Table 3.4.4-1 Trunk and Local Call Service

Tariff zone	Tg./One minute
A. long distance call	
1. 101 - 300 km	
- Automat call/Through operator	154.00
- Discounted automat call*	137.00
2. 301-1000 km	
- Automat call/Through operator	205.00
- Discounted automat call*	181.00
3. 1001 km and over	
- Automat call/Through operator	231.00
- Discounted automat call*	202.00
B. Local call	
- Sum Centre, Town and Cities	7.00

Note: Regular rates for long distance: 9:00 - 22:00 Monday through Friday.
Discounted rates for the same: 22:00 – 9:00 Monday through Friday, and Holidays, Saturdays and Sundays.
Source: PTA.

Table 3.4.4-2 Trunk Call Tariff to Aimag Centres from Ulaanbaatar, MT

No	Aimags and cities names	Area code	Tariff one minute call in Tg. Automatic Dialling	
			Regular	Discounted
1	Bulgan	34.2	205	181
2	Govi Altai	48.2	205	181
3	Dornogovi	52.2	205	181
4	Dornod	58.2	205	181
5	Uvorkhangai	32.2	205	181
6	Selenge	36.2	205	181
7	Khovd	43.2	231	202
8	Khentii	56.2	205	181
9	Darkhan uul	37.2	154	137
10	Orkhon	35.2	205	181
11	Baganuur	21	154	137
12	Bayanolgii	42.2	231	202
13	Umnogovi	53.2	205	181
14	Tuv	27.2	154	137
15	Nalaikh	23	154	137
16	Bayankhongor	44.2	205	181
17	Dundgovi	59.2	154	137
18	Sukhbaatar	51.2	205	181
19	Bagahangai	22.0		
20	Arkhangai	32.2	205	181
21	Huvsgul	38.2	205	181
22	Uvs	45.2	231	202
23	Zavkhan	46.2	205	181
24	Govisumber	54.2	154	137

Source: PTA.

Table 3.4.4-3 New Connection and Monthly Line Rental

	Business	Government	Home	
			Regular	Urgent
A. Installation Charge:	Tg	Tg	Tg	Tg
- Ulaanbaatar	100,000		70,000	100,000
- Darkhan, Erdenet	80,000		40,000	70,000
-Aimag Centres, Nalaikh, Baganuur, Choir	70,000		40,000	
- Sums	10,000		5,000	
B. Monthly line Rental				
1. Digital				
- Sums	1,200	1,200	500	
- Big Sums	3,800	3,000	600	
- Other places	6,900	4,500	750	
2. Analogue				
- Sums	1,000	1,000	600	
- Big Sums	5,500	4,500	1,000	
- Aimag centres, Nalaikh Baganuur	6,100	4,500	1,200	
- Ulaanbaatar, Orkhon, Darkhan	8,500	4,500	1,200	

Source: PTA.

Table 3.4.4-4 Leased Circuits in Local Area (Intra-city)

Indicator	Tariff	First connect pay
1. 1 pair/km (month)	Tg.	Tg.
- Special	5,000	100,000
- Business	7,000	100,000

Source: PTA.

Table 3.4.4-5 Call Charge - International

in US$

		Automatic Dialling				Through Operator	
		Regular		Discounted		1st full min.	Per min. thereafter
	Countries/Regions	1st 6sec.	Per 6 sec. Thereafter	1st 6sec.	Per 6 sec. Thereafter	Station Call	
1	Russia, Belarus, Kazakhstan, Ukraine	0.10	0.08	0.08	0.07	0.6	0.5
2	China	0.10	0.09	0.07	0.06	0.53	0.4
3	Japan, Hong Kong, S. Korea, Singapore	0.08	0.07	0.06	0.05	0.5	0.4
4	Taiwan, Thailand, Vietnam, Indonesia, Pakistan, Turkey, Israel, India, Australia	0.10	0.08	0.06	0.05	0.5	0.4
5	USA, Canada	0.09	0.07	0.07	0.06	0.6	0.5
6	Germany, UK	0.09	0.08	0.08	0.07	0.6	0.5
7	France, Norway, Italy, Check Switzerland, Hungary, Poland, Nederland, Belgium, Austria, Denmark, Bulgaria, Sweden, Finland, Ireland, Yugoslavia	0.10	0.09	0.08	0.07	0.65	0.6
8	Other countries	0.11	0.10	0.09	0.08	0.7	0.6

Note: Regular Rates 9:00 – 20:00 on Monday through Friday
Discounted Rates 20:00 – 9:00 on Monday through Friday, Saturdays, Sundays and 11th – 13th July
Source: PTA.

(2) Tariffs on Cellular Phone and Internet Services

Table 3.4.4-6 Tariffs on Cellular Phone Service

in US$

		Mobicom	Skytel
Local/Basic services			
1	Registration fee	100	100
2	Advanced fee with ILDC	300	300
3	Advanced fee without ILDC	100	100
4	Monthly Ground fee	22	20
5	Call Charge per minute	0.13	0.12
Card Service			
1	100 Unit card	32	29
2	40 Unit card	14	
3	30 Unit - Without fixed date	6	
4	50 Unit		15.5
5	20 Unit – Without fixed date		3.6
6	10 Unit – SIM card	15	

Source: PTA.

Table 3.4.4-7 Tariffs on Internet Service

in US$

Dial-up (56k bps)	Time Unit Hours/month	Extra hour Limit/month	Registration Fee	Monthly Fee	Chg/extra hour	Night Time 0:00-7:00
Mobicom						
- Enterprise	300		60	60	0.70	
- Soho	70		35	35	0.70	
- Economy	50		25	25	0.70	
- E-mail	20		10	10	0.70	
- MobEmail	10		5	5	0.70	
- My Mail	Unlimited		4	4	Free	
Datacom						
- Premium	300		10	69	1.20	Free
- Regular	100		10	39	1.20	Free
- Basic	5	30	10	None	1.20	Free
Micom						
- Platinum	Unlimited	Unlimited	10	65	Free	Free
- Silver A	75	Unlimited	10	30	1.00	Free
- Silver B	75	No extra	10	30	No extra	Free
- Bronze	25	10	10	10	1.00	Free
- Copper	10	5	10	4	1.00	Free
RailCom					Fixed Fee	
-Useful Period:	50		40	35	*25/**30	
*: 30 days	30		40	35	*15/**18	
**: 90 days	20		40	35	*10/**12	
	15		40	35	*8/**10	
	10		40	35	*5/**7	
- Grand	Unlimited		40	35	60	Free
- Business	90		40	35	35	Free
- Classic	25		40	35	10	Free
- E-mail			40	35	4	Free
-High Speed Service 64 kbps 128 kbps 256 kbps	Unlimited		800 ~ 1000	550 950 1200		
ADSL (8M bps)			License Fee	Monthly Fee		
- 1-5 PC			150	350		
- 6-10 PC			200	450		
- 11-15 PC			250	550		
- Extra/ PC				20		
- VPN			300	500		

Source: PTA.

Table 3.4.4-8 Tariff on MT "MY PHONE"(WLL) Service

in Tugrug

New Subscription	Monthly Charge	Local Call to PSTN	Price of Terminal
70,000	3,000	10 /minute	238,000 to be paid; 1st year 138,000 2nd year 50,000 3rd year 50,000

Source: PTA.

(3) Interconnection Charge

The following is the interconnection charge between telephone service operators.

Table 3.4.4-9 Interconnection Charge

1) Interconnection between networks of MT and Mobicom

① **From Mobicom to MT:**

in Tg. and **in bold**

		MT	Mobicom	Total subscriber payments
A. 9911xxxx (main subscriber)				
	Local	**15**	MC-15	MC
	Long distance	**LD**	MC	LD+MC
	International	**International**	MC	Internatoinal+MC
B. 99xxxxxx (Mobicard)				
	Local	**15**	MC-15	MC
	Long distance	**LD**	MC	LD+MC
	International	**International**	MC	Internatoinal+MC
C. 9515xxxx				
	Local	7	MC-7	MC
	Long distance	**LD**	MC	LD+MC
	International	**International**	MC	Internatoinal+MC

② **From MT to Mobicom:**

		MT	Mobicom	Total subscriber payments
A. 9911xxxx (to main subscriber)				
	Local	8	**18**	26
	Long distance from UB	20	**LD**	LD + 20
	Aimags	LD	**20**	LD + 20
	International			
B. 99xxxxxx (to Mobicard)				
	Local	15	**35**	50
	Long distance from UB	20	**LD**	LD + 20
	Aimags	LD	**20**	LD + 20
	International	International	**MC**	International + MC
C. 9515xxxx (to wireless telephone)				
	Local	7	**7**	14
	Long distance from UB	20	**LD**	LD + 20
	Aimags	20	**LD**	LD + 20
	International	t.n.t-0.035$	**0.035$**	t.n.t

2) Interconnection between networks of MT and Skytel

① From Skytel to MT:

		MT	Skytel	Total subscriber payments
A. 9111xxxx (main subscriber)				
	Local	**10**	SK-10	SK
	Long distance	**LD**	SK	LD + SK
	International	**International**	SK	International + SK
B. 91xxxxxx (card subscriber)				
	Local	**15**	SK - 15	SK
	Long distance	**LD**	SK	LD + SK
	International	**International**	SK	International + SK
C. 9617xxxx				
	Local	**6**	SK – 6	SK
	Long distance	LD	SK	LD + SK
	International	**International**	SK	International + SK

② From MT to Skytel:

		MT	Skytel	Total subscriber payments
A. 9111xxxx (to main subscriber)				
	Local	8	**18**	26
	Long distance from UB	20	**LD**	LD + 20
	Aimags	LD	**20**	LD +20
	International			
B. 91xxxxxx (to card subscriber)				
	Local	15	**35**	50
	Long distance from UB	20	**LD**	LD + 20
	Aimags	LD	**20**	LD +20
	International			
C. 9617xxxx				
	Local	7	**6**	14
	Long distance from UB	LD	**6**	LD + 6
	Aimags	LD	**6**	LD +6
	International	t.n.t-0.035$	**0.035$**	t.n.t

3) Interconnection between networks of Mobicom and Skytel

① From Skytel to Mobicom:

		Mobicom	Skytel	Total subscriber payments
A. From 9111xxxx				
	Local	**20**	SK-20	SK
	Long distance- from UB	**LD**	SK	LD+SK
	-Between Aimags	**LD/2**	LD/2+SK	LD+SK
	To 9515xxxx	**20**	SK-20	SK
B. 91xxxxxx (from card subscriber)				
	Local -UB	**30**	SK-30	SK
	- aimag	**20**	SK-20	SK
	Long distance to -9911, 9515	**20**	SK-20	SK
	- to aimag	**LD/2**	LD/2+SK	LD+SK

② **From Mobicom to Skytel:**

		Mobicom	Skytel	Total subscriber payments
A. From 9911xxxx				
	Local	MC-20	**20**	MC
	Long distance – from UB	MC	**LD**	MC+LD
	- between aimags	LD/2+MC	**LD/2**	LD+MC
B. 99xxxxxx (from card subscriber)				
	In - UB	MC-30	**30**	MC
	- Aimag	MC-20	**20**	MC
	Long distance – to 9111	MC-20	**20**	MC
	- to aimag	LD/2+MC	**LD/2**	LD+MC
C. From 9515xxxx				
	Local	MC	20	MC+20
	Long distance	MC	**LD**	MC+LD

MC: MobiCom Price
MT: Mongolia Telecom Price
SK: Skytel Price
LD Long Distance Charge
Source: PTA.

(4) Rural Telecommunications Development and issues of Telephone Tariffs

Since February 1997, when the across the board tariffs revision was made, the tariffs have been kept unchanged to date, except for an aggregate of 60 % lowering in the international call charge rate denominated in U.S. Dollars and some minor upward adjustments. During the five years, inflation in Mongolia made the effective prices of telecom services deflated by 41% except for the international call, the rate of which is in U.S. Dollars. MT exerted its efforts towards increase in revenues including net interconnection charge from newly developed sphere of mobile telephone services to keep annual revenues at the level of more than U.S. Dollars 220 per telephone line (See Table 11.2.1-1 in Chapter 11). It may appear that the timing for the next revision of MT tariffs is already matured, unless there are the needs and reality in the rural areas that necessitates MT to keep the existing tariffs. According to the explanation heard from CRC, its report for the revision of telecom tariffs is upcoming taking in the findings and recommendations of the studies so far made by the World Bank and foreign specialists, aiming at rebalancing of the respective tariffs reflecting indigenous requirements of Mongolia. As the general direction, the revision of the tariff is unavoidable, however, the following facts should be seriously considered.

According to the household survey made to 2,608 households from 80 Sums and settlements of Tuv, Bulgan, Khentii, Umnugovi and Govi-Altai Aimags, more than half of the respondents are considering that the current information mainly from the television (including the radio) and newspapers is insufficient and above 90% of the people on average would subscribe to the telephone line when it becomes available. However, the answers to the

"Willingness to Pay" items are not in line with the above context. The average monthly income of a mean income group family is Tg. 72,000 (Numbers from the Statistical Yearbook 2000 are an average income of Tg. 72,845 for rural household and Tg. 92,135 for urban household.) and of which the family spends 3 to 9 % (or Tg. 2,200 to Tg. 6,500) for telephone charges. The answered "Willingness to Pay" showed even lower amounts than the amounts that the people are currently paying as telephone charges. This result may be attributable to the facts that the people from the remote area from Ulaanbaatar are paying heavier telephone charges of about 9% of monthly household income and the telephone charges have already become burdens to their life, while the people from the nearer area are normally paying 3%. The above percentage ratio is higher than the examples of 3-5% from other countries having some similarity to the socio-economic status of Mongolia.

The above result is giving a hint that more powerful measures (including further discount of call charge rate up to a certain monthly volume of calls) should be taken as an immediate and a limited period assistance to help the rural people enable to increasingly access the telecommunications system of the country as the public wealth, while the efforts to reduce the gap in income between the urban and the rural areas should be made as a long range programme as a part of rural development.

3.4.5 Billing and Collection Activity of MT

(1) Current status

Billing and collection for the customers in Ulaanbaatar and Aimag Centres is proceeding well. Billing for the subscribers in Sum Centres is still handled by manual because PBAX in Sum Centres are not linked to ITC due to no Output or only Paper print out of charging data.

Details of billing and collection process in Ulaanbaatar and Aimag Centres is as follows:

(a) Billing

i) Information technology Centre (ITC) collects Call Data Records (CDR) from Aimag Digital Switch through NMS and computes Call rates on International calls, Toll calls and Calls to cellular phone etc. for Ulaanbaatar and all Aimag centres.

ii) Aimag Centres compute the Bill including monthly basic fee, Telegraph fee, Manual connection fee, Additional service fee etc. in addition to the above Call rates with Billing computer system and Customer Database.

iii) Computer supporting systems such as Customer Database, Billing system (Billing preparation and Payment receiving) have been introduced and are used effectively.

(b) Collection

i) Since Sales Offices collect the bill using terminal equipment of billing system, which shows monthly telephone charge of each subscriber, Customer visits the Sales office to confirm monthly telephone charge and pay it every month.

ii) MT doesn't delivery the bill to the customer's premises except public organisations and large business offices because of no Post mail delivery system in Mongolia.

iii) In case of payment delay, Outgoing call is suspended for more than two weeks delay and Contract is cancelled for more than two months delay.

iv) Collection ratio in whole company is high and 90% at 2001.However, Payment of Government organisation is constantly delayed, especially the delay is much in rural area (80% as average).

(2) Billing and Collection for Sum Centre Subscribers after New Rural Network

Present Billing and collection System is basically acceptable and the system should be expanded to Sum Centre subscribers with the following manners:

i) Digital Switch in Sum centre should have the function of charging data (CDR), which is linked to ITC.

ii) ICT computes Call rates on International calls, Toll calls and Calls to cellular phone etc. for all Sum centres also.

iii) Aimag centre should compute the billing up to Sum Subscriber based on the Customer database.

iv) Sum centre would handle the bill collection in the Sum centre Telephone Office.

v) Aimag Centre should manage the Billing and Collection process of Sum Centres to improve the collection rate.

vi) Computer supporting systems such as Customer Database, Billing preparation and Payment receiving should cover Sum Centres Subscribers.

3. 5 Present Status of Telecommunications Networks Operated by Other Operators

3.5.1 Communications Services

(1) Operator and Service

Telecommunication services other than the basic ones are rendered by private and national companies. They are:

a) MobiCom Corporation

MobiCom corporation is offering the people in Mongolia the Mobile Service and the WLL telephone service. MobiCom Corporation was established on March 18, 1996 as the first Mongolian mobile telephone service company, the investors of which are Newcom Co. Ltd., KDDI Corporation, Sumitomo Corporation.

Mobile and Internet Service

MobiCom's mobile network adopts the GSM (Global System Mobile) technology and available in major cities, i.e., Erdenet, Darhan, Nalaikh, Selenge, Sukhbaatar, Zamiin Uud, Sainshand.

This Internet network is connected using GSM mobile phone, Mobifone, CDMA systems data transfer device. This network is accessed by dialling the service number 1691 for connection MobiNet Internet network. Dial-up maximum speed is 56Kb/sec.

The Mobinet Internet network can be accessed using the following mobile devices such as: GSM mobile phone, Mobifone, CDMA systems data transfer device.

Mobile Internet service is available where the mobile service is available, that is, Erdenet, Darhan, Nalaikh, Selenge, Sukhbaatar, Zamiin Uud, Sainshand.

WLL Service

MobiFone can provide telephone service to all inhabitants of the city of Ulaanbaatar including international and domestic long-distance service through WLL technology.

WLL is a telephone service using radio waves instead of telephony cable. It provides telephone service in limited coverage areas were it is not possible to lay cables and supplies stationary telephone service to households and offices that have not been connected to the cable network.

MobiFone WLL service offers reliable transmission of data, fax messages and Internet access. It is not possible to tap into calls. WLL service has the approved security rating for the US military. It does not need to lay cable connections and the subscriber gets immediate service of high quality.

b) Skytel Company

Skytel Company received a licence for operation of mobile telephone network and a licence for radio frequency utilisation in March 1999. Skytel is the second mobile telephone service operator after MobiCom. Skytel operate an analogue mobile technology or AMPS. The shareholders of Skytel are SK Telecom Co. Ltd., Taihan Electric Wire Co. and Univcom of Mongolia.

The Skytel network covers Ulaanbaatar, Erdenet, Darhan, Zamiin Uud, Suhbaatar, Baganuur, Arvaiheer and Bulgan respectively. In February of 2001, Skytel has established a cutting edge technology - CDMA. Skytel has introduced public card phones in spring 2000.

c) MagicNet Co.,Ltd

MagicNet Network expanded to become the best Internet Service Provider with the largest number of customers since 1997. MagicNet provides various types of services such as E-mail, Dial-Up access, Web hosting&design, Domain name, High-speed Internet connection(DirecPC) and LAN&Intranet.

d) Datacom Co. Ltd.

