6.3.3 Signalling System in the Future

MT is going to adopt the ITU-T CCS No. 7 signalling system where it is applicable as it is an international standard of international telephony network. Some digital exchanges now in use in Mongolia is not equipped with the function of CCS No. 7, because their function is limited somewhat.

Most of the digital exchanges in Aimag centres are EWSD of Siemens. They are all able to be connected through CCS No. 7, if the transmission system is durable for the signalling system.

6.4 Routing Plan

The routing plan defines the route to which the traffic is directed. The routing plan is closely affected by the network form. The Mongolian network is formed in a star type where the inter-exchange circuits are let out of Ulaanbaatar to each Aimag centre. No short cut route is provided between Aimag centres, accordingly, order of route selection is not required in the existing telephone network. The routing plan of telephone network will be established when the number of exchanges has increased enough to provide short cut routes.

In regard to the MT network, there are only three (3) host exchanges in national capital Ulaanbaatar. Others are remote switch units of the host exchanges. The host exchanges are linked directly each other.

There is only one switching unit in Aimag centre principally. The Sum centres are not linked with inter-exchange circuits with its Aimag centre, but they have the long distance subscriber lines of the Aimag centre.

6.5 Charging Plan

6.5.1 Existing Charging System

The automatic telephone call of MT network is charged in proportion to its duration in digital exchanges in the national capital and Aimag centres. The call within Sum centre is charged by month.

The duration is converted to equivalent number of call units based on the tariff. Table 6.5.1-1 shows the charge in Tugrug. The call is charged per complete minute or not complete minute.

Table 6.5.1-1 Call Tariff

Description	Charge per minute (complete or not complete one minute)
A. Domestic long distance calls	---
1. Less than 300 km	---
Normal	154
Discount	137
2. 301 to 1,000 km	---
Normal	205
Disacount	181
3. 1,001 km or more	---
Normal	231
Discount	202
B. Local calls	---
Ulaanbaatar, Aimag centres	7

Source: PTA.

The duration of every call is calculated by the time shown in Table 6.5.1-1 and converted to call units to record as charge data at digital exchange of Aimag centre. The digital exchanges have the function to record the call charge data stored in the call charge meter provided corresponding to each subscriber number on suitable data media.

6.5.2 Exchange Functions for Charging

Since the tariff system is revised by various reasons, the switching system shall be flexible to meet such changes. MT has stipulated that the digital exchanges to be used as local or secondary switching centre switch should be so designed that the time of one call unit, hours during which the rate is applied and the days during which the rate is applied can be changed by man-machine interface at site when necessary.

The switching node related to charge should be able to record the call charge data stored in the call charge meter on suitable data media, such as reel/cassette type magnetic tape, hard disk, laser disk or floppy disk, etc. Every digital exchange related to charge is so designed to allow getting out put of charge data by man-machine inter-face at site when necessary. MT gate-way switches, which have links to/from network operators other than MT, should be able to record detailed data concerning the traffic.

MT digital switching equipment at transit point, which is actually the Aimag centre, is equipped with detail billing function. The switching system records the charge data in two ways, that is, subscriber meter and detail information. A subscriber is provided with four (4) counters; counter 1 is for local calls, counter 2 is for national (trunk) calls, counter 3 is for international calls, and counter 4 is for subscriber features. The detail information includes data required for compiling detail bills for subscribers, which includes calling party's number, starting/completed time of payable communication, called parties number, exchange code, etc.

6.5.3 Charging Node

The charge nodes should be local exchanges, transit exchanges and gateway switches for international connection. The gateway switch which has a link to/from the network of operators other than MT is equipped with charging function.

Local calls should be charged at local exchange. Trunk calls should be charged at transit switching. International calls should be charged at international switching centre. As to the inter-network calls, the call charge data is obtained at MT gate way switches.

6.5.4 Charge Data Transfer

Charge data collected at exchanges are transferred manually or electrically to MT billing centre. The digital exchanges, actually EWSD witching units of Siemens, send the charge data to the billing centre on X.25 protocol via digital transmission link. Analogue exchanges, or E-10B switching units, send manually the data file to the billing centre.

The charge data include calling party's directory number, called party's directory number, time of communication commencement, time of communication end. The collected data are kept for months, or more than a year sometimes, in order to meet user's inquiry. Figure 6.5.4-1 shows the data transfer diagram.

