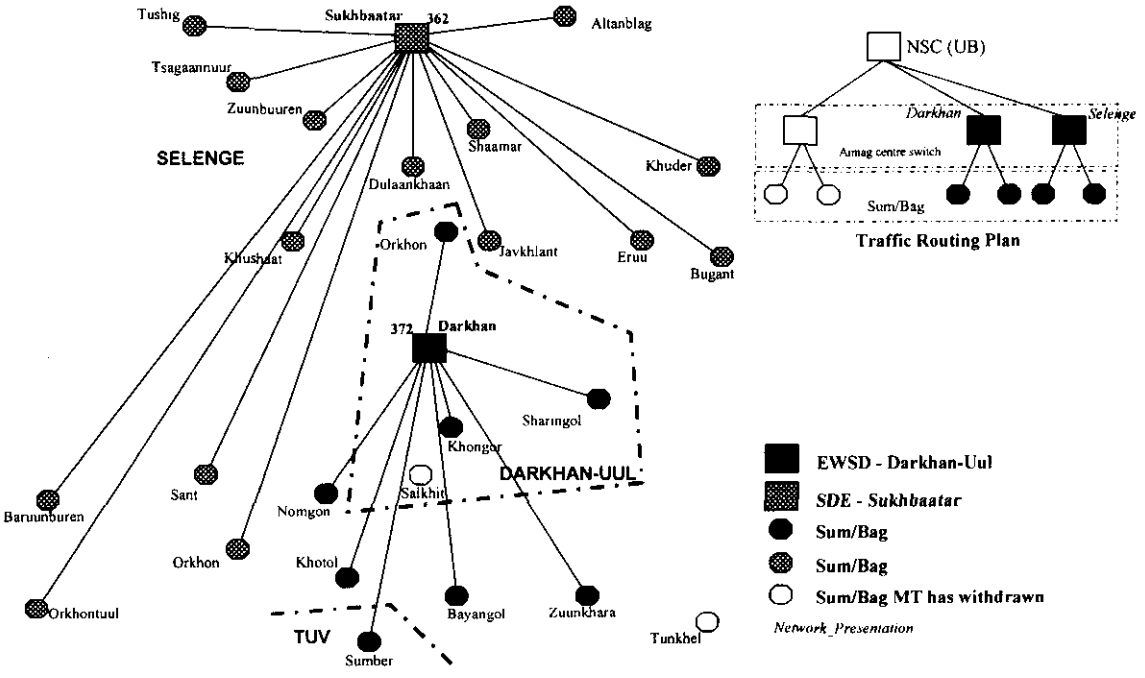


Figure 4.2.2-1 (2/2) Existing Switch Network - Selenge and Darkhan -Uul

4.2.3 Proposed Switching Network

(1) Target Exchanges

The switching systems of the following Sum centres will be replaced with digital switching system.

Uvurkhangai:

Burd, Bat-Ulzii, Bayangol, Esunzuil, ZB Ulaan, Nariinteel, Sant, Uyanga, Khujirt, Kharkhorin.(Total 10 Sums)

Selenge and Darkhan-Uul:

Altanbulag, Eruu, Zuunburen, Sant, Tsagaannuur, Orkhontuul, Shaamar, Khutul, Zuunkharaa, Bayangol (Baruunharaa), Tunkhel, Shariin gol. (Total 12 Sums)

(2) Exchange Allocation Plan under Feasibility Study

The allocation plan will not been changed in principle, that is, new switching systems will be installed at every existing exchanges which are in operation. No necessity was found to replace the existing exchange location. However, it was learned that Uyanga Sum centre will be moved gradually to a point adjacent to the existing point.

(3) Uvurkhangai Network

The switching network plan will be designed basically not changing the existing network. Taking over the existing network plan contributes for avoiding confusion which could be brought about to numbering plan and maintenance routine. See Figure 4.2.3-1 (1/2) Proposed Switch Network - Uvurkhangai.

In relation to the numbering plan, the Sum centre code is preferred to be within the series of the Aimag centre to which the Sum centre belongs. It is also preferred that the traffic to that Sum centre should be routed through the Aimag centre to which the relevant Sum centre belongs.

(4) Selenge and Darkhan-Uul Network

The switching network will be restructured in line with the national plan to merge Selenge and Darkhan-Uul into one Aimag. In the northern part of Selenge Aimag, the existing switching network plan will be kept unchanged. In the southern part of Selenge Aimag, most of Sum centre exchanges will be re-routed to Darkhan-Uul Aimag centre exchange. The new switching network will be decided in line with the rational transmission route design.

As a result, the unified Aimag will have two (2) switching network; a) one which accommodate Sum centre switches in northern half of the Aimag, and b) another which links those in southern half. The centre switch of the northern half will be that of Sukhbaatar, and it will be placed, in the network hierarchy structure, under the centre switch of Darkhan-Uul. See Figure 4.2.3-1 (2/2) Proposed Switch Network - Selenge and Darkhan-Uul.

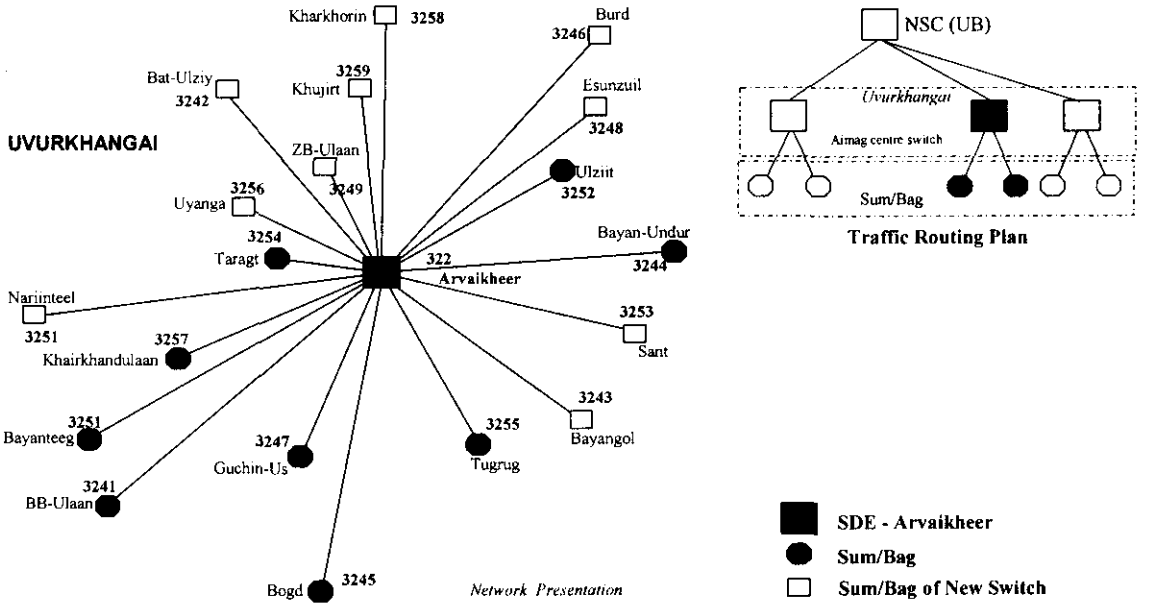


Figure 4.2.3-1 (1/2) Proposed Switch Network - Uvurkhangai

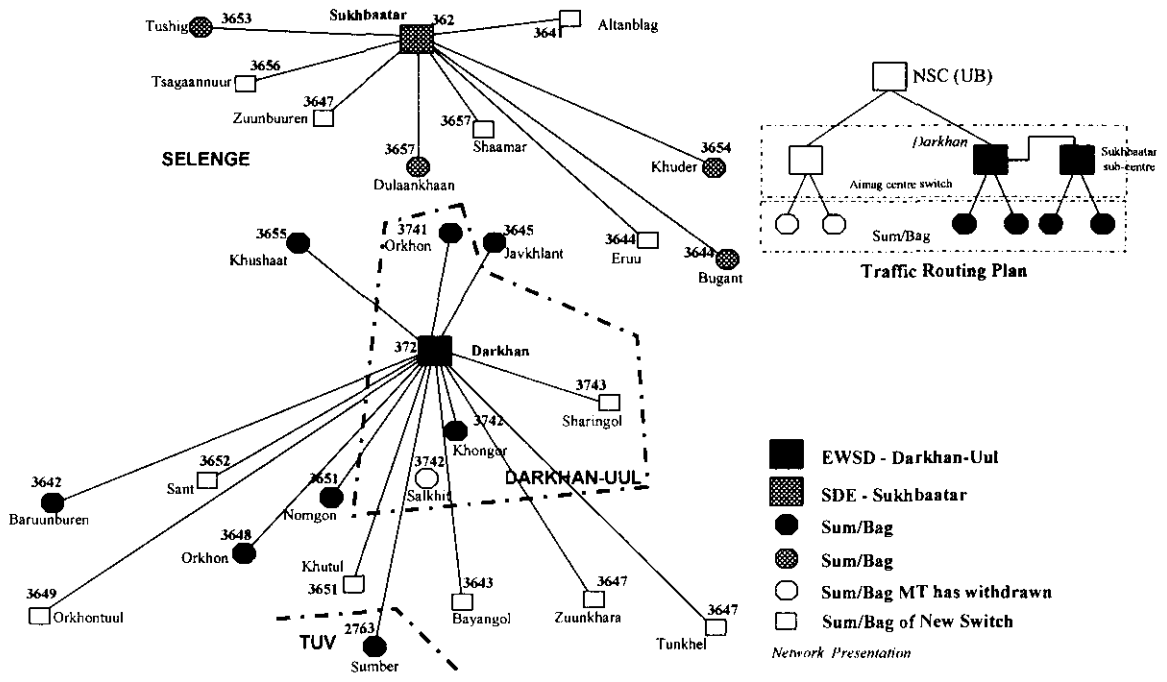


Figure 4.2.3-1 (2/2) Proposed Switch Network - Selenge and Darkhan -Uul

4.3 Traffic Forecast and Circuit Calculation

4.3.1 Purpose of Traffic Forecast

The traffic forecast was done in order to know adequate number of inter-exchange circuits between exchanges to be linked. Under this Feasibility Study, the number of circuits between Aimag centre and Sum centres was calculated.

4.3.2 Numerical Data for Calculation

In consideration of the purpose that the traffic is forecast for designing a new digital network under Feasibility Study, the forecast was done based on the numerical data presented in GAS 6, ITU-T Manual. Traffic data in Ulaanbaatar was also referred as well as consultant's experiences.

Sum centre switch traffic density has not been measured as part of PSTN, for the switches had been used as a stand alone PBX in Sum centres. The Sum centres are linked by means of long distant subscriber lines from Aimag centre, but those lines are not

accommodated to the PBX except a few cases. This resulted in that the switch traffic data were not measured.

4.3.3 Subscribe Line Calling Rate

The traffic density of subscriber lines, or calling rate, was set as 0.11 Erlang per line in the same manner discussed in the Master Plan as it is a value to design network. The percentage of outgoing/incoming traffic (or trunk traffic) to the whole traffic is set as 68.8% in the same manner discussed in the Master Plan.

The number of circuits required between exchanges is calculated based on the traffic forecast outcome. Regarding the circuit selection loss probability, one (1) % per link is applied to as a design value.

4.3.4 Required Number of Circuits

The required number of circuits between Sum centres and Aimag centre is calculated applying the calling rate, traffic density by call category, and link selection loss probability stated above.