The Mongolian first Internet Service Provider for the Internet access service, e-mail service, packet switching service, facsimile service.

e) Railcom

RAILCOM, a Business Service Centre, was established in March 2002 for enforcing the Mongolian Railway Company's (MRC) information and communication services and aiming to use more the existing optical network installed with foreign loan.

Internet Service

According the cooperation contract between Mongolian Railway Company and TransTeleCom (Russia) in the ICT Sector, the MRC optical fibre network is already connected to Russian and Chinese networks and high-speed Internet service started since August of 2002. The high quality and high speed Internet service will be offered first to only MRC's staffs and be expanded to the people living in the near cities of Mongolian Rrailway.

Optical Fibre Digital Transmission system

Under the "Railway Transportation Development" or MONP-II Project, MRC has established 1,405.5 km of optical fibre transmission system along the railway by a loan of US$ 16.6 million. MRC has realised full access connection with China Railway Company on December 2000, and with TransTeleCom (Russia) on January of 2002.

The MRC transmission system connects 56 cross points of Mongolian railway line and cities including the national capital, 5 Aimags, and 21 Sums. At 7 cities the MRC network has a connection to the commercial MT telecom network. The railway network has 18 ending points of STM-1 systems and 5 repeater stations. Digital switching systems were installed in 18 places and currently around 10 thousand subscribers are connected to all railways fixed network.

International Call Service

MRC has introduced for the fist time in Mongolia the high quality international call service through the optical fibre transmission system. The MRC international direct dialling (IDD) call service is accessed by dialling "006". The railway communication network passes through cities, villages where more than 70 percent of the total population of Mongolia lives in.

f) Incomnet LLC

Incomnet LLC is Mongoilian and Singapore Joint venture company established according to Mongolian law in 2001. Incomnet has implemented two (2) projects which stated in the beginning of 2002, that is,

- Nationa wide satellite communiction service, and
- Public switched telephone service in Mongolia.

The Incomnet network covers more than 30 sites in rural areas through VSAT terminals to provide voice and corporate data networking for public and banking sector.

Incomnet PSTN service started with a capacity of 2,000 lines of Alcatel switch in Ulaanbaatar.

(2) Mobile Phones and WLL Phones

Mobile phone service is offered by MobiCom and Skytel Company. The growth of the service in users are as shown in Table 3.5.1 and Table 3.5.1-2.

Table 3.5.1-1 Mobile Telephones and WLL Phones of MobiCom

Year	1997	1998	1999	2000	2001
Mobicard	---	2,647	17,543	74,482	160,000
Mobicom	2,416	2,718	3,059	3,474	10,000
Mobiphone (WLL)	---	---	1,976	2,044	10,000
Total	2,416	5,365	19,519	80,000	190,000

Table 3.5.1-2 Mobile Telephones of Skytel

Year	1999	2000	2001
Subscribers	10,000	23,000	38,000

(3) Fixed Telephone Lines

The fixed telephone line service is offered by MRC. The MRC fixed line telephone network covers populated areas along the railway connecting the northern border to Russia and the southern border to China. The MRC network is made up with optical fibre transmission system and its gateway switch is placed in Ulaanbaatar. The number of MRC subscribers is around 10,000, including 4,000 lines in Ulaanbaatar, as of October 2002.

MRC has 25 exchanges along the railway. Most of the switching system is HICOM and others are Panasonic and Russian Crossbar switches. Most of the exchanges are integrated in the automatic connection network, but some of them offer operator assisted trunk/international call service.

3.5.2 Internet Exchange

InfoCon Co. inaugurated an Internet exchange on April 20, 2001. The Mongolia Internet Exchange (MIX) intended to improve the country's future capacity for the use of e-commerce, reduces costs for Internet service providers (ISPs) and increases connection speed for Mongolians. The exchange is located at a neutral site or the Mongolia Telecom Office to alleviate concerns of competing ISPs.

Currently in Mongolia, there are eight (8) ISPs serving clients. The MIX was established, becasue the transfer of information between them could be a complicated affair. They were not interconnected in Mongolia, a user of one ISP trying to access information hosted by another ISP would be routed through a possible host of international gateways in foreign country. For example, a Magicnet user wishing to perform an e-commerce transaction with a client of Bodicomputer, might have to access Bodicomputer by way of gateways in

Hong Kong and California, increasing costs and decreasing performance. There was only one ISP provided by Magicnet before the Mongolian Internet Exchange of InfoCom started.

It is said that about 30 per cent of all traffic is originating and terminating in Mongolia, meaning that out of all the Internet users accessing information from Mongolian ISPs, 30 per cent are actually in Mongolia.

A presentation on the Internet exchange project was held to the five Mongolian ISPs --- Magicnet, MiCom, Bodicomputer, Erdemnet, and MobiCom --- in January, 2001. Following the presentation, all five ISPs signed a Memorandum of Understanding (MoU) to make use of the exchange, and not charge each other for receiving traffic coming from competing ISPs.

3.6 Telecommunications Development Plan and On-going Projects

3.6.1 General Strategy for Telecommunications Sector Development

The objective of the general strategy for developing the telecommunications sector in Mongolia for 2010, according to the MTSPS 2001, is to introduce more fruitful investment along with the latest high-tech and technology in Mongolia.

This objective shall be implemented in the manner of opting for the latest modern technologies in harmony with ensuring customers demands, issuing licenses to service providers as well as registering them:

a) Keep on the reformation and expansion of digitalisation of the telecommunications network in combinations with technologies of optical fibre, microwave, space and mobile communications;

b) Introduce the optical fibre technology into the backbone network, connect centres of all Aimags and towns with the high-speed broad bandwidth information transmission network, develop the integrated information network for the country;

c) Digitise the radio and television broadcasting and receiving stations broaden the receipt coverage of radio and television broadcasting from a satellite, increase channel numbers, improve the quality o broadcasting. These measures shall be implemented step by step;

d) Speed-up the penetration of optical fibre cables in to urban areas telephone network lines, and the copper, optical fibre cables and wireless technologies into subscriber lines and increase the coverage extent;

e) Introduce the space mobile communications system into the rural communications; and

f) Improve the telecommunications service supplies, by 2010, a telephone density in urban areas shall achieve 15 phones per 100 inhabitants in Ulaanbaatar, 10-12 in Aimag centres, international and domestic calls from all Sum centres shall be performed automatically and ensured no less than 50 percent of the population with technical opportunities to be connected into the Internet.

3.6.2 Telecommunications Network Development

The national integrated telecommunication network of the country consists of 4,000 km microwave routes and 30,000 km open wire lines connecting Aimag centres and districts, as of 1999. There were 325 switching systems with a capacity of 100,600 telephone lines in the network as of 1999. The establishment in 1990 of the ground station of the "Asiasat" and "Intelsat" system in Ulaanbaatar has enabled Mongolia to be connected automatically with a telex and fax networks of over 190 countries in the world. The international services are handled through 74 channels of satellite systems. In 1993 a new Ulaanbaatar city digital technology telephone exchange with capacity of 40,000 lines was installed and now is in full service. The international lines are now reliable and operate at fair price.

In 1997, 2.5 per cent of GDP was spent on the telecommunications sector. During 1994-1998, PTA invested US$ 58 million, financed mainly by ODA. This amounted to 6 per cent of total ODA. The completed Telecom Project 1 cost US$ 52 million. ADB financed the main portion, with co-financing from KfW, NDF and NORAD. Thanks to sectoral reform, private investment has started in the telecommunication sector. The main focus of the 1994-98 projects was to provide a fully digital trunk transmission network with digital switching facilities down to Aimag level by 2002. As of 2002, all 21 Aimag centres have been connected to the digital facility.

3.6.3 Recent and On-going Projects

The telecommunications network, being recognised as an important infrastructure for national development, has been improved steadily under various projects. Through the projects, the national trunk network is on the way of digitisation by introducing digital links of microwave and optical fibre transmission system, very small aperture, in addition to digital switching systems.

The digitisation started with the introduction of a digital switching system of a capacity of 16,000 line units in Ulaanbaatar under a 3-years project completed in 1998. MT projects MON-1300, Telecom-2, Telecom-3 were realised to provide digital transmission links and digital switching systems in the national capital Ulaanbaatar and Aimag centres. These projects have mostly implemented and planned to complete in 2003. In parallel with those MT projects, optical fibre cable was laid by Mongolian Railway Communications Company along the railway from the northern border with Russia to the southern border with China.

<u>MON-1300 Project</u>

Project MON-1300 started in 1994 and completed in 1999. It included:

(a) Introduction of six (6) units of digital switching units;
SDE of Siemens: In Bulgan, Selenge, Uvurkhangai (3 in total);
EWSD of Siemens: In Ulaanbaatar, Erdenet, Darkhan (3 in total);

(b) Card type payphones: 200 pieces;

(c) Subscriber access network in Ulaanbaatar;

(d) Operation Maintenance Centre (OMC) in Ulaanbaatar;

(e) Solar panel factory;

(f) Solar power supply to 25 microwave relay station in Western Region.

<u>Telecom-2 and Telecom-3 Projects</u>

The projects intended to improve the telecommunication service to international level by introducing digital exchanges of latest technology in Aimag centres and major cities. It also included very small aperture terminal (VSAT) satellite system to connect isolated Aimags with the national capital. It started in 1998 and supposed to be completed in 2003.

It included introduction of digital switching systems in Aimag centres in the Western, Eastern, and South Rigion in addition to two (2) cities nearby Ulaanbaatar. As a result, digital switching systems of EWSD were introduced in nine (9) Aimag centres under Telecom-2 and six (6) Aimag centres plus two (2) satellite cities under Telecom-3:

Telecom-2: Bayankhongor, Khuvsgul, Tuv, Zavkhan, Govi-Altai, Arkhangai, Khovd, Uvs, Bayan-Ulgii.

Telecom-3: Dornod, Sukhbaatar, Khentii, Dundgovi, Dornogovi, Umnugovi, Baganuur, and Nalaikh.

Installation of VSAT earth stations in 9 provincial centres and expansion of VSAT HUB system were implemented in 2000-2001 under Telecom-2 and Telecom-3 projects.

Type I station located at Ulaanbaatar consists of a 16 meter C-band antenna, and two redundant VSAT Plus IIe terminals.

Type II stations are located at 14 Aimags, that is, Dundgovi (Mandalgovi), Bayankhongor (Bayankhongor), Govi-Altai (Altai), Bayan-Ulgii (Ulgii), Umnugovi (Dalanzadogad), Khovd (Khovd), Khentii (Underkhaan), Sukhbaatar (Baruun-Urt), Bornod (Chibalsan), Arkhangai (Tsetserleg), Zavkhan (Uliastai), Uvs (Ulaangom), Khuvsugul (Muren), Dornogovi (Zamin uud).

Type III stations are located at three (3) Aimags, that is, Zavkhan (Tosontsengel and Tudevtei), Uvs (Baruunturuun), and Dornod (Sumber)

Renovation of International Exchange NEAX-61, signalling system No.7

The project intended to upgrade the signalling system function of the international gateway switch. The international gateway switch NEAX-61 was equipped with the ITU-T common channel signalling system (CCS) No. 7 under this project implemented with a Japanese grant assistance. The domestic side completed in 2001 and the international side is expected to complete in 2002.

Establishment of Optical Fibre Transmission Network along Mongolian Railway

The project on the installation of 1,700 km long optical fibre cable network with SDH system along the Railway Road from north to south of Mongolia was completed recently. Within the frame work of Telecom-2 and 3 Project, the new digital switches of Baganuur, Choir and Sainshand cities are planned to get connect to this optical fibre network.

Under the same conditions, there are being set the preconditions for connecting the Darkhan, Erdenet and Sukhbaatar cities to this optical fibre cable network as an alternative transmission backbone route.

Rehabilitation of Eastern Route's Backbone Network and Towns along the Eastern Network

A project to install optical fibre cable in the eastern part of the country is expected to complete in 2003. The Project named MON-4 includes the following facilites.

Switching System

Ulaanbaatar Area: Shuvuun Fabric, Banyangol, Gachuurt.

Eastern Area: Tsentermandal, Jargalthaan, Muren, Munkhhaan.

Transmission System

SDH: Ulaanbaatar, Bagakhangai, Baganuur, Tsentermandal, Jargalthaan, Muren, Underkhan, Munkhhaan, Barun-Urt, M/W 215, Choibalsan

PDH: Airport, Bio Kombinat, shuvuun Fabric, Host-68, Banyangol, ATC-45, Gachuurt.

Digital Links to South and West

In addition to the above PTA's concrete projects, followings are under way by Mobicom.

PDH: Digital microwave transmission link of 34 Mbps from Arvaikheer (Umnugovi) to Ulgii (Bayan-Ulgi).

PDH: Digital microwave transmission link of 34 Mbps from Choir to Dalanzadgad (Umnugovi).

3.6.4 Past Telecommunications Development Plans

(1) Telecommunications Development Plan for Mongolia up to 2010

The telecommunications development plan worked out by BT Telecom in February 1993 forecast capacity expansion of switching system to 125.5 thousands lines in 2000, 155 thousands in 2005, and 185 thousands in 2010.

The functional plans combined to give an overall Network Master Plan, the main thrust of which was to provide, by 2002, a fully digital trunk network withy digital switching down to Aimag level.

The plan was made in a situation that there was no local call charging no automatic trunk dialling. All inter-exchange calls, with the exception of calls within the capital, were connected via two or more operators.

Mongolia had inherited a network of about 35, largely Russian-build, telephone exchanges which were a mixture of electromechanical and manual. Interconnecting these exchanges was a network consisting of analogue microwave (86 stations) and open wire carrier. A 20,000 line digital switch E-10B of Alcatel was opened in the capital Ulaanbaatar. A new satellite earth station and gate way switch were then being build by a Japanese consortium. A very limited international direct dialling (IDD) service was availale from selected locations.

In 2002, the switch capacity exceeded 140 thousand and most of Aimag switches have been replaced with digital ones. Full digitalisation of Aimag centres' switch is expected to complete within 2002. In addition to analogue radio link in western region, digital links of optical fibre and microwave transmission system now in use and more digital links construction is under way.

(2) Telecommunications Network in Ulaanbaatar City

A basic plan for the development of the telecommunications network in Ulaanbaatar city up to the year 2010 was conducted by JTEC in 1996. It forecast to increase the switch capacity in Ulaanbaatar to 113 thousands in 2005 and 166 thousands in 2010. It recommended a) Ring connection of host exchanges in the capital, b) Introduction of ISDN, c) Signalling system ITU-T No. 7, d) Introduction of synchronous digital hierarchy (SDH) transmission system, and other. The item c) and d) have been realised up to 2002.

3.7 Issues in Telecommunications Development

3.7.1 Telecommunications Policy and Strategy

In spite of severe circumstances for telecommunications development in Mongolia, i.e. many small towns/villages (Sums) in vast countries, very few population, long distance between villages, very poor roads and electricity, etc. are big obstacles for development and investment, Mongolian Government has been tackling to develop telecommunications networks and services as the most important infrastructure, especially in rural areas.

In this line, Basic Policy and Strategy of Sector Development and Privatisation seems very good, however the following issues should be resolved in order to implement it:

(a) Telecommunication development plan

A long term Master plan for Telecommunication development is not arranged and the development frame work with scopes and investment costs are not clear. (This Master Plan is under preparation in 2002.)

(b) Technology

Cost effective telecommunication network technology for Mongolian geographic speciality which is vast and few population density is not established.

(c) Revenue and expenditure of rural telecommunication

- Operation of Aimag level (Aimags and Sums) is at a deficit and - investment incentive is very low.

- The detailed revenues and expenditures (real cost) demarcated in the Capital and Aimag level are not clear.

(d) Universal service obligation for rural telecommunication development

Detailed items such as service areas and time of universal service obligation are not clear.

(e) Universal Service Obligation Fund and applicable

- Fund calculation basis and amount is not clear
- Natures, kinds and costs of Projects applicable to fund are not clear

(f) Flow of financing for telecommunications projects

Flow and utilization/distribution of telecommunication financing are not clear.

(g) State-owned back-bone network facilities and lease

Already privatised companies own back-bone networks except international network and necessity of State-owned back-bone network is less.

(h) Privatisation

- All lease fees of network assets are not necessarily utilised for telecommunication projects
- Detailed concession items for investors of rural telecommunication development are not clear.

3.7.2 Provision of Telecommunications Services

(1) Services Availability

On the review of activities in telecommunications sector, the most important index is service availability and its quality. Owing to the nationwide telecommunications infrastructure established in past years, the very basic service of telecommunication is available in most of constantly populated settlements, though the quality is low.

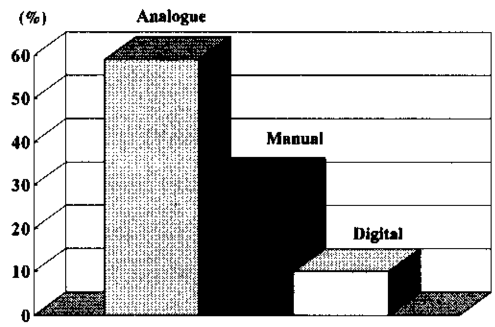
The Sum centres are provided with small analogue switching system or manual board, while some of the Sum centres are provided with only a magneto telephone terminal linked with Aimag centre. Very basic telecommunication service, or telephone conversation with distant place, is available in all Sum centres. However, its quality is not at international level because of low quality of transmission link between Sum centres and Aimag centre.

The service quantity expressed in telephone density per 100 inhabitants shows that rural areas are provided with less than 3 telephone lines per 100 inhabitants on the average of Aimag level. It is estimated through the Master Plan Study that waiting list is equivalent to 19 % of existing subscribers in Aimag cnetre and 35.5% in Sum centres as of 2001.

(2) Communication Quality

The very basic telecommunications service is available in most of target areas though the communication quality is lower than international level. The communication quality depends mainly on transmission system, and on switching system, access cables.

Most of the Sum centre switches are connected with Aimag centre switch through open wire transmission system, while very few of them are connected through VSAT links. The sections of the open wire transmission system link are 40 to 90 Km in average length, but many Sum centres are located further; distant sometimes more than 150 Km from the Aimag centre.



Source: PTA

Figure 3.7.2-1 Switch Type

The long distance open wire transmission system lowers the communication quality. VSAT transmission has transmission delay essentially. The analogue switch is good for voice conversation, but its noise, which is latent while voice conversation, affects the transmission quality when used for digital data transmission. The subscriber access cables are aged in many Sum centre network. The target areas' switch type is 10 % in digital PBX, 59 % in analogue PBX, and the manual 31 % as of 2001. See Figure 3.7.2-1.