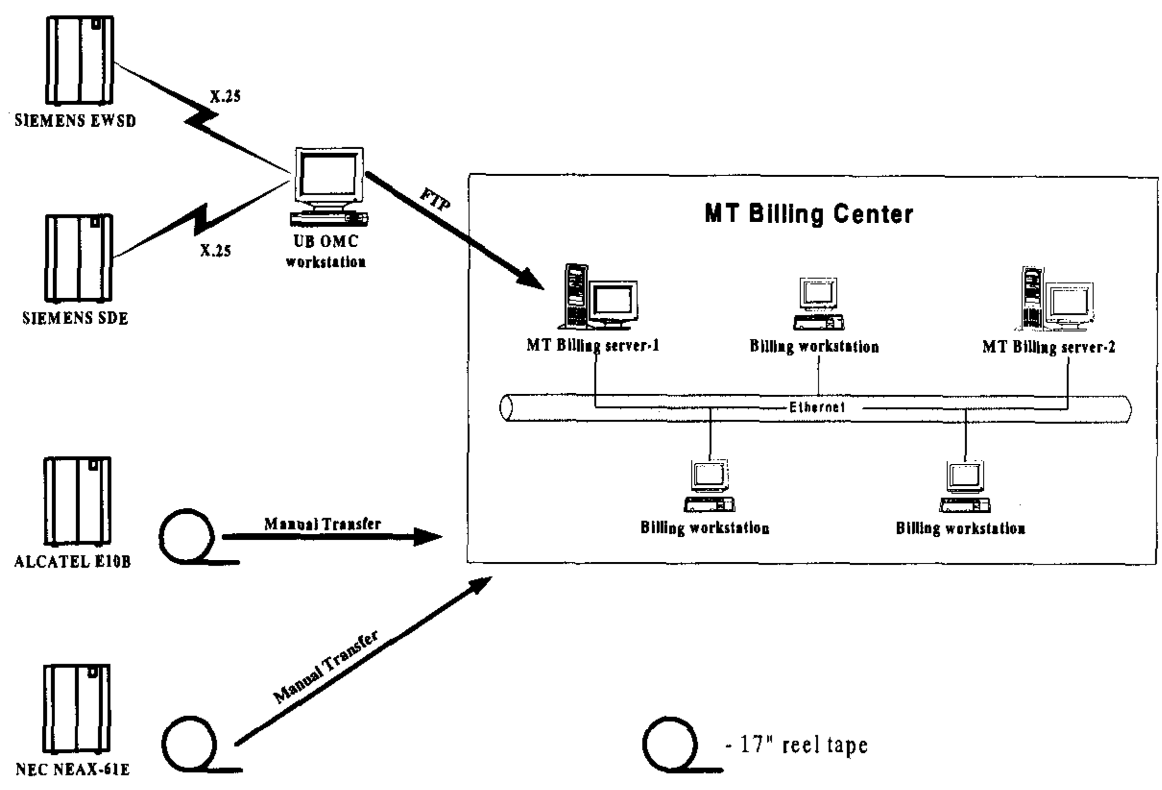


Figure 6.5.4-1 Charge Data Transfer

6.6 Network Synchronization Plan

The Mongolian Primary Reference Clock (Master Clock) is NFR2001 caesium oscillator, located in the international switch centre in Ulaanbaatar, with frequency accuracy of 10^{-11}, which frequency can be calibrated by GSM system. As all digital switches and SDH digital transmission systems must be synchronized with the Master Clock, those digital systems should have digital links with Master Clock all the way to the systems from Ulaanbaatar.

In Mongolia, PDH digital transmission systems are still used and will be installed more. Their synchronization with the master clock is not required, but they could be synchronized with the Master Clock. The clock timing can be carried through the PDH digital transmission systems anyway.

All telecommunication operators in Mongolia receive the primary reference for synchronisation of their equipment. This one primary reference clock policy in Mongolia should be kept not to make network connection troublesome among various telecommunication operators.

Another master clock should be introduced in a deferent place from Ulaanbaatar, say, in Erdenet, for back up of the Master Clock along with the network digitalisation development, since the clock supply become more vital in digitalized network.

Several Slave Clocks should be also installed in some regions of Mongolia, which are usually synchronized with the Master clock, through either of hot clock path or stand-by clock path, to supply accurate clock timing to digital network in the covering regions. The relay of clock timing from the Master Clock supplies more cleaner timing by reducing jitter and wander of clock timing, which occur by long travel through many digital networks. The Slave Clocks can also produce clock timing by themselves with frequency accuracy of 10^{-10} to prevent interruption of clock supply even in case of input clock timing failure.

6.7 Error Performance Objective

Mongolian telecommunication network is a part of international telecommunication network for which error performance objectives are recommended by ITU-T. The error performance objectives are distributed to national sections.

An example of error performance for national sections is shown below as reference. Error Performance is not measured by simple bit error rate. Statistical data gathering is becoming necessary.

Table 6.7-1 An Example of Error Performance Objective

Section	%DM	%ES	%SES
Subsriber line (one side)	1.5%	1.2%	0.015%
Trunk	3%	2.4%	0.03%
Total	6%	4.8%	0.06%

%ES: Percent Errored Second

%SES: Percent Severely Errored Second

%DM: Percent Degraded Minutes

6.8 Network Availability

Network Availability objectives for Mongolian telecommunication network should be made, on which networks are constructed.

However, in Mongolia, where network expansion has higher priority than network stability, following policies are made in the Study, in stead of making the network availability objectives:

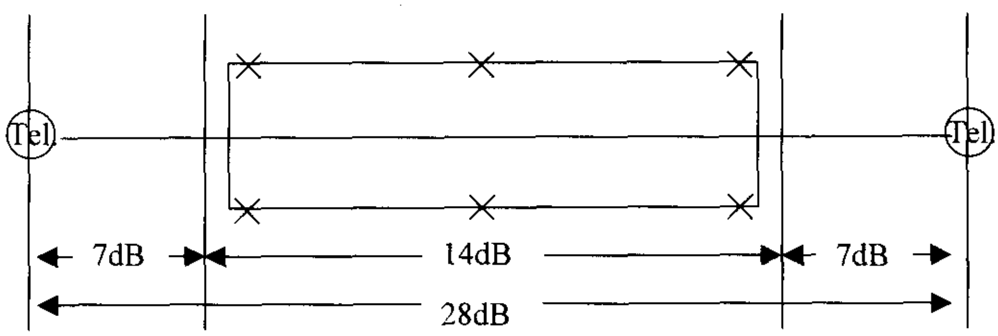
(1) Obsolete facilities are replaced to obtain high stability of networks in addition to high quality of networks,

(2) and then stand-by systems should be introduced for higher stability of networks, considering cost of stand-by systems.

There are many ways to increase network availability. However, in the Study of rural telecommunication, only stand-by system is considered if cost is not high. SDH ring configuration, which is a very fine method for network stabilities, is not applied in the rural network.

6.9 Loss Assignment

Standard loss assignment in Mongolia is shown in Figure 6.9-1.



Source: PTA.

Figure 6.9-1 Loss Assignment in Mongolia

6.10 Quality Standard (Quality of Service)

The Technical Comittee-3 in the National Centre for Standardisation and Meteorology (NCSM) have set up procedures to keep Quality of telecommunication Service in Mongolia, based on ITU recommendations, ITU-R.594-3, ITU-T E.424-428, 430-434, 450, 452,550,810, 820, and 830.

