CHAPTER 9

TELECOMMUNICATIONS NETWORK FACILITIES PLAN

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9.1 General

The telecommunications facilities plan under the Master Plan Study is focused to design the Sum centre network and links to connect them with Aimag centre. The facilities plan is worked out in line with the Key Development Target indicated in Table 6.2-1. The plan is established under the conditions that:

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

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

The facilities quality will be upgraded to an international level having a capacity of 370,000 telephone users, including 196,000 users in 21 Aimags, a capacity of 592,000 mobile terminals in the whole country. About 308,000 mobile users are expected to be allocated to 21 Aimags.

Analogue automatic and manual switches in Sum centres will be replaced with digital ones during the Master Plan Period up to 2020. Switching system by Small digital PBX will be reused, if removed at early stage of the period, at the sites where the digitisation is planned in Phase 3. The switching system to be introduced under the Master Plan Period shall be compatible with IP-based network.

Since the telecommunications network and facilities are shifting to those compatible with IP-based ones, the switching system introduction may be shifted sometime to IP-based switch, router, gateway, etc.

The analogue Aimag-Sum links, which are composed mainly with open wire transmission system, will be replaced with digital transmission links. The capacity of transmission systems will also be increased to meet the traffic of the increased telephone subscribers and IP-users. The target area transmission systems will be fully digitised to carry the IP-based signals by the end of Phase 3 or the year 2020.

Optical fibre transmission system, digital micro-wave transmission system, very small aperture satellite (VSAT) system will be adopted to provide digital links which could be compatible with IP-based network.

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

The technology to realise the capacity expansion of the facilities will be decided carefully paying attention to:

(a) Appropriateness to the site,
(b) Compatibility with the existing network,
(c) Flexibility in merging into IP-based network,
(d) Maintainability after service commencement,
(e) Purchase and installation cost, etc.

Attention is paid to the power supply scheme, because many target Sum centres are provided with unstable power source or some of them are out of community power supply. A power source will be provided for the telecommunications system, where the target Sum centre is not connected, or not planned to connect, with the national power grid.

The existing network management system will be expanded to monitor new equipment to be provided under the Master Plan. Alarms of new switching systems and transmission systems will be transferred to the Aimag centre. Billing data collected at each switching node will also be transferred to Aimag centre or to Ulaanbaatar.

9.2 Telephone Switching System

9.2.1 Switch System Introduction Principle

Telephone switching system will be introduced on the following basis. In this paragraph, the word "switching system" is used as defined in ITU-T Rec. Q.9 and used as an element to form an exchange.

The switching system discussed herein is that to be introduced in Sum centres. It could be a small switching node which could be made up with small PSTN switch, private automatic branch exchange (PABX) or digital loop carrier (DLC) system, etc. The node type should be decided concretely at the time to purchase.

The capacity of switching system to be introduced in Aiamg centres is also calculated, though the switching system itself is out of designing scope. It is supposed, however, that the existing switching system in Aimag centres, mainly EWSD of Siemens, will be kept operated before introduction of IP-based models.

The switching system in Sum centres should be introduced in line with the following basis.

a) The switching system should be of digital type compatible with existing telecommunications network.

b) The switching system should be a system flexible to be merged into IP-based network or compatible with IP-based network.

c) The switching system should be so designed to have a capacity enough to cater for the demand for five (5) years at least after its installation. In the case where the switching system capacity expansion range is small up to the target year, the size will be decided practically in consideration of the capacity range seen in the market.

d) New unit of switching system will be introduced in selected Sum centres in accordance with the Key Development Target. The digital switching system to be replaced with the new switch in early stages should be re-used in a site where the digital switch introduction is planned in Phase 3. The digital PBX "KX-TD" of Panasonic will be the subject of re-use. The Russian-made

analogue PBX will not be re-used in consideration of difficulty of spare parts purchase.

9.2.2 Exchange Allocation

Every target Sum centres will have one automatic exchange respectively. The exchange will be composed of switching system (or node) and power equipment. The exchange may accommodate other equipment of transmission and subscriber access network.

9.2.3 Switching System Features

The new switching nodes under the Master Plan, which are supposed to be a small switch or private automatic branch exchange (PABX) for the time being, will have digital links to connect them with Aimag centre switching system.

The switching system to be introduced under this Master Plan should be digital and in conformity with ITU-T Rec. Q.500 series, and be flexible to be merged into IP-based network. Details should be stipulated on the occasion of purchase.

The switching node type to be installed in the Sum centre may be taken over by IP-based switch or router in several years. The features should be then reviewed learning from trend of advanced countries. For the detail of transition from PSTN to IP-based network, see Figure 6.1.3-1.

9.2.4 Capacity Expansion

The exchange capacity is supposed to be expanded to meet the demand fulfilment plan of each target year, that is, 2008, 2013, and 2020 in whole the country. The capacity expansion of switching system in Sum centres is designed on the conditions that the national network will be expanded duly to meet national demand. Figure 9.2.4-1 shows the concept of switching facilities expansion as national network. The size of the switching system to be introduced in Sum centres is decided basically under that concept.

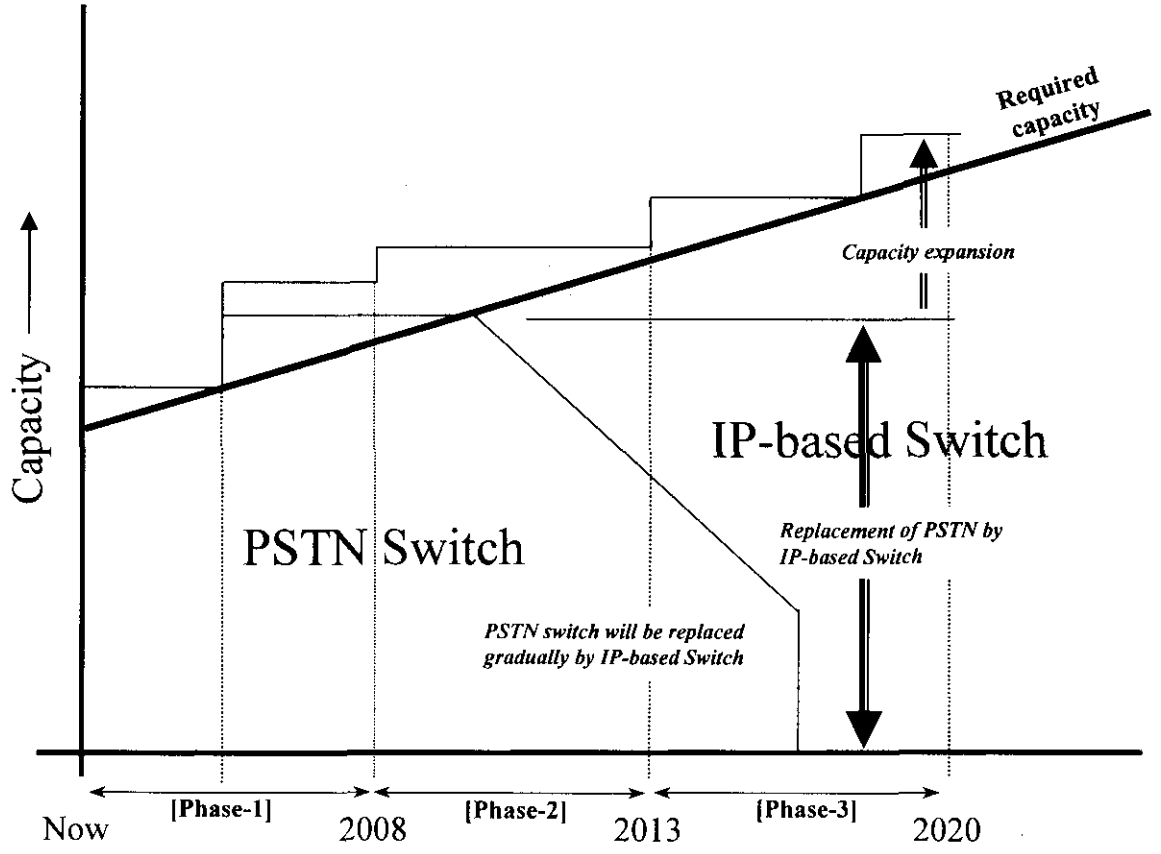


Figure 9.2.4-1 Concept of Switching Facilities Expansion

Regarding small switching systems, however, it was practically decided to adopt the demand of the year 2020 as its capacity at introduction. Three-fourths of the target Sum centres are planned to have a switching system capacity of 200 lines or less by the end of Phase 3.

The capacity of switching systems to be introduced in Sum centres will be around 62,000 lines in total by the end of Phase 3 (year 2020). Baganuur is out of scope of capacity expansion as it has no Sum centre in its area. Figure 9.2.4-2 shows the capacity increase by

Phase from 2001. Four (4) exchanges in Eastern Region will be expanded under MON-4 Project by the year 2003; they are SDX-RB exchanges of Munkhakhann (200 lines, Sukhbaatar), Jagaltkhaan (200 lines, Selenge), Tsenkhermandal (200 lines, Selenge), and Murun (200 lines, Selenge). Table 9.2-1 shows breakdown by Aimag. Annex 7-1 shows the detail by Sum by year.

The switching system capacity in 21 Aimags and 2 Districts, which counted 68,000 line units in 2001, will increase up to 203,000 lines in Phase 3, if the capacity is expanded duly to cater for the demand in that Phase. The total capacity of Sum centre switching system is planned to be 63,000 line units. Table 9.2.4-2 shows the total of switch capacity by Aimag. Annex 7-1 shows the detail breakdown of Sum centre level.

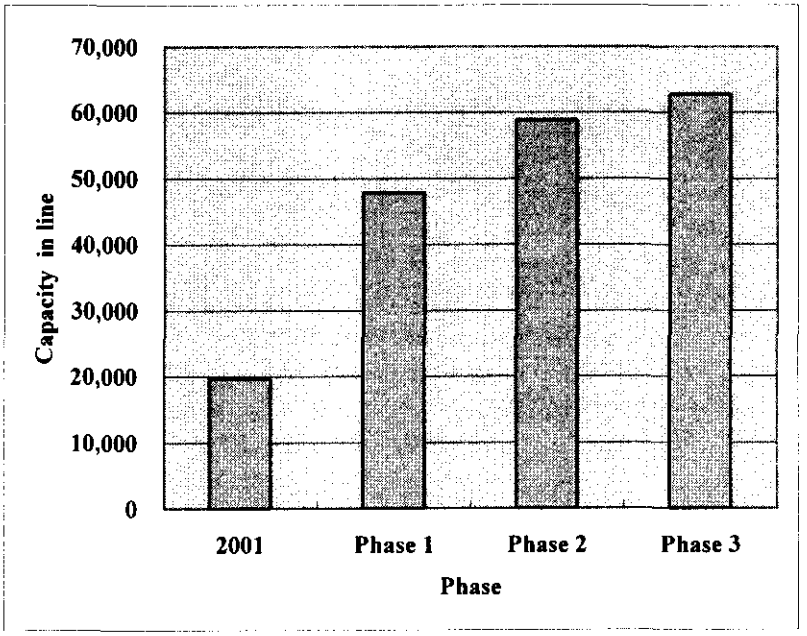


Figure 9.2.4-2 Sum Centre Switch Capacity Increase

Table 9.2.4-1 Switch Capacity of Sum Centres by Aimag

No.	AIMAG	Switch Capacity			
		2001	Phase-1	Phase-2	Phase-3
1	Arkhangai	550	3,018	3,400	3,400
2	Bayan-Ulgii	422	962	1,668	1,790
3	Bayankhongor	384	2,556	3,550	3,550
4	Bulgan	974	3,920	3,970	3,970
5	Govi-Altai	916	1,924	2,694	2,810
6	Dornogovi	894	1,938	2,760	2,920
7	Dornod	240	614	806	1,020
8	Dundgovi	912	1,266	1,456	1,550
9	Zavkhan	660	2,166	2,740	3,070
10	Uvurkhangai	2,308	3,684	4,518	4,530
11	Umnugovi	144	778	1,330	1,410
12	Sukhbaatar	424	1,828	2,010	2,130
13	Selenge	3,140	4,268	4,700	5,460
14	Tuv	1,488	4,130	4,418	4,560
15	Uvs	526	1,046	1,148	1,320
16	Khovd	734	1,592	1,950	2,060
17	Khuvsugul	900	3,546	4,650	4,690
18	Khenti	712	3,340	4,410	4,500
19	Darkhan-Uul	800	1,250	1,770	1,770
20	Orkhon	2,300	2,950	3,680	4,790
21	Govisumber	248	318	320	320
22	Nalaikh	48	48	280	480
23	Baganuur	0	0	0	0
	Total	19,724	47,142	58,228	62,100

Note: *Baganuur has no capacity expansion as it has no Sum centre in its area.*
Source: *PTA.*

Table 9.2.4-2 Switch Capacity of Sum and Aimag

No.	AIMAG	Switch Capacity			
		2001	Phase-1	Phase-2	Phase-3
1	Arkhangai	1,898	8,558	10,270	12,830
2	Bayan-Ulgii	2,457	5,012	6,698	8,680
3	Bayankhongor	1,984	7,126	9,210	11,320
4	Bulgan	2,358	5,890	6,410	7,320
5	Govi-Altai	2,666	4,174	5,474	6,630
6	Dornogovi	2,544	3,908	5,200	6,270
7	Dornod	2,467	2,841	3,296	4,430
8	Dundgovi	2,412	2,766	3,026	3,700
9	Zavkhan	2,228	4,046	5,070	6,270
10	Uvurkhangai	4,068	5,984	7,358	8,430
11	Umnugovi	2,008	3,188	4,320	5,510
12	Sukhbaatar	1,495	4,238	5,010	6,230
13	Selenge	5,020	6,818	7,380	8,880
14	Tuv	3,504	6,430	7,268	8,480
15	Uvs	2,542	3,306	3,948	5,160
16	Khovd	2,782	4,482	5,530	6,970
17	Khuvsugul	3,220	8,526	10,830	13,160
18	Khenti	2,352	5,420	6,980	8,030
19	Darkhan-Uul	6,408	8,960	11,190	14,500
20	Orkhon	7,700	22,940	28,470	38,800
21	Govisumber	760	938	900	1,110
22	Nalaikh	1,584	3,068	4,030	5,620
23	Baganuur	3,130	3,130	3,610	4,950
	Total	67,587	131,749	161,478	203,280

9.3 Transmission Facilities

Transmission facilities between Aimag Centres and Sum centres will be digitised in the Mater Plan for fixed telephone, mobile telephone and IT traffics. Back bone Networks, not included in the scope of the work, should be digitised before the digitisation of transmission facilities form Aimag centres to Sum centres. In the Master Plan Study, it is a pre-condition that some forms of digital transmission systems have been provided to Aimag centres from Ulaanbaatar. Although the pre-condition will be almost satisfied soon in Mongolia, attention should be paid to the backbone networks, when transmission projects from Aimag centres and Sum centres are planned.

9.3.1 System Selection

Optical fibre transmission system (FOTS), microwave system and very small aperture terminal (VSAT) satellite system are considered in the plan of transmission system between Aimag Centres and Sum centres. Transmission capacity delivered to each sum centre is estimated as 4 x 2Mbps in year 2020 for fixed telephone, mobile telephone and IT services. System Selection is based on the capacity in year 2020.

FOTS is not competitive in compare with Microwave system for such small capacity from view point of initial cost. FOTS is selected only for short distance section less than 10 km from Aimag Centre to Sum Centre, from Sum Centre to Sum Centre, or from backbone optical fibre route to Sum Centre. Since short distance section needs small amount of optical fibre cost, FOTS is competitive for short distance section even if small capacity is required there.

VSAT is selected for sum centres far from Aimag centres where many Microwave hops are required.

In actual projects, system selection should be more carefully made, considering the other factors such as geographical conditions, maintenances conditions and others. For example, if a new optical fibre backbone route is planned, Sums on the route should be connected with their Aimag centre by FOTS.

9.3.2 Optical Fibre Transmission System

FOTS are planned for Sum centres listed in Table 9.3.2-1. Sum Centres listed in Table 9.3.2-2 are excluded in the Master Plan shown in Table 9.3.2-1, because they already have a plan to be connected with the optical fibre backbone transmission system on the eastern route in the on-going project.

Table 9.3.2-1 Optical Fibre Transmission Systems in Aimags to be installed in the Master Plan

Aimag/District	Aimag Centre/Sum		Implementation year	FOTS	
				Fiber Length [km]	MUX
5. GOBI-ALTAI	1	Aimag center	2019		1
	2	Taishir	2019	3	1
	Sub Total			3	2
6. DORNOGOVI	1	Aimag center	2004	0	0
	2	Airag	2005	3	2
	4	Dalanjargalan	2009	3	2
	8	Urgun	2006	3	2
	13	Erdene	2007	3	2
	15	Zamiin-Uud	2004	3	1
	Sub Total			15	9
9. ZAVKHAN	1	Aimag center	2016	0	1
	19	Tsagaankharkhan	2016	10	1
	20	Tsagaanchuluut	2019	10	1
	Sub Total			20	3
10. UVURKHANGAI	1	Aimag center	2009	0	0
	9	Ulziit	2009	4	2
	Sub Total			4	2
13. SELENGE	1	Aimag center	2004	0	
	5	Khushaat	2016	10	2
	6	Orkhon	2033	10	2
	13	Dulaankhaan	2016	3	2
	18	Khutul	2004	3	1
	19	Zuunkharaa	2004	1	1
	20	Bayangol (Baruunharaa)	2004	1	2
	21	Tunkhel	2010	1	2
	Sub Total			29	12
14. TUV	1	Aimag center	2004	0	0
	5	Bayan	2005	3	2
	11	Bornuur	2004	3	2
	Sub Total			6	4
15. UVS	1	Aimag center	2008	0	1
	10	Ulgii	2019	3	1
	14	Tarialan	2008	10	1
	Sub Total			13	3
19. DARKHAN-UUL	1	Aimag center	2008	0	0
	3	Khongor	2008	10	2
	4	Orkhon	2009	1	2
	Sub Total			11	4
20. ORKHON	1	Aimag center	2004	0	1
	2	Jargalant	2004	10	1
	Sub Total			10	2
21. GOBISUMBER	1	Aimag center	2004	0	0
	2	Shiveegobi	2004	10	2
	3	Bayntal	2010	10	2
	Sub Total			20	4
22. NALAIKH	1	Nalaikh city	2011	0	1
	2	Terelj	2011	40	1
	3	Shokhoi	2016	10	1
	4	Arzanchivlan	2016	10	1
	5	Nisekh	2017	15	1
	Sub Total			75	5
Total				206	50

Table 9.3.2-2 Sums to be connected to Backbone FOTS in the on-going eastern project

Aimag/District	Sum	
12. SUKHBAATAR	8	Munkhkhaan
18. KHENTII	7	Jargaltkhaan
18. KHENTII	8	Tsenkhermandal
18. KHENTII	9	Murun
23. BAGANUUR	1	Baganuur city

STM-1 SDH optical fibre transmission systems and 8 fibres aerial optical cables are taken up in the Master Plan. STM-1 (Synchronous Transfer Mode - one) SDH (Synchronous Digital Hierarchy) optical fibre system is taken up because it is standard in almost all countries. 34Mbps PDH (Plesiochronous Digital Hierarchy) optical fibre transmission system could be used if it is more suitable and economical in actual projects.