3.7.3 Operation and Maintenance

(1) Circumstance of Rural Telecommunications Operation and Maintenance

Operation and Maintenance for the rural telecommunication network in Mongolia has many difficulties with a) The conditions of small scale of facilities scattering in the vast country; b) Difficulty of transport due to poor road and railway condition; and c) Very old facilities in model and lifetime, etc. But high-level quality of service will be required with the advance of internationalisation and competitive market environment in Mongolia even for the rural telecommunication. And the telecommunication carrier needs enough efficiency to maintain Company's finance well.

(2) Present Status of Operation and Maintenance in MT

MT is observed taking their successive efforts to improve Operation and Maintenace activities and work procedures. Even though, the most facilities such as switch, transmission and outside plant in every Sum centres were installed in the former Soviet Union era and their life had almost completed its span. MT allocates minimum number of personnel, that is, a head of exchange, one operator, and one technician, in order to operate the facilities in the majority of Sum centres. In the repairing work, they reuse the removal material from the deteriorated facility because of no available maintenance materials. However, the operation and maintenance system such as organisation, standard practice, management, materials, etc. are still needed to improved quality of service and for efficient work performance point of views.

(3) Subject of Improvement Plan for Rural Telecommunication Network

Under the Master Plan, the existing rural network is expected to be replaced with new digital network in very short time as that about half of old exchanges in Sum Centres will be changed to new digital switches by year 2008 and subscribers in old network will be only one forth at the year of 2004. And so main subject of the improvement plan becomes for the future rural telecommunication network.

On the other hand, the improvement of present Operation and Maintenance is basically limited without rehabilitation or extension of the network, because the operation and maintenance has been executing by minimum staff for old analogue facility in Sum Centre.

(4) Improvement Plan for the operation and maintenance of existing Network

It is necessary to review the present Quality control system such as the performance indicator and its quality levels and Facility control because present control system is still not enough to cover and control whole operation and maintenance activities and it quality.

(5) Improvement plan for the operation and maintenance of new rural network

According to the expansion and digitalization of the rural telecommunication network planed in this Master Plan, the Operation and Maintenance system of the rural network needs to be reviewed and improved. The followings are subject to improve in Operation and Maintenance activity of the new rural network.

- Reconstruction of Organisation for New Rural network
- Improvement of Outside plant Fault Repairing system
- Settlement of New Connections system
- Network management and Operation in Aimag Centre
- Tools, Equipment, Maintenance Material and Vehicles
- Information system in Sum Centre
- Cultivation of Staff for Digital Rural Network
- Billing and collection Activity

3.7.4 Human Resource Development of MT

(1) Productivity of Staff

The past and current Staff productivity of MT could be featured as follows:

- The current productivity in 2001 is 26.5 Telephones per employee.
- The productivity of MT is very low compared to the world trend.

Main reasons are due to:

- small size services,
- many O/M points(Sum offices),
- many operators for manual connection and
- vast/spread/long distance O/M area

Raise-up of productivity from 1996 to 2001 is only approximately 2 TEL/employee and very small

(2) Productivity Improvement

MT has been implementing the human resource development and the results are as follows:

- About 300 employees(6.2% of the total) are decreased from 1995 to 2001 and main contribution is decrease of administration/procurement employees

- About 300 employees are decreased from 2001 to 2002 by introduction of automatic connection for toll and international calls through Sum centre operators in 17 Aimags in 2001.

- In 2002 about 300 operators will be decreased by review of shift time, and also staff(average 3 to 4 persons) in very small telephone offices with only 1 telephone line will be decreased to average 1 to 1.5 persons including seasonal temporally workers.

However, the productivity is not enough, especially in Aimag level, so MT has to raise up more productivity by automatic connection of calls, digitalisation of facilities. Introduction of digital transmission systems between Aimag centres and Sum centres is most important factor for automatic call connection and modernization of facilities, i.e. raise-up of productivity

(3) Training

Issues on training issues to be tackled are as follows:

(a) Training plan

- To increase Aimag level basic training such as computer, digital technology, etc.
- To increase English language training through AV equipment, etc.
- To introduce customer service training for competitive market
- To introduce a career path system

(b) Training facilities

- To introduce and increase practical training facilities such as switches, transmission system, radio system, optical fibber system, LAN, etc.
- To increase training rooms
- To increase AV equipment

(c) Instructor

- To increase instructors
- To train instructors for new technologies

3.7.5 Organisation and Management of MT

(1) Organisation

The issues on present organisation and directions on improvement are analysed as follows:

(a) To decrease human resource in Aimag/Sum level is not so easy due to many small offices, but it is absolutely necessary through introduction of digital systems and automatic call connection.

(b) Management on Aimag/Sum level is ordered by Headquarters, but it is not necessarily on Aimag/Sum staff's own initiative.

(c) Skill of engineers/technicians are not enough for digitalisation and new technologies due to under introduction of these, therefore urgent and intensive training is needed for them.

(d) Productivity of small offices with very few subscribers are very low and these should be integrated as much as possible before digitalisation, etc.

(2) Management

Management issues of MT are analysed as follows:

(a) Minimum indicators to be managed as telecommunication operator are implemented, but the detailed procedures and forms are not necessarily clear

(b) Management strategy and corporate culture is not clear

(c) Control of Budget (income and expenditure) is carried out, but the control period is semi-annual and also analysis of settlement of account at Aimag/Sum level is not clear

(d) Bill issuance is only for business customers due to less development of postal and banking services, and charge collection is not managed

Common Database for required management, communication system among offices (Internet, WAN) and MIS (Management Information System) is not introduced.

CHAPTER 4

PRESENT TELECOMMUNICATIONS NETWORK FACILITIES

CHAPTER 4

PRESENT TELECOMMUNICATIONS NETWORK FACILITIES

4.1 General

The telecommunications facilities have indicated a steady growth for the past few years. The telephone service recorded a total of 358,000 telephone subscribers, with breakdown of 120,000 MT land lines, 10,000 MRC land line, 10,000 wireless local loop (WLL), and 218,000 cellular telephone subscribers, at the end of 2001.

The transmission network and switching systems which supported the rapid growth is mostly possessed by Post and Telecommunication Authority (PTA). The nation wide transmission system is operated by Mongolia Telecom, the facilities of which are leased from PTA.

The national telecommunication backbone network of MT is made up with 4,000 km of microwave transmission link, about 900 km of which is digital. As spur links, over 30,000 km of open wire lines of capacity of 3 to 12 channels connect Aimag centres to Sum centres. An optical fibre route is under construction from Ulaanbaatar to Choibalsan.

The switching facilities are consisted of various models. The switching systems in Ulaanbaatar are almost digital. They are NEAX of international gateway switch, EWSD of national transit switch, and E-10B of national transit switch. The capacity of existing switching facilities is 141,000 line units in total, including 73,000 line units in Ulaanbaatar.

The switching systems in Ulaanbaatar have been replaced with digital system since early 1990. Most of switching systems in Aimag centres have been replaced since 1999 and will be completed in 2002.

Sum centre's switching system is PBXs and manual consoles. Most of the PBXs are analogue and made in Russia. Many of them were products made in 1980's and 1990's, but many switches made in 1970' are also in use.

However, it should be noted that many switching systems in Sum centres are reportedly faulty because of shortage of spare parts and frequent interruption of power supply.

Power supply system for the switching systems in Sum centre is not reliable, i.e., it depends on diesel engine-generator or solar power system, sometimes.

4.2 Switching Network Facilities

4.2.1 PSTN Switching Networks

The switching network of Mongolia is consisted of Public Switched Telephone Network (PSTN) of Mongolia Telecom and another PSTN of Railway Communications Company (MRC). The switch facilities plan under the Master Plan Study is established on the condition that all the expansion or improvement is realised by that of the MT network the facilities of which is possessed by PTA. However, the facilities possessed and operated by the Railway Company's network and other private companies may be utilised where appropriate.

4.2.2 Telephone Network Structure

The telephone network of MT is consisted of four (4) levels, that is, the international gateway switch (ISC), the national transit switch (NTS), the primary centre switch (PSC) in Aimag centre, the PBX or manual switch of Sum centre, and the transmission link connecting them. The telecommunication device in Sum centres are mainly PBX, but in some cases it is manual switching device.

4.2.3 Exchange Allocation Plan

The ISC and NTS are located in Ulaanbaatar, the PSCs are located in each of Aimags (or Provincial centres) and District cities (Nalaikh, Baganuur, Erdene), 23 points in total. The NTSs and PSCs accommodate the subscriber lines in the same manner as the local exchanges (LEs) do.

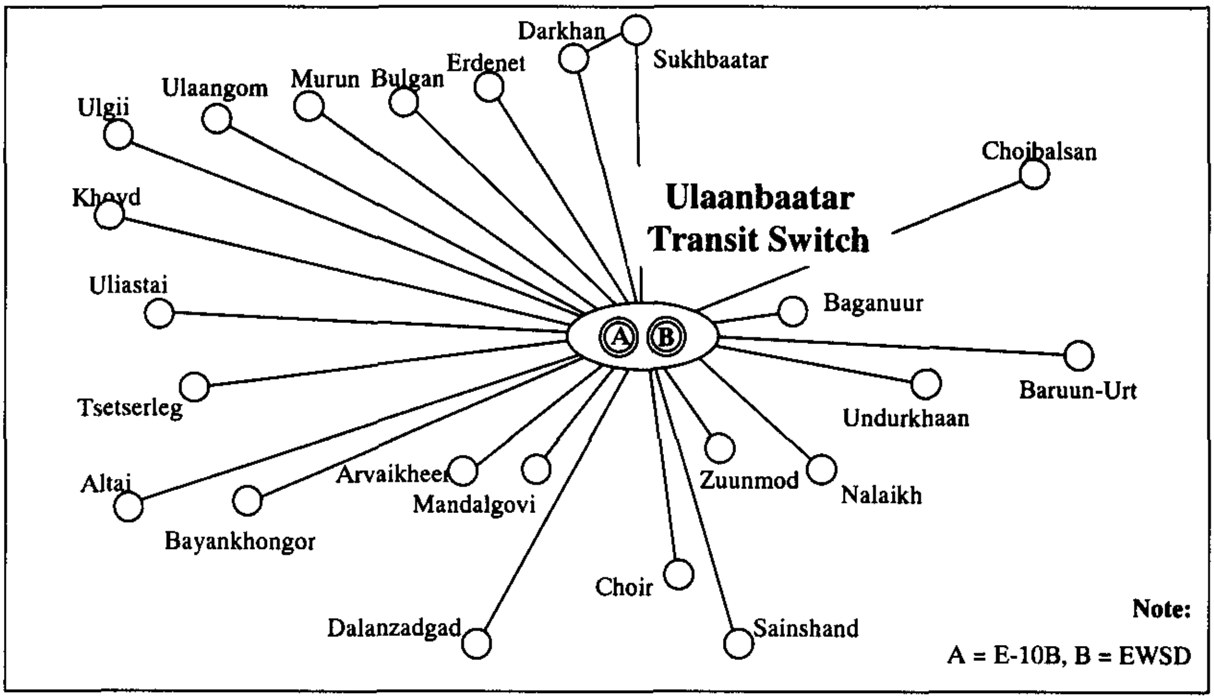
Each of Aimag centre and District centre has one (1) unit of automatic switching system.

Each of Sum centres has basically one (1) unit of switching equipment. Most of the Sum centres are furnished with a PBX system together with one (1) or two (2) long distance telephone lines of Aimag exchange. Some Sum centres are furnished with a magneto telephone apparatus on open-wire transmission and others with a radio link.

4.2.4 Network Configuration

(1) Switching Network between Ulaanbaatar and Aimag Centres

The switching systems of exchange in Aimag centres are connected radially with the NTC switching units located in Ulaanbaatar, though the transmission links run connecting the Aimag centre exchanges in series in some routes. Figure 4.2.4-1 shows the radial stretch of links connecting Aimag centre exchanges with NTC in Ulaanbaatar.



Source: JICA Study Team

Figure 4.2.4-1 NTC-Aimag Centre Switching Network

The circuits between exchanges in Aimag centres and the National Transit Centre (NTC) are provided with micro-wave radio transmission link, optical fibre transmission link, and/or Very Small Aperture Terminal (VSAT) system link.

The circuits to/from the switch of Aimag centre is basically used exclusively by each switching unit, but the circuits provided by means of VAST are shared by a group of switching units. Table 4.2.4-1 shows the relation.

Table 4.2.4-1 Inter-exchange Circuits between Aimag and Ulaanbaatar

Number of Inter-exchange Circuits As of Mar. 2002

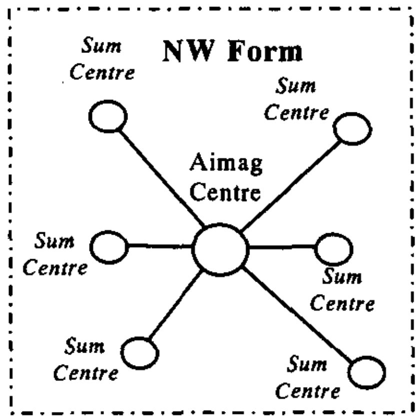
No.	Section			Number of Circuits				Siganlling System			Remarks
	From	To	(Switch)	Optical Fibre	Digital Radio	Analog Raio	VSAT	CCS #7	R2 (Q421EX)	Propriet-ry	
111	Ulaanbaatar ATC3	Orkhon	CDE	1	1	0	0	YES			
112	(E-10B)	Darkhan	CDE	1	1	0	0	YES			
113		Bulgan	SDE	0	1	0	0	YES			
114		Selenge	SDE	0	1	0	0	YES			
115		Uvurkhangai	SDE	0	1	0	0	YES			
116		Bayankhongor	EWSD	0	0	1	0		YES		
117		Govi-Altai	EWSD	0	0	1	0		YES		
118		Khovd	EWSD	0	0	1	0		YES		
119		Bayan-Ulgii	EWSD	0	0	1	0		YES		
120		Dundgobi	EWSD	0	0	1	0		YES		
121		Umunugobi	EWSD	0	0	1	0		YES		
122		Khenti	EWSD	0	0	1	0		YES		
123		Sukhubaatar	EWSD	0	0	1	0		YES		
124		Dornod	EWSD	0	0	1	0		YES		
125		Dornogobi	EWSD	0	0	1	0		YES		
126		Choir (GobiSumber)	HICOM	1	0	0	0		YES		
127		Sainshand (Dornogobi)	EWSD	1	0	0	0	YES			
128		Baganuur	EWSD	1	0	0	0	YES			
129		Arkhangai	EWSD	0	0	0			YES		
130		Khuvsgaul	EWSD	0	0	0			YES		
131		Uvs	EWSD	0	0	0	2		YES		
132		Zavkan	EWSD	0	0	0			YES		
133		Tosontsengel	0	0	0	0			YES		
134		Zamin-Uud	0	0	0	0			YES		
211	Ulaanbaatar ATC45	Orkhan	1	1	1	0	0	YES			
212	(EWSD)	Darkan	1	1	1	0	0	YES			
213		Bulgan	0	0	1	0	0	YES			
214		Selenge	0	0	1	0	0	YES			
215		Uvurkhangai	0	0	1	0	0	YES			
216		Arkhangai	0	0	0	0					
217		Khuvsgul	0	0	0	0			YES		
218		Uvs	0	0	0	0			YES		
219		Zavkhan	0	0	0	0			YES		
220		Bayankhongor	0	0	0	0			YES		
221		Bayan-Ulgii	0	0	0	0			YES		
222		Govi-Altai	0	0	0	0	4		YES		
223		Dundgobi	0	0	0	0			YES		
224		Sukhbaatar	0	0	0	0			YES		
225		Khovd	0	0	0	0			YES		
226		Khentii	0	0	0	0			YES		
227		Umnugobi	0	0	0	0			YES		
228		Dornod	0	0	0	0			YES		
229		Tuv (RSU)	14	14	0	0	0			YES	ATC45
229		Nalaikh (RSU)	12	12	0	0	0			YES	ATC45
230		Baganuur (RSU)	14	14	0	0	0			YES	ATC45
311	Ulaanbaatar ATC68	Erdenet (Orkhon)	1	1	0	0	0	YES			

JICA PTA

(2) Network of Aimag and Sum Level

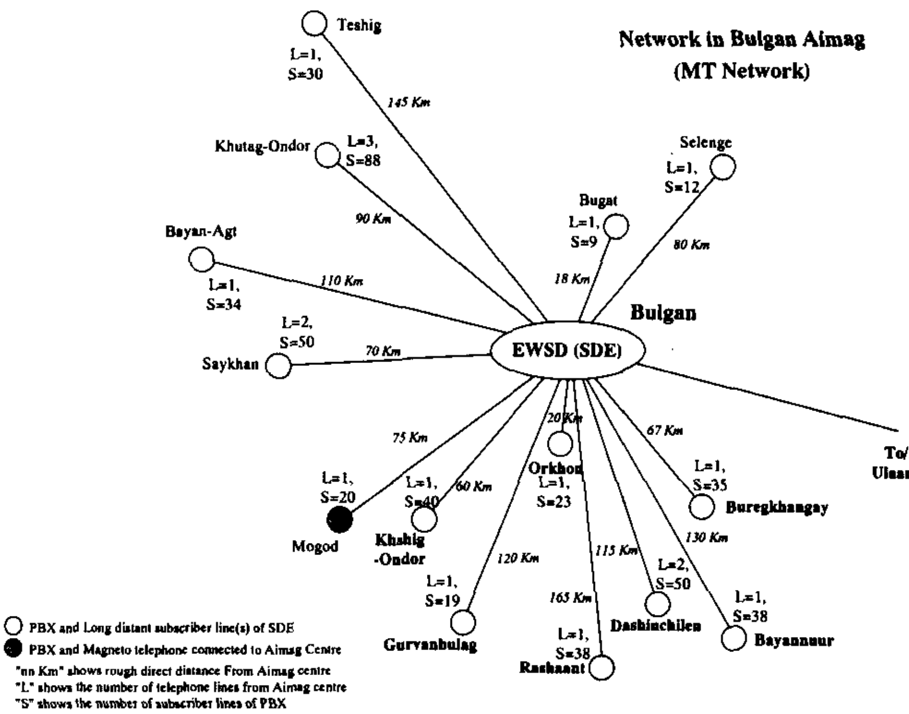
(a) Network between Aimag Centre and Sum Centers

The exchanges in Sum centres are connected radially with the Aimag centre, though the transmission links which run connecting the Sum centres in series in some routes. However, the link is a distant subscriber line of the Aimag centre switching unit, that is, the Sum centre has a telephone line which is given a Aimag centre's directory number. Connection of subscribers in Aimag centre and those in Sum centre is realised through operator's assistance. Figure 4.2.4-3 shows the relation of switching network connecting the Sum centres to the Aimag centre switch, taking Bulgan Aimag as example.