(1) Speech Quality

Because of obsolete equipment in Mongol, telephone speech quality is sometime deteriorated. Mongol should set up an objective for speech quality and improve their network to achieve the objective. Speech Quality should be evaluated by telephone users and MOS (Mean Opinion Score) is used for the evaluation. However, ITU-T has provided other evaluation methods such as AEN (Articulation Reference Equivalent, see ITU-T P-45) and LR (Loudness Ratting ITU-T P-11, P-78, etc.), which values correspond to MOS values. AEN, based on measurement of the fraction of speech sounds recognized correctly, is outdated, but good for analogue network on which speech quality is not always kept good. LR, mainly based on measurement of relative loudness of speech reached at the ears of customers, is better for digital network on which speech quality is easily kept good.

(2) Connection Loss Probability

Connection Loss Probability is required for better customer service and to calculate number of circuits from traffic as well.

For Example, if total connection loss probability is set as 10% for end to end toll call, the connection loss probability is distributed to switches, concentrators, TDMA radio systems as shown in Figure 6.10-1, assuming that two switches in Uraanbaatar are involved in the toll connection in the worst case.

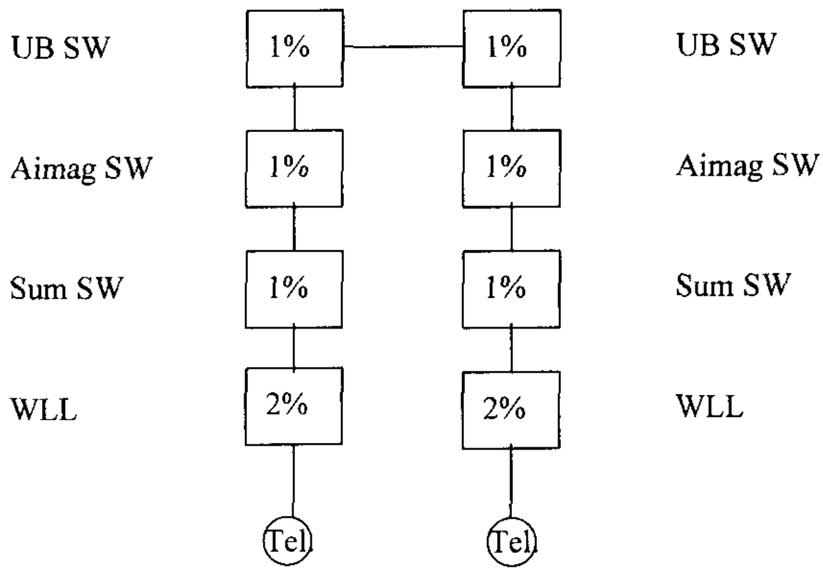


Figure 6.10-1 Loss Probability

(3) Connection Delay

Objective of delay in time from end of dialling to sending of ring-back tone should be set up for better service to customers.

For example, the connection delay objective is 15 seconds for end to end toll call or so.

6.11 Inter-Network Connetion

6.11.1 Inter-Network Connection of Existing Network in Mongolia

There are several telecomminications operators in Mongolia; telephone operatores, mobile telephone operators, WLL operatores, Pager operators, Internet service providers. Their networks are currently inter-connected in Ulaanbaatar. Along with network development of each operators, the points of interface will be scattered gradualy to remote areas from Ulaanbaatar, because it is one of business matters for telecommuncation operataors to bypass other operators' PSTN netowork for cost saving and try to make points of interface near to customers as many as possible.

6.11.2 Inter-Network Connection Issues

There are many things to be considered for inter-networks connection with other operators: location of Point of interface, singalling methode, numbering plan, billing methods, tariff (access charge), procedure of maintenace and operation, and etc..

As for nummbering plan, proper Destination Network Codes (DNC) to each of coming new carrier operatorss should be provided to have the options to establish the direct inter-network connection each other.

At points of interface, there will be propably gateway switchs by which networks of defferent operators are conneted each other, usually useing CCS No.7 singnalling system. Gateway switch usually gather billing informations related to the other operators, and act as demarkation point of maintenace and operation.

6.11.3 Interface

(1) Interface with the access network

As for an interface with the access network, V5 Interface has been standardized as a common platform of the subscriber line interface which connects the switching system (Main Switch Unit: MSU) and the access network (DLC/PON: Passive Optical Network/WLL) in accordance with ITU-T Recommendations G964 and G965.

An example of interface relationships between the switching systems and the access network is illustrated in Figure 6.11.3-1

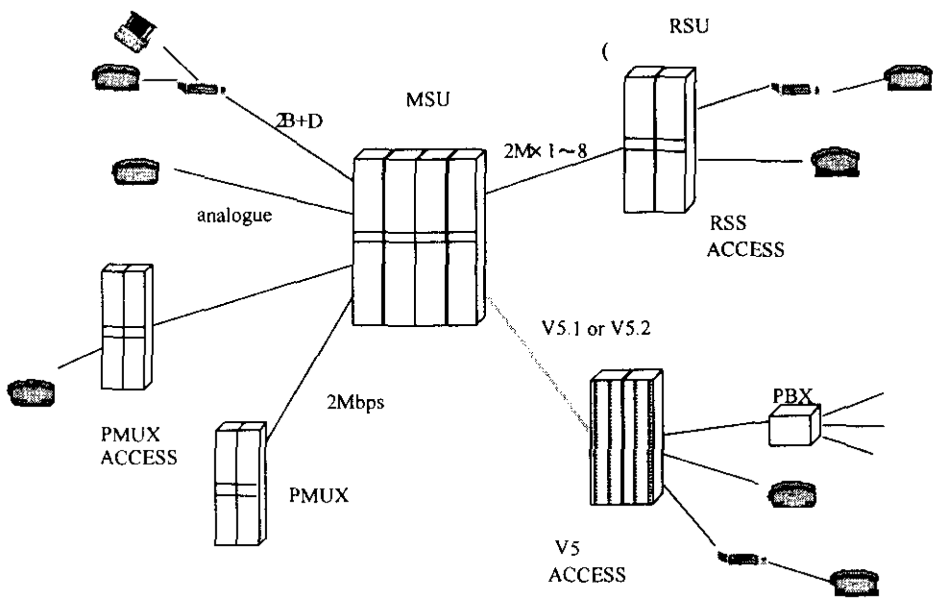


Figure 6.11.3-1 An Example of Access Network Configuration

(2) V5.2 Interface

V5.2 Interface was standardized by ITU-t in March 1995 in accordance with European Specification (ETSI Standard) as an international standard interface which connects Local Exchange (L. E.) and the access network in the Multi-vender Environment.