Optical fibre cable which has less than 8 fibres could be used in actual projects, but its cost reduction is not expected much because its installation cost, accounting for a large proportion of its total cost, is hard to reduce by making the number of fibres smaller in a cable.

In Master Plan, it is assumed to be possible to use one pair or two pairs of the backbone optical fibre cable cores for the local networks. How to use the backbone fibre cables for the local networks in the Master Plan follows the model shown in Figure 9.3.2-1

As for the backbone optical fibre cable owned by Mongolian Railway Company, however, it is assumed to be difficult for MTC to rent one or two pairs of optical fibres of the cable cores from the railway company due to their own usage plan of their optical fibre cables. Therefore the alternative configuration as shown in Figure 9.3.2-2 is used in the Master Plan, considering the failures of the branching route do not affect the backbone route.

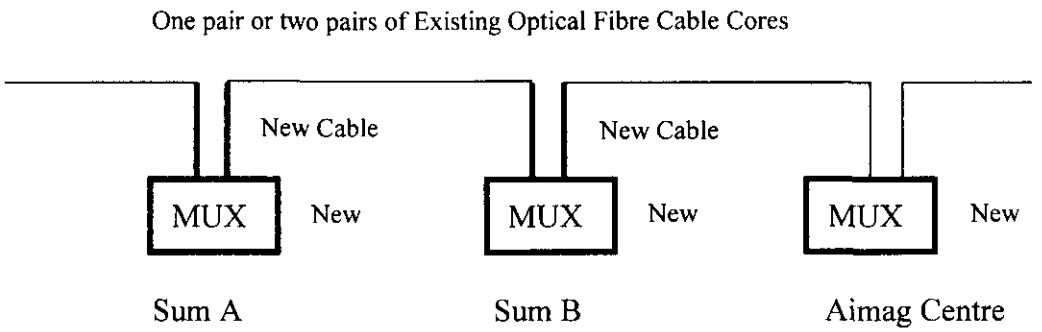


Figure 9.3.2-1 Usage of Backbone Optical Fibre

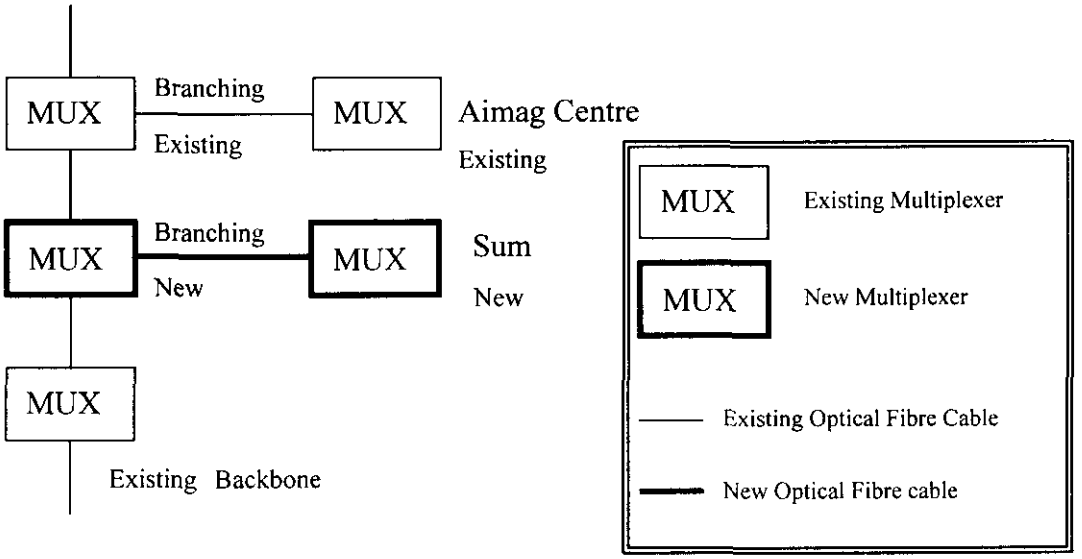


Figure 9.3.2-2 Alternative Usage of Backbone Optical Fibre

FOTS will be installed when other systems such as switch and access network are installed. For example, in Figure 9.3.2-1 above, Suppose FOTS for Sum A is planned in Phase 1 and FOTS for Sum B is planned in Phase 2, according to the installation schedule of Master Plan. In this case, in actual projects, FOTS for Sum B is likely to be installed in Phase 1 simultaneously with FOTS for Sum A.

FOTS requires following measuring equipment and tool.

OTDR (Optical Time Domain Reflect-meter)
Splicer
Optical Power Meter

Optical Attenuator
Laptop Computer Terminal (including Software)

OTDR, Optical Power Meter and Optical Attenuator will not be provided with Aimags in Master Plan, where Optical cable lengths are very short and maintenance staff can use measuring equipment provided or to be provided in backbone FOTS projects. Optical Power Meter and Optical Attenuator, however, will be provided in Selenge/Daklhan-Uul and Dornogovi, though the Aimags have backbone FOTS, because relatively large number of FOTS are planned to be installed there. Laptop computer terminal will be provided with each Aimag Centre in Master Plan dew to a reason to be explained latter. Splicer will be also provided with each Aimga Centre.

Alarms could be monitored in Aimag Centre, but FOTSs in local networks should be connected to the NMS (Network Management System) in Ulaanbaatar in order to monitor FOTS and carry out operation on FOTS. However it is sometime difficult for FOTS to be connected to the NMS, if vender of FOTS is different from vender of NMS, therefore Laptop computer terminal will be provided in Aimag centres to do similar work of the NMS in addition to local maintenance works.

9.3.3 Microwave Transmission Facilities

9.3.3.1 General

The existing Intra-provincial transmission network is mixed analogue and digital transmission network. The length of analogue microwave transmission link is 3027 Km and the length of digital microwave transmission link is 900 Km. The rate of transmission digitalisation in 2000 is 35 percent. The rural telephone trunk lines connects 339 sum centre exchanges with Aimag centre exchanges through open wire carrier transmission system or VSAT satellite transmission system.

Almost of all trunk lines between Sum centres and Aimag centres consists of 28,345 Km long open wire carrier transmission system with the capacity of 1 to 12 channels. 4 sums are now connected with the VSAT satellite communications network and 1 sum is connected by small capacity microwave equipment with Aimag centre.

The present analogue open wire carrier transmission facilities is outdated, fault prone and difficult to maintain, which cause the high operational cost and impossibility of introduction of the Internet and new IP services.

In order to eliminate all difficulties of present transmission system and satisfy demands for basic telephone service and Internet services, it is recommended for the digitalisation of the rural trunk lines between Aimag centres and Sum centres to construct digital microwave transmission facilities or optical fibre cable transmission facilities or the VSAT satellite transmission facilities by means of branching out from the digital backbone lines and by joint use of the existing backbone transmission facilities.

9.3.3.2 Facilities Plan

In order to implement of digitalization of rural transmission network between Sum centers and Aimag center, digital microwave relay link system shall be installed in the rural areas. In case the transmission route length is more than 10 Km long and it is not possible to access to the existing or ongoing Optical Fibre Backbone route, then Point-to-Point digital microwave radio link is selected and installed.

VSAT satellite transmission system is selected for sum centres very far from Aimag centres where many transmission hops are required due to non-visibility of microwave radio link. It is proposed to use 7 GHz frequency band and to use the PDH system with 34 Mbps transmission capacity. The traffic capacity from 1 x E1 (2 Mbps) to 4 x E1 (8 Mbps) bearers that meets the demand up to the year 2020 is selected and dropped at terminal station of the microwave radio transmission link in each sum centre. If a span distance of microwave radio link is longer than 30 Km then it is proposed to install unattended microwave repeater station to cover the longer span.

For the repeater station sites in case of the non-availability of power distribution line from the central grid the " Photovoltaic Division " solar and wind hybrid power supply facility will be installed at the site.

In general only 4 by 4 vehicles are recommended to access to the constructions sites and Mongolia side shall arrange some approach roads construction.

The whole facility plan for system selection of trunk transmission lines between Aimag centre and Sum centre is attached as shown in the Volume IV Part-1 Master Plan Annex 8-2.

9.3.4 VSAT Network Facilities

9.3.4.1 General

The Mongolia Telecom's VSAT satellite network is supporting rural telephony and data services to 18 rural sites and they are located at Aimag centers and Sum centers which had not a connection with Ulaanbaatar through intra-provincial digital microwave transmission network or optical fibre cable network (back-bone network). The existing VSAT domestic satellite transmission network consists of one Type I Hub station with a 16 meter C-band antenna (Naran Earth station) and 13 Type II VSAT station with a 3.7 meter C-band antenna (Tsetseleg, Uliastai, Ulaangon, Muren, Mandalgovi, Bayankhongor, Esonbulag, Jargalant, Ulgii, Daranzadgad, Underkhaan and Baruun-urt Aimag centers) , 2 Type VSAT station with a 3.7 meter C-band antenna (Zamin-Uud and Tosontsengel Sum centers) and 3 Type III VSAT stations with a 3.7 meter C-band antenna (Baruunturuun, Tudevtei and Sumber Sum centres).

In order to meet the rapid growth of Internet and Internet protocol-based international services ,and also, in order to digitalize rural communication trunk lines between Aimag centres and Sum centres, expanded use of the existing VSAT satellite network to the rural areas is very cost-effective measures. VSAT TDMA-DAMA technology architecture meets Mongolia's requirement to improvement of rural trunk lines in case planned microwave transmission link configuration exceeds more than five transmission hops or if it is difficult to get the line of sight in the construction of the microwave transmission route because of the topographical conditions.

Concerning the expansion and rehabilitation project of the rural telecommunication trunk lines, it is proposed to implement the project for satellite rural Internet access solution by VSAT application.

The VSAT expansion project to the rural areas will be economical and quick solution for minimization of digital divide between the urban and the rural because the installation is completed in a short period..

9.3.4.2 Facilities Plan

The existing VSAT TDMA-DAMA architecture best meets Mongolia's requirements for Mesh connectivity, multi-services (including basic telephone, fax, data, internet and

video), demand assignment and pre-assignment, flexibility, expandability, reliability, and cost effectiveness.

In order to introduce the Internet service into Sum remote village level, and also, to make minimization of digital divide between the urban and the rural in a short period, it is proposed to implement the satellite internet rural access solution project that install VSAT satellite transmission terminals at total 66 Inter-sum centres. In this project MCT (Multi-purpose Community Teleservice Centre) using the IP-related technology is also installed to introduce broadband Internet service to remote village peoples.

In order to introduce the Internet service into Sum remote village level, and also, to make minimization of digital divide between the urban and the rural within a short period, it is proposed to implement the satellite internet rural access solution project. In this project MCT (Multi-purpose Community Teleservice Centre) is also installed to introduce broadband Internet service to remote village peoples by using the IP-related technology.

The objectives of the satellite Internet rural access solution project are summarized as follows:

(1) To install VSAT remote stations at total 66 Inter-sum centres

(2) To install MCT (Multi-purpose Community Telcentre) at Inter-sum telecom office. (Note: In the telecom office it is proposed to install the PUMT (Public Usage Multipurpose Terminal) which is a single integrated terminal for multi-purpose use of PC-PC communication, IC-Card Payphone, Internet and Fax)

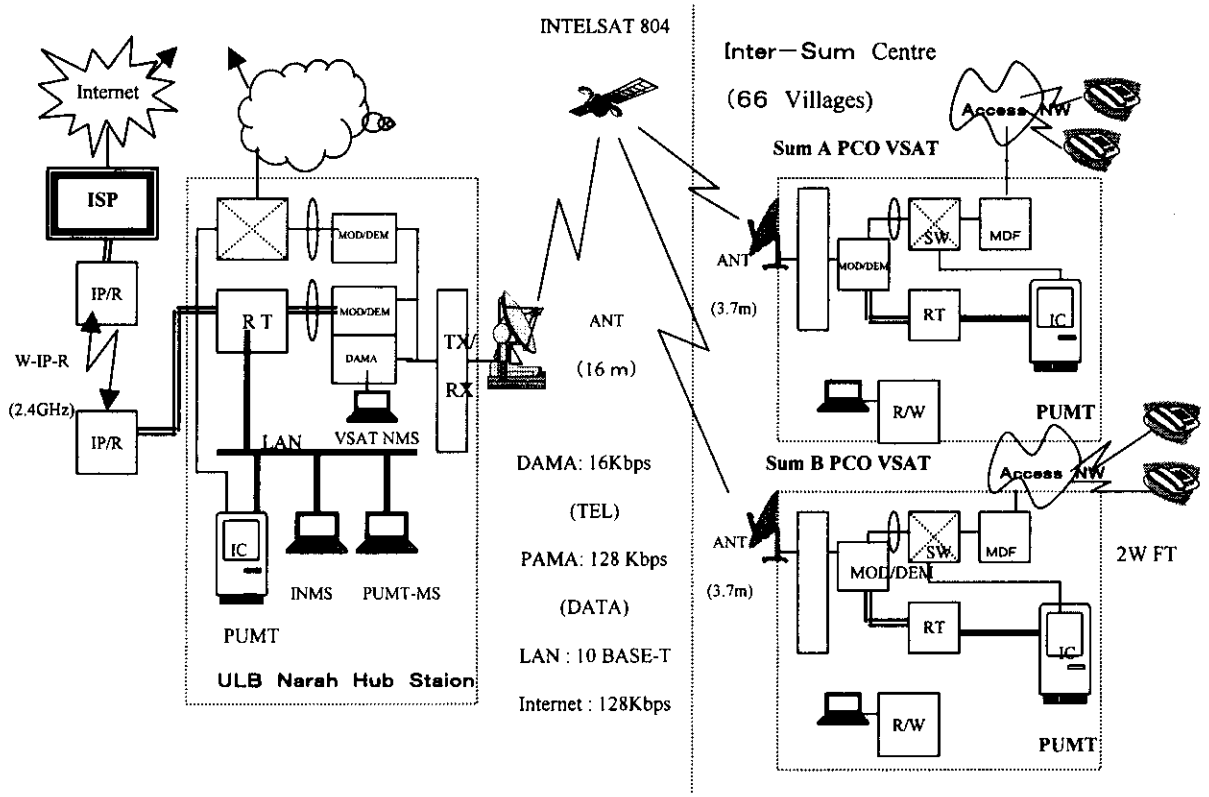
(3) To install MCT (Multi-purpose Community Tele-centre) at Inter-sum telecom office. (Note: PUMT (Public Usage Multipurpose Terminal) which is a single integrated terminal for multi-purpose use of PC-PC communication, IC-Card Payphone, Internet and Fax is installed at telecom office)

(4) To set up the DAMA satellite transmission link for telephone service and to set up the PAMA IP Internet transmission link at the speed of 128 Kbps between Inter-Sum centre and Ulaanbaatar Internet Service Providers using a satellite router and wireless IP router path.

(5) Existing HUB earth station at Naran in Ulaanbaatar is used as a gateway station for the Satellite Internet Rural Access purpose and necessary system expansion at the HUB station is also required to bring total 66 VSAT remote stations into operation

(6) Existing four Type III VSAT earth stations are requested to replace by the Type II VSAT terminal equipment.

The configuration of satellite Internet rural access facilities is shown in Fig.9.3.4.2-1



REMARKS:

IC : PUMT with Touch-less IC Card

PUMT : Public Usage Multi-Purpose Terminal

RT Satellite Router

R/W : IC Card Reader & Writer

SW : Telephone Switch

W-IP-R : Wireless IP Router

Fig.9.3.4.2-1 Satellite Internet Rural Access Solution

9.3.5 Rural HF Radio Telephony Facilities

9.3.5.1 Rural HF Radio-to-Phone Automatic Patch Solution Project

(1) Background and Justification

In order to establish a ZUD disaster relief communication network Japanese Government supported about ten million US dollars for installation of HF or VHF transceiver desk sets to Sum and Bag rural village people.

According to the Japan's Grant Aid and the decree of the Food and Agriculture Minister in Mongolia, the emergency radio communication network throughout Mongolia has been established in all Aimags, Sums and Bags in the framework of Mongolian Governmental Action Plan.

MT Company took speedy coordination measures to install those HF or VHF transceivers with its own resources and commissioned a total of 2050 radio transceiver terminals including 1071 to bag governors, 360 to Aimags' special commissions, 298 to sums' hospitals, 321 to sums' telecom offices.

This rural communication networks functioned efficiently on the occasion of a natural hardships and disasters.

Those radio transceiver equipment are now working very effectively but they are not possible to make dial-up connect with the existing PSTN desired telephone subscribers, it is only limited usage for a voice communications between the owners of the radio transceiver desk sets.

The solutions for automatic dial up connection with the existing PSTN telephone subscribers are urgently requested. The nomadic people with the radio transceivers have pressing needs for automatic radio-to-phone link connection by installing a rural radio patch system.

(2) Objects and implementation

The objects of this project are summarized as follows:

(i) To implement the project as a follow-up actions program of Mongolia Government to establish radio communication network throughout Mongolia including all Aimags, sums and bags

(ii) To facilitate automatic dial-up connection with the PSTN network through 2050 radio transceiver equipment

(iii) To be added a Radio to PSTN Phone Patch Interface Equipment with a function of selective calling and DTMF sending to the existing rural radio communication system.

(iv) It is proposed to connect the radio transceivers with Aimag centre or Sum centre digital local exchange through the Radio to PSTN Interconnection equipment and the calls between the radio transceivers and the PSTN subscribers are handled automatically and telephone operator assistance is not required.

(v) The connection diagram is attached with Figure 9.3.5.1-1.

(3) Implementation Period

The digitalisation of the telephone trunk transmission lines between Aimag centre and Sum centres is required prior to the implementation of the project, therefore, it is proposed to conduct the project simultaneously with the rehabilitation and improvement projects of rural telecommunication systems between Aimag centre and Sum centre..