Table 4.3.4-1 (1/2) Required Number of Circuits - Uvurkhangai

Aimag			Traffic Initial (Erl)		Traffic Final (Erl)		Trunks (in E1)	
Sum			Total	Trunk	Total	Trunk	Initial	Final
Arbaikheer Centre Switch								
1	**UVURKHANGAI**							
1	1	Bayan-Undur						
1	1	Burd	13	9	22	15	1	1
1	2	Bat-Ulzii	13	9	22	15	1	1
1	3	Bayangol	9	6	22	15	1	1
1	4	Esunzuil	11	8	22	15	1	1
1	5	ZB Ulaan	14	10	22	15	1	1
1	6	Nariinteel	21	14	44	30	1	2
1	7	Sant	12	8	22	15	1	1
1	8	Uyanga	23	16	44	30	1	2
1	9	Khujirt	35	24	44	30	2	2
1	10	Kharkhorin	125	86	165	114	4	5
	Arvaikheer Total		**277**	**190**	**429**	**295**	**14**	**17**

Table 4.3.4-1 (2/2) Required Number of Circuits - Selenge and Darkhan-Uul

Aimag / Sum			Traffic Initial (Erl)		Traffic Final (Erl)		Trunks (in E1)	
			Total	Trunk	Total	Trunk	Initial	Final
Sukhbaatar Sub-Centre Switch								
2	**SELENGE**							
2	1	Altanbulag	22	15	22	15	1	1
2	2	Eruu	33	23	44	30	2	2
2	3	Zuunburen	8	5	22	15	1	1
2	4	Tsagaannuur	28	19	44	30	1	2
2	5	Shaamar	22	15	44	30	1	2
	Sukhbaatar Total		**112**	77	**176**	**121**	**6**	**8**
Darkhan-Uul Centre Switch								
	SELENGE							
2	1	Sant	15	11	22	15	1	1
2	2	Orkhontuul	28	19	44	30	1	2
2	3	Khutul	66	45	88	61	2	3
2	4	Zuunkharaa	77	53	110	76	3	4
2	5	Bayangol (Baruunkharaa)	32	22	44	30	2	2
2	6	Tunkhel	25	17	44	30	1	2
2	**DARKHAN-UUL**							
2	7	Shariin gol	91	63	110	76	3	4
	Darkhan Uul Total		**334**	**230**	**462**	**318**	**13**	**18**
Selenge and Darkhan Uul Total			**447**	**307**	**638**	**439**	**19**	**26**

4.4 Numbering Plan

4.4.1 Existing Numbering Plan

Uvurkhangai Aimag centre is given Area Code "352" followed by Exchange Code (1 digit) and Subscriber number (4 digits), for instance, 01 322-2-XXXX (*Note: 1*). Sum centres are given Area Code "324X" and "325X" followed by Exchange Code (1 digit) and Subscriber number (3 digits), for instance, 01-3241-2-XXX (*Note: 1*).

Selenge Aimag centre is given Area Code "362" followed by Exchange Code (1 digit) and Subscriber number (4 digits), for instance, 01 362-2-XXXX (*Note: 1*). Sum centres are given Area Code "364X" and "365X" followed by Exchange Code (1 digit) and Subscriber number (3 digits), for instance, 01-3641-2-XXX (*Note: 1*).

Darkhan-Uul Aimag centre is given Area Code "372" followed by Exchange Code (1 digit) and Subscriber number (4 digits), for instance, 01 362-2-XXXX (*Note: 1*). Sum centres

are given Area Code "374X" followed by Exchange Code (1 digit) and Subscriber number (3 digits), for instance, 01-3741-2-XXX (*Note: 1*).

Note-1: This is the case that MT network is selected.

4.4.2 Proposed Numbering Plan

(1) National Significant Number of Target Areas

The numbering plan allocated to each of the exchanges of the target area will be designed in conformity with the existing numbering plan. Existing actual numbering will be succeeded without change. Table 4.4.2-1 shows the numbering plan of target Aimags.

Table 4.4.2-1 Numbering Plan of Target Aimags

	Uvurkhangai aimag /32/		
322	Arvaikheer city	3251	Naariin teel
3241	Baruun bayan ulaan	3252	Ulziit
3242	Batulzii	3253	Sant
3243	Bayangol	3254	Taragt
3244	Bayan undur	3255	Tugrug
3245	Bogd	3256	Uyanga
3246	Burd	3257	Hairkhandulaan
3247	Guchin us	3258	Kharkhorin
3248	Zuil	3259	Khujirt
3249	Zuun bayan ulaan		
	Selenge aimag /36/		
362	Sukhbaatar city	3648	Orkhon
3641	Altanbulag	3649	Orkhontuul
3642	Baruunburen	3651	Saikhan /Khutul/
3643	Bayangol	3652	Sant
3644	Yereu /Bugant/	3653	Tushig
3645	Javkhlant	3654	Khuder
3646	Zuunburen	3655	Hushaat
3647	Mandal /Zuunharaa, Tunkhel, Kherkh/	3656	Tsagaannuur
		3657	Shaamar /Dulaankhaan/
	Darkhan uul aimag /37/		
372	Darkhan city	3742	Khongor /Salkhit/
3741	Orkhon	3743	Sharin gol

(2) Numbering Capacity of Target Sum Centres

The numbering capacity is sufficient in all target Sum centres, as far as the capacity is concerned to the final stage of switching equipment under this Project. Most of the target Sum centres are estimated to have a switch capacity of 200 to 400 line units and the biggest one is supposed to be 1,800 line units of Zuunkharaa. The Sum centre switch is given a numbering capacity of 2,000 line units in the case of MT network and 1,000 line units in the case of MRC network basically, with flexibility to expand up to 20,000 and 10,000 line units, respectively.

In the case of Zuunkharaa, the telephony service is offered by MT and MRC and their share is 50% to 50% as of October 2002.

In Zuunkharaa, MT has a capacity of 2,000 lines, while the MRC capacity is expanded actually to have 10,000 directory numbers. It consists of one (1) digit of exchange code (EC) and four (4) digits of subscriber number (SN). The EC starts with "5".

4.5 Signalling System

The signalling system of new switch should be CCS No. 7. The EWSD/SDE in Arvaiheer, Sukhbaatar and Darkhan-Uul should be equipped with CCS No. 7, for it is an international standard of digital network. The signalling protocol ITU-T Protocol V5.2 will be applied to the section between Sum switching system and WLL equipment

4.6 Charging System

All the switching systems in Sum/Bag centres will be functioned to have local call meters of subscriber line. Detailed communication records for trunk and international calls will be monitored and collected by the switching system in Aimag centre. The Aimag centre switch shall send the call records to Operation and Maintenance Centre (OMC) in Ulaanbaatar through X.25 protocol transmission link.

4.7 Interconnection Plan

Competition or cooperation is always a problem among competitors in any business. In areas where business must be carried out for people's better life or people's welfare even though business is not profitable, cooperation is much more important than competition. Business cooperation is a matter of business, but it is a obligation of telecommunications operators in the rural development plan The policy of interconnection should be controlled by PTA or CRC to avoid duplicated investment such as investment by 2 operators in the same areas/ routes, to utilize/ share the systems each other in order to establish cost effective rural telecommunications, and to lease the systems with reasonable price (e.g. cost base)

From technical view point, location of demarcation points between two operators is the most important. Depending on location of demarcation, network configuration may be changed. As an example, cases in which MTC uses MRC optical fibre or fibre optic transmission system with various location of demarcation points is given below.

(1) Demarcation point 1

Demarcation point 1 shown in Figure 4.7-1 gives the simplest configuration. As MTC should lease one or two pairs, cost of lease rental may be more expensive than in the other cases.

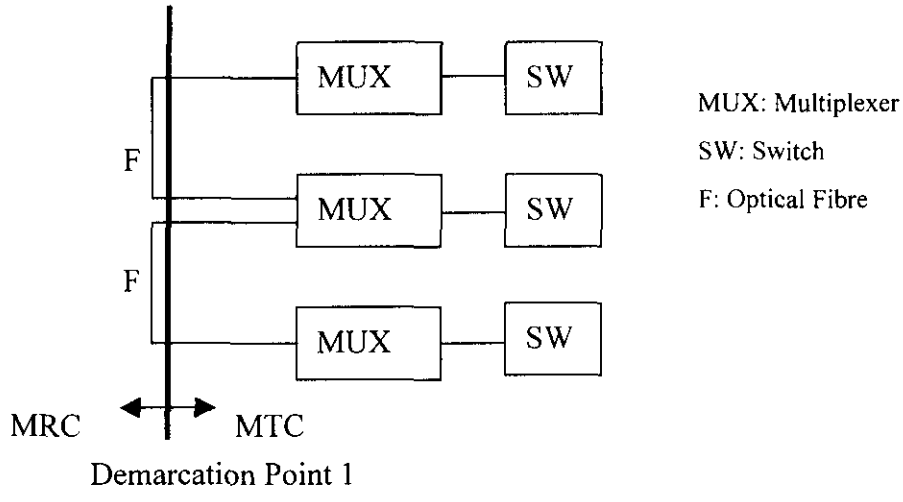


Figure 4.7-1 Demarcation Point 1

(2) Demarcation Point 2

Demarcation Point 2 shown in Figure 4.7-2 gives a simple configuration. The defect of this configuration is that failure of MTC equipment and failure of fibre cause failure of MRC main route. MRC may not accept this configuration.

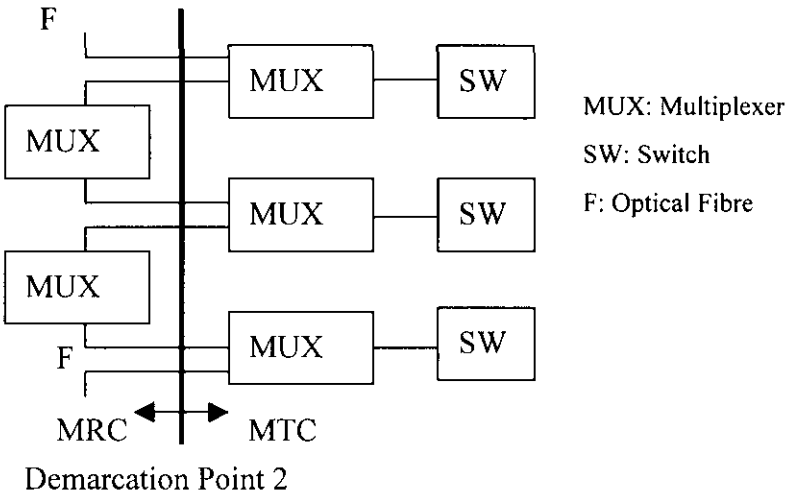


Figure 4.7-2 Demarcation Point 2

(3) Demarcation Point 3

Demarcation Point 3 shown in Figure 4.7-3 gives a complicated configuration. In this configuration, failure of the MTC branching routes does not causes failure of the MRC main route.

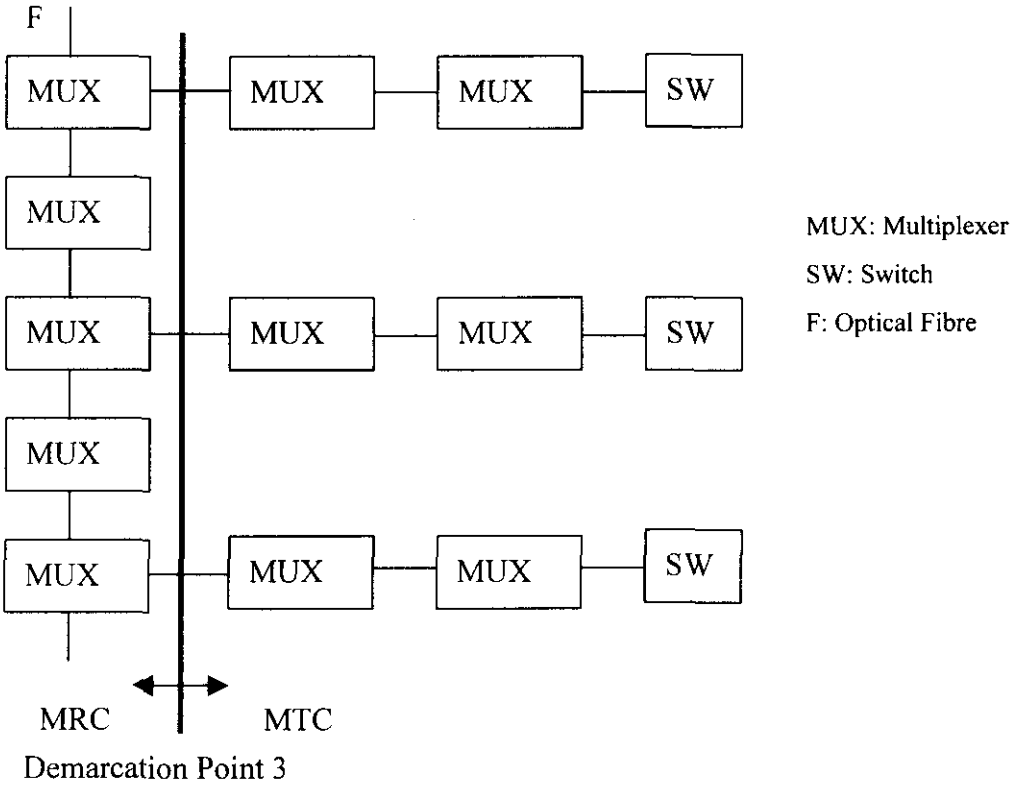


Figure 4.7-3 Demarcation Point 3

(4) Demarcation Point 4

Demarcation Point 4 shown in Figure 4.7-4 gives a simpler confuguration than in (4) while failure of the branching routes does not cause the main route. Maintenace work will be also simplifed becasue all transmission equipment are mainteined by MRC.