JICA Telecom Study

Figure 4.2.4-2 Network Form

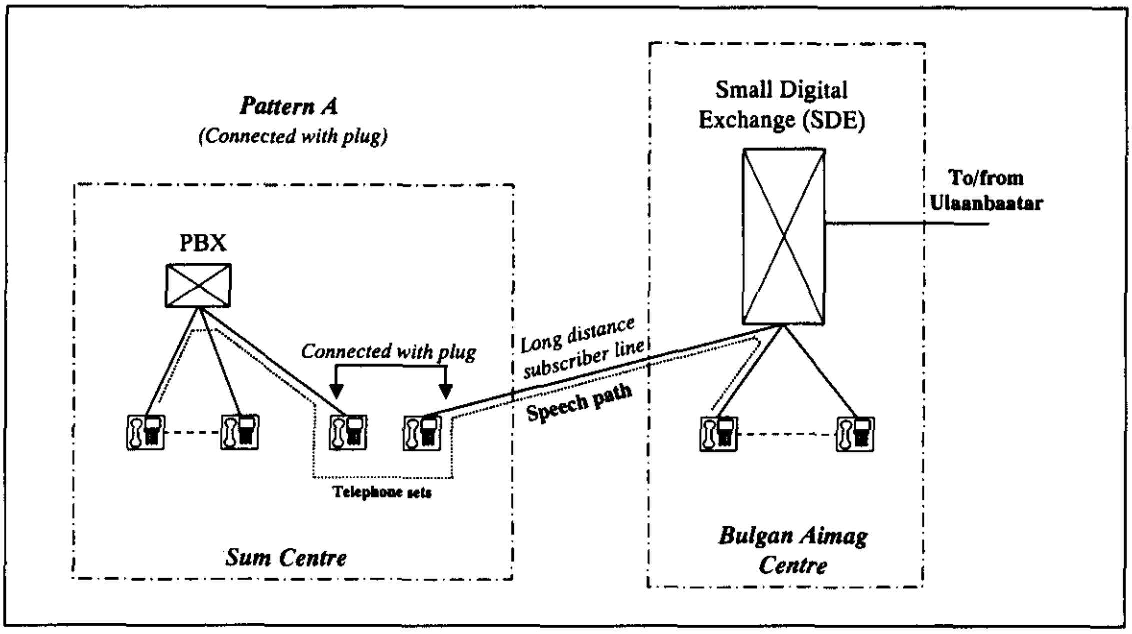


JICA Telecom Study

Figure 4.2.4-3 Switching Network Connecting Sum Centres to Aimag (in Bulgan)

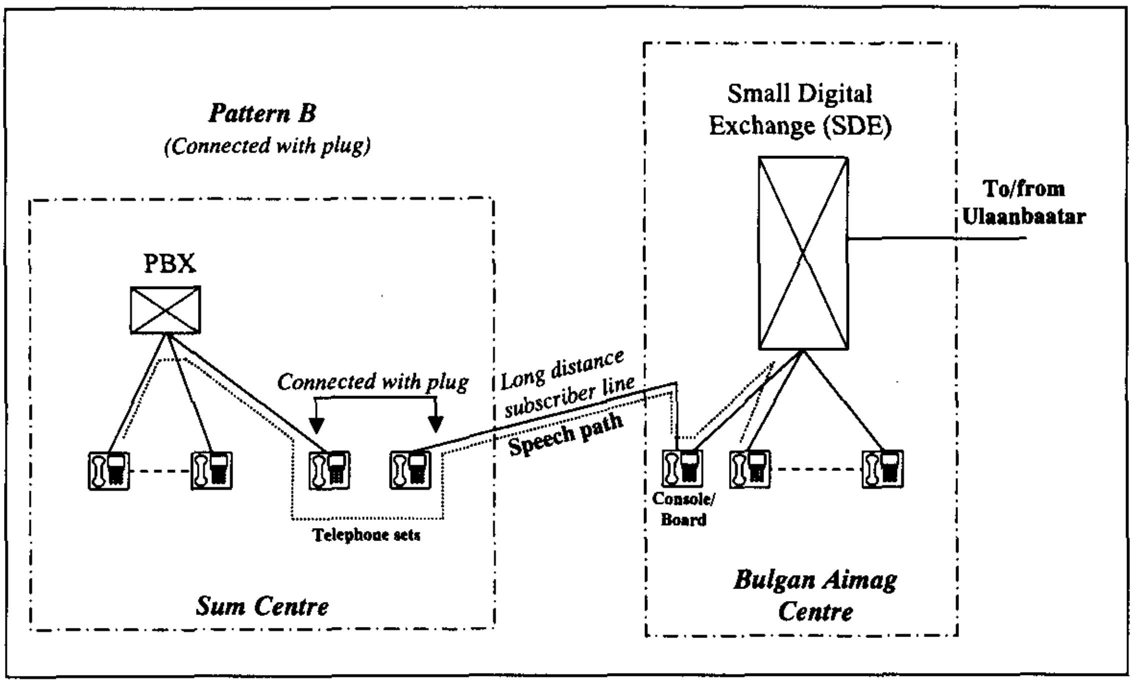
(b) Speech Path between Aimag Centre and Sum Subscribers

The exchanges in Sum centres are, in most cases, composed of a small switching system (PBX) and one (1) to two (2) telephone lines given directory numbers as distant subscribers of Aimag centre switching system. In Sum centre, the Aimag exchange telephone line is terminated with telephone apparatus not being accommodated with the switching system. In some cases, for instance the case of Khutag-Ondor in Bulgan Aimag, the Aimag telephone lines are accommodated with a key telephone, and the traffic is routed through PBX and the key telephone. Many Sum centres are still linked with a magneto telephone line instead of the long distance subscriber line. Figure 4.2.4-4 to Figure 4.2.5-6 show the pattern of speech path establishment. Figure 4.5.2-7 shows the jacks and plugs to connect the long distance subscriber lines and the Sum telephones.



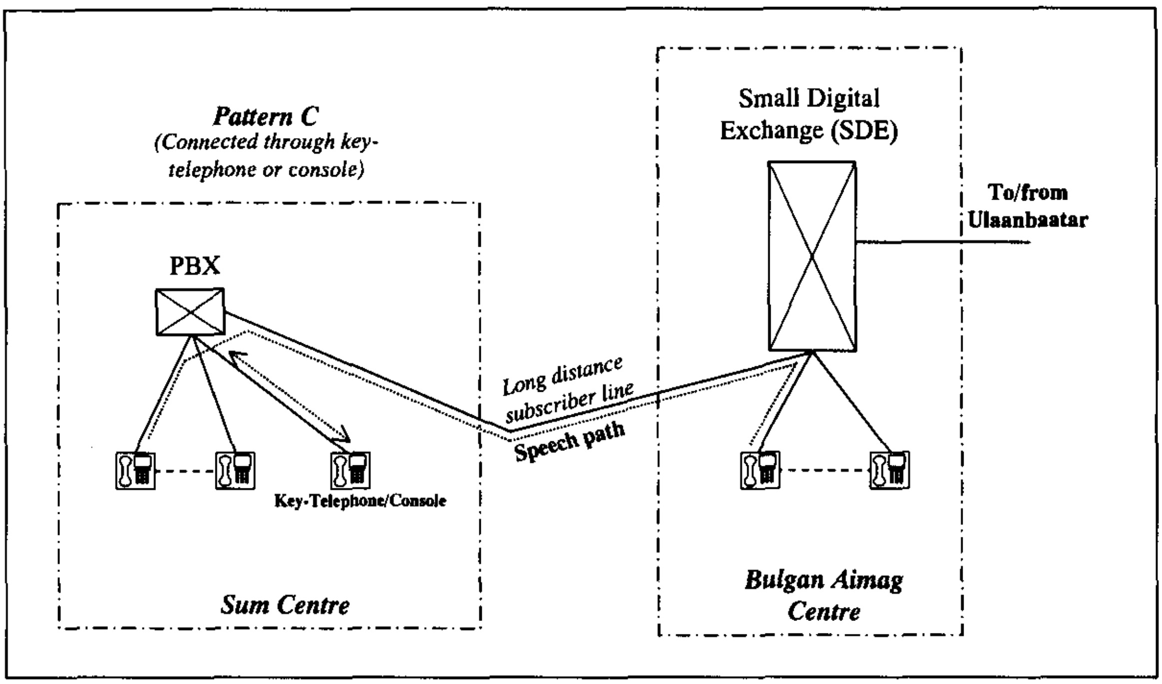
JICA Telecom Study

Figure 4.2.4-4 Speech Path at Sum Telecom Centre (Pattern A)



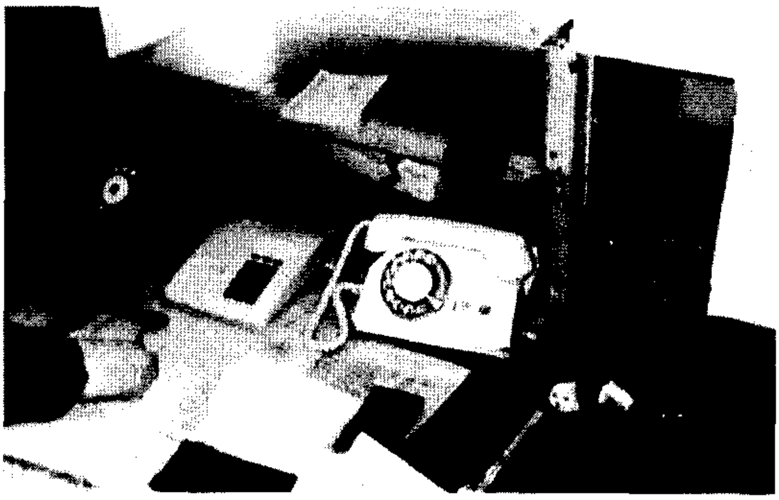
JICA Telecom Study

Figure 4.2.4-5 Speech Path at Sum Telecom Centre (Pattern B)



JICA Telecom Study

Figure 4.2.4-6 Speech Path at Sum Telecom Centre (Pattern C)



JICA Telecom Study

Figure 4.2.4-7 Plug and Jack for Pattern A Connection

4.2.5 Switching Facilities of MT Network

The total capacity of existing switching facilities is 141,000 line units in total including 73,000 line units in Ulaanbaatar. Annex 7 shows the detail.

The switching facilities are consisted of various models. The switching systems in Ulaanbaatar are almost digital. They are NEAX of international gateway switch, EWSD of national transit switch, and E-10B of national transit switch.

The switching systems in Aimag centres are mostly of EWSD and the rest is planned to be replaced with EWSD. All 23 Aimag centres will be furnished with EWSD by the end of 2002.

Under the MON-4 Project new exchanges are being installed. The switching system is product of Korea called SDX-RB which is a modified PBX. They are Shuvuun Fabric (600 line units), Bayangol (600 line units), and Gachuurt (600 line units) in Ulaanbaatar Area, Tsentermandal (200 line units), Jargalthaan (200 line units), Muren (200 line units), and Munkhaan (200 line units). The installation of all the exchanges under MON-4 will be completed before the end of 2002.

The switching system in Sum centres are mostly analogue. They are 220 units in total. Most of them are Russian made crossbar PBX of 1980's and the rest are small digital PBXs or manual consoles/apparatus.

The most serious problems are stop of power supply and purchase of spare parts. Some Sum centres are reported that they could not keep running the engine-generator because of fuel shortage due to insufficient finance. Almost of the analogue switches in Sum centres are products made in Russia the production of which has finished.

4.2.6 Switching Facilities Features

(1) Switching Equipment

Most of switching equipment installed in Sum centres are analogue PBX and others are manual, with few units of digital PBX. Table 4.2.6-1 shows the types of switching units installed in Sum centres.

The analogue PBX is manufactured for a simplified telephone service in 1970s to early 1990s. The PBX was designed to offer automatic telephone service in the Sum centre and trunk call with assistance with operator. It had been sufficient for that purpose.

The recently introduced switching equipment in eastern part in the country under MON-4 is equipped with almost same function with those in Aimag centres. They are products of Korea, which have 200 to 600 subscriber lines of capacity.

However, it is very difficult to meet user's requirement once the PBX is merged into automatic switching network, because the PBX is not equipped with the function of charging by subscriber. Subscriber's distant direct dialling (DDD), International subscriber dialling (ISD) are not possible. Internet dial-up connection is not met well because of analogue switching noises.

Manual console is outmoded equipment in comparison with the telephony services offered in urban area, needless to say.

Table 4.2.6-1 Switch Type of Sum Centres

No.	Name of Aimag	Name of Capital	Sum Centre Switch Type			
			Digital	Analogue	Manual	Total
1	Arkhangai	Tsetserleg	3	13	2	18
2	Bayan-Olgii	Olgii	3	7	4	14
3	Bayankhongor	Bayankhongor	1	8	11	20
4	Bulgan	Bulgan	2	14	0	16
5	Govi-Altai	Altai	0	17	2	19
6	Dornogovi	Sainshand	1	8	8	17
7	Dornod	Choibalsan	4	3	7	14
8	Dundgovi	Mandalgovi	1	11	2	14
9	Zavkhan	Uliastai	2	4	17	23
10	Uvurkhangai	Arvaikheer	1	17	1	19
11	Umnugovi	Dalanzadgad	0	3	12	15
12	Sukhbaatar	Baruun-Urt	1	7	5	13
13	Selenge	Sukhbaatar	2	18	0	20
14	Tuv	Zuunmod	4	22	1	27
15	Uvs	Ulaangom	3	6	10	19
16	Khovd	Khovd	1	15	0	16
17	Khuvsgul	Moron	3	11	10	24
18	Khentii	Ondorkhaan	1	9	12	22
19	Darkhan-Uul	Darkhan	0	3	1	4
20	Orkhon	Erdenet	0	2	0	2
21	Govisumber	Choir	1	2	1	4
22	Baganuur	---	1	2	0	3
23	Nalaikh	---	0	1	3	4
	Total	---	35	203	109	347

JICA Telecom Study

(2) Spare Parts

The analogue PBXs were introduced mainly in 1990s, but some were introduced in 1980s and 1970s. They are not sold in the market now, because their lower competitiveness in market in digitised world. For this reason, the spare parts must be supplied making use of removed switch units hereinafter.

(3) Power Supply

Power supply of the switching equipment in Sum centre is not reliable. Analogue PBX power is supplied in many cases from the central grid, but others are supported by engines or solar battery.

The switching equipment in Sum centre where the community is connected to the Central Power Grid is not equipped with battery banks for switching system principally. The battery banks are provided in the case the Sum is not connected to the Central Grid. And its capacity is designed to support the switching system for two (2) to three (3) hours.

Sum centres equipped with diesel engine-generator is small in number. Sum centre equipped with diesel engine-generator cannot supply the power well in summer. The engine-generator will be kept stopped, even the switching system depends on the engine-generator power. It is because of fuel cannot be purchased as much as required because of financial reason.

The solar battery system, which is provided at such Sums which are not connected to the Central Grid, can hold the switching system for two (2) days.

In Aimag centres, for the initial stage of period covered by the Master Plan, the capacity will be expanded through expansion of existing switching system. In the following stages, the switching equipment will be replaced gradually with a new concept switch or a switch node device of new technology, provided that the life of existing equipment is over and IP network is available at the target areas.

The switch capacity of Aimag centre will be expanded in order to meet the fulfilment plan both in Aimag centre and Sum centres.

Regarding the switching equipment in Sum centre, which is mostly PBX, it will be replaced with a digital device for traffic concentration and distribution. A small switch node may be introduced for the time being. The switch node shall be a device which can be installed at a certain point of Sum centre distant from the Aimag exchange and able to offer the same services as in the Aimag centre. It will be taken over by routers or gateway routers corresponding to the advance of IP-based network technology.

4.3 Transmission Facilities

While most advanced technologies in transmission are employed in Mongolia, analogue technologies are still widely used in Aimags. Analogue equipment is facing difficulties in maintenance because of spare-parts shortage, and does not totally meet various needs of digital age. All routes of analogue transmission systems should be digitalized up to Sum centres in the Study of Master Plan.

Outline of transmission facilities in Mongolia is described below. Existing and on-going transmission networks and systems are explained further in following sections.

(1) Backbone Network (Aimag Centre - Aimag Centre)

Figure 4.3 -1 shows the present Backbone Transmission Network and Table 4.3-1 is the list of the present transmission systems used in Mongolia. In early 1990s, The backbone network was consisted of Analogue Microwave systems on the main routes from north to south and from east to west, and Open Wire systems for Aimag Centers which are not on the main microwave routes. Some parts of the Microwave routes have been digitalized by using PDH and SDH systems. Fiber Optic Transmission Systems was introduced along the rail way from north to south. VSAT systems was introduced for some Aimag Centers and four big Sum centres.

Analogue-Digital Conversion systems (DSMX converter) are used to send digital signals through the analogue microwave systems.

Mobicom and Skytel , mobile telephone operators, rent circuits from MTC and the Mongolian Railway Company. Mobicom has a plan to provide their own transmission systems.

Mobicom constructed 34Mb/s Digital Microwave systems in 2002 from Ulaanbaatar to Bayan Ulgii, and from Coir to Dalazadgad in Umnugovi, using MTC Microwave repeater stations and towers. MTC is going to install 8 Mb/s Digital Microwave system from MW108 repeater station to Tseserleg in Arhangai.