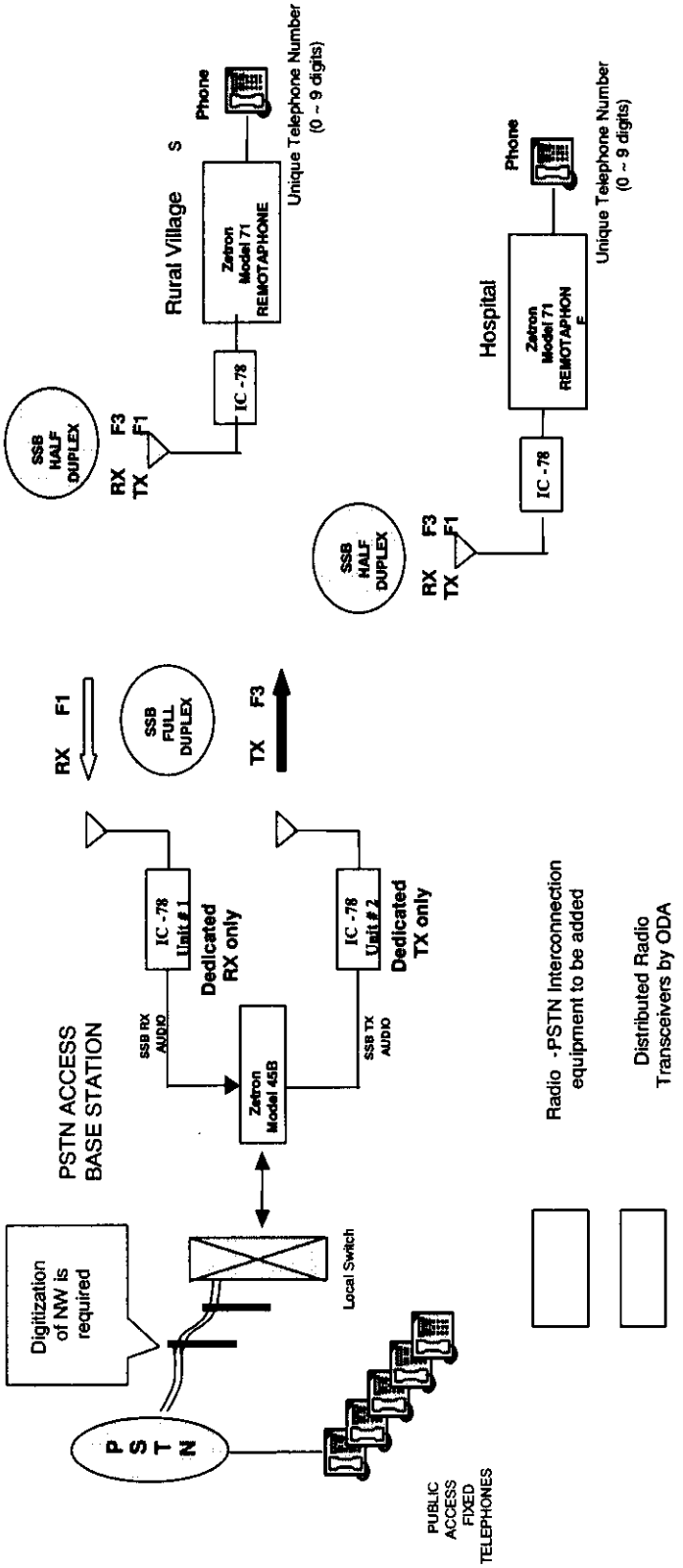


Figure 9.3.5.1-1 Rural Radio-PSTN Interconnection Diagram

9.4 Access Network Facilities

9.4.1 Wired System

(1) Basic Condition on the Facility Plan

a. Area Size and Population Density

The most remarkable feature in rural areas is extremely low population density. About 1.547 million inhabitants exist in a vast rural area of 1.565 thousands square kilometre. Population density is less than 1 person per square kilometre.

b. Distribution of Sum Centre in Aimag Area

Sum centres are scattered in each Aimag area. Average distance between Aimag centre and Sum centre and between Sum centres each other are at a range of 40 to 90 kilometres.

The roads between Aimag centre and Sum centre or between Sum centres each other are mostly earth road and only few part of then are paved roads.

c. Existing Wired Rural Access Network

Scales of existing wired rural access network in Sum centres are shown in Table 9.4.1-1.

Table 9.4.1-1 Scales of Sum Centres

Classification of Sum centre by area size	Proportion of number of Sum centre	Diameter of the Sum centre area	Existing terminated pairs on MDF
	(%)	(km)	(pairs)
Big Sum centre	20	4~6	500
Medium Sum centre	30	2~3	100~200
Small Sum centre	50	1.5~2	<100

d. Movement of Inhabitants in Summer Season

Half of inhabitants in about 30% of Sum centres move to Bags located outer Sum centre area for summering and Inhabitants in 70% of Sum centres are permanent resident.

e. Situation of Existing Cables in Sum Centres

Almost of cables in Sum centre haven't been renewed in past project. Especially the cables are deteriorated remarkably in Govi area. Facilities in a part of big scale Sum centres have only be renewed.

(2) Classification and Application of Wired Access Network

Architecture of the access networks can be constructed for the kinds of node and media of transmission line by wired, wireless and both mixed systems. Classification and application of wired access network shows in Table-9.4.1-2.

Table 9.4.1-2 Classifications and Application of Wired Access Network

System	Transmission Media	Node	Topology	Classification	Telecommunication Service				Design condition
					Voice	Inter-net	Broad band	Moving picture	
Wired	Copper	CCP	SS	Rigid network	O	O			<7dB, <1500Ù
				Flexible network	O	O			<7dB, <1500Ù
				ADSL	O	O			
	OFC			FTTH	O	O	O		
		DLC	ADS		O	O	O	O	
		Splitter	PDS		O	O	O	O	
	OFC+Copper	DLC	ADS	FTTC	O	O			Copper<500m
Wired + Wireless	Copper+WLL	CS			O	O			Copper<3.7km
	OFC+WLL	CS			O	O			

Abbreviation

ADS	:	Active Double Star
ADSL	:	Asymmetric Digital Subscriber Line
CS	:	Cell Station
CCP	:	Cross Connection Point
DLC	:	Digital Loop Carrier
FTTC	:	Fiber to the Curb
FTTH	:	Fiber to the Home
OFC	:	Optical Fiber Cable
PDS	:	Passive Double Star
SS	:	Single Star
WLL	:	Wireless Local Loop

Optimal network system should be selected optimal network type by area size of each Sum centre, the district configuration, dispersion of the demand and the situation of power

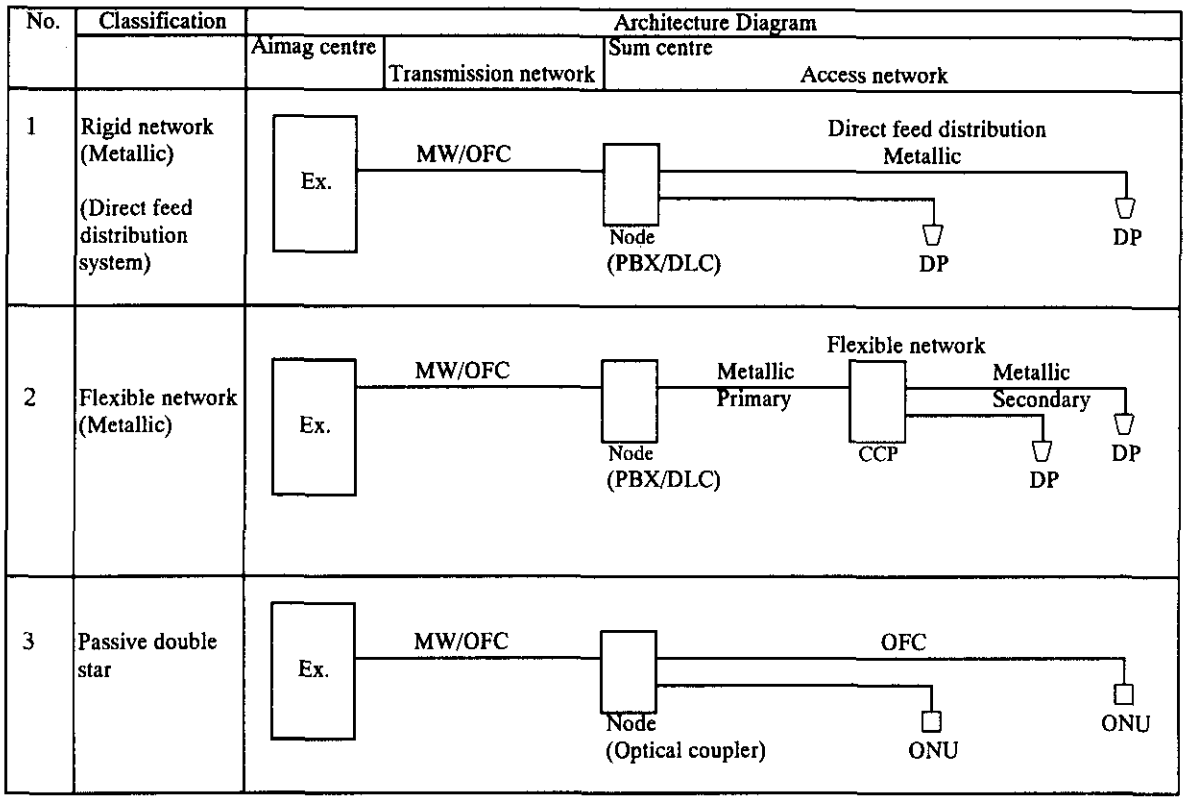
supply etc. in the objective Sum centre.

a. Selection of Transmission Media

- OFC system is advantageous for the big town that has large demand high demand density because of high capacity.
- Copper/OFC with WLL system is advantageous for wide service area.
- Therefore, copper access network is appropriate for wired access network in Sum centres.

b. Copper Access Network

Figure 9.4.1-1 shows typical pattern of copper wired access network configuration.



Ex. : Telephone exchange
PBX : Private Branch Exchange
DLC : Digital Loop Carrier
CCP : Cross Connection Point (Cabinet)
DP : Distribution Point
MW : Micro Wave
OFC : Optical Fibre Cable
ONU : Optical Network Unit

Figure 9.4.1-1 Typical Wired Access Network Configuration

Since the service area of Sum centres are very small size and low demand density area, the justice of the above networks for wired access network of Sum centre is as follws:

- Passive double star system is very expensive for small and low demand density area.

- Flexible network can not use the economical merit by shifting the investment timing

- Therefore, rigid network (Direct feed distribution system with metal cable) becomes the best solution for the wired access network in most Sum centres

Fig. 9.4.1-2 illustrates the typical structure of Rigid Access Network.

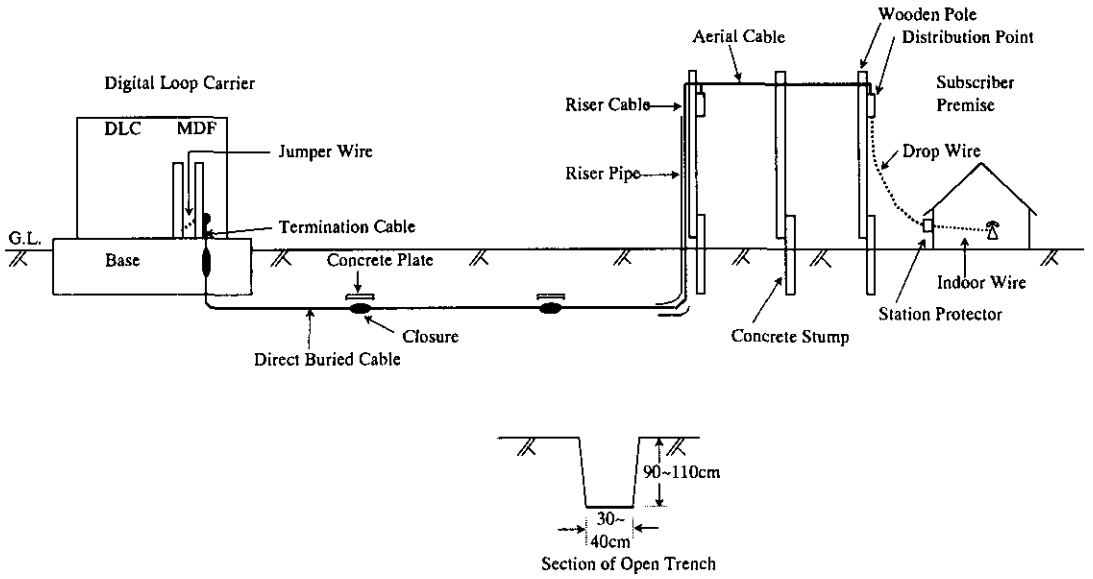


Figure 9.4.1-2 Typical Structure of Rigid Access Network

The other side, flexible network using cross connection point (CCP) is adopted for access network of large sized Sum centres as shown in Figure 9.4.1-3.

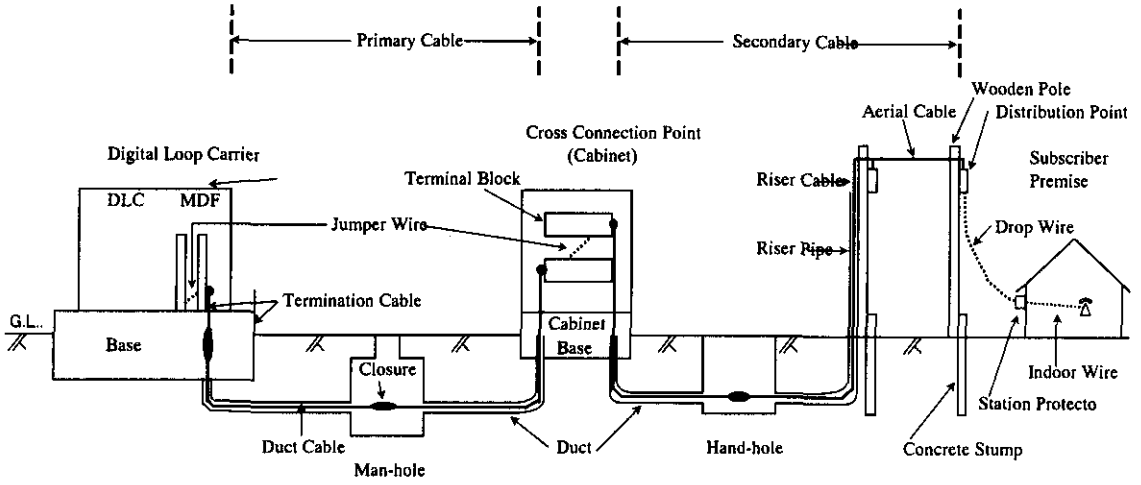


Figure 9.4.1-3 Typical Structure of Flexible Access Network

(3) Application of Copper Rigid Network and WLL

Generally the areas where demand density is high, especially diameter of service area is within several kilometre long, apply rigid wired network. And low demand density areas apply wireless system (WLL).

a. Limit of Copper Rigid Network

Demand density in each Sum centre can be considered as about 27 per square kilometre in spite of Sum centre size.

The attenuation loss of metallic cables and demand distribution in Sum centres cause the limit on this application of copper rigid network. Table 9.4.1-3 shows the distance and demand limit of wired system.

Table 9.4.1-3 Application Condition of Wired Network System

Conductor diameter	Attenuation	Line length in 7dB	Maximum area radius	Covering area size	Upper limit of demand
mm	dB/km	km	km	km^2	$D./km^2=27$
0.4	2.20	3.2	2.3	15.9	429
0.5	1.75	4.0	2.8	25.1	678
0.65	1.33	5.3	3.7	43.5	1,175

The unit cost of the wired system with 0.4 or 0.5 mm diameter cable is more economic than the unit cost of the wireless system in the objective Sum centres in the master plan.

Based on the above condition, the system should be selected according to the following criteria;

- Demand (2020) < 801 ----- Adoption of wired system
- Demand (2020) > 800 ----- Adoption of wireless system

According to the above criteria, copper rigid network will apply for 332 Sum centres and WLL network will apply for 7 Sum centres.

(4) Design Policy of Facility Plan for Wired System

a. Scope of work in Wired Access Network Plan

Scope of work in wired access network plan is from MDF to distribution point.

b. Climate

It becomes very severe condition especially in the winter season.

- Temperature range in year: -40 ~ +40°C,
- Maximum wind velocity: 40m/sec.

c. Provision Period

15 years.

d. Distribution System

Direct feed distribution system without cross connection point should be applied.

However, adoption of flexible distribution system with cross connection point will be examined in big scale and low growth demand Sum centres in feasibility study stage.

e. Capacity of the Cables

Circuits' accommodation rate of cable should be 90% and the remained 10% should be secured for maintenance pairs.

f. Conductor Diameter

Cable conductor diameter should be 0.4mm or 0.5mm. However, the furthest point from exchange in most of Sum centres will not be so long and 0.4mm diameter is sufficient even if x-DSL technology is introduced in future.

g. Cable System

Aerial cable system should be adopted basically.

h. Kind of Cables

CCP-SS cable (Colour Coded Polyethylene – Self Supporting cable) should be used for aerial cable of access network.

i. Lead in Cables

Lead in cables to the exchange buildings in big Sum centres should be installed by underground duct/trench through manhole/pulling box in front of exchange buildings.

j. Existing Open Wire

Existing local loop open wire shall be used for distant place from Sum centre for the time being.

k. Existing Facilities

Existing cable shall be renewed all.

Existing wooden pole will reuse utmost. If strength of supporting structures were insufficient, work of re-erection of the pole, installation of additional guy/stay

have to be planned. The survey result is attached in Annex 9.

(5) Work Volume of Wired Access Network

The work volume of access network in master plan stage is shown in Table 9.4.1-4.

Table 9.4.1-4 Work Volume of Wired Access Network

Region		Aimag/District		Termination Pairs on MDF (Pairs)				
				Phase 1-1	Phase 1-2	Phase 2	Phase 3	Total
1	Western Region	1	BAYAN-ULGII	0	998	994	182	2,174
		2	GOBI-ALTAI	1,127	1,186	1,501	190	4,004
		3	KHOVD	869	1,081	643	173	2,766
		4	UVS	227	700	158	384	1,469
		5	ZAVKHAN	2,232	1,008	658	343	4,241
2	Khangai Region	6	ARKHANGAI	3,294	1,176	550	0	5,020
		7	BAYANKHONGOR	1,977	1,728	1,442	0	5,147
		8	BULGAN	3,930	2,227	111	0	6,268
		9	ORKHON	0	0	0	0	0
		10	UVURKHANGAI	2,213	1,001	330	143	3,687
		11	KHUVSGUL	3,715	1,449	1,607	40	6,811
3	Central Region	12	DARKHAN-UUL	0	570	297	0	867
		13	DORNOGOVI	1,151	618	616	171	2,556
		14	DUNDGOBI	820	451	453	230	1,954
		15	GOBISUMBER	454	0	41	0	495
		16	SELENGE	2,695	1,179	354	407	4,635
		17	TUV	4,764	1,189	474	301	6,728
		18	UMNUGOBI	273	616	676	81	1,646
4	Eastern Region	19	DORNOD	259	229	335	318	1,141
		20	KHENTII	1,288	1,313	694	100	3,395
		21	SUKHBAATAR	2,174	423	306	116	3,019
5	Others	22	NALAIKH	0	0	482	200	682
		23	BAGANUUR	0	0	0	0	0
Total				33,462	19,142	12,722	3,379	68,705

9.4.2 Wireless Local Loop Facilities

9.4.2.1 General

The present subscriber access network in sums centres is mainly supported by small size metallic cables. In sum centres the local loop is composed of aerial cable by installing wooden poles and there is not underground cable. Rigid distribution system is adopted in a greater part of sum centres.

The existing cables of local loop in sums centre are very old-fashioned type, which was installed in the date of year 1980. Almost of the cables and the outside plant currently used in sums centres is deteriorated considerably. For distant bag place from sum centre, 4 mm diameter iron open wire has been used.

The wireless local loop (WLL) is the provision of fixed telecommunication services using terrestrial wireless technologies to connect subscribers to local exchanges. The WLL solution is used in the following cases:

(1) Supplementary Access Systems to Cable System

The radio subscriber systems are utilized as a supplementary access system to cable system in areas, where demand cannot be satisfied by cable systems in time/from economical viewpoint.

(2) Main Access System in Rural/Remote Area

The radio subscriber system is utilized as a main access system in areas, where the cable construction is difficult from the topological situation and economical viewpoints.

In this master plan study it is proposed to make renovation of the present subscriber access network using copper cable outside facilities or wireless local loop facilities. The PMP/TDMA-WLL system shall be introduced as a supplementary access system to cable system and it will be established to make overlay on the existing wired subscriber lines.