V5.2 interface is shown in Figure 6.11.3-2.

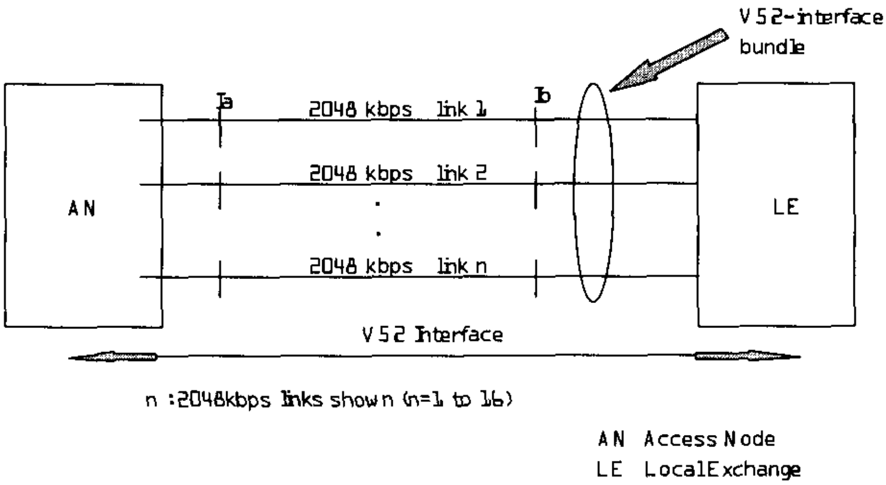


Figure 6.11.3-2 V5.2 Interface

(3) V5.1 Interface

V5.1 Interface is also standardized by ITU-T together with V5.2 Interface in June 1996 in accordance with ESTI Specification (European Standard).

A comparison between V5.1 Interface and V5.2 Interface is shown in Table 6.11.3-1.

Table 6.11.3-1 Comparison between V5.1 Interface and V5.2 Interface

	V5.1 Interface	V5.2 Interface
Interface Link	2,048kbps x 1	2,048kbps x N N:1～16
Channel Concentration	Not available	Available(BCC Protocol) BCC: Bearer Channel Connection
Subscriber Access Interface	-Analogue Telephone Interface -ISDN Basic Interface -Leased Line Access	-Analogue Telephone Interface -ISDN Basic Interface -Leased Line Access -ISDN Primary Group Access
Others	-	Link control etc is regulated for For Multi-media Link

6.11.4 Interconnection Interface

An interconnection interface is necessary to interconnect between the existing networks and new common carrier networks. For this purpose the following system must be standardized:

(1) Numbering Plan

There are two (2) cases to realized the associated interconnection between different networks in relation to the numbering plans;

(a) Present number plan can be applied without changing an identification code of the new common carrier network.

(b) A new identification code must be provided for a new common carrier network, depending on the network type and operation license of the new common carrier.

(2) Tariff System

In the tariff system for the mutual connection between different operator networks, there are two (2) kinds of tariff system;

(a) Sum-Up Charging System: Defining business services clearly with a boundary of POI (Point of Interface), communications fees will be individually set up for each operator who handles the communication traffic.

(b) END-TO-END Charging System: one out of an calling side operator, inter-provincial operators and a called side operator will set up a total amount of the communication fees and will collect the fees from customers.

(3) Types of Interconnections and Responsibility of Business Operators

(a) A type of the interconnection can be classified into two (2) types of interconnections in a major breakdown, as shown in the followings:

i) Transit Circuit Interconnection
ii) Subscriber Line Interconnection

(b) Advantage and Disadvantage of both types

i) Transit Circuit Interconnection

- Same communication quality as the existing network
- Overall economical effect is available
- Many interconnection interfaces

ii) Subscriber Line Interconnection

- Communication quality will be inferior than the existing network
- Economical effect will not be expected as a whole
- Interconnection interfaces are simple and renovation cost is rather low.

(4) Interconnection Method

The mutual interconnection of different common carriers are normally made through the Point of Interface (POI), as illustrated in Figure 6.11.4-1.