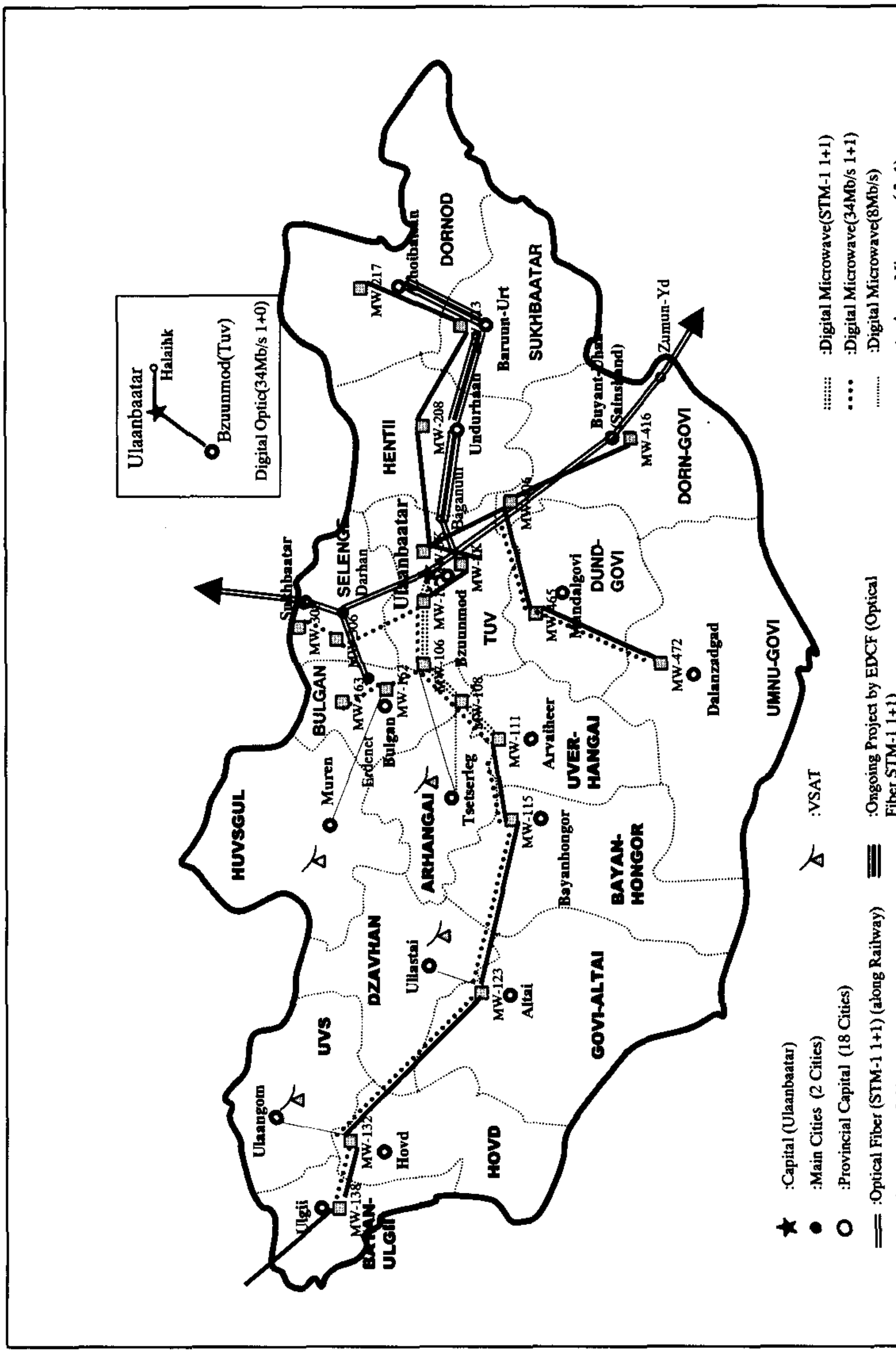


Figure 4.3-1 Backbone Transmission Systems

Source: PTA

Table 4.3-1 Backbone Transmission Systems

No.	Site Name	System	Capacity	Manu-facturer	Service Year	Remarks
1	Ulaanbaatar(MW-MTC) - Uvurkhangai(MW-111)	Digital SDH	155 Mb/s Micro(1+1)	NERA	1997	MK-111 - Availheer 16Mb/s x 2 Micro
2	MW-1K - Selenge(MW-308)	Digital PDH	34Mb/s Micro(1+1)	NERA	1997	MW-1K - Ulaanbaatar 34Mb/s Micro MK-306 - Darkhan 34Mb/s Optic MK-308 - Sukhbaatar 34Mb/s Optic
3	MW-106 - Erdenet(MW-163)	Digital PDH	34Mb/s Micro(1+1)	NERA	1997	MW-162 - Bulgan 34Mb/s Optic MW-163 - Erdenet 34Mb/s Optic
4	Uvurkhangai(MW-111) - Bayan-Ulgi(MW-139)	Analog	720channel Micro(3+1)	Russia	before 1989	
5	Ulaanbaatar(MW-1) - Halaihk(MW-3K)	Analog	720channel Micro(3+1)	Russia	before 1989	1 System for TV
6	Halaihk(MW-3K) - Dornod(MW-217)	Analog	720channel Micro(3+1)	Russia	before 1989	1 System for TV
7	Halaihk(MW-3K) - Doronogobi(MW-416)	Analog	720channel Micro(3+1)	Russia	before 1989	1 System for TV
8	Choir(MW-406) - Umnbobi(MW-472)	Analog	720channel Micro(3+1)	Russia	before 1989	1 System for TV
9	Ulaanbaatar - Tuv	Digital PDH	34Mb/s optic(1+0)	Seimens	2001	
10	Ulaanbaatar - Halaihk	Digital PDH	34Mb/s optic(1+0)	Seimens	2001	
11	Slenge - Ulaanbaatar	Digital SDH	155Mb/s optic(1+1)	NEC	2000	
12	Ulanbaatar - Zumum-Yd	Digital SDH	155Mb/s optic(1+1)	NEC	2000	
13	Ulanbaatar - Bayan Ulgii	Digital PDH	34Mb/s Micro(1+1)	NEC	2002	Mobicom
14	Choir - Dalanzadgad	Digital PDH	34Mb/s Micro(1+1)	NEC	2002	Mobicom
16	MW 108 - Tsetserleg	Digital PDH	8Mb/s Micro		on going	

(2) Trunk Transmission Network (AimagCenter -Sum Center)

Almost all Sum Centers are connected with Aimag Centers with Open Wire Systems which have multiplexed 12 channels and 3 channels. Some Sums such as in Dundgobi Aimag use VHF radio links of 6 channels, 4 channels or 2 channels. They are used for connection between microwave repeater stations and Sum centres. In Tuv, 4ch analogue microwave systems are used from microwave repeater stations to two sum centres. 2Mb/s, 8Mb/s, and 16Mb/s x 2 digital microwave systems link microwave repeater stations with some Sum Centres such as Zunnharaa

Mobicom has their own 2Mb/s Microwave systems for their services in some Sum Centres where MTC digital transmission systems are not available such as in Altanbulag.

(3) Junction Network

Although Ulaanbaatar has junction networks in which microwave systems and optical fibre systems are employed, there are no junction networks in Aimag Centres. Dalhan has a RSU 3km away from its host exchange. They are connected with a optical fibre transmission system. Erdenet also has a RSU which is linked with its host exchange by optical fibre. MTC switches (exchanges) and the Mongolian Rail Way company switches (exchanges) are connected each other with STM-1 optic systems as shown in the Figure 4.3.1-1. MTC and the Rail Way company have plans to connect their exchanges each other in some Sum Centres along the railway.

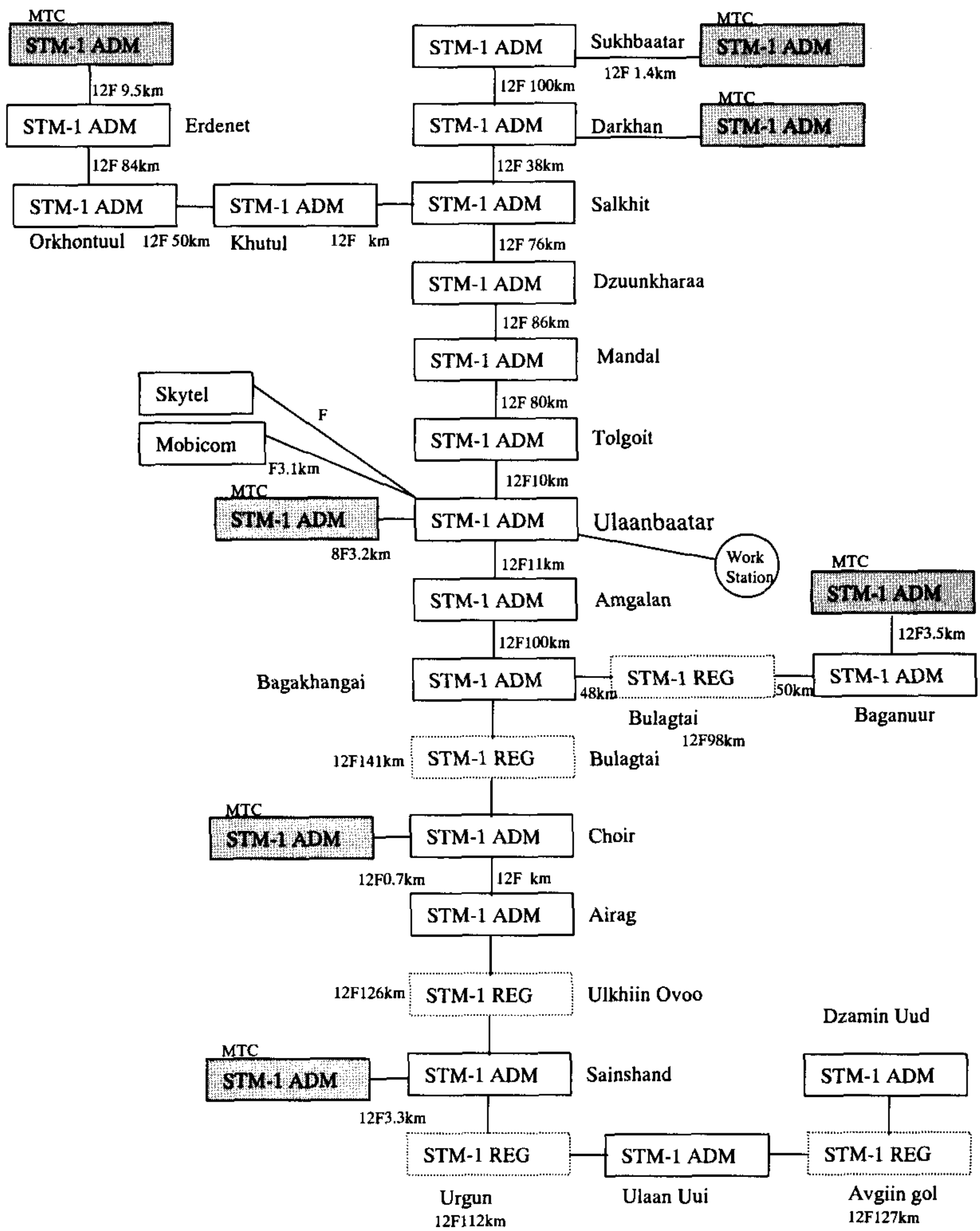
4.3.1 Optical Fibre Transmission Network

(1) Optical Fibre Transmission System for Backbone Network

Optical fibre transmission STM-1 systems were completed in 2000 along the rail ways under the Project financed by Japanese Yen Credit The Systems are owned by the Mongolian Railway company for their rail way business and PSTN services carried by them. The routes have 12 fibres. The detail of the configuration is shown in Figure 4.3.1-1.

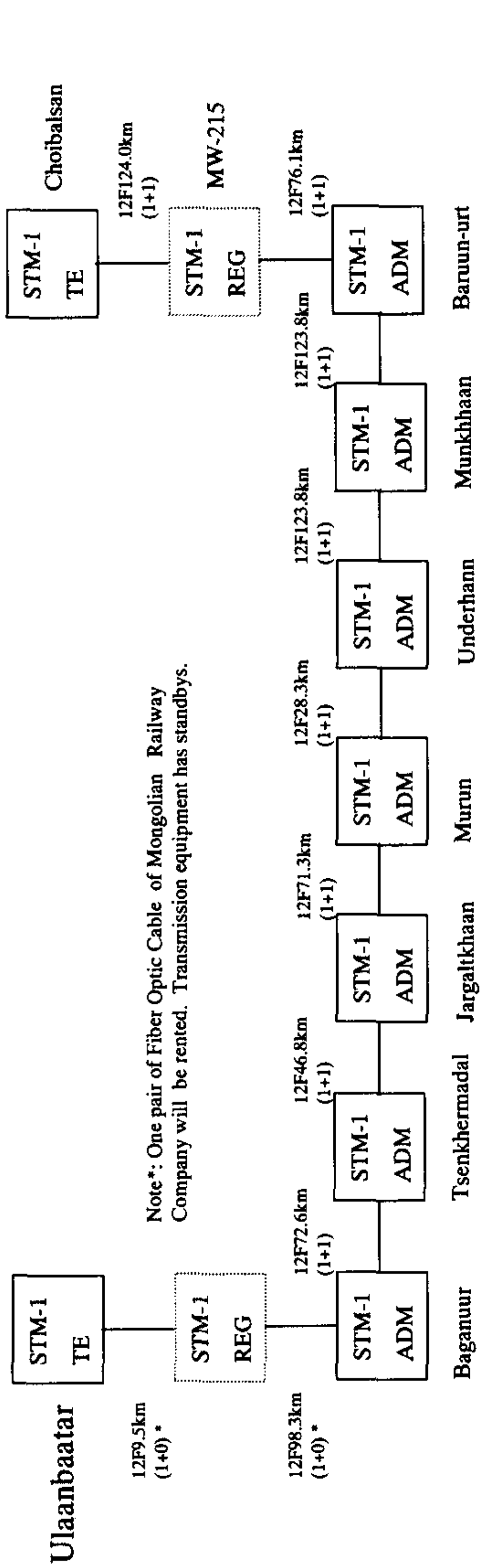
The East optic route, which is presently terminated at Baganuur, will be extended to Choibalsan, Aimag Center of Dornod by an on-going EDCF project as shown in Figure 4.3-1. Detail of the configuration is shown in Figure 4.3.1-2.

Optical fibre transmission 34Mb/s systems are used as accesses to Microwave systems. They are also utilized for links from Ulaanbaatar to two nearby sites.



Source: PTA

Figure 4.3.1-1 Mongolian Raiway Transmission Network



Source: PTA

Figure 4.3.1-2 On-going Optical Fibre Project (Eastern Area)

(2) Optical Fibre Trunk Transmission System

There are no optical fibre transmission systems from Aimag Centres to Sum Centres.

MTC requested the Mongolian Railway company to link Sum centres with the Railway optical fibre system by using optical fibre systems as shown in Table 4.3.1-1.

Table 4.3.1-1 Requested Sum Centre connection with the Railway Optical Fibre System

No.	Aimag	Sum Center	F/O cable (km)
1	Darhan	Zuunkharaa	1km
2		Baruuharaa	1km
3		Shrinngol	1.6km
4		Khutul	2.4km
5	Tuv	Batsumber	0.3km
6	Dornogovi	Urgun	0.4km
7		Zamin-Uud	0.5km
8		Zuunbayan	6km
9	Khentii	Bor-Undur	1.8km

Source: JICA Study Team

In the case that the Mongolian Railway company comply with the request above, they have to install optical fibre to Shrinngol (45km), Bor-Undur (60km), and Zuuunbayan (40km) along their railways.

4.3.2 Open Wire Transmission Network

(1) Open Wire Transmission Systems for Backbone Network

The Open Wire Trunk Transmission Systems are still used for four Aimags, that is, Uvs, Dzavkhan, Arkhangai, and Khvsgul.

Open Wire Trunk System is an analogue transmission system which has 12 channels multiplexed, using two wires. The Open Wire Systems are connected to the microwave systems to send signals to Ulaanbaatar.

For Dzavkhan, PTA has a plan to replace the System with Optic 34Mb/s transmission system from MW-123 to Ullanstai, utilizing the existing poles for the Open

Wire System. For Arhangal, PTA has a plan to replace the Open Wire System with 8Mb/s microwave system from MW-108 to Tsetserleg.

PTA recently made a plan to install Optic transmission system to replace the Open Wire System from MW-132 to Ulaangom.

(2) Open Wire Trunk Transmission System

Most of sum centres are connected with Aimag centres by Open Wire. Open wire routes were total nearly 30,000 km in 1995 as shown in Table 4.3.2-1 and most of them are still in use for networks in Aimags. They are used from Aimag Centers to Sum Centres, and from Sum Centres to Microwave repeater stations. The routes should be digitised when telecommunication facilities in Sum Centres are digitised.

Detail of Open Wire Toll routes are shown in an attached document.

Table 4.3.2-1 Open Wire Length In Aimags

No.	Aimag	Length [km]
1	ARKHANGAI	1,344
2	BAYAN-ULGII	1,101
3	BAYANKHONGOR	2,127
4	BULGAN	958
5	GOBI-ALTAI	2,239
6	DORNOGOVI	1,582
7	DORNOD	1,820
8	DUNDGOBI	1,598
9	ZAVKHAN	2,238
10	UVURKHANGAI	1,217
11	UMNUGOBI	1,434
12	SUKHBAATAR	1,381
13	SELENGE	1,361
14	TUV	1,294
15	UVS	1,506
16	KHOVD	1,221
17	KHUVSGUL	2,091
18	KHENTII	1,833
19	DARKHAN-UUL	
20	ORKHON	
21	GOBISUMBER	
22	NALAIKH	
23	BAGANUUR	
	Total	28,345

Source: JICA Study Team

4.3.3 Microwave Transmission Network

4.3.3.1 General

The existing transmission backbone network consists of terrestrial microwave, satellite communication VSAT systems and Optical Fibre system. The national telecommunications network consists of about 900 Km digital microwave transmission links, 3027 Km analogue microwave transmission links, 30,000 Km open wire carrier transmission lines, 18 Nodes of VSAT Plus II system, and 293 telephone exchanges with total capacity of 127,000 lines. The digitisation of transmission lines is 35 % in year 2000.

The average fixed telephone density per 100 populations is 5.4 for the whole country and 10.9 in Ulaanbaatar in year 2000.

At present, most of telephone calls originated from rural subscribers are manually routed from Sum centres to the Aimag centres and vice versa, via open wire transmission links. In most of sums, operator in sum telecom office is now handling long distant telephone calls manually by switchboards.

The present analogue equipment is outdated, fault prone and difficult to maintain, which cause the high operational costs and impossibility of introduction of new services.

In order to eliminate all difficulties of analogue system and to satisfy demands of basic service and new services, it is requested urgently to digitalize the national terrestrial backbone network and the trunk lines between Aimag centres and Sum centres.

4.3.3.2 Current MTC Microwave Transmission Network

Current MTC microwave transmission links are used for establishment of backbone network, TV relay, Intra-province trunk network and standby bearer. Current Inter-provincial microwave transmission network in 2002 is shown in Fig 4.3.3.2-1. Mongolia National Trunk Backbone Microwave Transmission Lines is shown in Fig 4.3.3.2-2.

(1) ULB-Western side microwave transmission route

Western route of Microwave Intra-Provincial Network facilities is shown in the Table 4.3.3.2-1. In the total length of about 1857.8 Km, about 30 % was digitised and 70 % remained analogue.