All of subscriber access network of sums centres are renewed to meet the traffic demand in the year of 2020.

9.4.2.2 Facilities Plan

In order to implement of renovation of the subscriber access system the wireless local loop facilities are selected as a supplementary access system in major sum centre area where the traffic demand of sum centre at the year of 2020 will be more than 800 direct telephone lines.

According to the master plan as attached in the Annex 8 it is proposed to install the PMP/PHS-WLL facilities at the following 7 sum centres by the year 2008:

(1) Orkhon:Jargalant
(2) Uvurkhangai:Kharkhorin
(3) Darkhan-Uul:Sharin-Gol
(4) Dornogovi:Zamin-Uud
(5) Selenge: Khutul
(6) Selenge:Zuunkharaa
(7) Khentii:Beg-Unduur

The proposed WLL system configuration is attached as Figure 9.4.2.2-1.

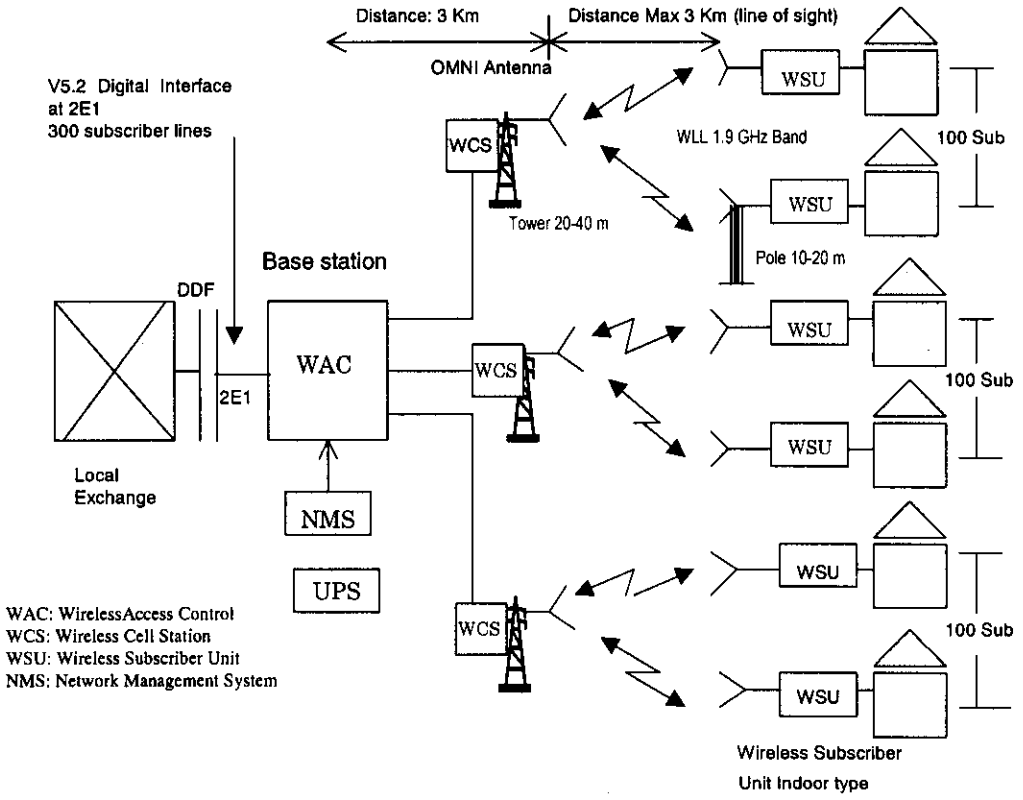


Figure 9.4.2.2-1 WLL System Configuration

9.5 Mobile Telephone System

9.5.1 Recommendation

In March, 1996 the first cellular telephone service company, MobiCom Corporation, started the operation in Ulaanbaatar City including the Buyan-Uhaa airport district. Global System for Mobile Communications (GSM900), the European standard for digital cellular systems, was adopted in the MobiCom service network.

The second cellular telephone service operator, Skytel Company, began its service since July, 1999. Skytel company started its service by Advanced Mobile Phone System (AMPS), analogue cellular system used in North America and Skytel now introduced a Code Division Multiple Access (CDMA) mobile network in Ulaanbaatar City to provide a broadband mobile service.

Having introduced prepaid card phone service with support of SIM card and roaming supported (SIM application: Subscriber identity Module, a smart card that carries data about subscriber. It is inserted into the phone before making a call), the number of mobile subscribers is now increasing tremendously.

A number of cellular telephone customers are more than a number of fixed telephone service customers of MT network. At the end of 2001 the number of subscriber is 134,724 and by the end of 2020, the total number of mobile subscribers in Mongolia will be 600,000.

Both networks are now operated in Ulaanbaatar, Darkhan, Erdenet, Selenge, Sainshand, Arvaikheer, Baganuur, Nalaikh, Zuunmod and Zamiin-Uud.

The number of mobile subscribers will continue to increase throughout the nation and it is required to expand the coverage of cellular telephone service to nation widely, operation in not only aimag centres but also sum centres in rural areas.

9.5.2 Facilities Plan

According to the demand forecasting of mobile telephone service in the master plan study, by the end of 2008 the number of mobile telephone subscribers will be 320,000, increase twice its amount compared the present number of mobile telephone subscriber.

It is forecasted that about 15 percent out of its total number of mobile telephone subscriber will be in Sum centres subscribers.

90 percent of its mobile telephone subscriber has been registered now in Ulaanbaatar, however, its service coverage shall be expanded from urban areas to rural areas according to the rural network development and rehabilitation plan, upon the completion of digitalisation of the fixed telephone trunk lines between Aimag centre and Sum centres.

In order to support the nation wide expansion of the mobile telephone service it is necessary to equip the digital transmission and digital switching system in not only urban area but also in rural areas. The rural transmission and switching system between Aimag centres and Sum centres shall be improved and rehabilitated immediately to expand the mobile communications services to the rural areas.

Mobile communications is approaching the stage where it can offer a viable alternative to the wired PSTN. In the coming years, mobile communications will continue to grow substantially and it will become replacement of fixed wired line. In order to cover the rapid demand increase of multimedia service it is recommended to move to 3G Mobile system in near future. 3G Mobile system is expected: (1) Global Services (Terminal mobility, User mobility, Service portability) (2) High Service Quality (same as fixed wired line) (3) Service delivery for all the mobile environment (In door/Out door, Metropolitan/Rural, Pedestrian/Mobile, etc) (4) Mobile Multi Media Service (High speed data transmission (ex. 2 Mbps), IP Packet, Flexible QoS (5) Telecommunication infrastructure for all the region.

9.6 IT Services

9.6.1 Internet and IP Network

(1) Networking of Internet in Sum area

At initial stage, i.e., Phase-1 and 2, there will not exist yet IP network or node (router) of ISP in Sum area basically. Internet user has to access to the Internet by dial-up connection and through PSTN as shown in the upper part of Figure 9.6.1-1.

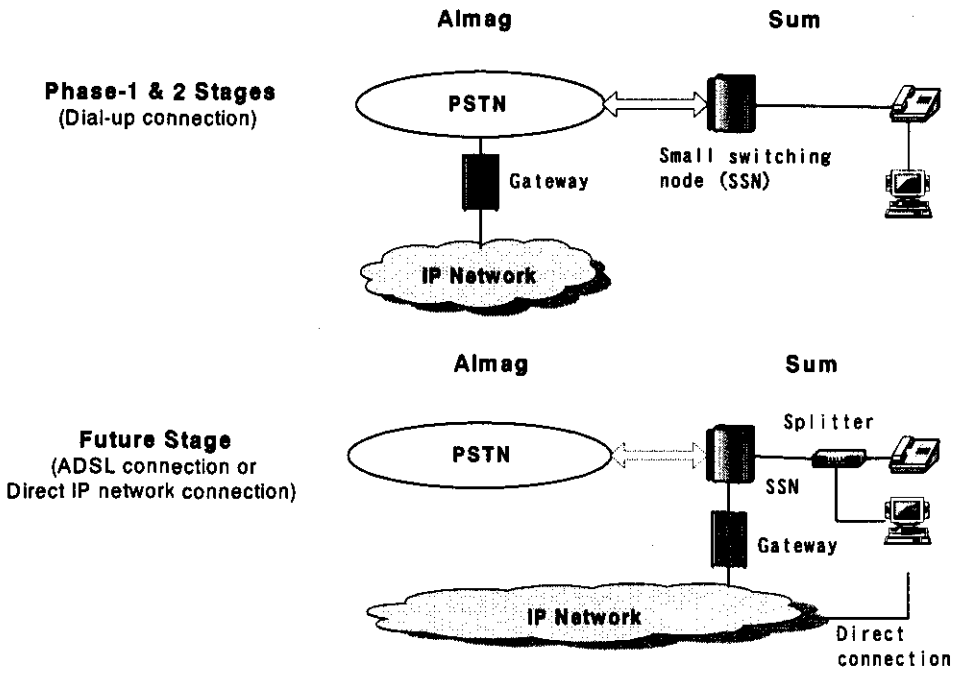


Figure 9.6.1-1 IP Networking in Sum Area

If IP network is introduced in future stage, user can access the network through telephone line but using ADSL (asymmetric digital subscriber line) modem and splitter, or direct line dedicatedly prepared. In this case PSTN will not be used.

(2) Access network topology

Access network topology between local telephone office and user's house is considered following three typical compositions:

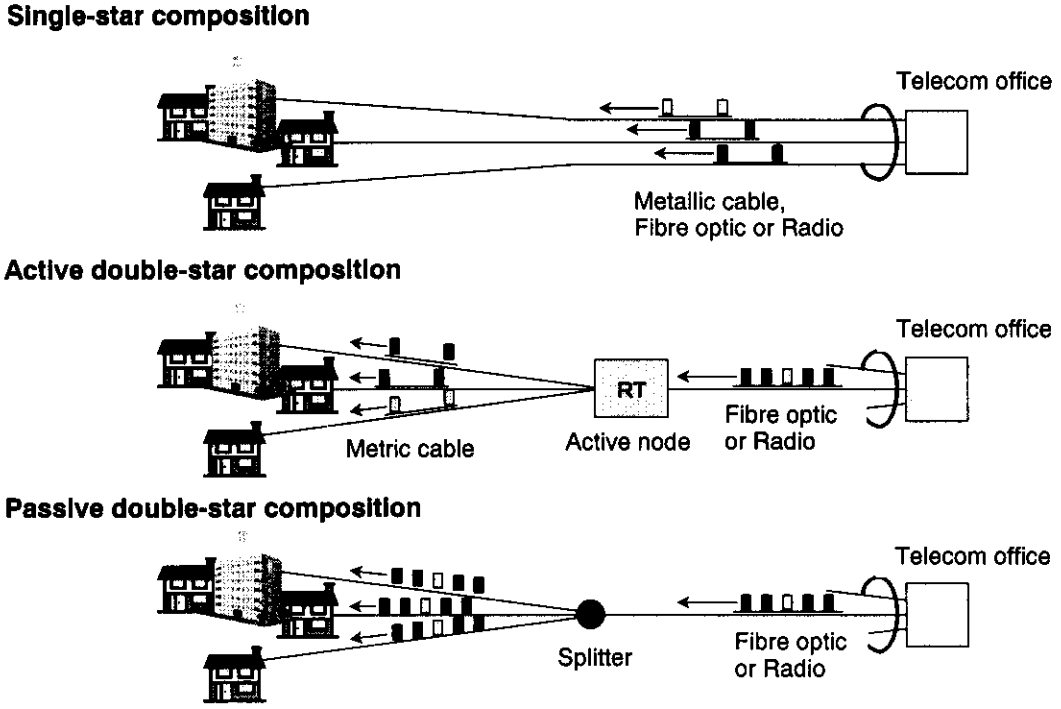


Figure 9.6.1-2 Topology of Access Network

At Phase-1 and 2 stages, there are only metric cables (or subscriber radio system) and are limited users. Then single-star composition will be taken. Active or passive double-star composition is that for the era of advanced cable network in future Sum.

(3) IT development in Sum area and provision of IT-spot

IT development in rural or distant area is under discussion in the government of Mongolia as well as the world telecommunications or international financial organizations such as ITU, APT, WB, ADB and JBIC.

One of the discussion items is the introduction of telecommunication centre, so called Tele-centre, Multipurpose Community Tele-centre (MCT), etc., to the rural area for the peoples who cannot hold their own communication facilities.

As the telecommunication centre so many concepts, shown in Table 9.6.1-1 for example, are arising on the discussion floors.

Table 9.6.1-1 Concepts of Tele-centre Imaged by Organizations Concerned

Calling of Tele-centre	Initiator & Operator	Size	Desirable Tariff	Tel/Fax	Internet	e-Education	e-Medicine
Basic Tele-centre	Government NGO	Small	Free or Very limited	○	◎	◎	X
Tele-centre Franchise	Private	Small	Profitable	◎	◎	◎	X
Civic Tele-centre	Government or Public affaire	Small	Free or Very limited	○	◎	◎	X
Cyber-café	Private	Middle or Big	Profitable	○	◎	X	X
Multipurpose Community Telecentre (MCT)	ITU Government	Small	Free or Very limited	○	○	◎	○
Phone Shop	Private	Small	Profitable	◎	X	X	X
Communication Technology Centre	Government NGO	Small	Free or Very limited	○	○	◎	X
The Community Communication Shop	Private	Middle or Big	Profitable	○	○	X	X
IT-spot (Recommended by this Report)	Government or Public affaire	Small or Middle	Free or Very limited	◎	◎	X	X

Remarks ◎: Basic or substantial needs ○: Needs as General

Those concepts are sometimes created by the rural image of;

- there are no (or poor) housing facilities for telecommunication, education, and medicine,
- there are no persons who educated or having computer literacy,
- therefore one integrated centre where furnishes telecommunication/IT apparatus, IT-based educational facilities and clinical functions, etc., should be established in local government or public premises.

However in Mongolia, there are 10-years (or 8-years) school and small size (number of beds: 10-20) hospital at least in all Sum centres as explained in Chapter 2 in detail. If such integrated tele-centre is prepared, and teacher(s) and doctor(s) have to go to centre frequently, their capabilities in the school/hospital will be dispersed. Students and patients also have to go to centre in addition to the usual places.

Meanwhile MT office in sum centre provides public telephone service using telephone booths (2-4 booths per office) and facsimile message transfer service.

From the above ready-prepared situations in this country, integrated centre is not needed even in Sum area. Just upgrading telephone booth function with automatic dialling system and furnishing access means to Internet, are required.

Schools and hospitals are requiring only the telephone lines that are reliable and possible to access to Internet.

Figure 9.6.1-3 shows an idea of rural area network in Mongolia in Phase-1 and 2 stages of the development. Of course the number of apparatus (telephone set, facsimile machine, video phone, PC, etc.) and connecting lines are depend on the office, school or hospital size. And in this report, the up-graded telephone booth is to be called as "IT-spot".

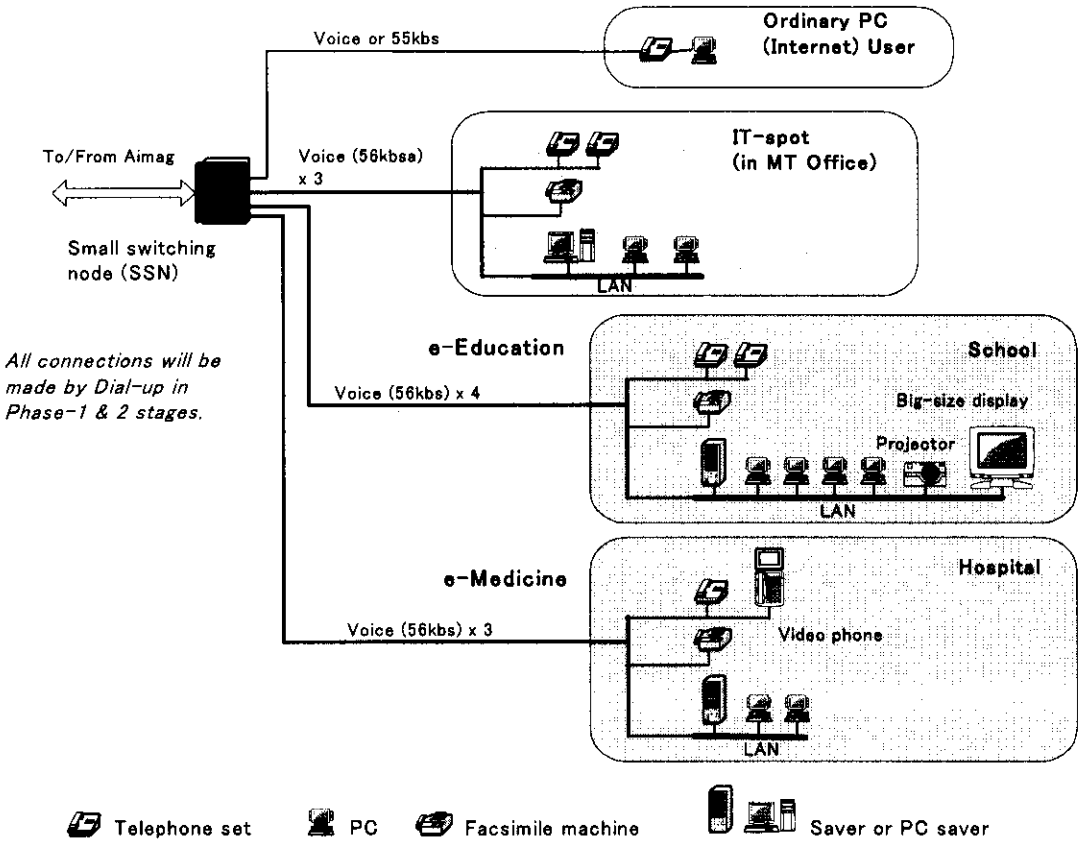


Figure 9.6.1-3 An Idea of IT Network Configuration in Sum Centre

IT-spot should have a feature so low income or no PC holding persons can visit frankly. Thus tariffs in IT-spot are strongly recommended to apply especially low rate one or free of charge.

The image of IT-spot is the "MT version's Internet café + Business centre". Table 9.6.1-2 shows recommended kinds and number of apparatus to be furnished in IT-spot at the initial implementation. And this IT-spot is recommended to be established at the time of installation of switch system of the concerned telephone office.

Table 9.6.1-2 Kinds and Number of Apparatus at IT-spot in Sum Area

	More than 10000 pop.	Less than 10000 pop.
Server PC with UPS	1	1
PC with UPS	6	3
Modem & LAN with cables	1	1
Printer (Middle size)	1	1
Printer (Small size & as a spare)	1	1
Facsimile machine	1	1
Telephone set	4	2
Software (Windows & games)	1	1

9.6.2 Leased Circuit

Leased packet network or packet exchange network using ITU-T X25 protocol which already installed in the world, is gradually shifted to IP (Internet protocol) network. The IP network makes data transmission easier, more flexible and cheaper by using of computer-based router and Internet technologies such as LAN (local area network)/Ethernet, WAN (wide area network) and VPN (virtual private network).

Neither packet network nor leased line exists in Sum at present. Therefore if leased line is required at Sum area, it will be established by IP network.

There are so many styles of leased line depend on the possessed networks of circuit providers or so called telecom common carriers. These styles are as shown in Figure 9.6.2-1.