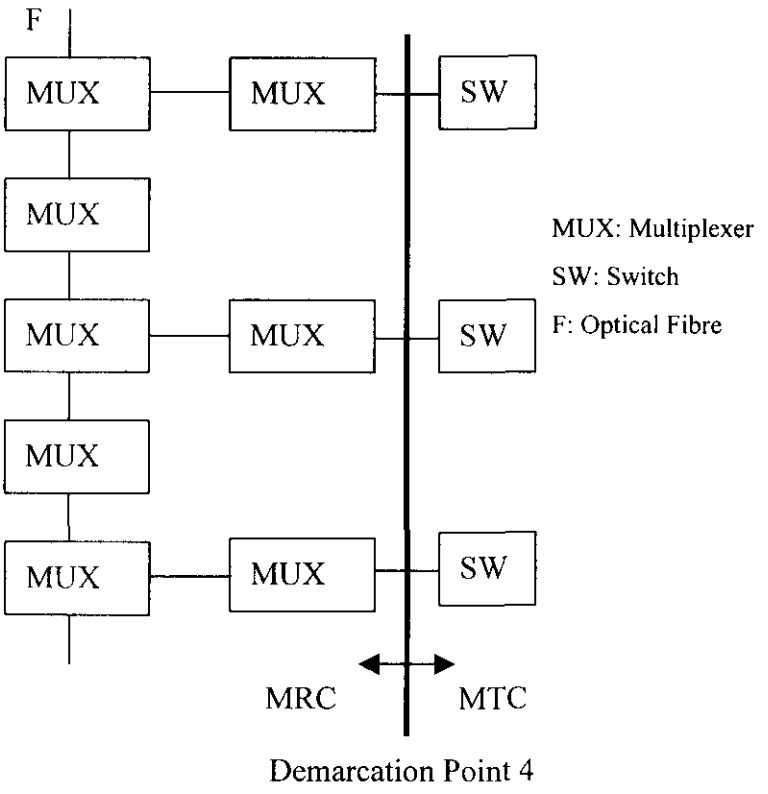


Figure 4.7-4 Demarcation Point 4

In the Study, the Demarcation Point 4 will be taken up as explained in Chapter 5.

4.8 Synchronisation Plan

All switches and digital equipment installed in the FS Project should be synchronized with Master clock in Ulaanbaatar. The backbone transmission systems in Uvurhkhangai and Selenge/ Dalkhan-Uul Aimags are all digital and Mongolia has the unique clock source applied to all telecommunications operators. Transmission equipment newly installed in the Project will be also digital. Therefore no synchronization problem is seen to transmit the master clock timing information to the digital equipment in Sums.

Although the timing information can easily be extracted from SDH digital transmission systems, it is also possible to obtain the timing information from bit streams of PDH digital transmission systems, received at far end.

4.9 Transmission Plan

4.9.1 Optical Fibre Transmission Plan

Specifications of fibre optic transmission equipment installed in Selenge/ Dalkhan-Uul Aimags are as following;

- Equipment shall comply with the ITU-T recommendations (especially G series recommendations).
- Equipment shall be connectable with existing equipment.
- Equipment shall be expandable to STM-4.
- Equipment shall be compatible with the existing TMS system, regarding main functions such as setting up paths and monitoring alarms.

Since new equipment is installed in tandem with the backbone equipment in Selenge/ Dalkhan-Uul Aimags, security of new equipment should be as same as that of backbone equipment. Failure of the branching routes should not affect the backbone network.

Optical fibre will be of single mode (mono mode) and 1.5 nm wave length, and shall meet ITU-T recommendations.

4.9.2 Radio Transmission Network Plan

4.9.2.1 System feature of digital microwave radio link system

(1) Design Criteria

The system design and radio path engineering will be undertaken to achieve the following criteria:

(a) As a frequency plan the ITU-R Recommendation 385-6 will be applied in the radio link frequency allocation.

(b) As s BER performance objective the ITU-R Recommendation 634-1 will be applied in the radio link design.

(c) The antennae heights on each path will be designed to keep at least First Fresnel Zone clearance above the tree canopy, or any other apparent obstruction, at any point along the path, at an effective earth radius factor K of 1.33.

(d) The antenna type and size and the feeder type will be selected to satisfy the link reliability considering the fading occurring probability.

(e) The microwave transmission facility shall be stable and reliable under th harsh climatic conditions

(2) System Parameters

The system parameters of the radio link are listed in Table 4.9-1. It is a PCM-QPSK system operating in the 7125 MHz to 7725 MHz radio frequency band. The transmission capacity for both frequency bands is 16 x 2 Mbps (16 E1) equivalent 480 telephone channels.

Table 4.9 -1 System Parameters

Frequency Band	7125 – 7725 MHz
Traffic capacity	16 x 2 Mbps (16 E1)
Transmission system	PCM-4PSK
Occupied Bandwidth	25.2 MHz
Allocated RF Bandwidth (Channel Spacing)	28 MHz
Transmitter output power	+30 dBm
Receive noise figure	5 dB
Transmission quality	ITU-R Rec. 634-1
Frequency stability	±5 ppm
Configuration	1+1 (Hot standby)
Threshold Level (dBm measured at Antenna Port) BER=10^{-6} 34 MB	- 81.0 dBm
Signals connected between ODU and IDU	TX IF: 850 MHz, RX IF: 70 MHz
Antenna	Parabolic Dual Polarization Antenna with 180 cm diameter
Height of Antenna Tower	20 m (steel pole)
Environmental Conditions	Temperature - ODU: -33 ℃ to +50℃ IDU: 0℃ to 50℃ Humidity - ODU: All weather conditions, IDU: Up to +95 %
Power Input	DC-24V±10%
Power Consumption	Less than 200 W (2 sets of ODU and IDU, 1set of MUX)
Size (WxDxH)	ODU: 264 x 316 x141 mm IDU: 482 x 132 x 286 mm

(3) Transmission quality and noise distribution

The transmission quality of the digital radio system is specified by the bit error rate. The design criteria is based on the ITU-R Rec. 634-1 as follows:

(a) Short term incompleteness
1 x 10-3 for more than (D/2500) x 0.054 % of any month (integration time 1 second)

(b) Long term incompleteness
1 x 10-6 for more than (D/2500) x 0.4 % of any month (integration time 1 minute)

(4) Basic condition for radio path calculation

It is calculated in accordance with presumed conditions, i.e. terrain profiles, surface conditions and obstruction height as follows:

(a) Height of obstructions: 25 m height trees is presumed on the terrain

(b) Path parameters: based on system configuration

(c) Feeder length: Antenna height + 10 to 20 m. The length of coaxial feeder varies depending on the result of detailed survey

(5) Power supply facility for microwave repeater stations

Power supply to the microwave repeater stations are made mainly by near-by power distribution lines of central grid power cable (Central Energy System), however, if it is difficult to extend the power distribution line from a power cable to the near the repeater station, then solar and wind hybrid power supply system is installed at the repeater station in order to shorten the construction period. Proposed power supply facility for the microwave repeater station is shown in Figure 4.9.2.1-1

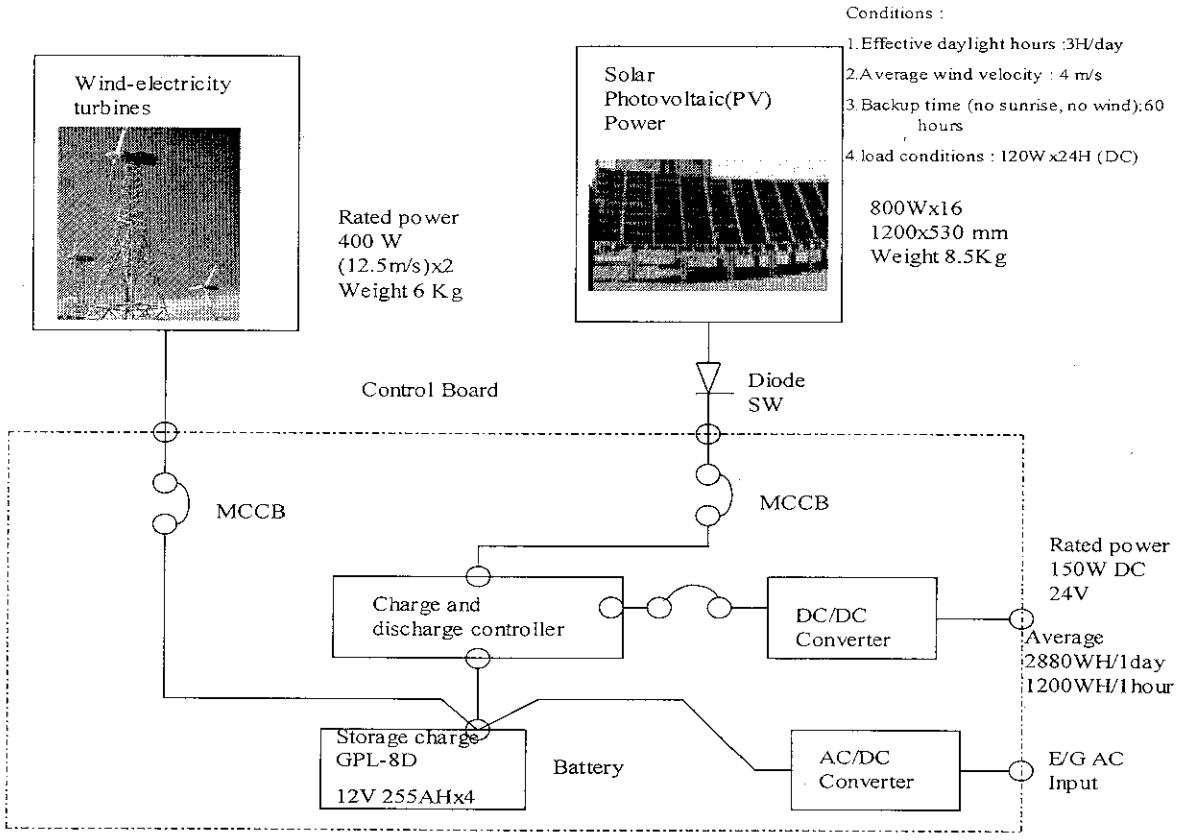


Figure 4.9.2.1-1 Proposed Power Supply Facilities for Microwave Repeater Station

4.10 Access Network Plan

4.10.1 Wired Access Network System

(1) Cable system

Aerial cable system should be applied.

(2) Kind of cable

- Air core type cables are applied for aerial cable system.
- Jelly filled cables are applied for underground cable system.

(3) The distribution method

- Direct feed method is applied for the wired access network in majority of Sum centres.
- Flexible distribution method that uses cross connection points is applied for the large size Sum centres.

(4) Attenuation loss and DC resistance limitation

Network design follows 7dB tolerance attenuation loss and 1500-ohm direct current resistance limitation from MDF to the furthest DP.

Electrical characteristics of the cables are shown in Table 4.10.1-1

Table 4.10.1-1 Electrical Standards of the Cables

Conductor Diameter	Air core		Jelly filled	
	Attenuation loss at 1.5kHz	DC resistance	Attenuation loss at 1.5kHz	DC resistance
mm	dB/km	Loop Ω/km	dB/km	Loop Ω/km
0.4	2.20	295	2.41	295
0.5	1.75	187	1.91	187
0.65	1.33	113	1.45	113

4.10.2 Wireless Access Network System

(1) General

A Wireless Local Loop (WLL) is a system, which provides radio links to the sections of a conventional wired telephone system. In order to construct and develop rural subscriber access network infrastructure quickly the feasibility study for introduction of Point-to-Multipoint/TDMA-WLL system in Mongolia has been implemented. The survey was made in Uvurkhangai (Kharkhorin), Selenge (Zuunkharaa, Khutul) and Darkhan-Uul (Sharin Gol). Those sum centres are desired to put the TDMA-WLL system into operation to meet the traffic demand up to 2020 that is expected more than 800 subscribers.

As developing countries look to build their telecommunications infrastructure, it is important that they chose systems, which are "forward-looking". In other words, and expansion of the network as well as an upgrade of services should be easily provided and at a low cost. Packet-based technology may prove to have the technical, and eventually, financial flexibility required in new network infrastructure. In a relative short time, it is forecasted packet-based networks have become the platform of choice for new telecommunication networks. In this respect the introduction of router –based wireless access system using IP in the rural areas shall be also studied to meet the future demand for the provision of Internet access at the high-speed in schools, hospitals and business where wired line infrastructure is unavailable.