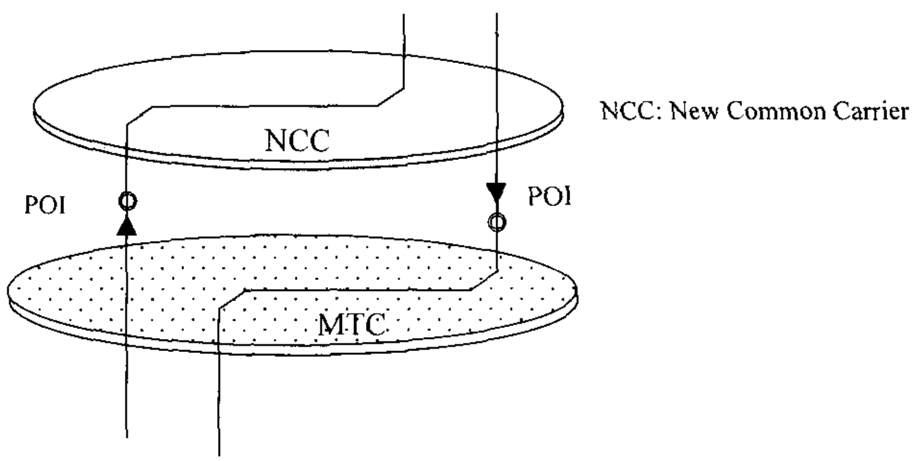


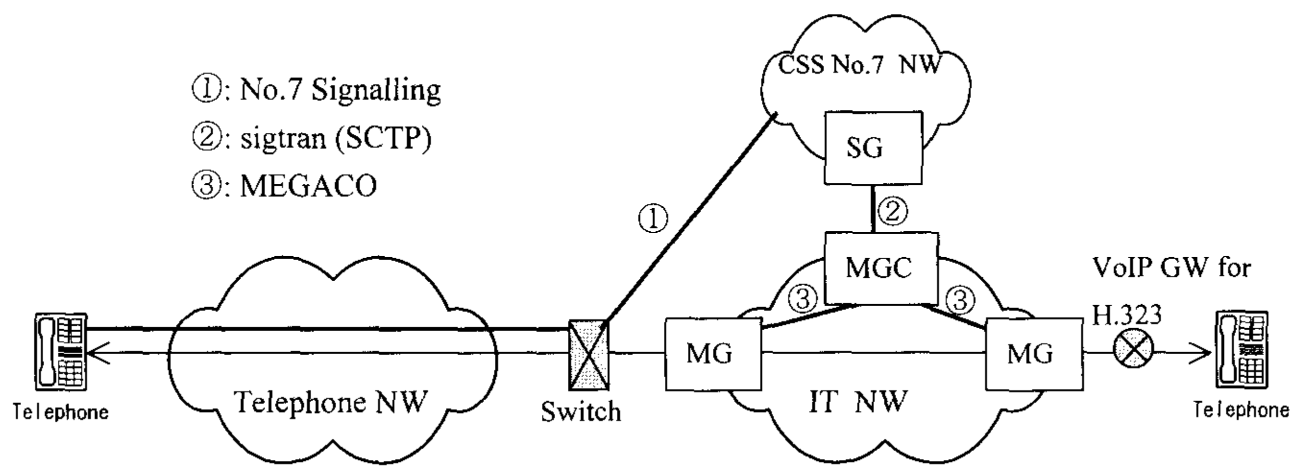
Figure 6.11.4-1 An Example of Point of Interface

6.11.5 Interconnection between PSTN Network and VoIP Network

Like CSS No. 7 signalling system in PSTN, there are call control protocols used in VoIP (Voice over IP) network. H.323, SIP and MEGACO (H.238) are the three main call control protocols.

H.323 is a recommendation by ITU-T and currently widely used. But H.323, which has full of functions including handling of multi-media data, is rather heavy: Connection delay is often long and terminals supporting H.323 are expensive. Therefore, a lighter protocol, SIP (Session Initial Protocol), which is a standard of IETF (Internet Engineering Task Force), is becoming popular. Within VoIP network, SIP will be most widely used in future.

As for Interconnection between PSTN network and VoIP network, MEGACO (Media Gateway Control or H.248) will be widely used. MEGACO is a standard of IETF and a recommendation of ITU-T. An example of configuration for the interconnection is shown in Figure 6.11.5-1.



SG:	Signalling Gateway
MGC:	Media Gate Way Control (Call Agency)
MG:	Media Gate Way
Volp GW:	VoIP Gate Way
sigtran:	signalling transport
SCTP:	Stream Control Transmission Protocol
MEGACO:	Media Gateway Control

Figure 6.11.5-1 Interconnection Configuration between PSTN NW and IT NW

CHAPTER 7

DEMAND FORECAST AND FULFILMENT PLAN

CHAPTER 7

DEMAND FORECAST AND FULFILMENT PLAN

7.1 Trend of Information and Communications Technology

7.1.1 Country Overview

(1) General

Mongolia is an area of 1,566,500 square kilo-meters with a population of 2.413 million of which 67% live in remote and rural areas as of the year 2001. The capital city, Ulaanbaatar accounts for 33% of the total population in the same year. Mongolia has a population of 1.5 per square kilometers, one of the lowest in the world. Mongolia has a relatively low growth rate of 1.9% (2000), down from 2.5 % in 1989. At this rate Mongolia's population will reach about 3.2 million by 2020. Administratively, the country is divided into 21 Aimags and more than 340 sums (counties). The population in the Aimags usually does not reach more than 120,000 persons; with an average at 80,000 as of the end of 2001.

(2) Telecommunications Development Strategy

Since the 1991, intensive measures directed toward establishing an economic structure of implementing phased market deregulation have been pursued with intentions to open the Mongolian markets to the world community. Mongolia's government defines the country's development strategy as an attempt to establish a democratic and humanitarian society. Different development models such as "Knowledge-based Economics", "IT–driven Economics", etc., are under discussion among government and public communities.

Within the framework of Mongolia's development strategy, information and communication technology is positioned as a key, and a vital development factor promoting Mongolia's "Information Communication Technology (ICT) Vision-2010" program, as defined in 1998. A new and updated national action plan for ICT development is currently enhancements made possible through global ICT and business Management innovations.

7.1.2 Telecommunications Demand

The main purpose of this Chapter is to estimate the growth in telecommunications demand for telephone and other service and to provide the basis for an economic and technical study of the basic plan for the telecommunications system development in rural areas (Aimag-Sum) in Mongolia up to the year 2020. The forecasting base year is set at 1995, and successive forecasts are made in 2008 (short-term), 2013 (medium-term) and 2020 (long-term). Because the economical development index of GDP and GDP per Capita should be fixed at 1995 constant price in US Dollar for evaluation and authorization purpose of the Master Plan Study.