- Case 1: To lease the line on the basis of circuit bearer or data speed (64 kbps, 2 Mbps, 34 Mbps, 155 Mbps ..). The contracted speed is guaranteed, and the data are passing in closed network.
- Case 2: To lease the physical line, for example, fibre optic core(s). User of this lease will be circuit re-seller, ISP, mobile phone operator or huge governmental organization.
- Case 3: To use Internet. The user receives the services through ISP. This is the cheapest connection for user, but data are transferred on a best-effort mode and not secured.
- Case 4: To use VPN (virtual private network) in IP network. Connection nodes on the virtual circuit (end to end) can be selected, and not so opened as Internet. Priority of transfer speed among data/packets of VoIP (voice), host communication, intranet can be given.

In sum level, if corporate customer, ISP or mobile operator wants to receive the lease service now, the bearer-based lease (Case 1) will be selected, however if requires in future, VPN (Case 4) will be chosen at first.

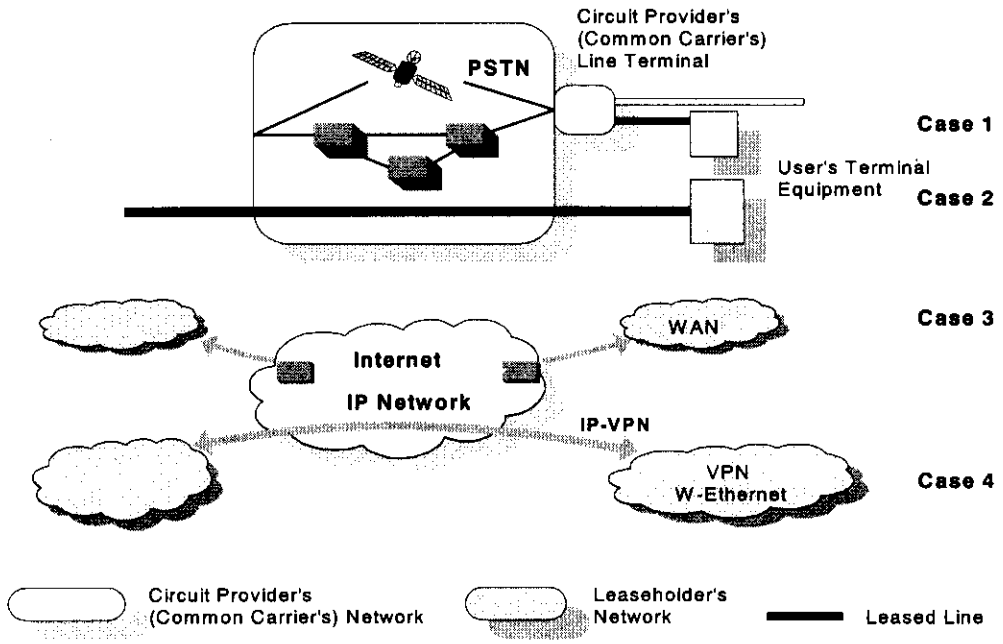


Figure 9.6.2-1 Typical Styles of Leased Line

9.7 Power Facilities

9.7.1 Introduction

This section is intended to describe a power supply facility plan by applying conventional thermal or diesel power generating systems as well as by utilizing renewable energy, such as solar energy. The power supply facility plan for the Interim Report is developed on the basis of the power supply facility plan described in Chapter 7 Power Supply Facility in the Progress Report of July 2002.

9.7.2 Power Consumption of Telecommunication Equipment

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

Power supply facility plan is basically made according to the power demand by the telecommunication system. In determining capacity of the power supply facilities, it shall be taken into account the fact that all of the power consuming equipment of the telecommunication system is not operated at a rated capacity. Time, duration, and level of power consumption of various loads of the telecommunication system differ from each other. Capacity of the power supply facilities, therefore, is determined on the basis of the power demand when a maximum demand occurs. Power demand or load patterns usually vary largely according to the traffic of the telecommunication system for each of the study sites.

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

In the case of switching facilities, for instance, power consumption was calculated in the following manner:

i) Load current, I_L:

I_L (A) = 0.0122 x Ns + 7.6074 (empirical equation)

Where, I_L : Load current (A)

Ns: Switch capacity (No. of subscribers)

ii) Power demand, P:

$P\ (kW) = I_L \times V_N \times 1/1,000$

Where, V_N : Nominal voltage (V), 48V (example)

iii) Electricity demand by the loads, E_L:

$E_L\ (kWh/day) = P\ (kW) \times 24\ (h/day)$

Note: Digital switches basically consume nearly constant power, irrespective of number of calls a day.

9.7.3 Power Supply for Telecommunication Systems

(1) General

Under the Master Plan Study, application of photovoltaic (PV) systems is planned as a key power supply source for telecommunication systems that are installed in the areas with a favourable level of insolation. The favourable level of insolation under the Master Plan Study is defined as annual average horizontal solar irradiation of 4.4kWh/m^2/day or more. Even the areas with annual average horizontal solar irradiation less than 4.4kWh/m^2/day are thought to have advantages of introducing PV systems from a mid-term and long-term renewable energy development viewpoint.

(2) Typical Power Supply System for Telecommunication Systems

It is intended for short-, mid-, and long-term power supply plans under the Master Plan Study that interconnected and independent hybrid PV system as indicated in Figure 9.7.3-1 will be used because this system is capable of fully utilizing electricity generated by the PV system and at the same time effectively utilizing the existing power system.

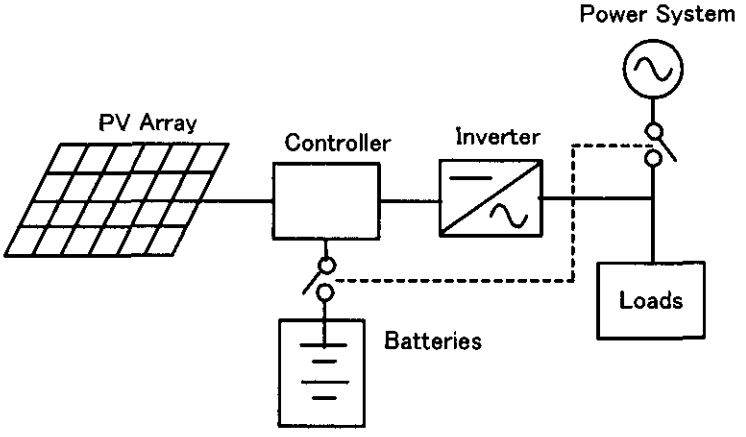


Figure 9.7.3-1 Typical Hybrid PV System Configuration

(3) Short-term Power Supply Plan

Power supply situations at the Aimag centres or Sums that are connected with grids (Central Energy System, Western Energy System, and Eastern Energy System) are comparatively reliable and stable. Under the Master Plan Study, therefore, telecommunication network that will receive power from those Aimag centres or Sums will not be provided with a new power supply source.

Similarly, telecommunication network that will receive power from Aimag DG stations will not be provided with a new power supply source. In other words, no investment plan is formulated for power supply for such telecommunication network.

Telecommunication network to be installed at the Sums that are or will be provided with DG stations will be provided with a new power supply source, that is, PV systems as described in preceding clause (2). In this scheme, PV systems will play a role of a main power supply source, while DG stations act as a sub power supply source. Short-period supply will be made by means of batteries, and long-period supply by DG stations.

Power supply plan for a short-term up to 2008 is comparatively easy to be prepared as the Master Plan Study will be completed in 2003 and the remaining period is relatively short five years. Therefore, basic power supply plan under this timeframe for rural telecommunication systems for each of the current power supply systems is proposed as indicated in Table 9.7.3-1.

Table 9.7.3-1 Short-term Power Supply Plan for Telecom Systems

No.	Category	Main / Sub Power Supply	Stand-by Power Supply	
			Short-period supply	Long-period supply
1	Aimag centres connected with CES or WES or EES	C, W, E	Batteries	Telecom DG
2	Sums connected with CES or WES or EES	C, W, E	Batteries	-
3	Aimag centres with diesel generating stations	Aimag DG	Batteries	Telecom DG
4	Sums with diesel generating stations	PV / Sum DG	Batteries	Sum DG
5	Sums to be provided with diesel generating stations	PV / Sum DG	Batteries	Sum DG

Note: DG - diesel generating station or diesel generator
C - Central Energy System (CES)
W - Western Energy System (WES)
E - Eastern Energy System (EES)

(4) Mid-term and Long-term Power Supply Plans

A mid-term plan up to 2013 and a long-term plan up to 2020 cover the time span over 10 years from now. Although it is quite difficult to make a specific forecast for the time span, technological developments and utilization of renewable energy in power supply will be made at an accelerating rate.

For these reasons, PV systems are expected to play a significant role in power supply, while effective use of the existing power supply systems is needed to avoid disbursement of excessive investment costs. Basic power supply plans under this timeframe for rural telecommunication systems for each of the current power supply systems are proposed as indicated in Table 9.7.3-2, which is similar to Table 9.7.3-1.

Table 9.7.3-2 Mid-term and Long-term Power Supply Plans

No.	Category	Main / Sub Power Supply	Stand-by Power Supply	
			Short-period supply	Long-period supply
1	Aimag centres connected with CES or WES or EES	C, W, E	Batteries	Telecom DG
2	Sums connected with CES or WES or EES	C, W, E	Batteries	-
3	Aimag centres with diesel generating stations	Aimag DG	Batteries	Telecom DG
4	Sums with diesel generating stations	PV / Sum DG	Batteries	Sum DG
5	Sums to be provided with diesel generating stations	PV / Sum DG	Batteries	Sum DG

It is assumed under the Master Plan Study that reliability and stability of the grids (CES, WES, and EES) will be maintained or improved in accordance with a national power development program; therefore, no investment cost for such a program is estimated for the Master Plan Study.

In addition, it is anticipated over the time span that PV systems will become connected with the grids without technological hindrance to the operation of the respective grids. Still in this case, cost and benefit analysis shall be made for introduction of the PV systems as an alternative power supply source.

(5) Typical Image of Power Supply Plans

Figure 9.7.3-2 illustrates a typical image of a short-term power supply plan and mid-term and long-term power supply plans, as compared with current power supply situations surrounding rural telecommunication systems.

Specific application of power supply systems for each of the study sites is summarized in Annex 10.1 (Table A10.1).

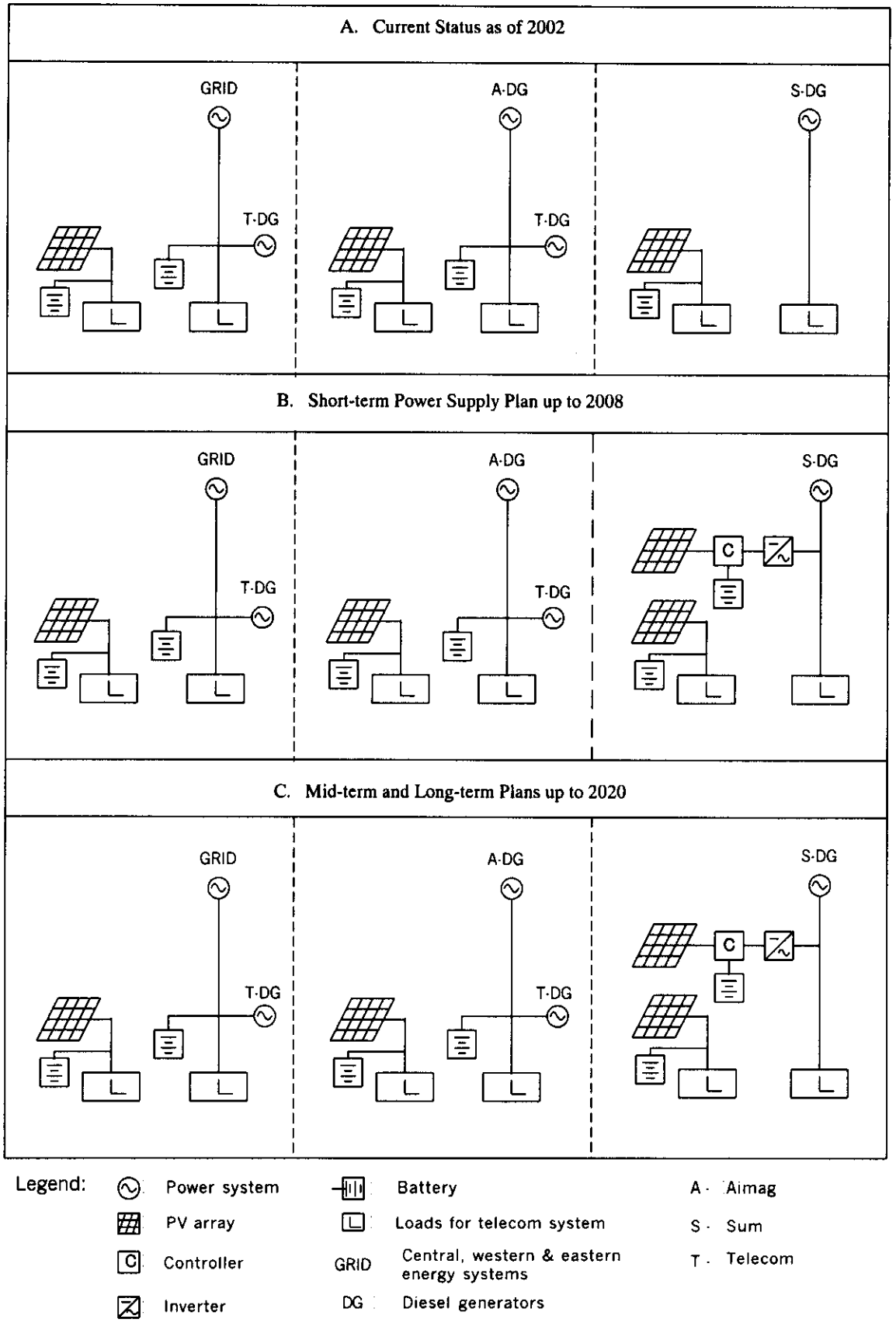


Figure 9.7.3-2 Typical Image of Power Supply Plans up to 2020

9.7.4 Sizing of PV Systems

Table 9.7.4-1 provides major design parameters that are applied for sizing of PV panels and batteries.

Table 9.7.4-1 Major Design Parameters for Sizing of PV Systems

No.	Design Parameters	Abbreviation	Figures or formula
1	Solar irradiation at the month when monthly solar irradiation on slope is minimum	H_A	4.4kWh/m^2/day
2	Overall design coefficiency	K	0.62
3	PV array capacity	P_{AC}	P_{AC} (kW) = E_L / (H_A x K)
4	Battery capacity,	B_C	B_C (kWh) = 1.45 x N_D x E_L / K_C
5	No-sunshine duration	N_D	2 days

Note: See Chapter 7 Power Supply Facility in the Progress Report of July 2002, for details of parameters and calculation methods.

As a result of calculations for sizing of PV systems by using above-mentioned parameters, PV array capacity and generated energy are obtained for power consuming facilities (switching and transmission) under the Master Plan Study, as provided in Table 9.7.4-2.

Table 9.7.4-2 PV Array Capacity and Generated Energy

No.	Description	PV array capacity (kW)	Generated energy (kWh/day)
1	Switching facilities	1,338	3,653
2	Transmission facilities	2,839	7,742
	Total	4,177	11,395

9.7.5 Scope of Power Supply Facilities Plan

Figure 9.7.5-1 shows a typical block diagram for power receiving equipment when power is supplied through near-by power distribution lines from a grid or a diesel generating station to the telecom office at the Aimag centre or the Sum.

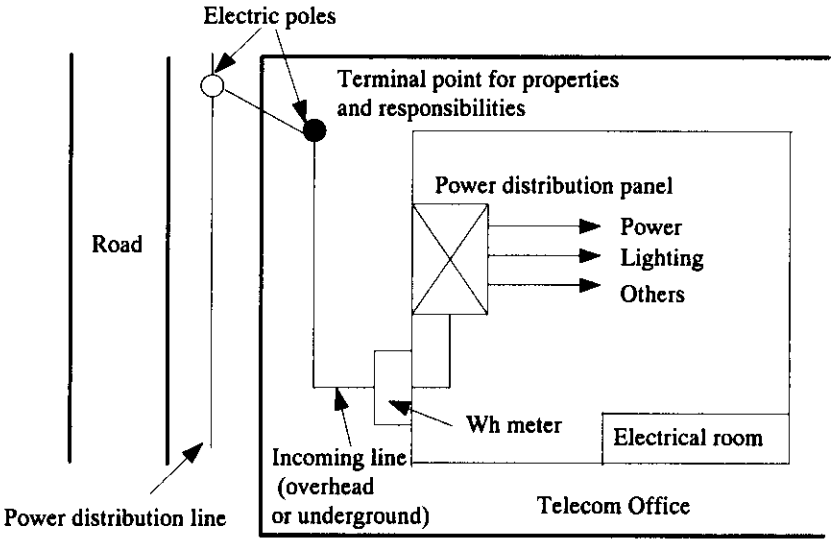


Figure 9.7.5-1 Typical Power Receiving Plan

Power supply for the telecommunication systems usually depends on power grids or commercial power supply sources. Power supply from the grid is usually stable; however, scheduled or unscheduled power outages cannot be avoided. Failure of the power supply system could occur at any time for various reasons. In preparation for such power outages, alternative power supply system is normally provided to secure reliability and stability of power supply.

It is generally planned that batteries are used to meet requirements for short-duration power supply, while diesel generators are used for long-duration power supply, as typically illustrated in Figure 9.7.5-2.

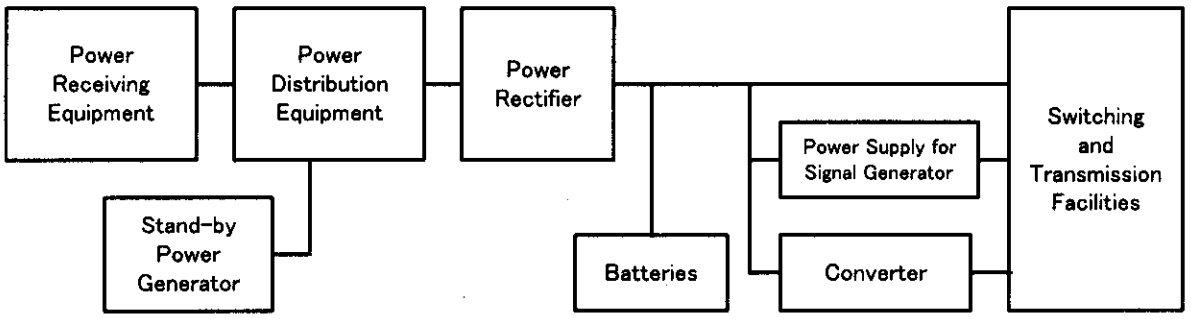


Figure 9.7.5-2 Typical Block Diagram for Power Supply Facilities

For the Master Plan Study, it is assumed that the existing power supply system is effectively used, and that PV systems will be integrated into the existing power supply

system for mid- and long-term development plans. For this reason, power supply for heating, ventilating, air conditioning, lighting, or the like for the existing or new telecom equipment rooms shall fall on the responsibility of the Mongolian side.

It is also assumed that the existing power receiving equipment and power distribution equipment as indicated in Figure 9.7.5-2 shall be fully utilized or renovated or expanded, whichever is applicable, by the Mongolian side at his own expense.