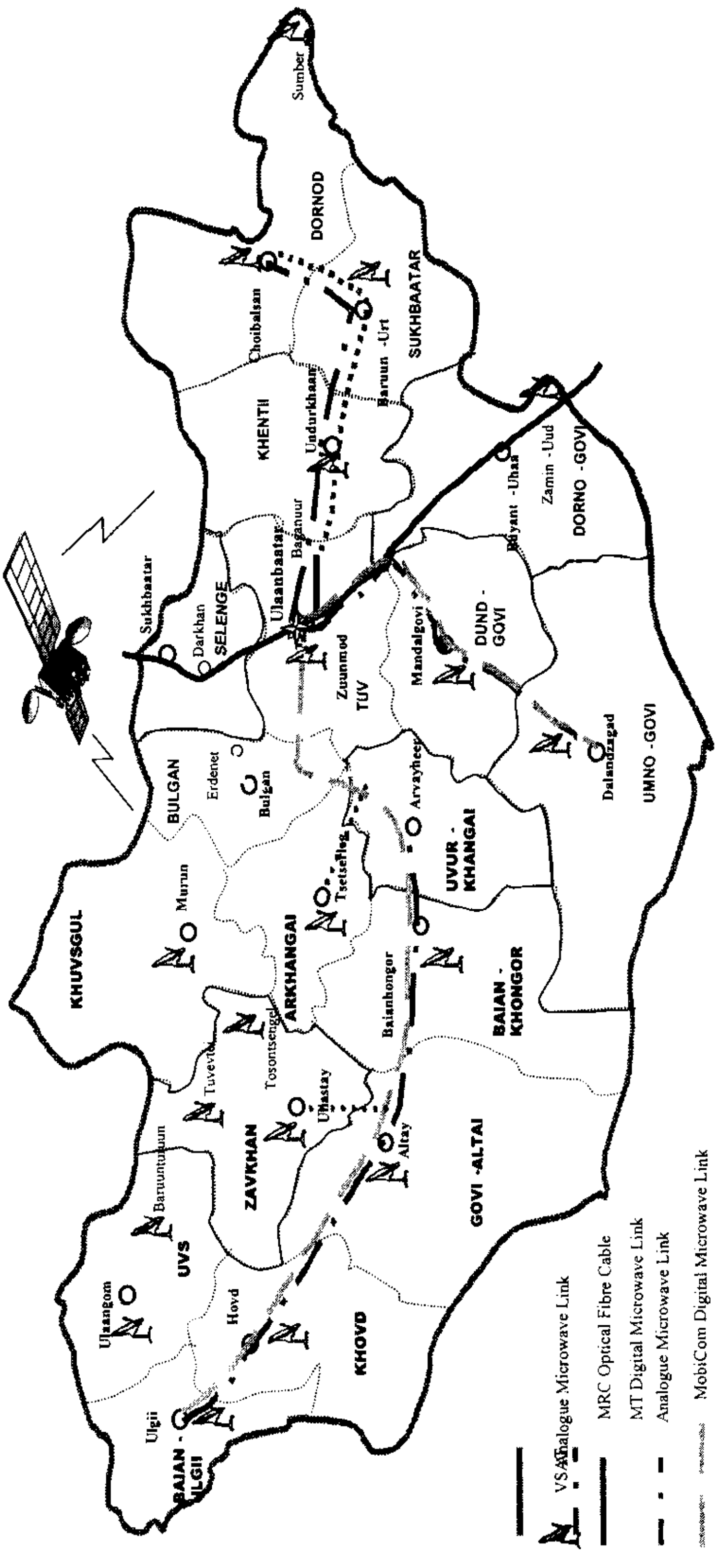
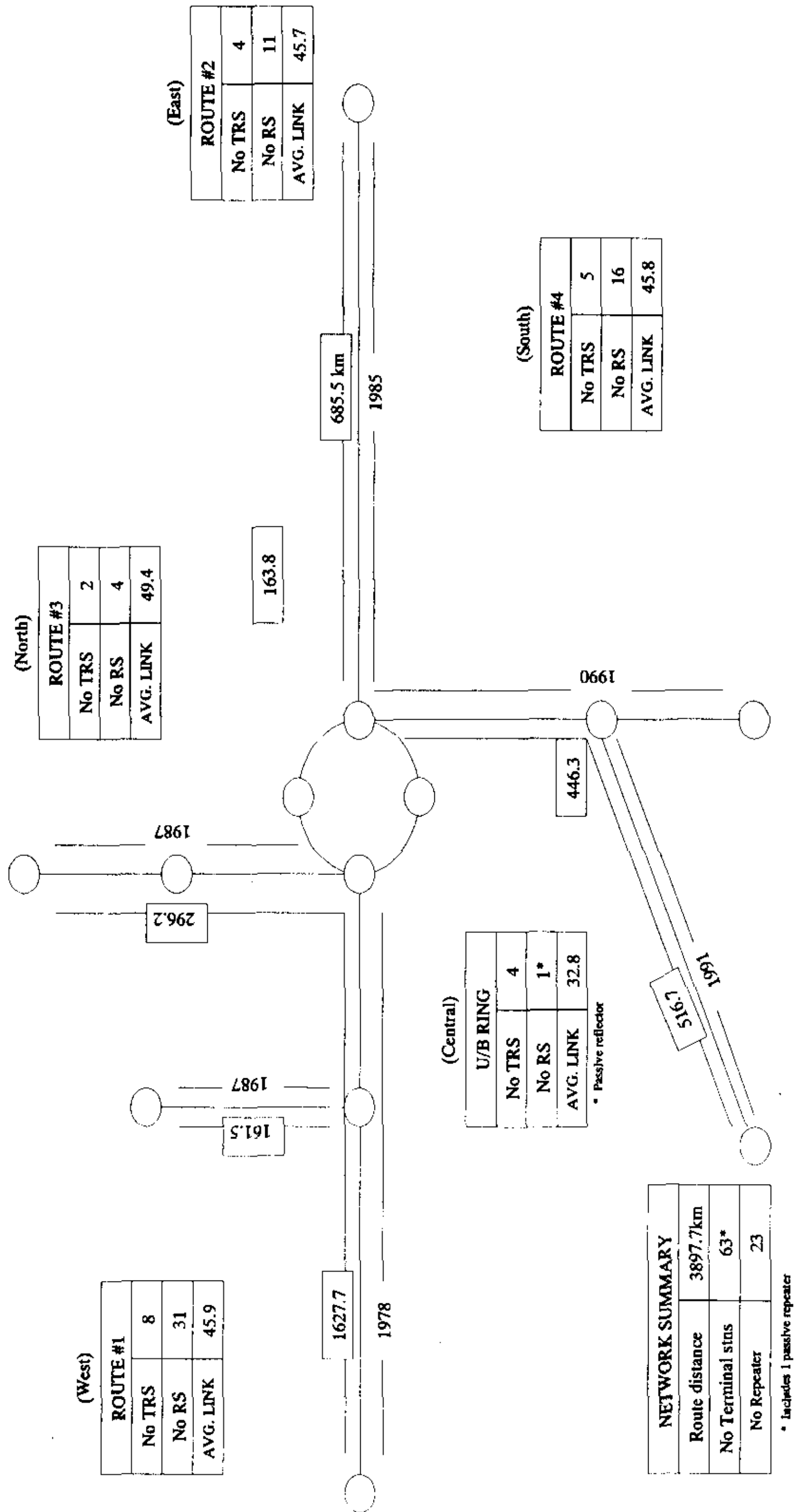


Figure 4.3.3.2-1 Inter-provincial Transmission Network 2002



4.3.3.2-2 Mongolia National Trunk Backbone Microwave Transmission Lines

Table 4.3.3.2-1 Western Route of MW trunk network

Aimags	Orkhon-Bulgan-Uvurkhangai-Bayanhongor-Govialtai- Khovd-Bayan-Ulgii
Total length	Total – 1857.8 Km Digital Section – 688.6 Km Analogue Section – 1169.2 Km
Number of MW Station	43 Stations
Analogue Section of MW Trunk Network (KURS-4)	No of Terminal Station: 5 No. of Repeater Station : 23 No. of TLP Channels : 720 CH(FDM)/3sys+1sys Radio Frequency: 4 GHz
Digital Section	No. of Terminal Station : 5 No. of Repeater Station: 10 No. of TLP Channels : 1920 CH(SDH)/1sys+1sys And 34 Mbps (PDH)/1sys+1sys Radio Frequency: 7 GHz
Installation Year	Analogue MW: 1979 Digital MW: 1997
Power Supply	Supply by Centralized Energy Network: 18 Stations Supply by Diesel Engine Generator: 25 Stations

MobiCom Mobile Communications Company has established new digital microwave transmission lines at 34 Mbps by joint use of MT existing microwave repeater stations. It will be put into service by the end of October in 2002. They will be used for the expansion of mobile communications service to the rural areas in the western region along the microwave trunk network. MobiCom Western Route Digital Microwave Transmission Network is shown in Table 4.3.3.2-2.

Table 4.3.3.2-2 MobiCom Western Route Digital Microwave Transmission Network

Aimags	Orkhon-Bulgan-Uvurkhangai-Bayanhongor-Govialtai-Khovd-Bayan-Ulgii
Total length	Total: 1699.4 Km
Number of MW Station	Terminal Station: 6 Repeater Station: 34
Digital Section	No. of TLP Channels : 480 CH System 34 Mbps (4 PSK/PDH)/1sys+1sys Radio Frequency: 7135/7163 MHz
Installation Year	October, 2002
Power Supply	Supply by Centralized Energy Network: 18 Stations Supply by Diesel Engine Generator: 25 Stations

(2) ULB-Northern side microwave transmission route

Northern route of Microwave Intra-Provincial transmission facilities is shown in the Table 4.3.3.2-3. The microwave transmission system was all digitised in linking with ULB-Tuv Aimag-Darkhan-Selenge Aimag.

Table 4.3.3.2-3 Northern Route of MW Trunk Network

Aimags	Tuv-Darkhan-Selenge
Total length	Total –301.7 Km Digital Section –301.7 Km
Number of MW Station	6 Stations
Digital Section	No. of Terminal Station : 2 No. of Repeater Station: 4 No. of TLP Channels :480CH (PDH)/1sys+1sys Radio Frequency: 7 GHz
Installation Year	Digital MW: 1997
Power Supply	Supply by Centralized Energy Network: 6 Stations Supply by Diesel Engine Generator: 0 Stations

(3) ULB-Eastern side microwave transmission route

Eastern route of Microwave Intra-Provincial transmission facilities is shown in the Table 4.3.3.2-4. The microwave transmission system type is analogue and not digitised.

Table 4.3.3.2-4 Eastern Route of MW Trunk Network

Aimags	Tuv-Baganuur-Hentii-Sukhbaatar-Dornod
Total length	Total –935.9 Km Digital Section –935.9 Km
Number of MW Station	17 Stations
Analogue Section (KURS-4)	No. of Terminal Station : 5 No. of Repeater Station: 12 No. of TLP Channels : 720 CH(FDM)/3 sys+1sys Radio Frequency: 4 GHz
Installation Year	Analogue MW: 1985
Power Supply	Supply by Centralized Energy Network: 5 Stations Supply by Diesel Engine Generator: 12 Stations

(4) ULB-Southern side microwave transmission route

Southern route of Microwave Intra-Provincial transmission facilities is shown in the Table 4.3.2.2-5. The route is not yet digitised and remained analogue link from ULB to Umnugovi aimag.

Table 4.3.3.2-5 Southern Route of MW Trunk Network

Aimags	Tuv-Govisumber, Dornogovi, Dundgovi, Umnugovi
Total length	Total -985.3 Km Digital Section -985.3 Km
Number of MW Station	22 Stations
Analogue Section(KURS-4)	No. of Terminal Station: 6 No. of Repeater Station: 16 No. of TLP Channels: 720 CH(FDM)/3 sys+1sys Radio Frequency: 4 GHz
Installation Year	Analogue MW: 1990
Power Supply	Supply by Centralized Energy Network : 15 Stations Supply by Diesel Engine Generator : 7 Stations

MobiCom Mobile Communications Company has established new digital microwave transmission lines at 34 Mbps by joint use of MT existing microwave repeater stations. It will be put into service by the end of October in 2002. They will be used for the expansion of mobile communications service to the rural areas in the southern region along the microwave trunk network. MobiCom Southern Route Digital Microwave Transmission Network is shown in Table 4.3.3.2-6.

Table 4.3.3.2-6 MobiCom Southern Route of MW Trunk Network

Aimags	Tuv-Govisumber, Dornogovi, Dundgovi, Umnugovi
Total length	Total -565 Km
Number of MW Station	12 Stations
Digital Section	No. of Terminal Station : 3 No. of Repeater Station: 9 No. of TLP Channels : 480 CH System 34 Mbps (4 PSK/PDH)/1sys+1sys Radio Frequency: 7428/7456/7512/7540 MHz
Installation Year	Digital MW : 2002
Power Supply	Supply by Centralized Energy Network: 15 Stations Supply by Diesel Engine Generator: 7 Stations

4.3.3.3 Major Features of Microwave Transmission Equipment

(1) Analogue Microwave Transmission Link

Current KURS-4 Analogue Microwave link main features are shown in Table 4.3.3.2-7.

Table 4.3.3.2-7 Main Feature of KURS-4 Analogue Microwave link

Items	KURS-4
Frequency band	3200 – 4200 MHz
Frequency allocation	3126 MHz, 3227 MHz, 3328 MHz, 3429 MHz, 3492.5 MHz, 3520.5 MHz, 3576.5 MHz, 3548.5 MHz and so on
Configuration	Operation 3 sys+ Standby 1 sys
Channel capacity per carrier	720 ch (10 KHz Bandwidth Available)
TV transmission capacity	Video (6.5 MHz) : 1 ch Sound : 2 ch
Type of antenna	Horn reflector (Aperture area : approx.7 m^2)
Antenna gain	39.5 dB
Transmit power	0.5 W
IF frequency	70 MHz

Radio transmission utilizes analogue frequency division multiplex (FDM), over a "4 bearer" interleaved 28 MHz channel plan, with frequency allocations predominantly in the upper and lower half of the 3.4-3.9 GHz band. Channel plans are based on ITU-R models, with horizontal and vertical polarizations used to successfully overcome potential interference problems between microwave stations.

(2) SDH Digital Microwave Transmission Link

Current SDH-155/140 Mbps STM-1 Radio-Relay Equipment main feature is shown in Table 4.3.3.2-8. Parabolic high XPD performance antenna is installed on tower or mast.

Table 4.3.3.2-8 Main Feature of STM-1 Radio Relay Equipment

Transmission capacity	155.520 Mbps synchronous or 139.264 mbps plesiochronous
System configurations	Hot stand-by, up to 7+1 frequency diversity, space diversity
Intermediate frequency	70 MHz
Frequency Band	6.4-7.1 GHz
System Gain B'B (BER=10^{-3})	102 dB
RF output level at ref point	+29.6 dB
Modulation method	64 TCM or 128 TCM combined with Viterbi decoding
Antenna gain	Parabolic High X Performance, 3.0 m/44.4 dB

(3) PDH Digital Microwave Transmission Link

Current 34 Mbps (16x2 Mbps) Digital Radio-Relay equipment is shown in Table 4.3.3.2-9.

Table 4.3.3.2-9 Main Feature of 34 Mbps Digital Radio-Relay Equipment

Transmission capacity	34 Mbps (optional 16x2 Mbps)
Frequency rang (GHz)	7.125-7.725 GHz
ITU-R Rec.	F385-6
System configurations	Hot stand-by, 1+0, up to 2+1 frequency diversity, space diversity
Type of modulation	4 PSK with coherent detection
Input/output interface	ITU-T Rec. G703, HDB3
RF out put level ref point	+28 dBm
Threshold BER=10^{-3}	- 82.5 dBm
Antenna gain	Parabolic High X Performance, 3.0 m/44.4 dB

MobiCom digital microwave radio link system is shown in Table 4.3.3.2-10

Table 4.3.3.2-10 Main Feature of MobiCom digital microwave radio link system

Transmission capacity	34 Mbps (16 E1)
Frequency rang (GHz)	7.125-7.725 GHz
ITU-R Rec.	ITU-R F385.6 (7GHz)
System configurations	Hot stand-by, 1+1, frequency diversity, space diversity
Type of modulation	4 PSK with coherent detection
Input/output interface	ITU-T Rec. G703, HDB3
RF out put level ref point	+27 dBm
Threshold BER=10^{-3}	- 90 dBm
Antenna gain	Parabolic High Performance, 1.8 m/40.2 dB (Dual POL)

(4) Power Supply of Microwave Relay Station

Microwave relay stations have to be supplied with electric energy either from public central commercial power line or locally generated by solar photo-voltaic panels or Diesel generators. Except for one, all stations of the western route have already been equipped with solar photo-voltaic systems within the frameworks of the almost completed ongoing project. The problem of keeping the batteries at a minimum temperature and of heating a living room for the guards of the station has not yet been solved satisfactorily. At present the energy for heating is generated by small Diesel generators in each repeater station.

4.3.3.4 Rural Telecommunication Network

The rural communication network has over 30 thousand kilometres of long open wire line, 1-12 channels each, which is connecting 342 sums with aimag's centres. There are operating over 230 telephone exchanges to which are connected over 8277 subscribers. The only 5 sums are connected with ULB through the rural satellite communication system, 1 sum through small capacity digital microwave link.

Four (4) Aimag centres are connected to the long distance transmission network through open wire line systems. The table below shows the Aimag's with open wire line systems and their connecting point to microwave system. The total length of the open wire trunk line network is 11700 Km.

Distance open wire system	Length of open wire system	Number of channel on the open wire system
Khuvsgul-Bulgan	188 Km	2 x 12 ch (15 ch on MW to ULB)
Zavkhan-Altai	181 Km	1x12 ch + 1x3ch(10ch on MW to ULB)
Uvs-Khovd	151 Km	1x12 ch + 1x3 ch (10 ch on MW to ULB)
Arkhangai-ULB	454 Km	1x12 ch + 1x3 ch (14 ch on MW to UB)

4.3.3.5 Introduction of new technology

The configurations of the Mongolian rural systems are remote subscriber unit without stand alone feature and small independent Exchanges. They are connected to the national network via centres where there is facility of billing and centralized operation and maintenance. Small capacity switches, networks of open wire lines (12 channels) and HF radio systems provide the telephone services to the rural areas. Main problems are that the most of the equipment in the network are analogue and are in operation since 1970's and early 1980's. They have become obsolete and inadequate for providing comprehensive telecommunications services and will not meet requirements for transition to a market oriented economy.

Mongolian northern telecom route's backbone microwave link was digitalized and in 5 provincial centres digital exchanges were installed in 1998. VSAT systems in 4 Provinces and 4 Villages (Sum) were installed. Also in some villages the small capacity microwave link has been installed. To introduce new and appropriate technologies in rural areas the site survey was done in 1997 at Tuv, Selenge, Hentii, Sukhbaatar, Dornod, Dornogovi Aimag centres and a total 101 villages or sum and 297 bugs (small unit). During the site survey analyses of socio-economic condition, traffic demand and existing telecom network of these provinces was also carried out..

Projects for Rehabilitation and Extension of central western, southern and eastern Telecommunications Network (KFW Telecommunication II and III) were completed on the 2000. After implementation of Telecom II and III project transmission and exchange systems of all Aimag centres were digitalized. According to these packages, Mongolia is now planning to install suitable rural communication system for its network such as Point to Multipoint Radio System and Access Links with multi access lines including voice, data, leased and internet lines. It is planned for the selection of transmission system from the VSAT, PMP multi-access radio system, Access Link (Small capacity microwave radio with capacity at 2 Mbps, 2x2 Mbps), Radio multiplex, WLL, OFC system, UHF/VHF radio system etc. For switching system it is now planned to install TDMA-WLL, PABX, RSU and payphones in connection with the projects of Telecom II and III

4.3.4 VSAT Network Facilities

4.3.4.1 General

Very Small Aperture Terminal (VSAT) equipment consists of an offset antenna, feed, Radio Frequency (RF) box, cables and a personal Computer (PC) controller. VSAT's in remote locations typically connect to the Public Switch Telephone Network (PSTN). In the areas where terrestrial communications is not feasible, VSAT provides both data and voice communication with the utmost accuracy and integrity. It is an ideal solution for places where traffic density is low but quick and reliable communication is required.