(2) System Feature of TDMA-WLL system

Wireless Local Loop (WLL) is a solution of fixed telecommunications services using terrestrial wireless technologies to connect subscribers to local exchange. In this project, implementation of a system integrated with point-to-multipoint and WLL technology is supposed.

The system feature is as follows:

(i) System feature

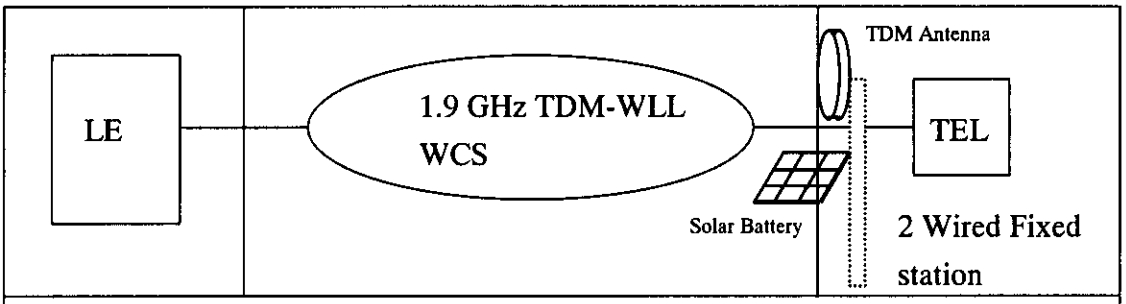
The proposed TDMA-WLL is a system that:

(a) Allows constructing a network infrastructure quickly.

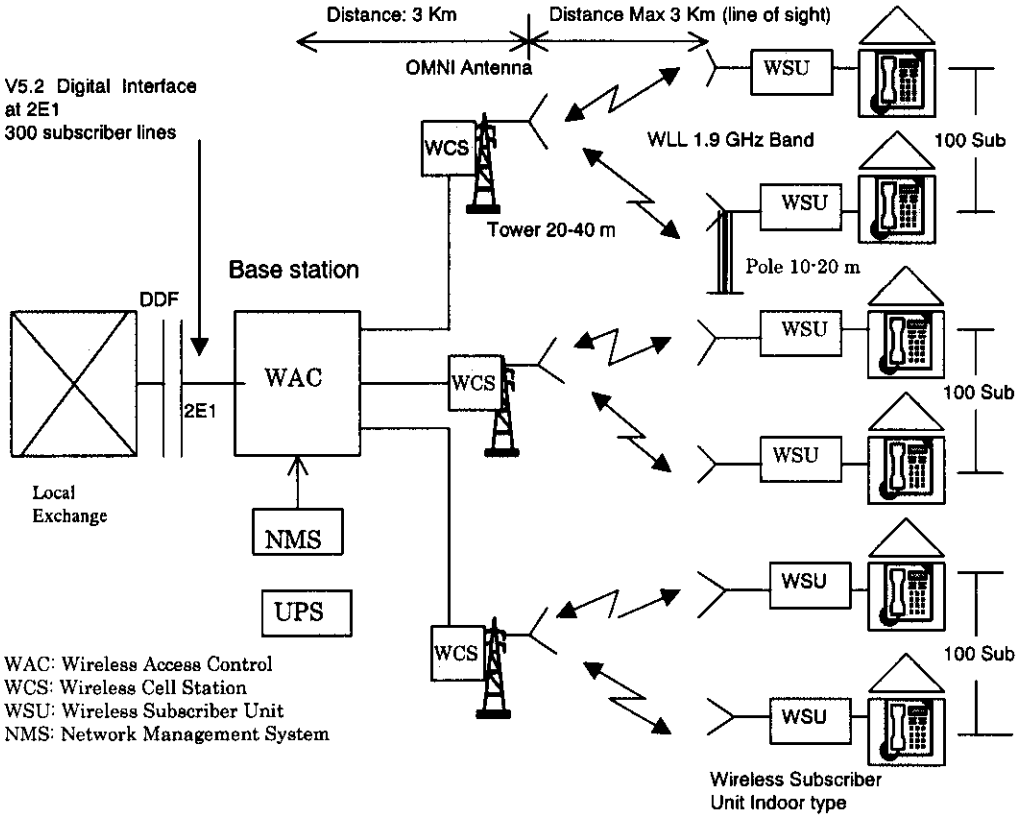
(b) Has the flexibility to vary its capacity when demand shifts or is difficult to forecast.
(c) Shows excellent cost/performance in rural to suburban areas.
(d) Covers large areas, having a maximum radius of 3 to 5 Km.
(e) Provide high speech quality and will support data transmission.
(f) Uses an analogue interface, ITU-T Rec. It also uses a standard interface, RCR STD-28, for the air interface. G.964/G.965 (the V5 interface) and Bellcore-standard GR-303, for the network interface.
(g) Is based on the technology which already has a track-record in Japan.
(h) Operates efficiently and is easy to maintain due to its high-performance NMS.

(ii) System parameters

The system parameters is shown as follows:



Digital Interface Protocol V5.2, 2E1	RF output power: 20mW: Frequency Band: 1.9 GHz Band (1895–1918.1 MHz) Speech coding: 32 Kbps ADPCM TDM-WLL Air Interface: RCR-28 standard Traffic loss probability: 5 % Carried traffic: 0.07 erl/subscriber System capacity: 300 subscribers/system Distance: Max. 3Km(line of sight, clearance 60 %) Service coverage: 30 Km^2 (r=3 Km) Subscriber density: 10 Sub/ Km^2	RF output power: 10mW 2W analogue interface Fixed Telephone, Pay phone, PABX, G3 Fax Dial-Up MODEM Note: 4800 BPS (BER: better than 1 x 10^{-6}) 9600 BPS (BER: better than 1 x 10^{-6})



WLL System Configuration

(3) WLL systems configuration

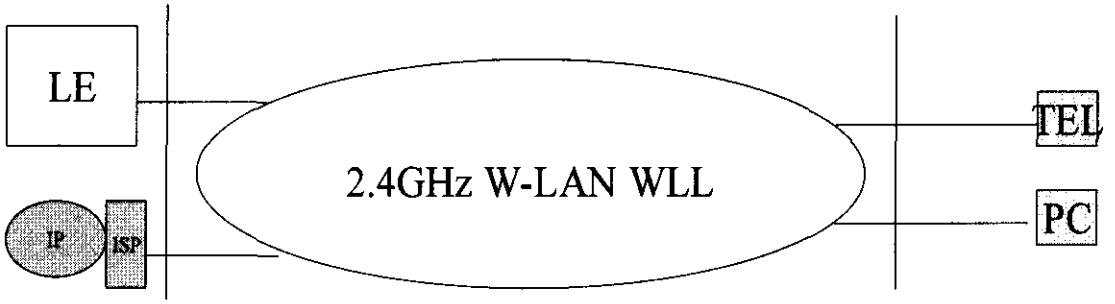
The use of TDMA-based point to point (PTP) or point-to-multipoint (PMP) radio systems with wireless local loop is introduced in rural areas in Mongolia. A TDM-WLL system generally comprises Wireless Access Control (WAC), Wireless Cell Stations (WCS), Wireless Subscriber Units (WSU), and 2-wire Fixed Terminals (2W-FT) as shown in the above Figure.

(4) Study Projects for Deployment of Wireless IP-based Systems in Rural Areas

While traditional telephone networks rely on a local exchange to route a call along set path from its origin to a destination, packet switched networks such as the Internet break up the data to be transmitted and send it in the form of packets along various routes to the destination.

It is technologically possible, using available products, to establish an access network in rural and remote areas using routing technology rather than circuit-switched local exchanges, When combined with wireless technology in the local loop, such a network may provide an affordable solution for rural areas, particularly when the primary services delivered over the network will employ multimedia. Router-based local access networks using TCP/IP in the network and transport layers (OSI layers 3 and 4) can be interconnected with the public switched telephone network using gateways that comply with ITU-T Recommendation H.323. The system feature of 2.4 GHz Wireless LAN WLL is shown in the following figure:

Wireless LAN WLL SYSTEM IMAGE



Analog interface	System parameter	2W analog interface(VoIP)
33lines	Frequency Band 2.4GHz(2400-2483.5MHz)	Telephone
	Speech coding G.711/64k ,G729/8k	G3 FAX up to 14.4kbps T.38
Erthert net	Method W-ALN WLL IEEE802.11b	
10Base-T	Traffic loss 5% Traffic 0.07erl/subscriber	Ethernet interface IEEE802.3u Fast Ethernet
	SYSTEM capacity 300 sub/system	IEEE802.3x Full-duplex
	Distance Max. 3km (line of sight, clearance 60%)	
	service Area : 30 Km^2 (r= 3km)	
	Subscriber density : 10 sub /km^2	

4.11 Power System

(1) Basic Requirements

Power supply facilities shall be designed and constructed to meet the following requirements:

i) Power in required quality and quantity should be supplied,

ii) Power supply shall be stable and reliable even under harsh climatic conditions,

iii) Initial investment cost and running cost should be within tolerable level, and

iv) Easy and sustainable operation and maintenance can be expected.

(2) Basic Plan

Power supply facility plan is basically made according to the power demand by the telecom system. In determining capacity of the power supply facilities, it shall be taken into account the fact that all of the power consuming equipment of the telecommunication system is not operated at a rated capacity. Time, duration, and level of power consumption of various loads of the telecommunication system differ from each other.

Capacity of the power supply facilities, therefore, is determined on the basis of the power demand when a maximum demand occurs. Power demand or load patterns usually vary largely according to the traffic of the telecom equipment for each of the Project sites.

Power demand as required by switching facilities, transmission facilities, etc. in terms of kW and kWh/day, together with back-up time in preparation for sudden power failure, was considered in estimating power consumption for rural telecom network.

Major power consuming telecom sub-systems or equipment included in the Feasibility Study are switching network facilities and transmission facilities. Outline or technical particulars of these facilities or systems can be found in relevant parts of the Feasibility Study Report.

(3) Typical Power Supply System

Power supply from the grid is usually stable; however, scheduled or unscheduled power outages cannot be avoided. In preparation for such power outages, alternative power supply system is normally provided to secure reliability and stability of power supply. Batteries are used to meet requirements for short-duration power supply, while diesel generators are used for long-duration power supply. Figure 4.11-1 indicates a typical block diagram for power supply facilities.

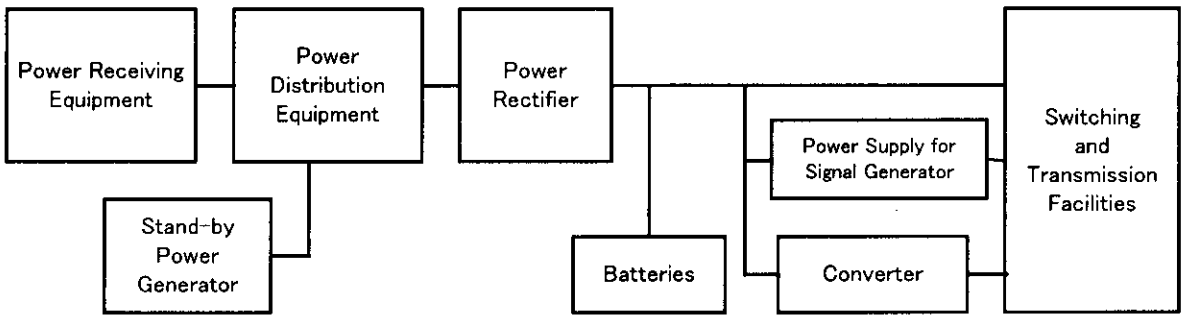


Figure 4.11-1 Typical Block Diagram for Power Supply Facilities

(4) Provision of Back-up Diesel Generators

Under the Feasibility Study, important switching and transmission facilities will be provided with back-up diesel generators to ensure continuous power supply at least two days even when main or sub power supply fails.

The generators will be provided basically for switching systems with 400 subscriber lines or more as indicated as "switching capacity – adjusted final" in the switching system plan. Switching systems that will be provided with diesel generators are indicated as "GT" in the "Proposed Power Supply System - Type" column in Annex 5-1.

As for transmission systems, diesel generators will be provided as a source for power supply to the new Radio and WLL equipment.

(5) Non-use of PV Systems

For the Feasibility Study, three Aimgs, namely, Darkhan-uul, Selenge, and Uvurkhangai, have been selected as priority project sites. One of the selection criteria was that power supply from the existing grid would be readily made available so that excessive

supply and construction costs for power supply facilities would not jeopardise feasibility of the priority projects.