Supply and installation of PV systems and batteries are assumed to be within the scope of the Japanese side and estimated costs for supply and installation are calculated under the Master Plan Study. Telecommunication equipment from power rectifier to switching and transmission facilities in Figure 9.7.5-2, together with automatic voltage regulator and uninterruptible power supply system, when required, is assumed to be basically under the responsibility of the Japanese side.

9.8 International Telecommunications Facilities

9.8.1 General

The MT international telecommunication facilities consist of Naran earth station with INTELSAT standard A antenna, NEAX-61E INTS switch, and of digital radio approach microwave system between ITMC Ulaanbaatar and Naran Earth station.

International telephone calls are handled by NEAX 61E digital international exchange, which was installed in August 1993 by the Japanese Government Grant Aid. Majority of international telephone traffic is carried by satellite communications via INTELSAT to most of the direct destinations and a part of traffic is established via INTERSPUTNIK satellite and via terrestrial lines to Russia.

Naran INTELSAT standard A earth station with C-band 16 m antenna was put into operation on 25 August, 1993.

An international telephone call service is provided to over 150 countries. The number of international circuits in 2002 is 324 and the number of direct routes is 8. The monthly total traffic is 2,250,000 minutes. The international telephone traffic increased in 2001 by 19.2 percent as compared with 1997 while majority of the international telephone calls was made through IDD.

Renovation of software of international exchange, introduction of ITU-C7 signalling system and increase of capacity of transmission link has been implemented. Expansion of transmission link system's capacity between satellite communications earth station and NEAX61E exchange was also conducted.

In relation with the increasing demand of international telephone call services, a multiplexing equipment of DTX-240E was installed for the route to Japan and Korea, where the international call traffic is relatively high and the number of international gateway channels increased by 67 % compared with the previous year.

During 2000, the Government of Mongolia established a fibre-optic cable network by ODA along the Mongolian railway road from the north border to south border (1410 Km). It is strategically important to have international telecommunications networks of Mongolia put on the fibre-optic cable and interconnected with railway networks in Russia and in People's Republic (PR) of China. Mongolia Railway Company (MRC) has made a contract with Russia Telecom and China Telecom Company to connect the MRC fibre-optic cable with the railway communications networks in Russia and China and already established 14 PCM E1 bearers (420 channels) with Russia Federation.

MRC is now planning to install the International Transit Switch (INTS) and to start the international telecommunications services with Russia Federation and People's Republic of China by way of those fibre optic cables along the railway roads.

9.8.2 Facilities Plan

In order to support increasing demand of internet service, expansion project of internet backbone capacity shall be implemented by way of new optical fibre transmission route along Mongolian Railway which is interconnected with backbone digital transmission systems of China or Russia Federation.

In order to support the IP service, introduction of International Frame Relay (FR) service, VPN service and VoIP service shall be implemented in the international network.

In order to improve the service quality the dependency on satellite transmission routing shall be decreased and increased to put the direct circuits on the new optical fibre cable routings. Change of signalling system from C-5 to C-7 shall be made as soon as possible to expand the international telephone services. By the year end of 2008 it is

recommend to construct new standard-A earth station because of the present Naran earth station equipment life time exceeds 15 years in the year of 2008..

CHAPTER 10

PROJECT IMPLEMENTATION PLAN AND COST ESTIMATE

CHAPTER 10

PROJECT IMPLEMENTATION PLAN AND COST ESTIMATE

10.1 Project Implementation Plan

Project implementation plan consists of the Phase-I by the year 2008, the Phase-II by the year 2013 and the Phase-III by the year 2020. Phase-I is divided into two phases: Phase I-1 by the year 2005 and Phase I-2 by the year 2008.

Phase-I is of facilities plans for Sums which are given high priority. Priority projects should be mainly formed out of Sums in Phase-I-1.

Phase-II and III are of facilities plans for Sums, not so highly evaluated in Master Plan, but Sums in Phase-II and Phase-III should be digitised within the periods to minimize the digital divide among people in Mongolia.

10.1.1 Priority of Sums

All the Sums are prioritised with four (4) ranks, since the plans made under this Master Plan should be implemented in a due order of time because of scale of projects and financial conditions. The priority ranks are "P-1" (first priority), "P-2" (second priority), "P-3" (third priority), and "P-4" (fourth priority).

The Sums of "P-1" are planned to implement the project for the first stage of Phase-I, or the period from the year 2003 to the year 2005. Those of "P-2" are for the second stage of Phase-I, or the period from the year 2006 to the year 2008. Those of "P-3" for the Phase-II from the year 2009 to the year 2013, and those of "P-4" for the Phase-III from the year 2014 to the year 2020.

Facility yearly installation schedule of each Sum is decided within the period mentioned above, based on the criteria that Sums with bigger demand come earlier than Sums with smaller demand in installation. Fulfilment plan and facilities plan meet the yearly installation schedule. Switching system, transmission system, subscriber access and Power facility should be implemented synchronously.

Installation cost for each Sum is summed up by year to make the investment plan. For the cost estimate for each Phase, the yearly summed installation costs are summed up further by the Phases.

10.1.2 Project Formation

The following items should be considered in actual project formations.

(a) A number of Sums in a same phase in a same Aimag should be grouped to make an integrated project. Sums in a later phase could be added to the project, if they are on the transmission route from Aimag centre to Sums already selected in the project.

(b) In order to earn money soon after completion of facilities installation, facilities such as switch, transmission facility, subscriber facilities, which are components of network, should be installed in synchronization as much as possible.

(c) Attention should be especially paid in project formation to the back-bone network, which is not included in the scope of this Mater Plan, to prevent facilities from not working well due to insufficient provision of backbone network.

(d) In the case that cooperation from other projects is necessary, state of the other projects should be carefully studied in project formation.

(e) Benefits obtained from project should be studied and pre-conditions for the benefits should be explained.

(f) Project plan should be made, based on Feasibility Study for technical and economical feasibilities.

10.1.3 Issues on Project Implementation

Following issues should be considered for successful implementation of actual projects.

(1) Project Execution

(a) A project manager should be assigned to control the project execution.

(b) It may be necessary to employ consultants especially for projects financed from overseas countries to cope with a lot of works in projects, such as detail designing, preparation of tender documents, tendering, contracting, installation, and reporting.

(c) Meeting should be periodically (say, weekly or monthly) held among project manager, contractor, consultant, and others to check progress of projects, to find out problems and to study solutions of the problems.

(2) After Completion of Projects

(a) A manager should be assigned to watch whether the facilities are used as much as expected.

(b) It is necessary to analyse problems and act against the problems if the facilities are not used well and benefits from the project are not obtained expectedly.

(c) Evaluation teams may be dispatched to Mongolia especially in the case of projects financed from overseas countries, to evaluate the fruits of the project. Evaluation points are basically how much the facilities are actually used and contribute to benefits of Mongolian people. Sometimes other points are examined; for example, state of facility maintenance is checked.

10.2 Cost Estimate

Costs are estimated, based on the facilities plans made in Chapter 9. Table 10.2-1 summarizes the costs. Main scopes corresponding to the costs are shown in Table 10.2-2. In this cost estimate, taxes (import tax, VAT), consultant fee, cost of overseas training and contingency are not included in the costs.

The estimated total cost is US$ 155 million as shown in Table 10.2-1. The cost for Phase-I is US$ 85 million and about half of the total cost. The cost for Phase-II is US$ 47 million and about one third of the total cost. The cost for Phase-III is US$ 23 million and about one sixth of the total cost.

The costs are broken down into costs of each Aimag as shown in Tables 10.2-3 to 10.2-7 below. Annual investment plan is shown in Table 10.2-8.

Table 10.2-1 Cost Estimate of Facilities Plan

(US$1,000)

Item		Short-Term		Medium-Term	Long-Term	Total
		(2003-2005)	(2006-2008)	(2009-2013)	(2014-2020)	
Switchin System		6,535	7,457	7,135	3,245	24,372
Transmission System	*Optical Fibre Cable*	1,421	787	1,547	1,492	5,247
	Microwave and VSAT	18,479	8,888	17,742	8,783	53,892
	Sub-total	19,900	9,675	19,289	10,275	59,139
Access System	Wired	9,035	5,169	3,434	913	18,551
	Wireless	3,519	567	567	567	5,220
	Sub-total	12,554	5,736	4,001	1,480	23,771
Power Plant		7,272	6,094	10,690	4,802	28,858
IT Services	IT Spots	1,245	615	1,035	540	3,435
Total		47,506	29,577	42,150	20,342	139,575

Table 10.2-2 Main Scopes of Facilities Plan

Items		Facilities	Short-Term		Medium-Term	Long-Term	Total
			(2003-2005)	(2006-2008)	(2009-2013)	(2014-2020)	
Switchin System		Line Unit	27,460	15,020	14,580	5,040	62,100
Transmission System	Optical Fibre Cable	Length (Km)	37	26	69	74	206
		SDH Section	9	4	7	9	29
	Microwave	Terminal Sation	84	46	76	42	248
	VSAT	Earth Sation	19	12	22	2	55
Access System	Wired	Cable Pair	33,440	19,133	12,712	3,377	68,662
	Wireless	Cell Sation	30	3	4	5	42
Power Plant			-	-	-	-	-
IT Services	IT Spots	Sites	122	60	103	54	339

Table 10.2-3 Cost Estimate by Aimags (Total)

Total of Phase 1-1 (by 2005), Phase 1-2 (by 2008), Phase 2 and Phase 3 [US$ 1,000]

No.	Reigion	Aimag	Switch	Transmisson			Access			Power	IT	Total
				FOTS	MW, VSAT	Subtotal	Wired	Wireless	Subtotal		IT-Spot	
1	Western Region	Bayan-Ulgii	1,317	0	2,012	2,012	587	0	587	1,347	160	5,423
		Govi-Altai	948	177	3,308	3,486	1,081	0	1,081	3,065	190	8,769
		Khovd	1,424	0	2,648	2,648	747	0	747	1,969	160	6,948
		Uvs	1,207	321	2,756	3,077	397	0	397	2,090	190	6,961
		Zavkhan	1,278	372	3,944	4,316	1,145	0	1,145	3,529	235	10,502
2	Khangai Region	Arkhangai	1,186	0	2,708	2,708	1,355	0	1,355	677	180	6,106
		Bayankhongor	842	0	3,464	3,464	1,389	0	1,389	2,851	200	8,747
		Bulgan	928	0	2,432	2,432	1,692	0	1,692	57	160	5,269
		Orkhon	1,488	228	0	228	0	756	756	4	10	2,486
		Uvurkhangai	1,491	203	3,227	3,431	995	738	1,733	1,009	195	7,859
		Khuvsugul	984	0	4,100	4,100	1,839	0	1,839	3,363	240	10,526
3	Central Region	Darkhan-Uul	895	379	405	784	234	738	972	4	35	2,690
		Dornogovi	1,631	776	2,276	3,052	690	756	1,446	1,332	170	7,631
		Dundgovi	1,878	0	2,708	2,708	528	0	528	676	140	5,930
		Govisumber	1,182	444	0	444	134	0	134	1	20	1,780
		Selenge	1,063	1,093	2,457	3,550	1,251	1,476	2,727	49	210	7,599
		Tuv	1,721	343	3,763	4,106	1,817	0	1,817	76	270	7,990
		Umnugovi	1,594	0	3,404	3,404	444	0	444	2,078	150	7,670
4	Eastern Region	Dornod	316	0	2,324	2,324	308	0	308	1,586	140	4,675
		Khentii	624	0	3,080	3,080	917	756	1,673	1,422	210	7,009
		Sukhbaatar	135	0	2,876	2,876	815	0	815	1,675	130	5,632
5	District	Nalaikh	237	912	0	912	184	0	184	1	40	1,374
		Baganuur	0	0	0	0	0	0	0	0	0	0
Total			24,371	5,247	53,892	59,139	18,551	5,220	23,771	28,859	3,435	139,574

Table 10.2-4 Cost Estimate by Aimags (Phase I-1)

Phase 1-1 (2004-2005) [US$ 1,000]

No.	Reigion	Aimag	Switch	Transmisson			Access			Power	IT	Total
				FOTS	MW, VSAT	Subtotal	Wired	Wireless	Subtotal		IT-Spot	
1	Western Region	Bayan-Ulgii	680	0	129	129	0	0	0	59	15	883
		Govi-Altai	0	0	885	885	304	0	304	715	50	1,954
		Khovd	302	0	561	561	235	0	235	378	30	1,506
		Uvs	684	0	980	980	61	0	61	518	70	2,313
		Zavkhan	227	0	993	993	603	0	603	754	65	2,641
2	Khangai Region	Arkhangai	242	0	1,533	1,533	889	0	889	372	90	3,126
		Bayankhongor	76	0	945	945	534	0	534	728	40	2,322
		Bulgan	151	0	1,736	1,736	1,061	0	1,061	38	100	3,086
		Orkhon	248	228	0	228	0	189	189	3	10	677
		Uvurkhangai	475	0	1,728	1,728	598	738	1,336	451	105	4,095
		Khuvsugul	76	0	1,304	1,304	1,003	0	1,003	1,107	90	3,579
3	Central Region	Darkhan-Uul	306	0	81	81	0	738	738	0	15	1,140
		Dornogovi	630	279	297	576	311	189	500	257	40	2,003
		Dundgovi	760	0	993	993	221	0	221	213	50	2,236
		Govisumber	76	228	0	228	123	0	123	0	10	436
		Selenge	151	344	1,269	1,613	728	1,476	2,204	21	115	4,104
		Tuv	611	343	1,628	1,971	1,286	0	1,286	35	130	4,033
		Umnugovi	361	0	176	176	74	0	74	119	30	760
4	Eastern Region	Dornod	0	0	176	176	70	0	70	126	30	403
		Khentii	404	0	1,641	1,641	348	189	537	609	100	3,290
		Sukhbaatar	76	0	1,425	1,425	587	0	587	769	60	2,916
5	District	Nalaikh	0	0	0	0	0	0	0	0	0	0
		Baganuur	0	0	0	0	0	0	0	0	0	0
Total			6,535	1,421	18,479	19,900	9,035	3,519	12,554	7,272	1,245	47,505

Table 10.2-5 Cost Estimate by Aimags (Phase-I-2)

Phase 1-2 (2006-2008) [US$ 1,000]

No.	Reigion	Aimag	Switch	Transmisson			Access			Power	IT	Total
				FOTS	MW, VSAT	Subtoal	Wired	Wireless	Subtotal		IT-Spot	
1	Western Region	Bayan-Ulgii	378	0	540	540	269	0	269	418	50	1,655
		Govi-Altai	378	0	648	648	320	0	320	660	30	2,036
		Khovd	605	0	419	419	292	0	292	423	40	1,779
		Uvs	457	228	48	275	189	0	189	411	20	1,352
		Zavkhan	378	0	372	372	272	0	272	493	30	1,545
2	Khangai Region	Arkhangai	227	0	648	648	317	0	317	173	50	1,415
		Bayankhongor	144	0	899	899	467	0	467	877	80	2,467
		Bulgan	288	0	588	588	601	0	601	16	40	1,533
		Orkhon	439	0	0	0	0	189	189	0	0	628
		Uvurkhangai	522	0	156	156	270	0	270	139	20	1,107
		Khuvsugul	364	0	1,128	1,128	391	0	391	957	60	2,900
3	Central Region	Darkhan-Uul	220	228	324	552	154	0	154	3	10	938
		Dornogovi	302	331	324	655	167	189	356	277	20	1,611
		Dundgovi	522	0	216	216	122	0	122	94	10	964
		Govisumber	562	0	0	0	0	0	0	0	0	562
		Selenge	378	0	432	432	318	0	318	7	25	1,160
		Tuv	529	0	648	648	321	0	321	15	40	1,553
		Umnugovi	583	0	480	480	166	0	166	399	30	1,659
4	Eastern Region	Dornod	181	0	0	0	62	0	62	72	0	315
		Khentii	0	0	480	480	354	189	543	323	40	1,387
		Sukhbaatar	0	0	540	540	114	0	114	337	20	1,012
5	District	Nalaikh	0	0	0	0	0	0	0	0	0	0
		Baganuur	0	0	0	0	0	0	0	0	0	0
Total			7,457	787	8,888	9,675	5,169	567	5,736	6,094	615	29,577

Table 10.2-6 Cost Estimate by Aimags (Phase-II)

Phase 2 (2006-2013) [US$ 1,000]

No.	Reigion	Aimag	Switch	Transmisson			Access			Power	IT	Total
				FOTS	MW, VSAT	Subtotal	Wired	Wireless	Subtotal		IT-Spot	
1	Western Region	Bayan-Ulgii	258	0	912	912	269	0	269	620	75	2,133
		Govi-Altai	450	0	1,344	1,344	405	0	405	1,193	80	3,472
		Khovd	517	0	1,128	1,128	174	0	174	796	60	2,673
		Uvs	66	0	324	324	43	0	43	221	20	674
		Zavkhan	510	0	1,823	1,823	178	0	178	1,404	80	3,995
2	Khangai Region	Arkhangai	554	0	527	527	148	0	148	132	40	1,402
		Bayankhongor	306	0	1,620	1,620	389	0	389	1,246	80	3,641
		Bulgan	318	0	108	108	30	0	30	3	20	479
		Orkhon	485	0	0	0	0	189	189	0	0	674
		Uvurkhangai	332	203	804	1,007	89	0	89	274	40	1,742
		Khuvsugul	485	0	1,560	1,560	434	0	434	1,207	80	3,766
3	Central Region	Darkhan-Uul	258	151	0	151	80	0	80	1	10	501
		Dornogovi	265	166	1,283	1,449	166	189	355	630	80	2,779
		Dundgovi	365	0	743	743	122	0	122	197	50	1,478
		Govisumber	126	216	0	216	11	0	11	0	10	363
		Selenge	372	367	216	583	96	0	96	8	20	1,078
		Tuv	529	0	683	683	128	0	128	13	60	1,414
		Umnugovi	590	0	2,424	2,424	182	0	182	1,377	80	4,653
4	Eastern Region	Dornod	135	0	743	743	91	0	91	526	50	1,545
		Khentii	87	0	851	851	187	189	376	438	60	1,813
		Sukhbaatar	60	0	648	648	83	0	83	403	30	1,223
5	District	Nalaikh	66	444	0	444	130	0	130	1	10	651
		Baganuur	0	0	0	0	0	0	0	0	0	0
Total			7,135	1,547	17,742	19,289	3,434	567	4,001	10,690	1,035	42,150

Table 10.2-7 Cost Estimate by Aimags (Phase-III)

Phase 3 (2014-2020) [US$ 1,000]