VSAT can efficiently and flexibly promote telecommunications development in rural areas and directly links geographically dispersed areas into an integrated network.
The VSAT network is transparent to the signal transmitted by the existing networks. This means that VSAT can replace a terrestrial multidrop network without changing existing software. The VSAT central (master and hub) station can be configured to support thousands of remote stations.

In order to improve the rural telecommunications in Aimags of Mongolia which had no access to trunk line of optical fibre line or microwave transmission links were connected by installing VSAT (Very Small Aperture Terminal) system.

By foreign aid plan TELECOM II and TELECOM III project implemented the installation of total 19 VSAT stations to improve the rural telecommunication network in remote Aimags from Ulaanbaatar during the period from year 1998 to year 2002.

At the first stage in 1998 the VSAT rural telephony system was established at 9 western Aimag centres they are Arkhangai, Bayankhongor, Bayan-Ulgii, Gobi-Altay, Khovd, Hubsgul, Uvs, Zavkhan aimag's Tosontsengel, Tudevtei and Uliastai to connect VSAT facilities with the HUB station at Naran Earth station in Ulaanbaatar.

At the second stage during the period from 2000 to 2001 the VSAT network was expanded in the 7 eastern and southern aimag centres of Dornod, Khentiy, Sukhbaatar, Dornogovi, Dundgovi and Umnugovi.

4.3.4.2 VSAT Network overview

The VSAT Network consists of Streamline VSAT products. The network provides full-mesh connectivity for voice traffic, a star configuration for data capability between the sites.

The system is now operating over the Intelsat-804 satellite East hemi beam, located at 64 degrees east.

The network has the following configuration:

(1) A Type I station located at Naran Earth station, Ulaanbaatar consists of a 16-meter C-band antenna and two redundant VSAT terminals, one is furnished with eight (8) E1 card for 30 channels (8 kbps voice) and two (2) voice cards for 4 channels (8 Kbps voices). The other VSAT terminal can support seven (7) data cards, each has 2 ports, and each port is able to transmit up to 512 kbps data rate.

(2) 13 Type II station located at Tsetserleg, Uliastai, Ulaangom, Muren, Mandalgovi, Bayankhongor, Esonbulag, Jargalant, Ulgii, Dalanzadgad, Undekhaan, Baruun-urt, Choibalsan, each consisting of a 3.7 meter C-band antenna, redundant VSAT terminals furnished with one (1) E1 card, one (1) 4 channels voice card and one (1) two-port data card for 64 Kbps data service.

(3) 2 Type II stations located at Tosontsengel and Zamin-Uud, each consisting of a 3.7 meter C-band antenna, redundant VSAT station terminals furnished with one (1) E1 card and one (1) 4 channels voice card.

(4) 3 Type III stations are located Baruunturuun, Tudevtei and Sumber, consisting of a 3.7-meter C-band antenna, a non-redundant VSAT station terminal furnished with one (1) four-port voice.

The network parameters is shown in the Table 4.3.4.2-1

Table 4.3.4.2-1 VSAT Network Parameters

Number of Earth Stations in Network	
Type I Station	1
Type II Station	15
Type III Station	3
Multiple Access to Satellite Transponder	TDMA
Satellite	INTELSAT - 804
Number of Voice circuits	
Type I Station	216
Type II Station	< 30
Type III Station	< 4
Number of Data circuits	
Type I Station	13
Type II Station	1
Type III Station	None
Data Rate	64 Kbps
Inter-connectivity	
Voice	Mesh DAMA
Data	Star

Table 4.3.4.2-2 INTELSAT-804 Space Segment Parameter

Parameter	Beam Centre
Beam	East Hemi 55/55
Uplink Frequency	6 GHz
Downlink Frequency	4 GHz
Bandwidth	72 MHz
Polarization	Circular
Saturated EIRP	40 dBW
G/T	- 4.5 dB/K
SFD	- 79.0 dBW/m^2
IBO	10 dB
OBO	4.5 dB

Based on a single carrier burst rate at 1072 Kbps, the total occupied satellite bandwidth of 11 carriers is 8 MHz.

4.3.4.3 VSAT Terminal Description

The VSAT TDMA terminal is configured in a self-contained, lightweight, compact unit that contains one set of common equipment cards and power supply. There are three versions of the VSAT terminal:

(1) VSAT*Plus II*
(2) VSAT*Plus II*e
(3) VSAT*Plus II*e redundant terminal

The VSAT*Plus II* is a desktop chassis, which accept up to three modules of interchangeable interface cards. The VSAT*Plus II* is configured in a standard 19-inch-wide chassis mounted in a small rack cabinet that supports one set of common equipment cards, a power supply, up to 10 slots for interchangeable interface cards. The VSAT *Plus II*e redundant terminal is identical to the VSAT*Plus II*e with an additional set of common equipment cards and power supply to support 1:1 redundancy.

The following table highlights the features, performance specifications and options of the VSAT terminals:

70 MHz IF Interface	BNC connector, 75 ohms
Modem satellite access technique	TDMA(Time Division Multiple Access)
Information Data Rate Range	256 Kbps to 8.75 Mbps
Burst Rate Data Range	512 Kbps to 10.0 Mbps
Minimum BER	
Sum to Sum Voice	$1x10^{-4}$
Sum to Aimag Voice	$1x10^{-4}$
All Data Traffic	$1x10^{-6}$
Transmit Carrier Frequency	70 MHz
Propagation availability	99.95%

4.3.4.4 Station Configuration

Each VSAT station consists basically of an antenna, RFT and VSAT terminal with appropriate interfaces. Station configuration is classified into Type I, II and III stations, depending on the particular VSAT interface configuration and the offered services.

All station is designed with identical antennas and RFT (10W) equipment. For configuration of the VSAT Network, a 3.7-meter antenna and a 10-watt RFT were selected. The RFT is mounted outdoors on the antenna structure. Each station is supplied with the necessary RFT mounting kit, which includes SSPA- and LNA-to-transceiver cables, transmit rejection filter and mounting hardware. In general it is possible 300 feet IFL distances without line conditioners or amplifiers.

The VSAT terminal is mounted indoors and interface to the RFT using a standard coaxial cable at 70 MHz IF.

Type I Station – Ulaanbaatar (HUB)

Figure 4.3.4.4-1 illustrates a block diagram of the station. The station consists of two redundant VSAT *Plus IIe* terminals equipped with the following interfaces:

Quantity	Interface	Ports	Channels	Service
8	E1	8	210	DAMA & PAMA voice 8 Kbps
2	Voice	8	8	PAMA voice 8 Kbps
7	Data	2	13	Internet Data 64 Kbps, EWSD X25 Links data 64 Kbps

Type II Station

Figure 4.3.4.4-2 shows a block diagram of the station. The station is furnished with a VSAT *Plus II* terminal. The type II station interfaces and services is shown in the following table.

Quantity	Interface	Ports	Channel	Service
1	E1	1	<30	DAMA Voice channel at 8 Kbps
1	Voice	4	1-4	PAMA Voice channel at 8 Kbps
1	DATA	2	1	Internet data at 64 Kbps

Type III Station

The Type III station provides DAMA voice and data services. The station is supplied with a non-redundant desktop VSAT *Plus II* terminal. Type III station interfaces and services are:

Quantity	Interface	Ports	Channels	Service
1	Voice	4	1-4	DAMA voice channel at 8 Kbps

The four analogue voice connections from customer equipment will interface to the VSAT Plus II terminal using 2 wire FXS standard interface. The Type III station diagram is shown in Figure 4.3.4.4-3.

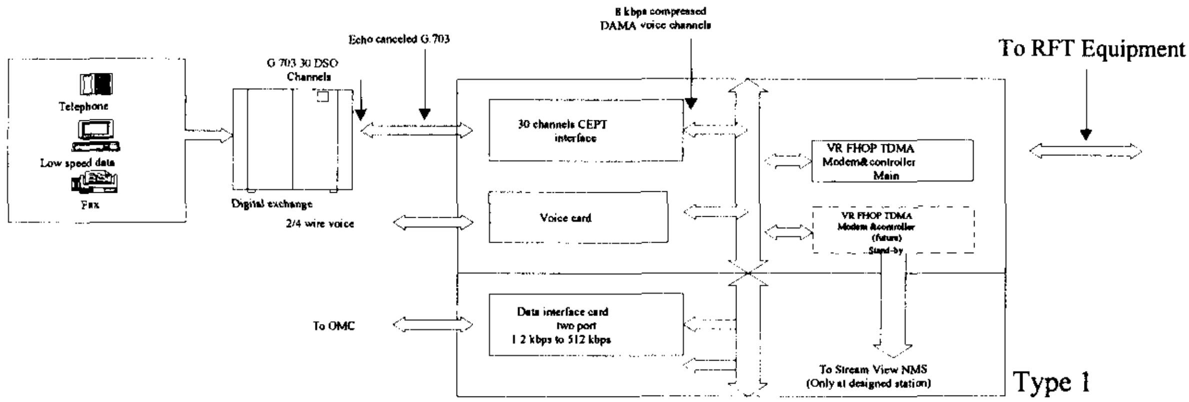


Figure 4.3.4.4-1 Type I Staion VSAT Plus IIe Terminal Block Diagram

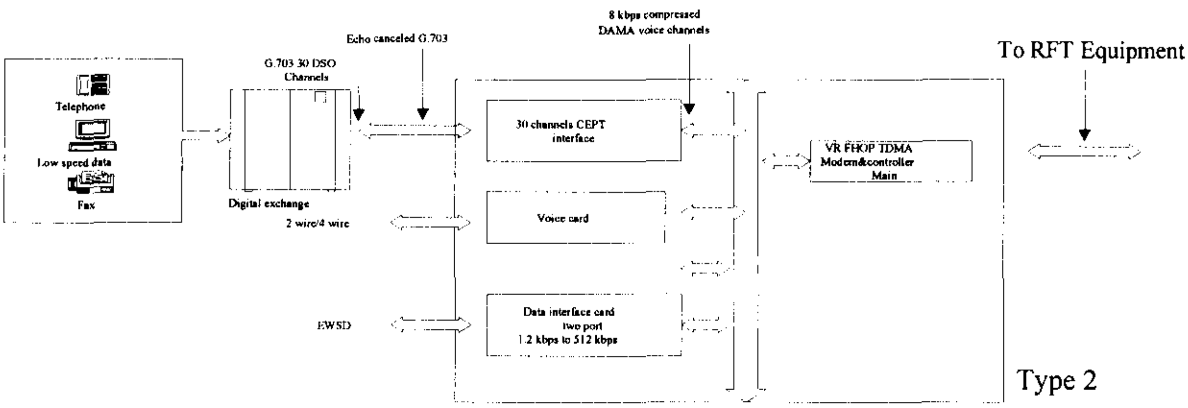


Figure 4.3.4.4-2 Type II Station VSAT Plus II Terminal Block Diagram

4.3.4.5 VSAT Network Traffic

The Mongolia Telecom's satellite network supports voice, data service to 18 sites, which are located at rural villages, and they had not a connection with Ulaanbaatar through National Transmission Trunk Network. The HUBSTATION (Type I station) is located at Ulaanbaatar's Naran central Earth station. The site serves as a central customer site. The 13 Type II stations are located in Aimag centres.

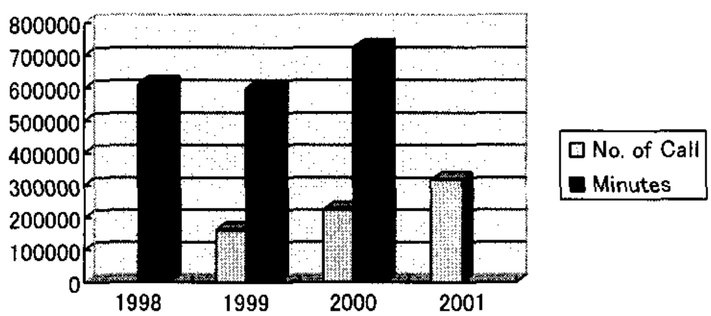
The 2 Type II stations and 4 Type III stations are located at sum centres. The VSAT network with DAMA channels is configured by mesh for connection with PSTN network and the 64-128 Kbps data links (PAMA channels) is connected with star configuration between Ulaanbaatar Type I station and the Type II station or Type III station. The transponder assignment by Intelsat is on a Hemisphere Beam for the service. To minimize satellite bandwidth, FEC at 3/4 is used for the carrier traffic. Based on a single carrier burst rate of 1072 Kbps, 4 carriers are required to fulfil the network capability requirements.

The occupied bandwidth of VSAT network, which translates into 3.72 % of a 72 MHz transponder, is now 2.68 MHz and the annual satellite transponder fee is 68,310 US Dollars. For connection with PSTN, each VSAT stations installed at Aimag centres are connected by HICOM (Siemens) Digital Switching Equipment with 300-subscriber line capacity. Four Sum centres, in Tudevtei, Baruuturuun, Zamin-Uud and Sumber, are connected with digital PBX equipment. The location of VSAT station and the VSAT rural telephony network is shown in Figure 4.3.4.5-1. The Mongolia VSAT network traffic in 2001 is shown in Table 4.3.4.5-1.

The rural telephone traffic after installation of VSAT telephony system has been remarkably improved. For example, the traffic in Zavkhan was increased by 20 percent comparing with the previous year traffic as a result of installation of VSAT telephony system. The trend of Zavkhan Aimag Long Distance Telephone call from year 1998 to year 2001 is as follows:

Table4.3.4.5-1 Mongolia VSAT Network Traffic (Year 2001)

Network Type (Channel Capacity)	Aimag	Location of VSATstation	Number of Fixed Subscriber	Total Call Minutes from Station	Busy Hour Traffic Density (Erl.)	Required No. of Circuits
Type I (216) HUB	Ulaanbaatar	Ulaanbaatar	74247	10,652,119	91.9	100
Type II(30)	Dundgovi	Mandalgovi	1536	789,038	6.8	14
Type II(30)	Bayanhongor	Bayanhongor	1608	846,347	7.3	14
Type II(30)	Govi altai	Altai	1768	860,725	7.4	14
Type II(30)	Bayan Ulgii	Ulgii	2040	538,352	4.6	11
Type II(30)	Umunugovi	Dalanzadogad	1864	729,874	6.3	13
Type II(30)	Khovd	Khovd	2064	792,259	6.8	14
Type II(30)	Khentii	Underkhaan	1640	802,257	6.9	14
Type II(30)	Sukhbaatar	Baruun-urt	1072	397,060	3.4	9
Type II(30)	Dornod	Choibalsan	2480	423,198	3.7	9
Type II(30)	Arkhangai	Tsetserleg	1448	790,514	6.8	14
Type II(30)	Zavkhan	Uliastai	1520	312,785	2.7	8
Type II(30)	Uvs	Ulaangom	2016	396,130	3.4	9
Type II(30)	Khuvsgul	Murun	2352	816,678	7.0	14
Type II (30)	Dornogovi	Zamin Uud	1640	712,005	6.1	13
Type III(4)	Zavkhan	Tosontsengel	1520	312,785	2.7	8
Type III(4)	Zavkhan	Tudevtei	1520	312,785	2.7	8
Type III(4)	Uvs	Baruunturuun	2016	396,130	3.4	9
Type III(4)	Dornod	Sumber	2480	423,198	3.7	9



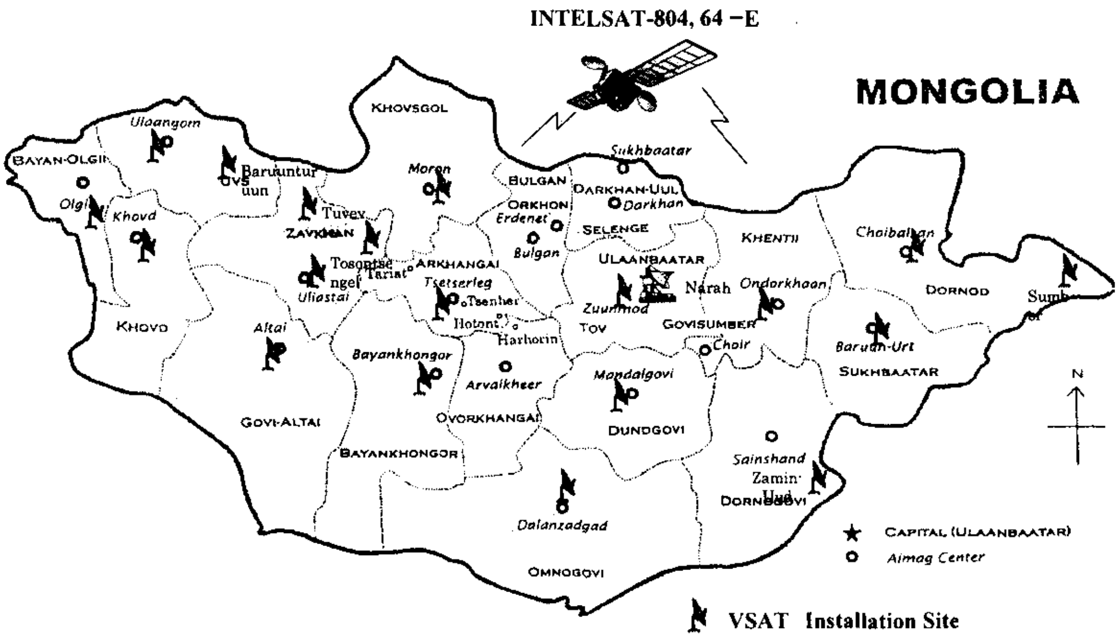


Fig.4.3.4.5-1 Current VSAT Transmission Network in 2002

4.3.5 Rural Radio Telephony System

4.3.5.1 General

Rural radio telephony is one of solutions of extending telephone service out to an area that lacks access to the PSTN (Public Switched Telephone Network). Two-way radio transceivers are used to achieve the link. In a rural radio telephony or "wireless telephone" system, a person uses a standard telephone desk set to place and receive telephone calls, without having to operate a two-way radio set. Total 29 sums are now possible to connect with a PSTN network through VHF radio link equipment.

In order to set up an emergency call for protection of livestock from natural disasters (ZUD) a rural radio telephony system was installed in the Sum and Bag rural villages by Japanese Official Development Assistance. Total 2030 desk sets of HF or VHF transceiver were distributed to the Sum and Bag rural villages. Those radio transceivers are now working very effectively as an emergency communication tool between nomadic people, however, upgrade for automatic link connection with the existing PSTN telephone subscribers through those radio transceivers equipment is urgently required to improve the sum radio telecommunication system.