The target Sums selected for the Feasibility Study, therefore, are being provided with electricity from Central Energy System, and are anticipated to receive comparatively reliable and stable power supply continuously in the coming years. It has been decided, therefore, that PV System will not be provided at the target Sums as a means of a power supply source.

In the case of Uvurkhangai Aimag, major part of the land is rich in solar energy, as exemplified by annual average horizontal solar irradiation of 4.5-5.0kWh/m^2/day. This will usually present rationale to introducing PV systems, provided that any alternative power supply source cannot be found.

4.12 IT Plan

4.12.1 Internet and IP Network

At initial stage, i.e., Phase-1 and 2, there will not exist yet IP network or node (router) of ISP in Sum area basically. Internet user has to access to the Internet by dial-up connection and through PSTN as shown in the upper part of Figure 4.12.1-1.

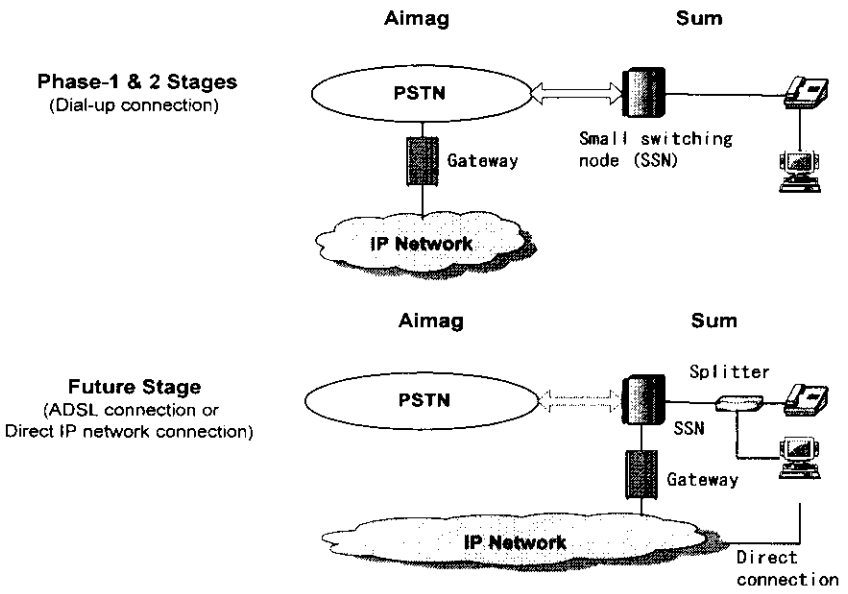


Figure 4.12.1-1 IP Networking in Sum Area

4.12.2 Internet Traffic Forecast

All the Internet traffics for Sum subscribers will flow to/from Ulaanbaatar via Aimag. This star connection style will be continued for the time being.

(1) Estimation of traffic

The below-mentioned assumptions are given to the calculation for each segment's traffic.

Table 4.12.2-1 Subscriber's Ratio in Each Phase

Sum & other rural only

	56 kbps (Dial-up connection)	**10 Mbps** (xDSL connection)	**100 Mbps** (xDSL or HDSL connection)
	Connection Time: 10 hours/(month·person)	**Actual Connection Time:** 25 hours/(month·person)	**Actual Connection Time:** 25 hours/(month·person)
Phase 1	100%	-	-
Phase 2	90%	10%	-
Phase 3	70%	30%	-

Traffic generated by each category's subscriber is estimated by the following formula:

(a) Traffic of each subscriber using 56 kbps

- Connection time: 10 hours/month
- Data transfer duration: 50% time
- Congestion period: 12 hours among the 24 hours (2 times)
- Redundancy: 1.5

$(10^{hours} \div 24^{houre} \div 30.5^{days}) \times 0.5 \times 1.5 \times 2 \times 56^{kbps} = 1.148\ kbps/subscriber$

(b) Traffic of each subscriber using 10 Mbps

- Connection time: 25 hours/month
- Data transfer duration: 20% time
- Congestion period: 12 hours among the 24 hours (2 times)
- Redundancy: 1.5

$(25^{hours} \div 24^{houre} \div 30.5^{days}) \times 0.2 \times 1.5 \times 2 \times 10^{Mbps} = 205.2\ kbps/subscriber$

(2) Results of traffic forecast

Calculation results of the Internet traffic between the Sums and the Aimag centres at Uvurkhangai and Selenge areas are shown in Table 4.12.2-2. The table shows required circuit capacity to transmission system too. Detailed calculation results are shown in Annex 6.3.

At initial stage as of 2008, if a 2 Mbps circuit is prepared dedicatedly for Internet at each Sum, no traffic congestion will happen. However from the phase-2 stage, 10 Mbps order broadband service will start even in Sum area, then preparation to deal with such broadband era is also necessary.

Table 4.12.2-2 Internet Traffic in the Subjected Sums of F/S

	Estimated Data Speed (kbps)			Required Capacity (Mbps)		
	(2008) (Sum & Other)	(2013) (Sum & Other)	(2020) (Sum & Other)	Initial (2008)	Minimum (2020)	Recommend (2020)
UVURKHANGAI						
Burd	25	812	3,356	2	4	10
Bat-Ulzii	34	1,101	4,551	2	4	10
Bayangol	29	946	3,909	2	4	10
Esonzuil	27	871	3,602	2	4	10
ZB Ulaan	30	994	4,110	2	4	10
Nariinteel	28	911	3,765	2	4	10
Sant	27	899	3,717	2	4	10
Uyanga	55	1,810	7,483	2	4	10
Khuzirt	53	1,747	7,223	2	4	10
Kharkhorin	110	3,603	14,895	2	4	16
Total	417	13,696	56,613			
SELENGE (DARKHAN-UUL)						
Shariin gol	105	3,435	14,200	2	4	16
Total	105	3,435	14,200			
SELENGE						
Altanbulag	38	1,234	5,103	2	4	10
Eruu	45	1,469	6,074	2	4	10
Zuunburen	35	1,159	4,792	2	4	10
Sant	25	836	3,455	2	4	10
Tsagaannuur	47	1,535	6,344	2	4	10
Orkhontuul	46	1,513	6,255	2	4	10
Shaamar	41	1,334	5,514	2	4	10
Khutul	48	1,563	6,461	2	4	10
Zuunkharaa	271	8,912	36,839	2	32	32
Bayangol (Baruunkharaa)	60	1,960	8,101	2	4	10
Tunkhel	17	553	2,288	2	2	10
Total	672	22,070	91,226			

CHAPTER 5

FACILITIES PLAN

CHAPTER 5

FACILITIES PLAN

5.1 General

The telecommunications facilities plan under the Feasibility Study is focused to design the Sum centre network and links to connect them with Uvurkhangai, Selenge, and Darkhan-Uul Aimag centre. The plan is established under the conditions that:

(a) The proposed expansion and improvement be realised solely as part of MT network which is possessed by PTA;

(b) The facilities to be introduced under the Feasibility Study be compatible with existing operators' networks.

The quality of facilities will be upgraded by introduction of digital transmission and digital telephone switches having a capacity of 6,580 telephone lines.

The analogue Aimag-Sum links, which are composed mainly with open wire transmission system, will be replaced with digital transmission links. The capacity of transmission systems will also be increased to meet the traffic of the increased telephone subscribers. Analogue automatic and manual switches in target Sum centres will be replaced with digital ones.

Subscriber access network, which makes up links between user terminals and switching system or traffic concentration/distribution node, will be provided with mainly metallic cables and partly with wireless local loop (WLL) system. Deteriorated or aged metallic cables will be replaced with new one.

5.2 Switching Facilities

5.2.1 Switching System General Features

The new switching system is planned to be:

a) Full digital;

b) Compatible with existing network;
c) Durable in the Mongolian weather conditions;
d) Detailed billing function at Aimag centre;
e) Equipped with CCS No. 7 and R2 (D) signalling, V5.2 protocol function.

5.2.2 Services to be Provided

The new switching system are preferred to have basically same feature services as provided to subscribers in Aimag centre.

a) Malicious call tracing.
b) Charge meter observation.
c) Hotline.
d) Diversion.
e) Abbreviated dialling.
f) Subscriber blocking of international traffic origination.
g) Subscriber blocking of trunk traffic origination.
h) Origination call blocked.
i) Call waiting.
j) Three party service.
k) Call transfer service.
l) Wake-up alarm service.

5.2.3 Dimensioning of Switching System

The switching systems to be introduced in each of the target Sum centres are dimensioned based on the given demand fulfilment plan.

The size of the switching system is decided so that the new switching system have a capacity enough to cater for the demand at least five (5) years after its commissioning. Some exchanges will be designed to have a capacity more than that where the increase was forecast 100 or less in another 10 years. The Zuunkharaa exchange was dimensioned under the condition that the MRC's existing switch would share with its full capacity the forecast demand.

Table 5.2.3-1 (1/2) Proposed Switching Capacity - Uvurkhangai

Aimag / Sum			Capacity in 2002	Switch capacity	
				Initial	Final
Arvaikheer Centre Switch					
1	**UVURKHANGAI**				
1	1	Burd	48	120	200
1	2	Bat-Ulzii	48	120	200
1	3	Bayangol	48	80	200
1	4	Esunzuil	100	100	200
1	5	ZB Ulaan	50	130	200
1	6	Nariinteel	50	190	400
1	7	Sant	50	110	200
1	8	Uyanga	200	210	400
1	9	Khujirt	262	320	400
1	10	Kharkhorin	1,000	1,140	1,500
	Arvaikheer Total		**1,856**	**2,520**	**3,900**

Table 5.2.3-1 (2/2) Proposed Switching Capacity - Selenge and Darkhan-Uul

Aimag / Sum			Capacity in 2002	Switch capacity	
				Initial	Final
Sukhbaatar Sub-Centre Switch					
2	**SELENGE**				
2	1	Altanbulag	200	200	200
2	2	Eruu	100	300	400
2	3	Zuunburen	32	70	200
2	4	Tsagaannuur	100	250	400
2	5	Shaamar	100	200	400
	Sukhbaatar Total		**532**	**1,020**	**1,600**
Darkhan-Uul Centre Switch					
	SELENGE				
2	1	Sant	50	140	200
2	2	Orkhontuul	50	250	400
2	3	Khutul	600	600	800
2	4	Zuunkharaa	700	700	1,000
2	5	Bayangol (Baruunkharaa)	228	290	400
2	6	Tunkhel	0	230	400
2	**DARKHAN-UUL**				
2	7	*Shariin gol*	*500*	*830*	*1,000*
	Darkhan Uul Total		**2,128**	**3,040**	**4,200**
Selenge and Darkhan Uul Total			**2,660**	**4,060**	**5,800**

In addition to the switching system to be installed at Sum centres, the capacity of switching system of Aimag centre will also be expanded in relation to the interface devices with the Sum centre switches.

Spare parts will be provided to cater for the repair demand for five (5) yeas after commissioning.

5.2.4 Scope of Work and Cost Estimate

(1) Scope of Work

The scope of work of switching facilities under this Project is summarised as:

a) Switching systems: 22 units with 6,580 line units; which include
b) Three (3) units of Operation and Maintenance Centre.
c) Trunk interface hardware of three (3) Aimag centre switches.

Regarding the power equipment essential for the equipment including switching facilities, the scope includes rectifiers, but not including battery banks, air-conditioning equipment, power receiving panels, engine-generators, and solar power system, which are calculated as power system.

(2) Cost

The basic data for cost estimate were studied based on the cost of switching systems purchased recently in Mongolia, as well as consultant analysis in other countries. The switching facilities investment cost, which does not include consultancy fee, is estimated at US$ 2.1 Million. The consultancy fee is calculated for the whole project separate from this switching facilities. The investment cost is estimated as follows. Annex 2 shows the detail.

Table 5.2.4-1 Switch Facilities Cost (CIF)

(US$ 1,000.)

Aimag	Foreign	Local	Total
Uvurkhangai	914.0	2.4	916.4
Selenge and Darkhan-Uul	1,143.4	3.0	1,146.4
Total	2,057.4	5.5	2,062.8

5.2.5 Operation and Maintenance Centre at Aimag

An Operation and Maintenance Centre (OMC) will be established at each Aimag Centre, that is, at Arvaikheer, Sukhbaarat, and Darkhan-Uul. The OMC will be equipped with such function to monitor the running condition of Sum centre switching systems, to collect traffic data of the switching systems, and to control the switching systems.

5.2.6 Aiamg Centre Switching System

The switching systems now in use at the target Aimag's centres shall be expanded in its capacity of inter-exchange interface equipment. Programming of exchange data and up-grading in software will be required, for new digital switches are to be connected. Such work should be born by other projects than this Project of Development of Rural Telecommunication System.