The national demand forecast for fixed telephone is done by applying the ITU model which counts on the correlation between the Gross Domestic Product (GDP) per Capita and telephone density per 100 inhabitants in Mongolia. In applying the ITU models for Mongolia, after the analysis of two (2) models of (i) ITU Asian Country group and (ii) all ITU country group with same GDP value as Mongolia. Finally, the first model for macroscopic forecast method (i) was selected due to the reason mentioned below;

In order to verify a increasing trend or gradient of the fixed telephone development, various country groups of ITU members such as the whole world, European and southern Asian country group and former Russian socialist country group, etc. are studied and analysed. The Asian group countries proved to have similar average growth rate in GDP to that of Mongolia at a growth rate of GDP at about 5%.

On the other hand, development trend of the fixed telephone in Mongolia has the similar development tendency in the past in terms of GDP and similar trend in the future as the Asian Group as well.

Demand forecast estimated for the whole country of Mongolia is further distributed to obtain the demand for rural areas (Aimag-Sums) by using the correlation factor between the rural telephone density and Gross Regional Domestic Product (GRDP).

To determine the most optimal estimation for demand forecasting of fixed telephone services, three (3) exponent formulae are worked out to study which one of three would secure a more reliable correlation between the equation and targeted trends of estimation: ① low growth curve (formula), ② medium growth curve and ③ high growth curve (Refer to Annex 1 and Annex 2).

As for the demand forecast for project sums (counties) in Mongolia, a few variation patterns are studied in combination with the population growth rates, telephone density and influences of various development plans up to the year 2020.

The demand forecast for mobile telephone services in Mongolia is estimated by using the ITU Asian country group in the same way as in the case of fixed telephone services. But getting an optimal formula of demand forecasting for the mobile telephone is rather difficult for harmonizing the past development record and the future development trend of this service. Because, the supplied volume of the mobile telephone service in Ulaanbaatar and major cities in Mongolia by two carriers (Mobicom and Skytel) are so high with concentration of investments in those viable areas in the years 1999, 2000 and 2001. Therefore, it is not easy to justify the most appropriate method of forecasting for the future.

To solve this matter, a logarithm curve can be applied in accordance with the ITU average regression curve and three (3) models can be also applied to clarify the past supplied volume and to foresee the demand deployment trends for the year 2020 in the same manner as applied to the fixed telephone; ① low growth curve (formula), ② medium growth curve and ③ high growth curve.

The other services than fixed telephone and mobile telephone services, the approaching method for forecasting the demand of Non-Voice services, Internet, E-Mail etc. are almost of same nature as in the above-mentioned methods.

7.2 Approach Method of Telecommunications Demand Forecast

7.2.1 General

The telecommunications demand forecast on national basis is done by applying the ITU model, since a demand growth estimation has a close correlation between the Gross Domestic Product (GDP) per capita and telephone density per 100 inhabitants in general. In applying the ITU models for Mongolia, after the analysis of the socio-economic development records in the past and in the future as well for Mongolia, ITU Asian Country group data are selected due to the reason mentioned below;

Mongolia belongs to the Asian country group and the Asian group countries have proved to have similar average growth rate in GDP to that of Mongolia.
On the other hand, a growth of the telephone in Mongolia has the similar development tendency in terms of GDP and teledensity .

7.2.2 Demand Forecast Procedures

(1) Fixed Telephone Model (GDP/capita vs. Telephone Density)

Demand forecast for fixed telephone is carried out by using a regression model of ITU, because the Mongolia's economy has the similar development trend as the average growth rate in GDP of ITU Asian country group. But it is not enough to apply this regression curve directly to calculate the distributed demand forecast for Aimag-Sums in accordance with the relationship between telephone density and GDP growth rate in Aimags-sums.

Therefore, three (3) growth curves are employed as described in the above; ① low growth curve(formula), ② medium growth curve and ③ high growth curve.

(2) Method of Approach

The method of approach employed here is an integration of "top-down and bottom-up" and "backward estimate and forward forecast" approaches, as shown in Figure 7.2-1 below:

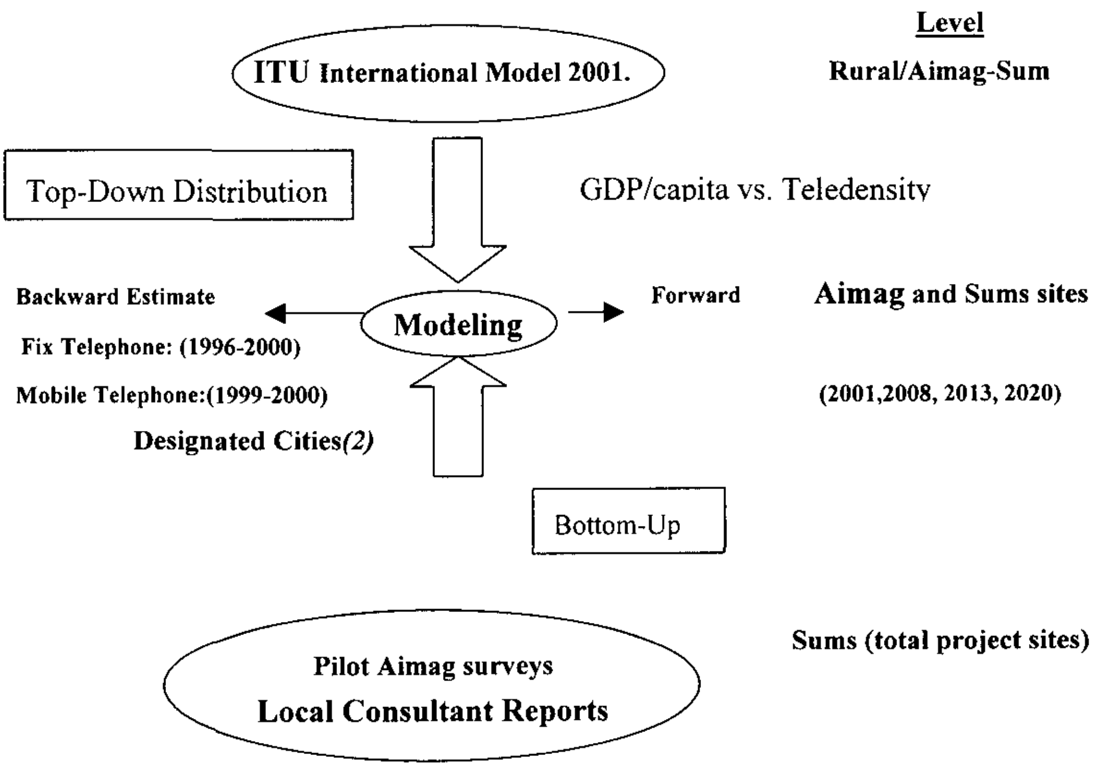


Figure 7.2-1 Method of Approach

In this study;

(a) Top-Down approach method is used to calculate the average growth formula by Asian group countries.