No.	Reigion	Aimag	Switch	Transmisson			Access			Power	IT	Total
				FOTS	MW, VSAT	Subtotal	Wired	Wireless	Subtotal		IT-Spot	
1	Western Region	Bayan-Ulgii	0	0	432	432	49	0	49	251	20	752
		Govi-Altai	120	177	432	609	51	0	51	497	30	1,307
		Khovd	0	0	540	540	47	0	47	373	30	989
		Uvs	0	94	1,404	1,498	104	0	104	940	80	2,622
		Zavkhan	162	372	756	1,128	93	0	93	878	60	2,321
2	Khangai Region	Arkhangai	162	0	0	0	0	0	0	0	0	162
		Bayankhongor	316	0	0	0	0	0	0	0	0	316
		Bulgan	171	0	0	0	0	0	0	0	0	171
		Orkhon	316	0	0	0	0	189	189	1	0	506
		Uvurkhangai	162	0	540	540	39	0	39	144	30	915
		Khuvsugul	60	0	108	108	11	0	11	92	10	281
3	Central Region	Darkhan-Uul	111	0	0	0	0	0	0	0	0	111
		Dornogovi	435	0	372	372	46	189	235	168	30	1,239
		Dundgovi	231	0	756	756	62	0	62	172	30	1,251
		Govisumber	419	0	0	0	0	0	0	0	0	419
		Selenge	162	382	540	922	110	0	110	13	50	1,257
		Tuv	51	0	804	804	81	0	81	13	40	990
		Umnugovi	60	0	324	324	22	0	22	182	10	598
4	Eastern Region	Dornod	0	0	1,404	1,404	86	0	86	862	60	2,412
		Khentii	133	0	108	108	27	189	216	51	10	519
		Sukhbaatar	0	0	264	264	31	0	31	166	20	482
5	District	Nalaikh	171	468	0	468	54	0	54	1	30	724
		Baganuur	0	0	0	0	0	0	0	0	0	0
Total			3,244	1,492	8,783	10,275	912	567	1,479	4,803	540	20,342

Table 10.2-8 Annual Investment Plan

[US$ 1,000]

No.	Region	Aimag	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
1	Western Region	Bayan-Ulgii	101	101	437	452	766	629	280	597	280	539
		Govi-Altai	752	1,429	688	655	693	706	565	890	770	600
		Khovd	740	615	396	456	701	955	357	357	357	502
		Uvs	765	939	750	30	676	229	203	101	101	101
		Zavkhan	1,630	1,032	645	586	375	841	1,169	602	754	602
2	Khangai Region	Arkhangai	1,395	2,170	269	775	522	334	131	131	379	131
		Bayankhongor	1,581	968	501	1,108	1,319	651	637	944	684	937
		Bulgan	2,266	1,353	334	1,027	342	123	26	26	26	26
		Orkhon	828	5	189	0	0	276	0	0	0	0
		Uvurkhangai	2,679	1,416	710	69	327	849	289	202	202	202
		Khuvsugul	2,033	2,082	786	1,172	1,107	508	508	1,019	1,131	643
3	Central Region	Darkhan-Uul	786	48	112	217	570	300	2	2	72	2
		Dornogovi	974	641	698	689	149	1,054	803	505	353	353
		Dundgovi	868	759	411	89	230	494	272	186	186	293
		Govisumber	431	5	0	0	0	2	289	2	2	2
		Selenge	3,380	1,202	388	543	154	114	274	175	48	360
		Tuv	2,658	1,524	557	381	608	488	215	150	150	246
		Umnugovi	145	330	488	246	705	1,171	1,042	730	875	730
4	Eastern Region	Dornod	147	331	278	0	0	583	433	233	233	233
		Khentii	1,973	1,275	939	385	647	547	425	385	234	725
		Sukhbaatar	1,604	1,542	391	433	407	301	193	193	193	541
5	District	Nalaikh	0	0	0	0	0	2	2	643	2	2
		Baganuur	0	0	0	0	0	0	0	0	0	0
	Total		27,737	19,767	9,966	9,311	10,300	11,158	8,116	8,074	7,032	7,770

Inverstment Plan [US$ 1,000]	Phase	Phase 1	Phase 2
	Amount	77,082	42,150

No.	Region	Aimag	2014	2015	2016	2017	2018	2019	2020	Total
1	Western Region	Bayan-Ulgii	207	201	93	93	93	93	93	5,055
		Govi-Altai	106	228	106	208	106	491	106	9,099
		Khovd	122	238	122	122	215	122	210	6,587
		Uvs	310	310	418	588	400	538	476	6,935
		Zavkhan	182	182	664	478	278	507	182	10,713
2	Khangai Region	Arkhangai	0	0	0	0	0	0	0	6,239
		Bayankhongor	0	0	0	0	0	0	0	9,329
		Bulgan	0	0	0	0	0	0	0	5,548
		Orkhon	323	0	0	0	0	0	0	1,621
		Uvurkhangai	97	97	187	97	173	97	165	7,859
		Khuvsugul	26	26	26	26	26	117	26	11,263
3	Central Region	Darkhan-Uul	0	0	0	0	0	0	0	2,114
		Dornogovi	369	74	74	74	74	154	148	7,186
		Dundgovi	326	132	132	132	132	204	132	4,980
		Govisumber	0	0	0	0	0	0	0	733
		Selenge	392	168	629	85	85	85	85	8,167
		Tuv	208	290	122	122	122	184	122	8,147
		Umnugovi	70	180	70	70	70	70	70	7,060
4	Eastern Region	Dornod	310	310	420	310	672	398	310	5,204
		Khentii	316	22	22	22	22	22	22	7,978
		Sukhbaatar	57	165	57	57	57	57	141	6,392
5	District	Nalaikh	4	4	451	251	4	4	4	1,379
		Baganuur	0	0	0	0	0	0	0	0
	Total		3,425	2,627	3,592	2,735	2,528	3,144	2,291	139,574

Inverstment Plan [US$ 1,000]	Phase	Phase 3	Total
	Amount	20,342	139,574

CHAPTER 11

ANALYSIS OF FINANCIAL, ECONOMIC AND SOCIAL ASPECT

CHAPTER 11

ANALYSIS OF FINANCIAL, ECONOMIC AND SOCIAL ASPECT

11.1 Introduction

For the purpose of evaluating financial and economic efficiency of capital investment of this M/P, the Study Team mainly relied on the calculation results of Financial Internal Rate of Return on Investment (FIRROI) for the financial evaluation, and Economic Internal Rate of Return (EIRR) for the economic evaluation.

Revenues and expenditures of MT and PTA for the periods from 1997 to 2001 have been reviewed and analysed to support the relevant factors of the operating revenues and costs plan of the M/P.

Main independent plans comprising projection of the long-term income and cash flow are as follows:

(1) Capital Investment Plans
(2) Subscribers Development Plan
(3) Revenues Plan
(4) Personnel Plan
(5) Operations/Maintenance Costs Plan
(6) Telecom Tariffs

The results of the household survey carried out by the local consultant are fully utilised for the economic evaluation.

11.2 Financial Performance

11.2.1 Financial Performance of MT

The financial performance for the latest 5 years (1997-2001) of MT on consolidated with its subsidiary MICOM is shown in Tables 11.2-1 (1) & (2).
Revenues grew steadily as the subscribers increased. Thus, MT has been maintaining an adequate profit after paying the rental of backbone network to PTA and income taxes. As

reported at its annual shareholders meeting for the year 2001, MT was honoured as the "best business enterprise" by the Chamber of Commerce and Industry of Mongolia for its 2001's business performance.

Table 11.2-1 (1) MT Income Statements

in US$ mln

	1997	1998	1999	2000	2001
Subscribers (lines)	87,341	96,033	105,796	113,337	119,906
Revenues	22.2	22.7	23.4	26.5	27.3
Operating Costs	9.5	10.2	9.3	11.3	12.2
Rental to PTA	5.1	5.9	7.1	7.0	7.7
Total Costs	14.6(66%)	16.1(71%)	16.4(70%)	18.3(69%)	19.9(73%)
Non-Operating Costs	-0.6	-0.5	-0.3	-0.6	0.3
Profit before Tax	8.2	7.1	7.3	8.8	7.1
Tax	3.6	3.6	3.6	4.5	3.4
Net Profit	4.6	3.5	3.7	4.3	3.7
Revenue/Subs. ($)	249	227	215	228	222

(Note) Source: MT, Revenue/Subscriber: excluding TV & Radio Revenue

Exchange Rates for 1 US$: Tg. 787('97), 839('98), 1025('99), 1080('00), 1102('01)

Table 11.2-1 (2) MT Balance Sheets

in US$ mln

	1997	1998	1999	2000	2001
Current Assets	7.2	6.4	7.1	9.4	10.3
Fixed Assets net	3.7	6.9	6.0	7.2	8.6
Investments, etc.	1.2	1.3	1.2	1.2	1.1
Total Assets	12.1	14.6	14.3	17.8	20.0
Current Liabilities	1.9	3.0	2.6	4.4	3.7
Other Liabilitities	1.0	0.6	0.1	0	1.0
Total liabilities	2.9	3.6	2.7	4.4	4.7
Capital	3.2	3.1	2.5	2.4	2.3
Retained Earnings	6.0	7.9	9.1	11.0	13.0
Total Equity	9.2	11.0	11.6	13.4	15.3
Total Equity/Liab.	12.1	14.6	14.3	17.8	20.0

(Note) Source: MT

11.2.2 Financial Performance of PTA

Financial information regarding the telecom activities of PTA for 2001 was obtained through the hearing from a high-ranking official in charge of finance and accounting. The findings are shown in Table 11.2-2 below.

Judging from all available data so far obtained, the amount of the rental for the use of backbone network would be higher than an amount that is equivalent to the amount of

depreciation expense under a normal rate of depreciation, if such depreciation method is followed for the calculation of the rental for the use of backbone network.

Table 11.2-2 Estimated PTA's Financial Performance for 2001

in US$ mln

	2001
Cash Receipt:	
Rental from MT	7.7
Cash Outlay:	
Repayment of Loan	2.6
Payment of Interest	2.1
Repair of Backbone NW	1.3
O/M Costs	0.1
Total Outlay	6.1
Balance of Cash	1.6

Source: PTA

11.3 Preconditions for Financial and Economic Evaluation

11.3.1 Preconditions for Financial Evaluation

(1) Special Features of the M/P

The special features of this M/P in terms of the long-term operations projection should be taken into consideration for the execution of evaluation as described below:

1) An operating entity possessing the newly acquired facilities for rural telecom operations covering 339 Sum Centres and equivalent settlements is assumed.

2) The entity would start business operations in 2004 and cut-off year would be set in 2025 as a result of "trial and error" approach, reflecting continuous capital investments for the above rural telecom services from 2004 to 2020 under the M/P.

3) The average useful life of the new facilities is assumed for 15 years and straight-line depreciation method is applied, regardless of the financing sources including grant and donation.

4) The entity would use the backbone network and a proportionate cost to the outstanding numbers of Sums' subscribers would be charged to the entity, while the revenues derived from the use of the backbone network would be distributed to the entity in accordance with the same proportionate rate.

5) The cost of satellite use for VSAT would be borne by the entity (US$ 83,100 for 55 stations annually).

6) The entity extends services for both of the existing and the new subscribers (10,521 subscribers as at the end of 2001 and an aggregate of 50,259 new subscribers from 2002 to 2020, and no increase in subscriber after 2020).

(2) Assumptions

1) Project Evaluation Period
2004 to 2025 (22 years)

2) Fixed Price Base
All revenues and costs are expressed at the fixed prices at the end of 2001 set as the base year of the M/P.

3) Exchange Rate
Exchange Rate is fixed at Tugrug 1,102 for one U.S. Dollar (at the end of 2001).

4) Revenues
Installation Charge: Number of new subscribers x tariff rate (home 67%, business 33%)

Monthly Line Rental: Number of subscribers x weighted tariff rate
Call Charges (Local, Long Distance, International): Distributed amount proportionate to the number of subscribers

5) Bill Collection Ratio: 80% (Results of the Socio-Economic Field Survey of the M/P)

6) Personnel Cost: Number of Staff for Rural Telecom Services x average salary (Tg. 99,956) x 1.205

11.4 Cost and Revenue Estimation of Financial Evaluation

11.4.1 Cost Estimation

(1) Summary of Operations/Maintenance Cost

Table 11.4-1 (1) Summary of Operations/Maintenance Cost (Excluding Depreciation Expenses)

in US$ '000

Year	O/M Cost	Year	O/M Cost
2004	1,347	2016	1,589
2005	1,351	2017	1,631
2006	1,418	2018	1,471
2007	1,595	2019	1,305
2008	1,727	2020	1,344
2009	1,836	2021	1,354
2010	1,893	2022	1,365
2011	1,993	2023	1,375
2012	1,818	2024	1,381
2013	1,863	2025	1,388
2014	1,654		
2015	1,541		
		Total	34,242

Source: JICA Study Team

(2) Summary of Capital Investment Plan

Two cases (including Duties and VAT and excluding Duties and VAT) have been calculated.

Table 11.4-1 (2) Summary of Capital Investment Plan

in US$ '000

Year	Case A	Case B	Year	Case A	Case B
2004	33,801	27,737	2016	4,377	3,592
2005	24,089	19,767	2017	3,333	2,735
2006	12,144	9,966	2018	3,081	2,528
2007	11,347	9,311	2019	3,831	3,144
2008	12,552	10,300	2020	2,792	2,291
2009	13,598	11,158			
2010	9,891	8,116			
2011	9,839	8,074			
2012	8,570	7,032			
2013	9,468	7,770			
2014	4,174	3,425			
2015	3,202	2,627			
			Total	**170,088**	**139,574**

(Note) Case A: including Duty and VAT

Case B: excluding Duty and VAT

Source: JICA Study Team

11.4.2 Revenue Plan

(1) Subscribers Development Plan

Table 11.4-2 (1) Subscribers Development Plan

(Lines)

	National Base		Sum Base			National Base		Sum Base	
Year	New	Aggregate	New	Aggregate	Year	New	Aggregate	New	Aggregate
End '01		130,000		10,521	2013	10,355	270,175	2,556	42,392
2004	11,050	174,200	6,682	17,203	2014	14,330	284,505	2,664	45,056
2005	11,050	185,250	3,443	20,646	2015	14,330	298,835	2,686	47,742
2006	11,050	196,300	2,198	22,844	2016	14,330	313,165	2,663	50,405
2007	11,050	207,350	3,460	26,304	2017	14,330	327,495	2,670	53,075
2008	11,050	218,400	2,998	29,302	2018	14,330	341,825	2,624	55,699
2009	10,355	228,755	3,045	32,347	2019	14,330	356,155	2,596	58,295
2010	10,355	239,110	2,060	34,407	2020	14,334	370,489	2,486	60,780
2011	10,355	249,465	3,004	37,411					
2012	10,355	259,820	2,424	39,835					
					Total	207,339	Total	50,259	

(Note) 2002-2003 National Base Subscribers Increase: 33,150

Source: JICA Study Team

(2) Summary of Revenue Plan

Table 11.4-2 (2) Summary of Revenue Plan

in US$ '000

Year	Revenue	Per Subs. ($)	Year	Revenue	Per Subs. ($)
2004	3,137	182	2016	9,103	181
2005	3,699	179	2017	9,531	180
2006	4,181	183	2018	9,961	179
2007	4,799	182	2019	10,396	178
2008	5,346	182	2020	10,823	178
2009	6,032	186	2021	10,808	178
2010	6,375	185	2022	10,808	178
2011	6,898	184	2023	10,808	178
2012	7,320	184	2024	10,808	178
2013	7,776	183	2025	10,808	178
2014	8,270	184			
2015	8,684	182			
			Total	176,370	

(Note) Subs. : Subscriber

Source: JICA Study Team

11.5 Financial Analysis of Master Plan

11.5.1 Summary of Income and Cash Flow Projection

For the purpose of financial analysis of the M/P, the two base cases (See Paragraph 11.4.1(2) Summary of Capital Investment Plan) of income and cash flow projection are summarised in the Table 11.5-1.

Table 11.5-1 Summary of Income and Cash Flow Projection

	Case A	Case B
Period of Evaluation	22 years (2004-2025)	22 years (2004-2025)
Capital Investment $ '000	**170,088** (2004-2020)	**139,574** (2004-2020)
Average Revenue/Yr $'000	8,017	8,017
Annual Revenue/ Subscriber $	181	181
Positive Profit in	16th year	16th year
Positive Cash Flow in	9th year	9th year
Positive Accumulated CF in	21st year	20th year
FIRROI	**0.948%**	**1.871%**
Required Subsidies Total $'000 Average/year $'000	 41,300 2,753 (for 15 years)	 19,800 1,414 (for 14 years)

(Note) Case A: including Duty and VAT

Case B: excluding Duty and VAT

CF: Cash Flow

Source: JICA Study Team

11.5.2 Financial Analysis

(1) Base Case Analysis

First of all, it was thought that the capital investment should include the import duties and VAT on the basis of fair competition among all users of the equipment and facilities under the market economy, regardless of financing sources (including grant and donation). Thus, Case A is prepared. However, as the impact of the import duties and VAT totalling 30.5 million U.S. Dollars is quite substantial to the investment evaluation, Case B is further prepared, leaving the issues in the hands of the Mongolian government how to eliminate the burden of those taxes. Therefore, the financial analysis is hereinafter made towards Case B and its sensitivity, unless otherwise referred to.

- Financial Analysis of Base Case B

Financial Internal Rate of Return on Investment (FIRROI) that indicates viability of investment is 1.871 %. The fundamental cause is the fact that the capital investment of 2,296 U.S. Dollars per telephone line that is accumulated over the project period (2004-2020) is required for the development of rural telecommunications system due to geographic and socio-economic features of Mongolia, while average annual revenues would be limited to 181 U.S. Dollars per telephone line. (For reference: The World Bank statistics publicised on 9 September 2002 as entitled "ICT at a glance - Mongolia" indicated that the annual average telecom revenue per line of the countries of less than US$ 411 GNP per Capita was US$ 199 in the year 2000.) Accordingly, the case needs to be supported by the subsidies in an average annual amount of 1,414 thousand U.S. Dollars for 14 years. Financial self-sufficiency (after full recoupment of the subsidies) would be achieved in the beginning of the 21st year of operations.

But the disbursements from the state budget appear to be very difficult and the current legislation of Universal Service Obligations Fund (USOF) cannot take care of the operating losses of rural service providers. Nonetheless, in our opinion, those subsidies can be realised in Mongolia, provided that the workable system of the USOF is created as being studied by MOI. The current provisions of USOF should be revised under the consensus of telecom sector stakeholders, so that the operating losses can be covered in addition to the capital investment, following the customary practices of USOF in many countries of the world. Proper action of the Mongolian government for the revision of USOF is of vital importance.

For the revision of USOF should be discussed simultaneously with the fair adjustment of telecom tariffs. As explained in Paragraph 3.4.4-(4), the tariffs have been kept unchanged to date since 1997, except for an aggregate of 60 % lowering in the international call charge rate denominated in U.S. Dollars and some minor upward adjustments. The timing for the revision of tariffs appears to be matured in consideration of the effect of inflation, unless there are the needs and reality in the rural areas that necessitate that the existing tariffs should be kept at least and that a limited period incentives (including further discount of call charge rate up to a certain monthly volume of calls) should be given to the rural people to help them enable to increasingly access the telecom system of the country as the public wealth. CRC's 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 (e.g. a set of upward adjustment of local call charges and reduction in interconnection charges). In view of the obtaining situation, in this Master Plan the effect of the tariffs adjustment is dealt with in the 10% increase in the revenues of the sensitivity analysis in Paragraph 11.5.2-(2).

① Detailed explanation are as follows:
- Profit would become positive in the 16th year (in 2019).
- Accumulated Cash Flow would become positive in the 20th year (in 2023).
- An average annual amount of subsidies of US$ 1,414,000 would be required for the first 14 years.