5.3 Transmission Facilities

5.3.1 Digital Microwave Transmission Facilities

5.3.1.1 General

With this project the national trunk transmission lines between Aimag centre and Sum centre shall be digitalized not only to improve the transmission quality but also to introduce IP-based new services in rural areas. Concerning the system selection of the transmission facilities for digitalisation it is proposed to construct new 7 GHz Point-to-Point digital microwave relay system in Uvurkhangai, Darkhan-uul and Selenge Aimags.

In accordance with Master Plan for Development of Rural Telecommunications System in Mongolia it is recommended to implement mainly to the priority Sum centres that development potential and social service needs are high, and also, it is possible to implement the project economically by joint use of the existing backbone microwave transmission facilities, such as use of tower, building and power supply.

5.3.1.2 Uvurkhangai Transmission Network

The recommendation for digitisation of rural transmission lines between Aimag centre and Sum centres in Uvurkhangai Aimag is shown in Figure 5.3.1-1. The proposed network

configurations for Uvurkhangai are shown in Annex 8 Figure 5.3.1-2 and Figure 5.3.1-3. The transmission link configuration is shown in Table 5.3.1-1.

Table 5.3.1-1 Transmission Link Configurations

Priority SC	System Selection	Traffic Capacity	Transmission Link Configuration between AC and SC
Kharkhorin	Micro	5E1	SC-MW108-MW109-MW110-MW111-AC
Khujirt	OFC+Micro	3E1	SC-OFC-MW109-MW110-MW111-AC
Bat-Ulziy	Micro	2E1	SC-R/S- MW109-MW110-MW111-AC
Burd	Micro	1E1	SC-R/S-Eson-Zyil-R/S-R/S-MW109-MW110-MW111-AC
Esonzuil	Micro	2E1	SC-R/S- MW109-MW110-MW111-AC
ZB Ulaan	Micro	1E1	SC- MW110-MW111-AC
Uyanga	Micro	2E1	SC-R/S- MW110-MW111-AC
Bayangol	Micro	2E1	SC-R/S- Sant-R/S-R/S- MW111-AC
Sant	Micro	2E1	SC-R/S- R/S-MW111-AC
Nariinteel	Micro	2E1	SC- MW113-MW-112-MW111-AC

Note-AC Aimag Centre SC: Sum Centre, MW: Microwave station, R/S: Microwave Repeater Station, OFC: Optical Fibre Cable

In addition to the construction of toll transmission link the following approach transmission lines between AC or SC and nearest existing Microwave relay station shall be also constructed to connect with Local Exchanges:

(a) OFC approach transmission lines (PDH 34 Mbps): 4 Km length Fibre Optic Cable between Hujirt Sum centre and MW 109 radio relay station

(b) Digital microwave approach transmission lines (PDH 34 Mbps): 13 Km hop length microwave transmission between Arvaikheer Aimag centre and MW 111 radio relay station.

The proposed 7GHz point-to-point digital microwave trunk transmission system is summarized in Table 5.3.1-2.

Table 5.3.1-2 Proposed 7 GHz P-P Digital Microwave Trunk Transmission Lines

Region	Link	Distance (km) /Sections	Radio Capacity (Initial Capacity)	Repeater Station	Number of Links	Required Antenna Diameter (cm)
Uvurkhangai	MW108 – MW109	52.5	16E1	–	1	300
	MW109 – MW110	34	16E1	–	2	180
	MW110 – MW111	34	16E1	–	3	180
	MW111 – MW112	51	16E1	–	4	300
	MW112 – MW113	43	16E1	–	5	240
	MW108 – Kharkhorin	30	4E1	–	6	120
	MW109 – Esunziil	60/2	4E1(2E1)	#1	7	120
					8	120
	Esunziil – Burd	32/2	4E1(1E1)	#2	9	60
					10	60
	MW109 – Bat-Ulzii	64/2	4E1(2E1)	#3	11	120
					12	120
	MW110 – ZB Ulaan	28	4E1(1E1)	–	13	120
	MW110 – Uyanga	30/2	4E1(2E1)	#4	14	60
					15	60
	MW111 – Arvailheer	13	16E1	–	16	60
	MW111 – Sant	94/3	4E1(2E1)	#5 #6	17	120
					18	120
					19	120
	Sant – Bayangol	46/2	4E1(2E1)	#7	20	120
					21	120
	MW113 – Nariinteel	30	4E1(2E1)	–	22	120
Selenge and Darkhan-Uul	MW304 – MW305	57.8	16E1	–	23	300
	MW305 – MW306	43.1	16E1	–	24	240
	MW306 – MW307	48.3	16E1	–	25	300
	MW307 – MW308	31.6	16E1	–	26	180
	MRC Orkhontuul – Orkhontuul	18/2	4E1(2E1)	#8	27	60
					28	60
	MW305 – Sant	43.8/2	4E1(2E1)	#9	29	120
					30	120
	MW306 – Darkhan	4.5	16E1	–	31	60
	MW306 – Sharin-Gol	40.3/3	4E1	#10 #11	32	60
					33	60
					34	60
	MW307 – Tsagaanuur	44.8/2	4E1(2E1)	#12	35	120
					36	120
	M307 – Shaamar	21.8	4E1(2E1)	–	37	120
	MW307 – Eruu	72.3/3	4E1(2E1)	#13 #14	38	120
					39	120
					40	120
	M308 – Sukhbaatar	25	16E1	–	41	120
	M308 – Zuunburen	26.1/2	4E1(2E1)	#15	42	60
					43	60
	M308 – Artambulag	23	4E1(2E1)	–	44	120

Radio Capacity	Repeater Station	Number of Links
16E1	0	12
4E1	15	32
Total	15	44

Required Antenna Diameter (cm)	Number of Links
60	13
120	22
180	3
240	2
300	4
Total	44

Distance of Links between Aimag Centre and Sum Centre

Region	Aimag Centre	Sum Centre	Number of Links	Distance (km)
Uvurkhangai	Arvailheer	Kharkhorin	5	30+52.5+34+34+13 = 163.5
		Khujirt	OFC + 3	OFC+34+34+13 = 81
		Esunziil	5	(30+30)+34+34+13 = 141
		Burd	7	(16+16)+(30+30)+34+34+13 = 173
		Bat-Ulzii	5	(32+32)+34+34+13 = 145
		ZB Ulaan	3	28+34+13 = 75
		Uyanga	4	(15+15)+34+13 = 77
		Sant	4	(31+31+32)+13 = 107
		Bayangol	6	(23+23)+(31+31+32)+13 = 153
		Nariinteel	4	30+43+51+13 = 124
Selenge and Darkhan-Uul	Darkhan	Orkhontuul	2 + OFC	(9+9)+OFC = 18
		Sant	4	(21.9+21.9)+43.1+4.5 = 91.4
		Sharin-Gol	4	(13.4+13.4+13.5)+4.5 = 44.8
	Sukhbaatar	Tsagaanuur	4	(22.4+22.4)+31.6+25 = 101.4
		Shaamar	3	21.8+31.6+25 = 78.4
		Eruu	5	(24.1+24.1+24.1)+31.6+25 = 128.9
		Zuunburen	3	(13.0+13.1)+25 = 51.1
		Artambulag	2	23+25 =48

The longest Distance	173

Availability of the longest Link for BER = $1x10^{-6}$	Unavailable time per year (minute)	Unavailability per km (%)
99.98%	= 525600 x 0.0002 = 105	= 0.02/173 = 0.000116

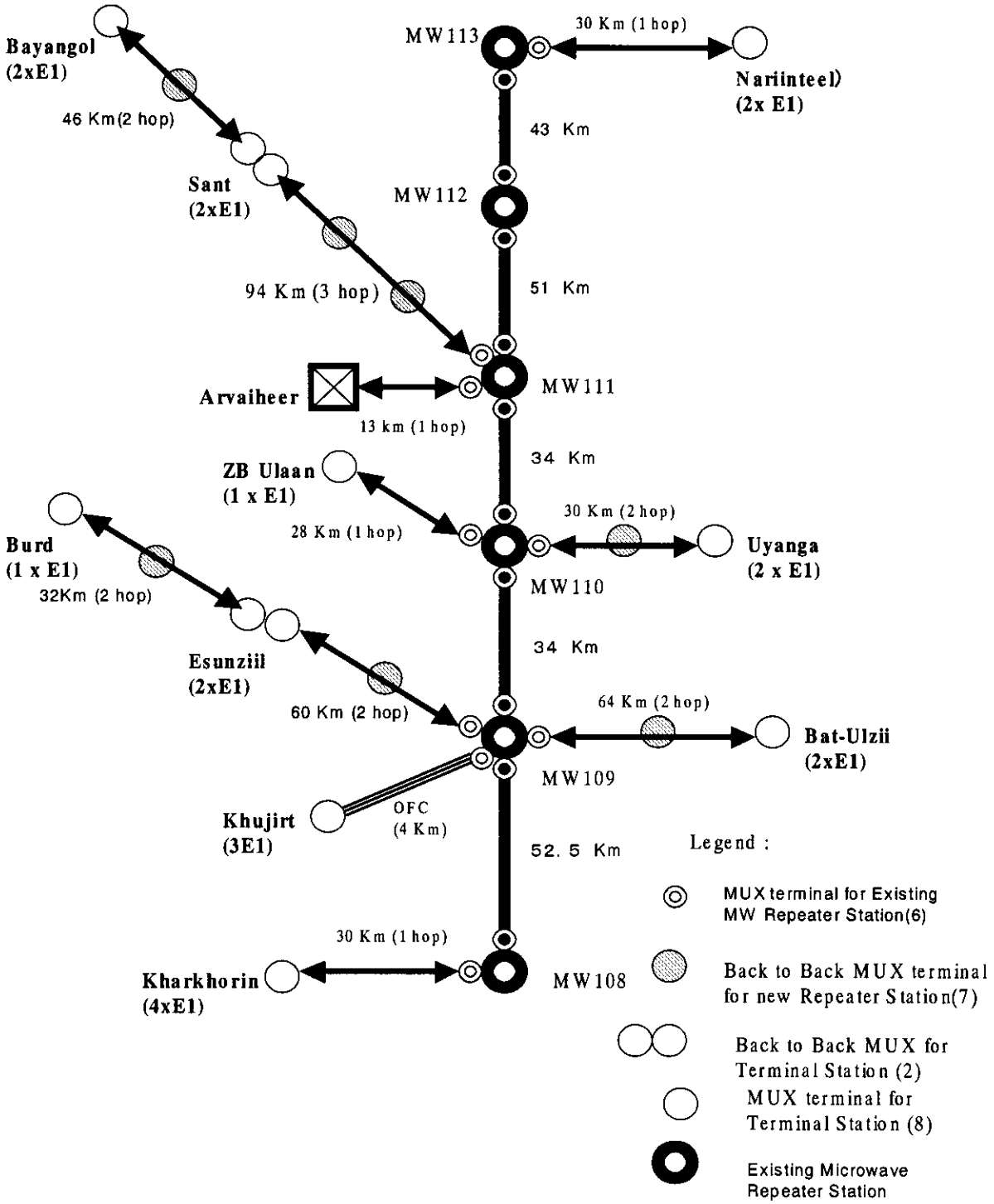


Figure 5.3.1-1 Digital Microwave Link Configuration for Uvurkhangai

5.3.1.3 Selenge and Darkhan-Uul Transmission Network

The recommendation for digitisation of rural transmission lines between Aimag centre and Sum centres in Selenge and Darkhan-Uul Aimags is shown in Figure 5.3.1-4. Proposed network configurations for Selenge and Darkhan-Uul Aimag are shown in Annex 3 Figure 5.3.1-5 and Figure5.3.1-6. The transmission link configurations are shown in Table5.3.1-3.