(b) Bottom-up approach is used with analysis of the results of piloted field survey reports and a various kind of socio-economic reports conducted, policies of Mongolia government and PTA guidelines and reports.

(c) Backward estimate and Forward Estimate are made to analyse the fluctuations of GDP, growth rate of population and telephone density in the past and in the future.

It is well known that GDP (Gross Domestic Product) per Capita in a specific country has a strong correlation with the telephone density (Main Lines/100 Inhabitants). However, simple application of a regression formula derived from available data, in a specific year and for a specific country, to an estimate of fixed telephone has been misleading as evidenced by the fact that Mongolia accomplished connecting fixed telephone lines, in 2000/2001, more than about 2 times as many as the estimate deducted from a regression formula (obtained average curve of Asian country group).

It has been found out the regression formulae differ from year to year, GDP to GDP/ from telephone density to telephone density. In this study three (3) regression formulae are derived on the conditions that demand markets will be changed in proportion to growth of teledensity in keeping the growth rate of GDP at 1995 constant price in US Dollar.

7.3 Basic Data for Macroscopic Demand Forecast (Fixed and Mobile Telephone)

The basic data for the macroscopic demand forecast are carefully studied for key factors of population, GDP and teledensity to finally set up simulation scenarios of demand forecast.

The basic data for macroscopic demand forecast is listed in Table 7.3-1 in relation to population, GDP/Capita and GRDP/Capita and the related growth rate of teledensity.

Table 7.3-1 Basic Data for Demand Forecast (Fixed and Mobile Telephone)

Items	Estimated at 2020	Growth Rate	Estimation Base/Precondition
GDP/Capita (National Base)	**1,385 US$**	(1) High Growth Rate • Annual Growth rate: **4.34%** • GDP Growth Rate: **5.86%**	Based on the latest MOFE Forecast
	1,169 US$	(2) Medium Growth Rate • Annual Growth rate: **3.46%** • GDP Growth Rate: **4.97%**	Based on the forecast made by Prof. J. Zags. Harvard University
	892 US$	(3) Low Growth Rate • Annual Growth rate: **2.07%** • GDP Growth Rate: **3.56%**	Based on the forecast made by Prof. J. Zags. Harvard University
GRDP/Capita (Rural Base)	**1,093 US$**	(1) High Growth Rate • Annual Growth rate: **4.25%** • GDP Growth Rate: **5.34%**	GRDP per capita is at 1995 Constant Price in US Dollar Data Source: MOFE
	922 US$	(2) Medium Growth Rate • Annual Growth rate: **3.37%** • GDP Growth Rate: **4.45%**	
	704 US$	(3) Low Growth Rate • Annual Growth rate: **1.98%** • GDP Growth Rate: **3.05%**	
Population	National:3,182,000 Rural: 1,976,700 (excluding Ulaanbaatar)	National: Annual Growth rate: **1.46%** Rural (Aimag-Sum): Annual Growth rate: **1.04%**	Data Source: MOFE of Government of Mongolia

Note 1: All data for Socio-Economic are obtained from Ministry of Finance and Economy (MOFE).
Note 2: Values of GRDP/GRDP per Capita are at 1995 constant price in US Dollar.
Note 3: GRDP per Capita (1995 constant price) are prepared by JICA Study Team

7.4 Macroscopic Demand Forecast of Fixed Telephone

7.4.1 Forecast Method

The macroscopic demand forecast for the fixed telephone was made in the manner mentioned below:

(1) Forecast Method

As the forecast method, ITU Model (2001.2; 45 Asia and Neighbouring Countries Data) are used, assuming that this country group economic growth rate has a similar development trend to that of Mongolia (Refer to attached Annex 4.4).

(2) Tendency of 45 Asian Countries

The correlation between GDP per Capita and telephone density for 45 Asian countries is as follows;

$y=0.0608x^{0.6536}$ Correlation index $R^2=0.5938$,
where "y" is the telephone density and "x" is GDP per Capita.

7.4.2 Forecasted Macroscopic Demand

(1) Scenario of Demand Forecast

Based on the above (b) and the actual Mongolian GDP/Capita & Density, the following three (3) scenarios are formulated. The detailed is described in the attached Annex 4.3.1.

① Low Growth Demand Forecast

This low rate demand forecast is estimated on the assumption of the growth rate of GDP per Capita (at 1995 constant price in US Dollar) at about 4%, including the following conditions;

(i) The demand forecast curve of Mongolia starts at the point of GDP per Capita of US$ 593 and telephone density of 5.32% in 2001. This point is located much higher than that of curve of the Asian country already, but in this low growth case, the demand growth rate in future is estimated at rather lower as compared with the average growth rate of the Asian countries.

(ii) Telephone density in Aimag and Sum centres will not become so high.

(iii) Growth rate of demand will become lower in the future, as compared with the past 5 year-supply record from 1996 to 2000.

$y=0.25958x^{0.5090}$
where "y" is telephone density and "x" is GDP per Capita.