4.3.5.2 Utilization of HF radio systems for rural telecommunications

Peculiar characteristics of telephone traffic in rural telecommunications areas make the utilization of HF radio system very practical and economic. This has been particularly verified for two typical models of subscriber's distribution

In the first model, a small number of subscribers populating a limited area are connected by HF radio to a Sum centre telecom office where access facilities to the national/international telephone network are provided.

The second model refers to a different situation in which a certain number of isolated subscribers dispersed over a large area, are connected by HF radio to a base radio station (BRS) operating over a limited radius of about 500 Km.

Furthermore, the possibility should be pointed out of connecting HF radio circuits to remote telephone exchanges.

In order to take measures of natural disaster (ZUD), many HF radio station equipment have been provided to nomads at Sums and Bags as an emergency communications purpose.

Number of installation of radio station at Sums and Bags according to the Installation report of IC-F420/IC-78 Radio Station provided is shown in Table 4.3.5.2-1.

Table 4.3.5.2-1 No. of Installation of Radio Station at Sums and Bags

No.	Province Aimag Name	Planned Number for Radio Set Installations	Actual Number of Installed Radio Set	Implementation Percentage	Number of Radio Stations	
					At Sum Center	At Bag
1	Arkhangai	117	112	95.73	57	55
2	Bayankhongor	129	129	100.00	59	70
3	Bayan- Ulgii	92	92	100.00	38	54
4	Baganuur	11	11	100.00	6	5
5	Bulgan	86	86	100.00	45	41
6	Gobi- Altai	136	136	100.00	56	80
7	Gobisumber	13	13	100.00	8	5
8	Darkhan- Uul	37	37	100.00	23	14
9	Dornogobi	78	78	100.00	38	40
10	Dornod	82	82	100.00	41	41
11	Dundgobi	90	90	100.00	42	48
12	Zavkhan	151	151	100.00	71	80
13	Orkhon	5	5	100.00	3	2
14	Uvurkhangai	135	135	100.00	56	79
15	Umnugobi	78	78	100.00	38	40
16	Sukhbaatar	80	80	100.00	38	42
17	Selenge	70	70	100.00	41	29
18	Tuv	145	145	100.00	71	74
19	Uvs	110	110	100.00	52	58
20	Khovd	111	111	100.00	50	61
21	Khuvsgul	163	163	100.00	72	91
22	Khentii	116	116	100.00	54	62
	Grand Total	**2,035**	**2,030**	**99.81**	**959**	**1,071**

4.3.5.3 Subscriber Radio Systems in Rural Areas

Subscriber Radio System (SCR) are normally utilized in a dedicated radio channel mode to perform the function of distribution in a rural telephone network and are used for connection with PSTN through radio communication system.

Systems of this type are used where subscriber density is very low and where no problems exist with regard to the availability of radio channels. When the number of users in a given area is comparatively high, or where the number of available RF channels is limited a multi-access system is preferred.

Using SCR equipment, telephone service can be extended to mobile stations and villages or suburbs with a low population where no physical subscriber's lines from exchanges are available. A service area of about 50 Km radiuses may be covered.

The frequencies, which may be used for the single-channel radiotelephone system, are found generally in the 150 MHz, 250 MHz, 400 MHz or 800 MHz bands.

Frequency separation between transmission and reception in each band is normally about 3 to 5 % of the radio channel frequency.

In regions with very low traffic a common channel mode may be applied. In this case each radio channel is associated with two or three subscriber radio terminals, to simplify the multi-access system.

One single-channel radio SRT can also be connected to an FDMA or TDMA radio subscriber terminal to extend service to even more remote individual subscribers.

In order to connect Sum centre subscribers with the PSTN by radio telephony system the VHF radio telephone link was established in Sum centres. 26 Sums were now connected to the PSTN through the HAWK Radio link equipment.

The HAWK radio link equipment provides one or two telephone circuits to subscribers, isolated from the Public Switched Telephone Network. Hawk equipment is possible to replaces copper pairs with reliable, full ITU-T standard radio telephone connections using DSP (Digital Signal Processing) technology supporting payphone, fax, data and electronic fund transfer at point of sale (EFTPOS). The frequency bands assigned for the rural radio telephone link is shown in Table 4.3.5.3-1

Table 4.3.5.3-1 Frequency Bands for Rural Radio Telephone Link

Frequency Bands (MHz)			
VHF	68-78	72-82	78-88
	138-148	148-162	159-174
UHF	335-356	380-403	403-423
	410-430	430-450	450-470
	470-490	480-500	490-512

4.3.5.4 Radio-PSTN Phone Patches Solutions

In connection with rural radio telephony solutions to make interconnection with the existing PSTN subscribers through HF Transceiver installed at Sums and Bags rural villages, interconnection controller device is necessary to add on the present HF communications system.

In order to interconnect with PSTN automating all radio functions such as sending DTMF access codes and toggling the radio's Push to Talk circuit are required.

The method of connecting a HF radio transceiver subscriber with a PSTN telephone subscriber is automatically implemented by Radio-to-Phone interconnection equipment as shown in the Fig 4.3.5.4-1.

The proposed telephone conversations method is as follows:

(1) PSTN telephone subscriber-to-Remote Radio Transceiver User Call

(a) Public access user calls unique telephone number (trunk) to MODEL 45B. MODEL 45B senses rings, goes-off hook (answers)

(b) Recorded voice prompts (in Mongolian language) instructs caller to over-dial the number of the party they wish to call.

(c) Caller dials unique telephone number of remote user, MODEL45B selectively calls remote Model 71. Model 71 decodes call and rings phone set.

(d) Called party answers, telephone conversation proceed with "semi" full duplex operation to public user, half-duplex to remote user

(2) Remote Radio Transceiver User-to-PSTN Telephone Subscriber Call

(a) Handset of phone of remote village users is lifted, dial tone generated by Model 71, DTMF ANI digits automatically sent to Model 45B

(b) Model 45B access PSTN Local Switch telephone line, remote transceiver users dials telephone number of PSTN access telephone subscribers

(c) Called party answers, telephone conversation proceeds with "simulated" full duplex operation to public telephone subscriber, half-duplex to remote user.

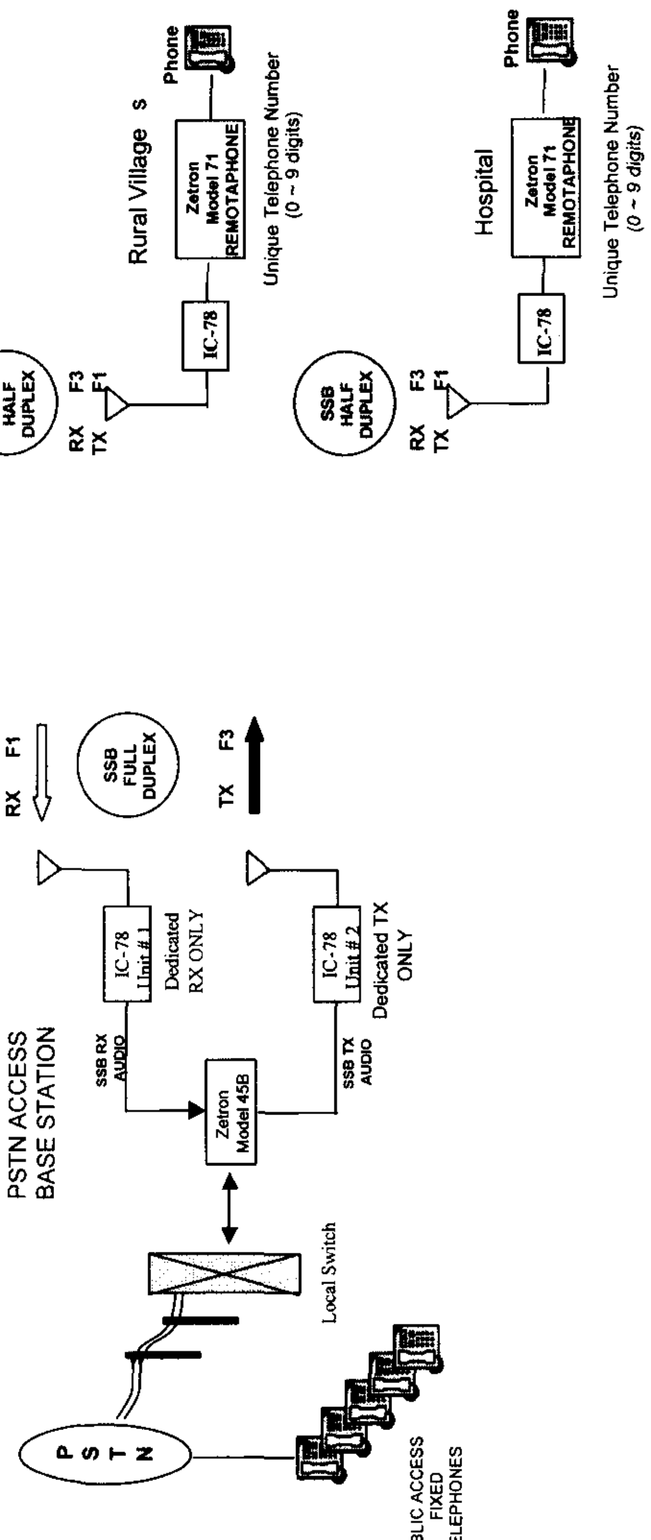


Figure 4.3.5.4-1 Proposed Interconnection Diagram of Rural Radio-tranceiver and PSTN in Mongolia

4.4 Access Network Facilities

4.4.1 Wired Access Network Facilities

When deciding upon the most appropriate rural communications network development plan for Mongolia, grasp of existing network facilities is important. Especially, the judgment on the reuse of the existing facility is necessary.

The followings are the situation on the existing rural wired access network facility.

(1) General

a. Existing Rural Access Network

Average numbers of the cable pair terminated on MDF are about 60 lines for the average inhabitants of 1,100 in Sum centre as shown in Table 4.4.1-1.

Table 4.4.1-1 Scale of Sum Centres by Aimag Basis

No.	Region	Name of Aimag	Aimag centre only (Except UB region)	Sum centre only						
				Except Ulaanbaaatar region, Aimag centre & Bag						
				Inhabitant		No.of	Switching capacity		Cable pair	
			Inhabitant	Sum centre total	Sum centre Average	Sum centre	Sum centre total	Sum centre Average	Sum centre total	Sum centre Average
			Person	Person	Person	ea	LU	LU	Pair	Pair
1	Western	Bayan-Ulgii	25,763	17,084	1,220	14	422	30	350	25
2		Govi-Altai	14,657	11,595	610	19	916	48	798	42
3		Khovd	26,418	17,857	1,116	16	734	46	530	33
4		Uvs	23,217	18,848	992	19	526	28	NA	
5		Zavkhan	16,542	22,286	969	23	660	29	1,110	48
6	Khangai	Arkhangai	17,799	19,042	1,058	18	550	31	600	33
7		Bayankhongor	17,424	13,190	660	20	384	19	370	19
8		Bulgan	7,870	16,155	1,010	16	974	61	720	45
9		Orkhon	65,266	2,208	2,208	1	2,300	2,300	500	500
10		Uvurkhangai	18,963	26,253	1,382	19	2,308	121	2,580	136
11		Khuvsugul	27,092	22,989	958	24	900	38	710	30
12	Central	Darkhan-Uul	72,556	12,366	4,122	3	800	267	1,940	647
13		Dornogovi	13,624	9,318	548	17	894	53	880	52
14		Dundgovi	10,063	8,172	584	14	912	65	710	51
15		Govisumber	7,048	2,552	1,276	2	248	124	290	145
16		Selenge	20,282	49,497	2,475	20	3,140	157	670	34
17		Tuv	14,771	35,430	1,312	27	1,488	55	1,556	58
18		Umnugovi	11,739	8,533	569	15	144	10	130	9
19	Eastern	Dornod	36,423	15,711	1,122	14	240	17	NA	
20		Khentii	13,479	17,016	810	21	712	34	NA	
21		Sukhbaatar	11,873	11,521	886	13	424	33	330	25
22	Others	Nalaikh				4	48	12		
23		Baganuur				0	0			
Subtotal			472,869	357,683		339	19,724		14,774	
No. of data			21	335			339		281	
Average			22,518	**1,068**			58		53	

Source : Population, Number of Sum centre =Year 2000
Existing Switch : = PTA
Existing Cable pairs : Arkhangai = PTA, Others = M/P pre-study data

Almost bags are not provided telephone service yet. At the present, some of the Bags have just introduced HF (High Frequency) and VHF (Very High Frequency) radio communication system by urgent aid form Japan government. However this system cannot connect with the PSTN (Public Switched Telephone Network).

Average inhabitants of Aimag centres become around 23 thousands. Telephone exchanges in Aimag centre have the line capacity of 1,000 to 2,500 (average capacity is about 1,800 lines). Average numbers of subscribers are about 1,300.

b. Quality of the Network

The existing wired rural access network such as cable, pole drop wire etc. in Sum centres haven't been renewed generally by past rehabilitation project. Therefore, almost of the cables and other outside plant have deteriorated considerably. A part of local cables in big scale Sum centre only have been renewed by the past project.

c. Existing Rural Access Network in each Sum Centre

Table 4.4.1-2 shows existing rural access network in each Sum centre in Arkhangai Aimag area.

Table 4.4.1-2 Sum Basis Existing OSP in Arkhangai Aimag Area

Aimag No. : [6] Name of Aimag : [Arkhangai]

No.	Name of the Sum	General data			Number of channels between Aimag center and Sum center								Access network in the Sum center (Excluding Bag)					
					Wired system				Wireless system				Internal plant		Outside plant			
		Area size km^2	No. of inhabi-tant	No. of house-hold	Optical fiber cable (ch)	Metallic Cable (ch)	Open wire (ch)	Open wire (Carrier) (ch)	Fixed Wireless Access (ch)	Ultra high frequency (ch)	Micro wave (ch)	VSAT (ch)	Type of switch	Switch-ing capacity (lu)	MDF terminat-ing pairs (pair)	Type & length of cable (km)	No. of Open wire (wire-km)	No. of Manhole, Hand-hole (ea)
1	Battsengel	3300	4,106	1,234	none	none	1	none	none	none	none	none	ATC 50/200	50	30	PE cable, Lead sheathed cable, drop wire cable	70	none
2	Bulgan	3200	2,374	703	none	none	1	none	none	none	none	none	KX 616	16	20		35	none
3	Jargalant	2800	4,531	1,176	none	none	1	none	none	none	none	none	C 12/48	48	50		70	none
4	Ihtamir	4800	6,577	1,497	none	none	1	none	none	none	none	none	KX 616	16	50		25	none
5	Ugiinuur	1700	3,400	864	none	none	1	3	none	none	none	none	EM 4	12	10		115	none
6	Ulziit	1700	3,386	964	none	none	1	none	none	none	none	none	KX 616	16	20		150	none
7	Undor Ulaan	4400	6,068	1,665	none	none	1	none	none	none	none	none	JC 20	20	20		130	none
8	Tariat	4600	5,673	1,455	none	none	2	3	none	none	none	none	EM 48	48	20		151	none
9	Tuvshruuleh	1200	3,628	893	none	none	1	3	none	none	none	none	ATC 40/80	40	50		45	none
10	Tsahir	3400	2,218	622	none	none	1	none	none	none	none	none	MONTEL	20	10		70	none
11	Tsenher	3200	5,414	1,545	none	none	1	none	none	none	none	none	JC 20	20	20		30	none
12	Tsetserleg	2500	4,437	1,130	none	none	1	2	none	none	none	none	C 12/48	48	50		45	none
13	Chuluut	4000	3,965	1,036	none	none	1	none	none	none	none	none	C 12/48	48	50		117	none
14	Hairhan	2500	3,783	1,244	none	none	1	none	none	none	none	none	ATC 50/200	50	50		66	none
15	Hangai	3400	3,455	959	none	none	none	none	none	none	none	none	JC 20	20	20		70	none
16	Hashaat	2600	4,347	1,082	none	none	1	none	none	none	none	none	MONTEL	20	30		30	none
17	Hotont	2400	5,544	1,482	none	none	1	3	none	none	none	none	ATC 50/200	50	50		60	none
18	Erdenemandal	3400	6,395	1,482	none	none	2	6	none	none	none	none	C 12/48	48	50		138	none
	Total	55,100	79,301	21,033	none	none	19	20	none	none	none	none		590	600		1,417	none

Source : based on PTA data

(2) Cable Plant

a. Cable system

Wired access network in these Sum centres have been consisting on small size cables with two or three directions. Main features of the network in the greater part of Sum centres are

- Aerial cable system
- Rigid distribution system
- 7 dB attenuation loss for local loop

b. Open Wire system

For long distant place from Sum centre, 4mm diameter iron open wires are used. Attenuation loss of 10.4dB is applied for the open wire section as the maximum tolerable loss and the open wire can cover 162.5km line length at the maximum. (The loss of 4mm iron open wire per kilometre values 0.064dB/km at 0.8kHz.)

(3) Civil Plant

a. Duct

Existing pipes are classified with two types, asbestos cement pipe in traditional plant and PVC pipe in new installed plant.

b. Manhole

Main body of manholes are constructed by bricks. The sizes of manholes are too small for cable arrangement and working space for construction and maintenance work. Manhole covers are made from reinforced concrete or casting iron.

Accessories of manhole (Hardware: vertical channel, cable bearer, pulling bolt, ladder etc.) are missing here and there. And rearrangement of the cables in the manhole is required because state of existing cables is disorderly in the manhole.

(4) Customer Premises Equipment

Outside plant from telephone exchange up to distribution point belongs to PTA assets and subscriber's side facilities such as drop wire, indoor wire and terminal equipment are subscriber's private property in Mongolia.

a. Station Protector

Station protector consist of arrestor and is not inserted between drop wire and indoor wire because protection function is equipped in the distribution point.

b. Telephone Equipment

The following Terminal equipments are provided in the rural access network in Sum Centres.

- Telephone set
- Facsimile apparatus
- Telephone and facsimile multi function apparatus
- Personal computer
- Additional devices

All of these apparatus are available in Mongolian market and they are manufactured in various countries.

(5) Urban Area

Information on situation of existing facilities in urban area is necessary for establishing a development plan in rural area to find common factor of issues and for the cost comparison.

a. Access Network

Each service area in exchange is divided into several hundred-demand areas that is called "cross connection point area".

Primary cable aims to feed the circuits from exchange to cross connection point and secondary cable is installed to distribute the circuits from cross connection point to distribution point.

Flexible distribution system has been employed by using cross connection point for effective use of primary cable pairs.

Secondary cable pairs from cross connection point to the distribution points have been assigned by fixed distribution method without multiple pair assignment.

b. Cable Plant

Metallic cable has been utilized for the media of access network between telephone exchange and subscribers in urban area,. Traditional plant applied lead sheath paper insulated cable with gas (dry air) pressurised system. These maintenance systems aren't functioning now because of failure of gas supply system.

Underground duct system is adopted both primary and secondary cables basically.