③ Financial and Economic Internal Rate of Return of Other Projects of Telecom Sector in Mongolia

Reference is made to the latest results of FIRR and EIRR of other projects of telecom sector in Mongolia as follows (The evaluation results varied depending on the scope, details and preconditions of study.):

	Year completed	FIRR	EIRR
Mater Plan Study on Telecommunications Network in Ulaanbaatar City (JICA)	1996	8.5%	14.9%
Feasibility Study on Development of Telecommunication services in Mongolia (ADB)	1997	4.2-5.8% (several scenarios)	

In our trial calculation applied to the feasibility study of the selected 22 Sum centres of Uvurkhangai, Selenge and Darkhan-Uul Aimags (explained hereinbelow), FIRROI would become some 5 %, if the three Aimag centres were added.

(2) Sensitivity Analysis

Sensitivity analysis is made in the following five cases:
- Revenue (plus/minus 10%) Case SR-1 and SR-2
- Operation-Maintenance Cost (plus/minus 10%) Case SO-1 and SO-2
- Capital Investment (minus 15%) Case SI-1
- Case of combined effect (Increased Revenue +5%, Reduced O/M Cost –10%, Reduced Capital Investment –10%) : CMB

1) Sensitivity as to change in Revenue

Plus and minus 10% from the Base Case are tested and the results are as follows:

① Case SR-1: In the case the revenues increase by 10% as a result of tariffs adjustments (such as upward adjustment of local call charges and reduction in international call charges as well as interconnection charges) or other causes, FIRROI would become 2.452%, achieving self-sufficiency in the 18th year (2021). Required annual subsidies are decreased by 34% to US$ 927,000 for 11 years. Impact of increase in the revenues is substantial.

② Case SR-2: On the other hand, in the case the revenues decrease by 10%, FIRROI would shrink to 1.299%, required annual subsidies are US$ 2,013,000 for 15 years and the viability of the project would be lost.

Table 11.5-2 (1) Sensitivity-Revenue

	SR-1 Revenue +10%	SR-2 Revenue -10%
FIRROI	**2.452%**	**1.299%**
Positive Profit in	14th year	16th year
Positive Cash Flow in	9th year	9th year
Positive Accumulated CF in	20th year	21st year
Required Subsidies Total $'000 Average/year $'000	 10,200 927 (11years)	 30,200 2,013 (15 years)

Source: JICA Study Team

2) Sensitivity as to change in Operations/Maintenance Cost; SO-1 & SO-2

As the weight of O/M costs is not significant, change in O/M costs does not cause much impact to FIRROI.

Table 11.5.2 (2) Sensitivity-O/M Cost

	SO-2 OM Cost -10%	SO-1 OM Cost +10%
FIRROI	**1.958 %**	**1.791%**
Positive Profit in	16th year	16th year
Positive Cash Flow in	9th year	9th year
Positive Accumulated CF in	20th year	20th year
Required Subsidies Total $'000 Average/year $'000	 17,500 1,250 (14 years)	 22,200 1,586 (14 years)

Source: JICA Study Team

3) Sensitivity as to Decrease in Capital Investment; SI-1

Provided that the capital investment is reduced by 15% as a result of competitive bidding or other causes, FIRROI would become 2.839%, achieving financial self-sufficiency in the 17th year (2020). Required annual subsidies are decreased by 50% to US$ 710,000 for 10 years. Impact of decrease in the capital investment is substantial.

Table 11.5-2 (3) Sensitivity-Investment Cost

	SI-1 Capital Investment -15%
FIRROI	**2.839%**
Positive Profit in	12th year
Positive Cash Flow in	9th year
Positive Accumulated CF in	19th year
Required Subsidies Total $'000 Average/year $'000	 7,100 710 (10 years)

Source: JICA Study Team

4) Case of combined effect (Increased Revenues +5%, Reduced O/M Costs –10%, Reduced Capital Investment –10%); CMB

In this case, FIRROI would become 2.926 %, achieving financial self-sufficiency in the 16th year (2019). Required annual subsidies are decreased to US$ 436,000 for 11 years.

Table 11.5-2 (4) Sensitivity-Combination

	CMB Combination
FIRROI	**2.926%**
Positive Profit in	12th year
Positive Cash Flow in	9th year
Positive Accumulated CF in	19th year
Required Subsidies Total $'000 Average/year $'000	 4,800 436(11 years)

Source:JICA Study Team

11.6 Economic Evaluation

(1) Approach and Calculation Methodology

For the purposes of securing relevant information for economic evaluation of the M/P, in particular, purchasing power or affordability of people in the rural areas in terms of telecommunications is considered as the key factor. The Study Team conducted the socio-economic household survey of the rural areas using questionnaires that contained necessary queries. Among those queries, there were items regarding "Willingness to Pay" and "Travel to Ulaanbaatar" as well as "Travel to Aimag Centre".

The household survey was carried out by the local consultant towards 2,608 households from 80 Sums and settlements of Tuv, Bulgan, Khentii, Umnugovi and Govi-Altai Aimags. The results show that most of rural people are getting necessary information for their business and private life from the television (including the radio) and newspapers and more than half of the respondents are considering that information is insufficient. And furthermore, above 90% of them 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 answered monetary amounts are even lower than the amounts that the people are currently paying as telephone charge. This result may be attributable to the facts that the people from the remote area from Ulaanbaatar (e.g. Sums in Govi-Altai Aimag) are paying heavier telephone charges of about 9% of monthly household income and the telephone charges have already become burdens to them, while the people from the nearer area to Ulaanbaatar (e.g. Sums in Tuv Aimag) are normally paying 3% to their household income. Consequently, the "Travel Cost" method is applied for the economic evaluation instead of the "Willingness to Pay".

According to the household survey most of the rural people go to Ulaanbaatar about 5 times a year on average and to Aimag Centres about 9 times. The cost of travel and an opportunity cost such as forgone wages during the travel become a heavy burden to their household income (being equivalent to 3.5 times (or Tg. 252,000) of average monthly income of Tg. 72,000), though all of such cost could not be saved by the use of telephone, even if the telephone would be readily in use.

Another attention should be paid to the facts that the number of times of travel that the rural people can afford to make is limited, even though the net economic benefits for one time of travel are enormous (Travelling would costs 25 times of telephone charge). As such, the "Saved Travel Cost" cannot fully substitute the benefits being covered by telecom revenues. Therefore, the economic evaluation of the M/P still has to mainly rely on the

telecom revenues with a supplement of the assumed "Saved Travel Cost" that would cover one half of the aggregate of actual travel costs and accompanying opportunity costs. (Note: The telecom revenues that are comprised in the total economic benefits are the net telecom revenues excluding such amount as used to compute "Saved Travel Cost".)

(2) Summary of Economic Evaluation

Summary of Economic Evaluation for Base Case B is shown as follows:

Table 11.6-1 Summary of Economic Evaluation

Period of Evaluation		22 years (2004-2025)		
Costs			**Benefits**	
Capital Investment	$ '000	139,574	Net Tel. Revenue $ '000	171,959
O/M Cost	$ '000	34, 242	Saved Travel Cost $ '000	107,517
Working Capital	$ '000	1,496		
Total Costs	$ '000	175,312	Total Benefits $ '000	279,476
			Positive Accumulated Cash Flow at end 2025 $ '000	104,164
			EIRR	**7.66%**
			Cash Flow: Positive Cash Flow in	8th year
			Positive Accumulated CF in	16th year

Source: JICA Study Team

(3) Economic Evaluation

① Economic Internal Rate of Return (EIRR) that is a useful tool to clarify the magnitude of economic contribution of the Master Plan is calculated at 7.66%, based on the assumption as explained in Paragraph 11.6-(1). The rate amply exceeds the forecast frame of Mongolia's GDP growth rate of 4.97% of the medium growth case. Though nobody can say that this EIRR is a decisive factor for the M/P to be pushed through, the result of Economic Evaluation may suggest that the implementation of the M/P facing the serious financial issues can be accomplished by a comprehensive development approach to be made jointly and harmoniously by the government, people and the relevant firms as the matter of total development of Mongolia.

② Detailed explanation are as follows:
- Cash Flow would become positive in the 8th year (in 2011).
- Accumulated Cash Flow would become positive in the 16th year (in 2019).

11.7 Conclusion

The conclusion of this Chapter is enumerated as follows:

1) The issues of import duties and VAT pertaining to the equipment and facilities to be acquired under the Master Plan should be resolved by the Mongolian side.

2) The amount of the rental for the use of backbone network should not be higher than the proper annual depreciation expense of backbone network.

3) Subsidies such as the Universal Service Obligations Fund, etc. should be indispensable to give a fair competition opportunity to telecom operators for the rural areas.

4) Establishment of financial self-sufficiency could be realised towards the final stages of the evaluation period. This means that the implementation of the Master Plan as a business project would still need measures to cover operating losses for a long period of time. To make this Master Plan feasible, we would urge prioritisation of project components (such as development speed, scope and investment scale of each development phase, etc.) through its proper and timely review.

5) Sensitivity analysis suggests the importance of increased revenues in addition to the reduced capital investment. Above all, formulation and implementation of the tariffs adjustment that are acceptable to all stakeholders of telecom sector should be urgently required.

6) To aim at the increased telecommunications revenues in the long run, there should be realised a comprehensive development in the rural areas of agriculture and livestock farming industry, small and medium scale enterprises of manufacturing, mining, tourism and services sectors.

7) Economic evaluation of the Master Plan suggests that this Master Plan can be fulfilled by a comprehensive development approach jointly and harmoniously made by the government, people and the relevant firms as the matter of total development of Mongolia.

8) In addition to the above development activities, social and public services securing basic human needs in the rural area, such as educational services, health and medical care services, etc. should be improved.

CHAPTER 12

OPERATION AND MAINTENANCE PLAN

CHAPTER 12

OPERATION AND MAINTENANCE PLAN

12.1 General

12.1.1 Definition

The purpose of maintenance is to retain and perform a required function of the telecommunications network.

Operation is all operational daily activities, to run the telecommunications facilities effectively and efficiently, for provision of the customer services that include the new connections and small-scale projects.

- Effectiveness means doing the right things, i.e., producing the desired results.
- Efficiency is a measurement of the use of resources to achieve results.

12.1.2 Consideration to Operation and Maintenance in Mongolia

Following characteristics and conditions around the rural telecommunications network in Mongolia are necessary to consider for the improvement of the Operation and Maintenance.

- Small scale of Facilities scattering in the vast country.
- Very old facilities in model and lifetime
- Difficulty of transport due to poor road and rail way condition.

That means, Operation and Maintenance for the rural telecommunications network in Mongolia has many difficulties. However, high-level quality of service will be required with the advance of internationalisation and competitive market environment in Mongolia even for the rural telecommunications. And the telecommunications carrier needs enough efficiency to maintain Company's finance well. Therefore, the following points are especially important for the Efficient and Effective Operation and Maintenance in Mongolia:

- Effective and reliable management.
- Proper arrangement and cultivation of employee
- Procurement and arrangement of maintenance material and tools.
- Preparation of Standard practice.

– Effective organisation structure.

12.1.3 Summary of Recommendation

Followings are summary of the Operation and maintenance Improvement Plan

(1) Quality of Services (QoS) and Network Performance Control

– The results of Quality control in MT were evaluated and Future target levels are recommended for Fault ratio, Fault clearance rate, New subscriber connections and Call completion rate.

– The desirable indicators of QoS, Network performance and Facility control are recommended for monitoring total activity of Operation and Maintenance.

– The preventive maintenance method covered all telecommunications facility is recommended on the category of Work scope, Objective facility, Checking Method and Objective items for Facility Quality control.

(2) Operation and Maintenance System for New Rural Network

The operation and maintenance system should be reconsidered for the new rural network planed in the master plan to execute the efficient operation and maintenance.

a. Organisation for New Rural Network

Since the centralization of jobs in Sum Centres will be possible with the digitalisation of rural network and introduction of PC Supporting system, it is recommendable that the operation and maintenance of facility in Junction Network and Switch, Billing and collection work, New connection work and some management work etc. in Sum Centres should be centralized to Aimag Centre or Large Sum Centre for the efficiency and unification of work. On the other hand, each Sum centre should handle mainly the operation maintenance of Access Network in Sum Centre.

The details of recommendation are stated on the Job Demarcation, Organisation of Aimag Centre, Organisation of Sum Centre and Staff allocation.

b. Improvement of Outside Plant Fault Repairing System

The execution of accurate repair work on the site is essential and work procedure, repair method and repair report are recommended for reducing the high fault ratio of outside plant.

c. Settlement of New Connections system

With the extension of Rural Telecommunications Network, mass of new connection in Sum centres will be occurred at the commencement of new network and it is recommendable to provide the Task Force in Aimag centre to implement mass connection work. Otherwise, mass connection work should be included in the rural network expansion project together with the cutover work of existing subscriber lines.

Work procedure of Service Order in Sum centre and Aimag centre is also recommended.

d. Network management in Aimag Centre

Aimag Centres should manage the new rural network up to Sum Centre Switch with the NMS functions, which should be included in New Rural Network system to monitor the Alarm and Traffic from Aimag Centre.

The necessary operation works for rural network management are listed as a recommendation to be handled by Aimag Centre.

e. Tools, Equipment, Maintenance Material and Vehicles

- It is necessary to review the allocation of suitable tools and equipment for the operation and maintenance of the new digital rural telecommunications network. These should be basically stored in each Aimag centre.

- Proper volume of Maintenance material should be secured in the Aimag Centre for Rural Network. It is recommendable to procure the Materials for three years of maintenance period in the rural network implementation project.

- It is recommend that 2-3 vehicles as minimum requirement should be arranged

for the maintenance group of rural network in each Aimag Centre to shorten the repair time of the fault in the rural network.

f. Information system in Sum Centre

It is desirable to introduce the Computer network with E-Mail system between the Aimag centre and Sum centres for the smooth execution of Operation and Maintenance.

g. Cultivation of Staff for Rural Network

The staff training is required to cultivate staff for the digitalisation of rural network and Job Centralization, especially for the digital technical staff, multi-skill staff, high skill expert etc. with in-house training and Supplier training.

h. Billing and collection

Billing System should be expanded to Sum centre subscriber.
Aimag centre should compute the billing up to Sum Subscriber and Sum centre would handle the bill collection in the Sum centre.

12.2 Present Status and Problems on Operation and Maintenance

12.2.1 Operation and Maintenance Situation in 1996

(1) Basic Plan for the development of the telecommunications in Ulaanbaatar city

JTEC (Japan Telecommunications Engineering Consultant) made survey and analysis for O&M statue in Ulaanbaatar area (95-96) by the above study. Recommended improvements items are as follows:

a. Strategy

To remedy the fundamental weakness which comes from the poor management structure, lack of statistical management, poor quality and shortage of spares.

b. Organisation

Organisation structure should be functionally divided into three levels as follows;

National Management Centre (NMC).
Regional Management Centre (RMC).
Outside Plant Maintenance Centre (OPMC).

c. Method and Procedure

To provide common operational standard practices.

d. Staffing and Training

Number of personnel should be reduced.
Settlement of Training centre in Ulaanbaatar city.
Execution of Training program of Network Planning, installation and maintenance with Technical standard practice and High-level Management course.

e. Material Management

Introduction of the computer system to improve material management.

f. Information system

Performance of the network, the traffic and call completion.
QoS of the local cable, fault clearance performance.
Billing process and operators response time.

g. Future operation and maintenance improvement plan

Provision of Target Quality of Services
Introducing of Total quality control system

12.2.2 Operation and Maintenance Situation at Present (July, 2002)

JICA Mission made surveys, interviews with PTA and MT in June 2002 and collected various data, information and documents regarding the present situation of O&M activities in Mongolia.

In general, it was observed that considerable improvements have been applied and

implemented in all O&M areas of MT in response to the previous recommendations. According to our observation, MT is taking their successive efforts to improve O&M activities and work procedures. Even though, the most facilities such as Switch, Transmission and OSP in every Sum centres were installed in the former Soviet Union era and their life had almost completed its span, minimum number of personnel, Head of Exchange, one operator and one technician, 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 need to be improved in QoS and efficient work performance point of views.

(1) Improved items

Following are the improved items we found:

a. Management of QoS

QoS such as Operator response time, Fault occurrence rate and duration of failure so on are monitored in every Aimag and Sum Centre. The performance results and Customer satisfactions are collected and reported as monthly report in Headquarters. (See Annex 12-1 and 12-2)

b. Digital network management

Operation Maintenance Centre in Ulaanbaatar manages the digital network performance such as surveillance, trouble handling, traffic measurement, data analysis and reporting. Therefore, the basic Digital network management system has been provided for the backbone network and Aimag Digital Exchanges.

After this, it is necessary to review the management system for the improvement of the network performance.

c. Operators' response time

Target of Operator's response time has been settled up to Sum Centres. The results of Operators' response time in Aimag Centres are reported as Average of 6.6 sec and success for the target in the monthly report. (See Annex 12-2).

d. Set up performance target

MT has already set up detail performance targets that are for Fault clearance period, Operator call reposes time, Telegraph delivery and New Subscriber line installation etc. issued in 1997. (See Annex 12-3)

And Operation and maintenance performance have been controlled with the targets and improved much. As example, the number of Cable faults was clearly improved in every Aimag and the deviation among the Aimags also has been considerably narrowed, especially after the target settlement at 1999. (See Annex 12-4).

e. Adequate daily and monthly report

The reporting system is being applied in Head Quarters, Aimags and Sums and Service Quality and Performance of each exchange is reported. However, the reported items in the report are still part of the whole O&M activities and the reporting system should be improved. (See Annex 12-6)

f. Organisation

MT organisation has been reorganized at many areas since 1995. Annex 12-7 shows the organisation that was destructed for improvement of function, especially in the area of O&M in 1996.

- Information Technology Centre was established for handling of Billing and Finance Data.
- MT settled their own Training Centre for their employees and 700 trainees attend courses every year.
- Operation Maintenance Centre (OMC) for Digital SW and Transmission System with NMS was also established in Ulaanbaatar.
- Repair Centre function was instituted in OMC for easy repairing of SW, Battery, TR and Air-condition hardware troubles and to manage the supplier's repair work for Maintenance parts.

g. Customer service activity

MT prepared the procedures such as "Telephone usage regulation", "New subscriber connection system" (Ref. Annex 12-10 (Figure): Workflow of New Subscriber Connection) and "Reception and installation role on new subscriber connection" for new subscriber connection and manages the progress in Ulaanbaatar. However, there is no standard practice and progress management in the rural area because of few work volume.

h. Outside plant activity

OSP activity is organized and the Work is demarcated to Work performance management, Facility management and working group. Standard practice is also provided.

Periodical Facility inspection and preventive maintenance work are also made by OSP group. During facility inspection, simple deteriorated facilities in Subscriber line are reinforced and others are listed on the deteriorated facility list for yearly plan.

However, the work procedure and standard practice are still need to review the details for reduction of faults and shortening of repair time.

i. Plant record management

Plant record on the used pairs, vacant pairs and fault pairs in the primary cable and Secondary cable are managed by Facility management Group and pair number assignment for New subscriber connection is also done by this group in Ulaanbaatar.

Periodical test on the vacant pairs are executed and the results are feedback to the up-date of the record.

The record is maintained by manually on MDF terminal Table and Cross Connection Cabinet (CCC) terminal tables. The PC supporting system is under preparing.

j. Billing and collection activity

Information technology Centre (ITC) computes Call rates on International calls,