Table 5.3 1-3 Transmission Link Configurations

Priority SC	System Selection	Traffic Capacity	Transmission Link Configuration between AC and SC
Zuunkharaa	OFC	6E1	SC-MRC Zuunkharaa-MRC Salhit – MRC Darkhan –MT Darkhan (AC)
	Micro *1	6E1	SC-MW304-MW305-MW306-Darkhan AC
Sant	Micro	2E1	SC-R/S-MW305-MW306-Darkhan AC
Tunkhel	OFC*2	2E1	MRC Tunkhel-MRC Zuunharaa- MRC Salkhit-MRC Darkhan (AC)
Bayangol	OFC	3E1	SC-MRC Bayangol-MRC Salkhit-MRC Darkhan-MT Darkhan AC
	Micro*1	3E1	SC-MW304-MW305-MW306-Darkhan AC
Orkhontuul	Micro+OFC	2E1	SC-R/S- MRC Orkhontuul-MRC Khutul-MRC Darkhan-MT Darkhan
	Micro*1	2E1	SC-R/S- MW305-MW306-Darkhan AC
Khutul	OFC	3E1	SC-MRC Khutul-MRC Darkhan-MT Darkhan AC
	Micro*1	3E1	SC-R/S- MW305-MW306-Darkhan AC
Sharin Gol	Micro	2E1	SC-R/S-R/S-MW306-Darkhan AC
Eruu	Micro	2E1	SC- Javkhlant R/S- R/S-MW307-MW308-Sukhbaatar AC
Tsagaanuur	Micro	2E1	SC-R/S- MW307-MW308-Sukhbaatar AC
Shaamar	Micro	2E1	SC- MW307-MW308-Sukhbaatar AC
Zuunburen	Micro	2E1	SC-R/S- MW308-Sukhbaatar AC
Altanbulag	Micro	2E1	SC- MW308-Sukhbaatar AC

*1 In case of difficulty in branching out from MRC OFC system it is proposed to establish digital lines by digital microwave transmission system

*2 In case of non-availability of OFC branch out the Sum centre development is disregarded.

Note-AC: Aimag Centre SC: Sum Centre, MW: Microwave station, R/S: Microwave Repeater Station, OFC: Optical Fibre Cable, MT: Mongolia Telecom, MRC: Mongolia Railway Company

In addition to the construction of toll transmission link the following approach transmission lines between AC or MRC railroad station and nearest existing Microwave relay station is required to construct:

(a) Digital microwave approach transmission lines (PDH 34 Mbps): 4.5 Km hop length microwave transmission between Darkhan Aimag centre and MW 306 radio relay station.

(b) Digital microwave approach transmission lines (PDH 34 Mbps): 25 Km hop length microwave transmission between Sukhbaatar Aimag centre and MW 308 radio relay station.

(c) Digital microwave approach transmission lines (PDH 34 Mbps): 18 Km two hop length microwave transmission between Orkhontuul MRC Railroad station and Orkhontuul Sum centre MT telecom office.

The proposed 7GHz point-to-point digital microwave trunk transmission system is summarized in Table 5.3.1-3.

5.3.1.4 Bill of Quantity and Project Cost Estimates

(1) General

All prices shall be quoted in US dollars for "Goods" and "Services" as per Bill of Quantity. For transparency of the project costs following price break down of the Project Price (Grand Total) is requested network wise. The itemised price break down shall provide detailed information on goods and services in a list version for each site and at least for following items:

(2) Break Down of the Equipment Costs

(2-1) Digital Microwave Radio equipment (Terminal stations, Repeater stations)
(2-2) Power supply
(2-3) Antenna
(2-4) Shelter
(2-5) Test equipment
(2-6) Tools
(2-7) Spare parts

(3) Break Down of the Service Costs

(3-1) Installation
(3-2) Training

(4) Explanation on Civil Work and Antenna Supports

The Mongolian side shall prepare the site of microwave repeater station, the access roads, the civil work and antenna supports. Only the technical specifications for the construction of antenna supports and foundations are requested from the Contractor.

(5) Cost Estimation

(a) Digital Microwave Radio Link Systems for Uvurkhangai
Detailed bill of quantity and cost estimation of digital microwave transmission system for Uvurkhangai is attached with Annex 3 Table 5.3.1.4-1.

(b) Digital Microwave Radio Link Systems for Selenge and Darkhan Uul
Detailed bill of quantity and cost estimation of digital microwave transmission system for Selenge and Darkhan-Uul is attached with Annex 3, Table 5.3.1.4 - 2.

(c) Project Cost Estimation of Digital Microwave Transmission for Uvurkhangai
According to the feasibility study it is estimated for the project cost for Uvurkhangai as shown in the following table:

(d) Project Cost Estimation of Digital Microwave Transmission for Selenge and Darkhan-Uul

According to the feasibility study it is estimated for the project cost as following table:

Table 5.3.1.3-1 Cost of Digital Microwave Radio Link System Uvurkhangai

Foreign Currency Portion

No	Description		Total Price (US$1,000)
1	Digital Microwave Equipment		469
2	IF Cable and Connector		14
3	NMS		36
4	Antenna		174
5	DC Power Supply		287
6	Installation Material		288
7	Steel Pole (30 M)		194
8	Solar and Wind Hybrid System		20
9	Shelter		189
	Sub-total		1,671
10	Tools and test equipment	0.05	84
11	Spare parts	0.002	3
12	CIF	0.1	167
13	Installation	0.1	167
14	Training		15
	Sub-total		436
	Total		**2,107**

Local Currency Portion

No	Description	Total Price (US$1,000)
1	Civil Work and Installation and Commissionir	84
2	Access Road and Power Cable	216
3	Local Transportation	5
	Total	**304**

Table 5.3.1.3-2 Cost of Digital Microwave Radio Link System Selenge and Darkhan Uul

Foreign Currency Portion

No	Description		Total Price (US$1,000)
1	Digital Microwave Equipment		459
2	IF Cable and Connector		14
3	NMS		36
4	Antenna		174
5	DC Power Supply		287
6	Installation Material		306
7	Steel Pole (30 M)		205
8	Solar and Wind Hybrid System		23
9	Shelter		221
	Sub-total		1,725
10	Tools and test equipment	0.05	86
11	Spare parts	0.002	3
12	CIF	0.1	175
13	Installation	0.1	175
14	Training		14
	Sub-total		452
	Total		**2,178**

Local Currency Portion

No	Description	Total Price (US$1,000)
1	Civil Work and Installation and Commissionir	81
2	Access Road and Power Cable	252
3	Local Transportation	5
	Total	**338**

5.3.1.5 Scope of Work for Uvurkhangai Network

(1) Target Aimag Centre and Sums Centres

Target Aimag Centre	Target Sum Centres
Arvaiheer	(1)Kharkhorin
	(2)Khujirt
	(3)Bat-Ulzii
	(4)Burd
	(5)Esonzuil
	(6)ZB Ulaan
	(7)Uyanga
	(8)Bayangol
	(9)Sant
	(10)Nariinteel

(2) Network Configuration

New digital microwave radio link construction for improvement of rural areas shall be based on microwave branching off from the existing microwave radio relay stations (MW 108 through MW 113).

The rural transmission lines from Sum centre shall be terminated at Aimag center Arvaiheer TS (Transit Switch). In order to carry the rural traffic demand up to 2020 it is required to expand the existing traffic channel capacity on the microwave inter-province toll transmission route between MW 108 through MW 113. The additional transmission capacity required shall be at 34 Mbps.

The carried traffic on new microwave transmission links shall be based on E1 bearer connection with switching equipment. For cost effective Operation and Maintenance purpose of new microwave network it is proposed to install the Network Management System at Aimag centre Communication Office to access local/remote equipment for maintenance.

5.3.1.6 Scope of Work for Darkhan-Uul/Selenge Network

(1) Target Aimag and Sums

Target Aimag Centre	Target Sum Centre
Darkhan	(1) Sharin Gol
	(2) Zuunkharaa
	(3) Sant
	(4) Bayangol (Baruunkharaa)
	(5) Orkhontuul
	(6) Khutul
	(7) Tunkhel
Sukhbaatar	(1) Tsagannuur
	(2) Sharmar
	(3) Zuunburen
	(4) Altanbulag
	(5) Eruu

(2) Network Configuration

New digital microwave radio link construction for improvement of rural areas shall be based on microwave branching off from the existing microwave radio relay stations (MW 304 through MW308).

New digital Optical Fibre Cable construction for rural areas shall be based on optic branching off from the MRC Fibre Optic Transmission System in North to South direction. The rural transmission lines from Sum centres in Selenge and Darkhan Uul aimags shall be terminated at Aimag center Darkhan Transit Switch (TS) and Sukhbaatar TS respectively as shown in the above item (1).

The toll transmission links from Altanbulag, Zuunburen ,Shamar, Tsagaanuur and Eruu Sum center telecom office switch shall be connected with MT Sukhbaatar Aimag center switch. The toll transmission links from Sharin Gol, Sant, Khutul, Orkhontuul, Zuunkharaa and Bayangol Sum center switch shall be connected with MT Darkhan Aimag switch. The toll transmission link from MRC Tunkhel railroad switch shall be connected with MRC Darkhan switch.

In order to carry the rural traffic demand up to 2020 it is required to expand the existing traffic channel capacity on the microwave inter-province toll transmission route between MW 304 and MW 306, and also, between MW 307 and MW 308. The additional transmission capacity required shall be at 34 Mbps.

The carried traffic on new microwave transmission links shall be based on E1 bearer connection with switching equipment. For cost effective Operation and Maintenance purpose of new microwave network it is proposed to install the Network Management System at Aimag centre Communication office to access local/remote equipment for maintenance.

5.3.1.7 Recommendation for Development of Rural Telecommunication System

(1) Network System Selection

Microwave radio-relay systems are well suited for the transmission of digital signals over large distances in difficult geographic and topographic conditions. Medium and low-capacity systems (34 Mbps) are used to connect digital concentrators, remote subscriber units etc. to the parent exchange. .

(2) Joint Use of Existing Microwave Sites

Due to existing microwave links in Ulaanbaatar to Uvurkhangai and Ulaanbaatar to Selenge direction, those sites shall be used in general for construction of new Point-to-Point (PTP) digital microwave transmission network for development of rural area, mainly as repeaters. Such measure supports the cost efficiency of the PTP microwave construction project portion.

For the installation of the digital microwave radio relay facilities, at existing MW sites, old unused equipment has to be removed. Existing antenna support structures at all of the MW stations can be used for PTP digital microwave construction purpose.

(3) Frequency Plan

The 7GHz frequency band (7125 MHz to 7725 MHz) shall be utilized for all Point to Point digital microwave transmission networks. The frequency channel allocation shall be according to CCIR Rec. 385-6 with a RF channel separation of 28 MHz.

The frequency channel arrangement in each system shall generally be optimised to the necessary minimum utilisation of channels but paying attention to:

- Co-ordination with the Mongol Frequency Planning Management;
- Avoidance of co-channel interference;

- Avoiding interferences from/with future broadcast satellite systems;
- Economical re-use of frequency channels for future extension of networks
- Cost reduction of spare equipment and units for O&M
- Provisions of simple antennas (low cost types)
-

In particular, the frequency plan shall take into account no occupancy of this band in the adjacent countries and consider future expansions. The contractor shall make transparent all the details of the frequency planning, interference calculation and selection of channels and include sample co-calculation by listing and using the characteristic values and patters of equipment and antennas.

(4) Training

There will be two versions of know how transfer:

- Installation instructions for digital transmission system (OFC, microwave transmission and WLL system)
- Training on the digital transmission system (OFC, microwave transmission and WLL system) including NMS (Network Management System) (class room training)

The installation instructions shall be mainly executed as on-the-job training. Nevertheless three days classroom instructions in Mongolia training centre shall be executed in advance to familiarise the installation teams with the installation principles for digital transmission system.

The training for the digital transmission system requires personnel with knowledge on digital techniques and good competence to communicate in the English language. This training will be directed to the key personnel in the digitisation of rural telecommunication network like the managers of the Aimag centre communication office with their acting representatives and the engineers in charge for digitisation of rural telecommunication system from PTA and MT.

Those trained engineers shall train their subordinates in Mongolian language and with concern to the local conditions. For this project with Uvurkhangai, Selenge and Darkhan-Uul Aimags in total 6 trainees are required. The training shall be executed in the contractors premises with all required equipment and facilities. A training of six weeks is required as minimum duration.

(5) Spare Parts

(1) The contractor is asked to submit a complete list of all spare parts that are considered necessary for an efficient maintenance of the whole system for a period of five years.
(2) The Contractor shall recommend the distribution of consumables and spares, for each level of maintenance, including those items, if any, to be held at each individual station.
(3) The spares may be categorized as consumable items, spare components, etc, and the unit price shall be quoted for each item.
(4) The Contractor is requested to state the quantity of each spare unit that should be purchased, compared with the number of units in service. The Contractor shall provide details of how the offered quantities have been calculated.
(5) At the issue of the acceptance certificate, the contractor must have the complete set of spares available.

5.3.2 Optical Fibre Transmission Facility

Transmission facilities between Aimag Centres and Sum centres will be digitised in Selenege/Dalkhan-Uul Aimags and Uvurkhangai Aimags for fixed telephone, mobile telephone and IT traffics.

5.3.2.1 Site Survey

Site Survey was conducted in Selenge/Dalkhan Aimags from 8th October 2002 to 10th October 2002 regarding Fibre Optic Transmission System (referred to as FOTS hereafter). Main survey items are road distance from MRC (Mongolian Railway Company) buildings and MTC buildings, road conditions and problems on branching routes, and branching points on the backbone fibre optic cables

Among Sums surveyed, branching from the backbone is quite easy for Orhon, Dulaankhaan, Khutul, Orhontuul, Khongor, Bayangol and Zuunharra, since they have mechanical closures or Multiplexers on the ground. Branching is said to be also easy for Thnkhel which was not surveyed.

Since Shaamar has not mechanical closures nor multiplexes on the ground, branching is not so easy as for Sums above, but it has optical fibre cable loop under the ground, and branching is possible from the loop point.

The Optical fibre cable run near Orhon and Nomogon in Selenge Aimag, but has only jointing points under the ground and no loop points near the two Sums. It is rather difficult to branch from the jointing points, although not impossible. The Survey results are attached to the Data Book.

5.3.2.2 Optical Fibre Transmission Network Plan

Figure 5.3.2.2-1 shows the network configuration plan for Selenge/Dalkhan-Uul Aimags and Figure 5.3.2.2-2 shows one for Uvurhangai Aimag. The Mongolian Railway Company Fibre Transmission System are utilized for Aimag-Sum transmission in Selenge/Dalkhan-Uul Aimagas. Since Mongolian Railway Company has their own plan for usage of the 12 fibres, the Project will not use any of the fibres as they are, but will use a part of the exiting STM-1 capacity.

Since new equipment is installed in tandem with the backbone equipment in Selenge/ Dalkhan-Uul Aimgas, security of new equipment should be as same as that of backbone equipment. Failure of the branching routes should not affect the backbone network.

In the case that usage of the MRC facilities become impossible from various reasons, the microwave systems will be used for Sums in Figure 5.3.2.2-1 in place of the optical transmission systems, except for Tunkhel, for which microwave system is too expensive to be planned in the FS project.

Interface cards will be mounted on existing equipment where necessary.

For the branching routes, aerial 8 cores optical fibre cables will be installed. Four cores are actually used for the transmission systems and the remaining four cores are used for maintenance purpose and reservations for future use.

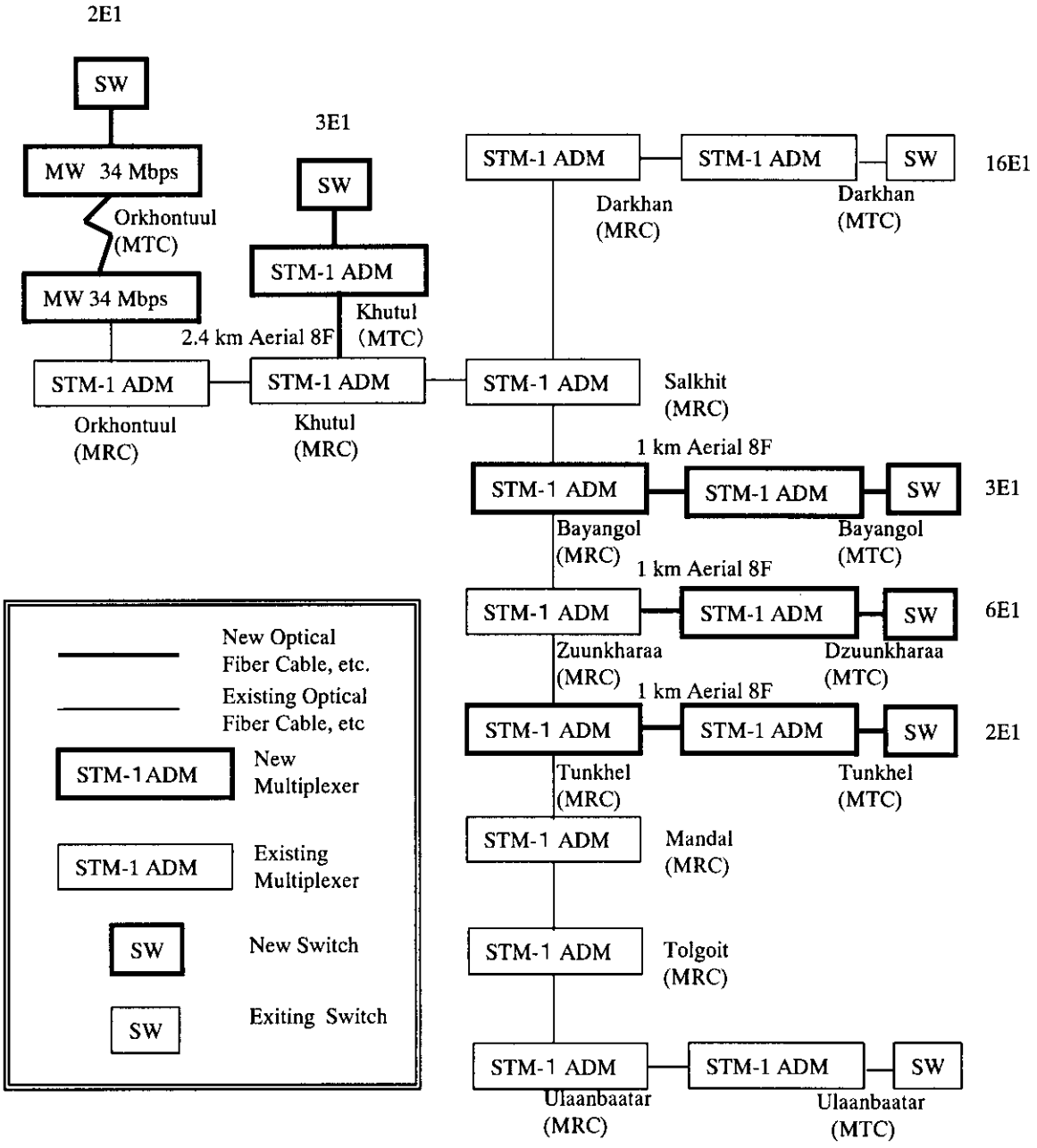


Figure 5.3.2.2-1 FOTS Plan for Selenge/ Darhan-Uul Aimags

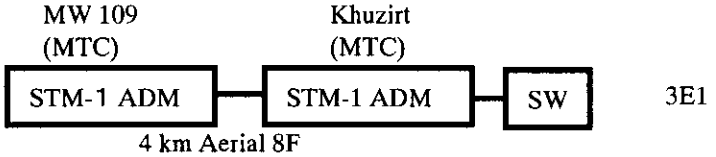


Figure 5.3.2.2-2 FOTS Plan for Uvurkhangai Aimag

(1) Maintenance and Operation

Maintenance and Operation is conducted by MTC for FOTS in Uvurkhangai Aimag, and by MRC for FOTS in Selenge/ Daklhan-Uul Aimags.

Failute of FOT system in Uvurkhangai will be watched at MTC Arvaiheer and actual maintenance work will be also done from MTC Arvaiheer.

As for Selenge/ Dalkhan, the existing workstation at MRC UB will watch the whole FOT sytems and actual maintenance works are carried out by MRC Dalkhan.

Demarkation points of Maintenance and Operation in Selenge/ Dalkhan-Uul Aimags will be considered as in Figure 5.3.2-3.

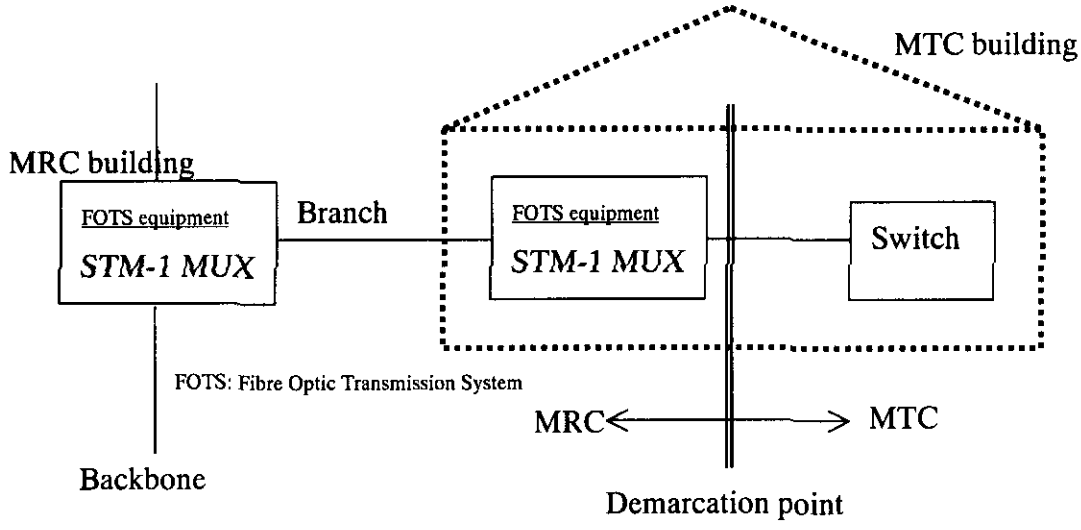


Figure 5.3.2.2-3 Demarcation point between MRC and MTC

(2) Tool and Measuring Equipment

A set of Lap-top Computer (including software), optical power meter, optical variable meter and splicer will be provided at MTC Arvaiheer and at MRC Dalkhan.

(3) Spare Parts

One set of spare parts for active circuits will be provided at MTC Arvaiheer, and two sets of spare parts for active circuits will be provided at MRC Dalkhan.

(4) Overseas Training

Overseas training will be provided for two engineers in total from Selenge/ Dalkhan-Uul Aimags and Dalkhan Aimag.

5.3.2.3 Bill of Quantity

As for reference, bills of quantity for main components of FOTS are shown in Table 5.3.2.3-1 and Table 5.3.2.3-2. Bill of Quantity will be fixed later at detail design stage.

Table 5.3.2.3-1 Bill of Quantity for Uvurkhangai Aimag

Description	Arvaiheer (MTC)	MW 109 (MTC)	Khujirt (MTC)	Total Q'ty
SDH Equipment				
Equipment Rack		1	1	2
Subrack		1	1	2
TSI		2	2	4
STM1 Optical Card		2	2	4
POWER		2	2	4
2MCard (21 x 2M)		2	2	4
2M SW		3	3	6
Spare Parts (set)	1			1
Tool and Measuring Equipment				
Laptop Computer (including Software)	1			1
Optical Power Meter	1			1
Optical Variable Attenuator	1			1
splicer	1			1
OTDR	1			1
Power (Rectifier and Battery)		1	1	2
Optical Fiber Cable (8 F Aerial) (km)		4		4

Table 5.3.2.3-2 Bill of Quantity for Selenge/Dalkhan-Uul Aimags

Item No	Description	Dalkhan (MRC)	Bayangol (MRC)	Bayangol (MTC)	Zuunkharaa (MRC)	Zuunkharaa (MTC)	Tunkhel (MRC)	Tunkhel (MTC)	Khutul (MRC)	khutul (MTC)	Orkhontuul (MRC)	Total Q'ty
1.	**SDH Equipment**											
1.1	Equipment Rack		1	1		1	1	1		1		6
1.2.1	Subrack		1	1		1	1	1		1		6
1.2.5	TSI		2	2		2	2	2		2		12
1.2.6	STM1 Optical Card		6	2	2	2	6	2	2	2		24
1.2.7	POWER		2	2		2	2	2		2		12
1.2.8	2M (21 x 2M)			2		2		2		2	1	9
1.2.9	2M SW			3		3		3		3		12
	Spare Parts (set)	2										
	Tool and Measuring Equipment											
1.5	Laptop Computer (including Software)											
2	Optical Power Meter	1										1
3	Optical Variable Attenuator	1										1
	splicer	1										1
	OTDR											
	Power (Reqtifier and Battery)		1	1		1	1	1		1		6
	Optical Fiber Cable (8F Aerial) (km)		1		1		1		2.4			5.4

5.3.2.4 Cost Estimate

Costs of FOTS equipment, measuring equipment, spare parts, fibre optical cable, and power facility (rectifier and battery), installation costs and overseas training cost are included in the cost estimate shown in Table 5.3.1.4-1. Breakdowns of the costs into Aimags are shown in Table 5.3.1.4-2 and Table 5.3.1.4-3.

Table 5.3.2.4-1 FOTS Cost Estimate (Total)

[1,000 US$]

Item	Cost Estimate	Foreign Portion	Local Portion	Main Work
Multiplexer	542	487	54	8 Multiplexers
Optical Fiber Cable	68	34	34	9.4 km
Total	609	521	88	