② Medium Growth Demand Forecast

This medium growth demand forecast is estimated on the assumption of the average annual growth rate of GDP per Capita (at 1995 constant price in US Dollar) at about 5% averagely obtaining in the Asian countries, based on the correlation curve of the above-mentioned item ①.

$y=0.4392x^{0.7869}$

where "y" is telephone density and "x" is GDP/Capita.

③ High Growth Demand Forecast

This high growth demand forecast is estimated on the assumption of high growth rate of GDP per Capita (at 1995 constant price in US Dollar) at about 7.5%, including the following conditions and reasons;

(i) With the starting point of the curve in Mongolia at GDP per Capita (at 1995 constant price in US Dollar) of US$ 593 and telephone density of 5.32% in 2001, the growth rate is estimated at rather higher level as compared with the average growth rate of the Asian countries.

(ii) Fixed telephone will be installed so much in Aimag and Sum centres.

(iii) Growth rate of demand will be increased so much in the future, as compared with the past 5 year-supply record from 1996 to 2000 in Mongolia.

$y=0.0058x^{1.104}$

where "y" is telephone density and "x" is GDP per Capita.

The macroscopic demand of the fixed telephone is illustrated in Figures 7.4-1 and 7.4-2 in relation to three (3) scenarios; low growth, medium growth and high growth. The results of the demand forecasts in low, medium and high growths are summarized in Table 7.4-1 below.

Table 7.4-1 Three (3) Scenarios for Fixed Telephone Demand Forecast

Scenario	Formulae for Demand Forecast	Results of Forecasted Demand at 2020 Number of Fixed Telephone/Telephone Density
①Low Growth	$y=0.2595x^{0.5090}$	2020; Fixed Telephone: 327,800, Density: 10.30
②Medium Growth	$y=0.4392x^{0.7869}$	2020; Fixed Telephone: 414,600, Density: 13.03
③High Growth	$y=0.0058x^{1.104}$	2020; Fixed Telephone: 543,500, Density: 17.08

Note: The forecasted results are tentatively calculated by using a GDP/Capita growth rate similar to the High Growth Rate in Table 7.3-1.

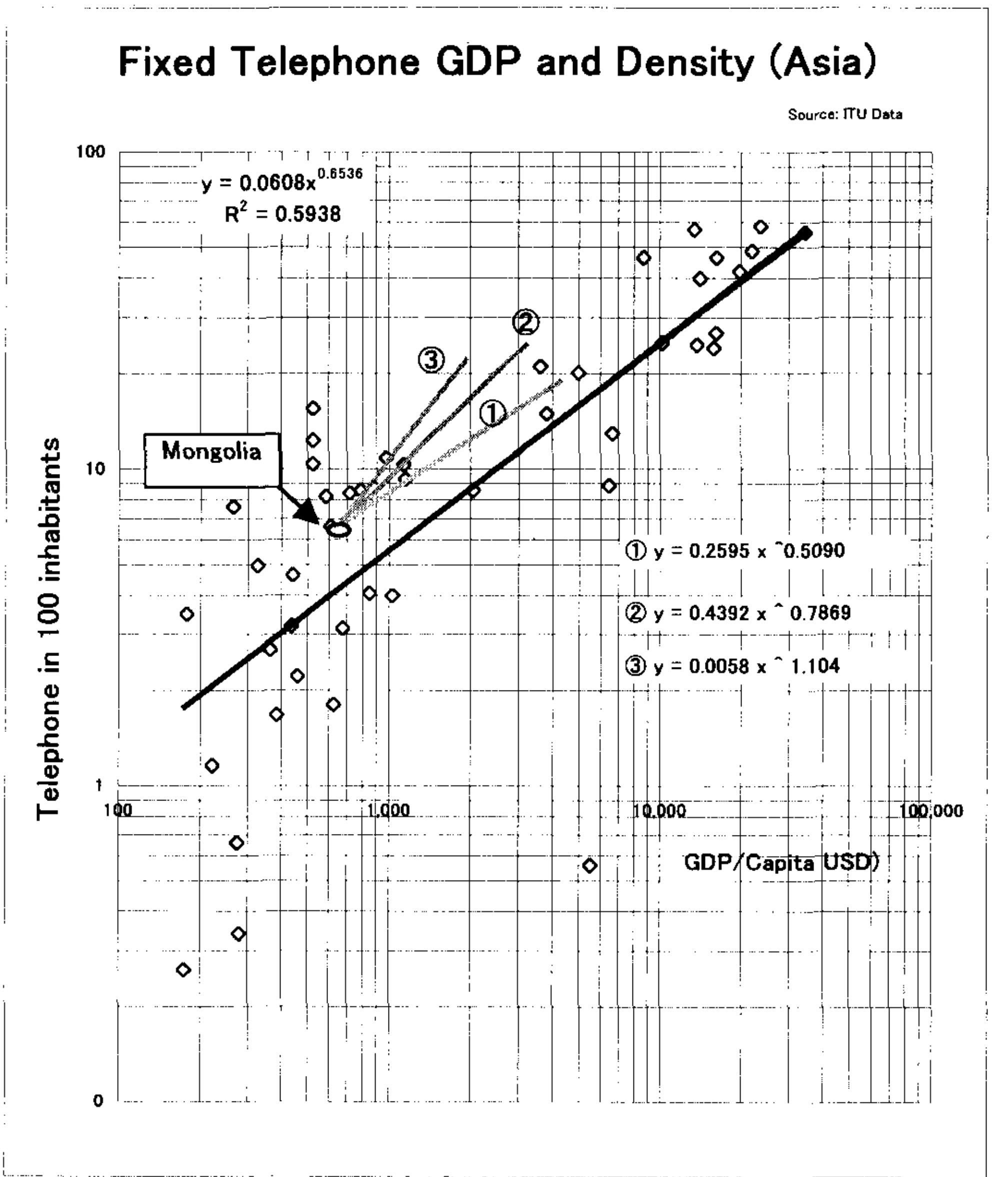
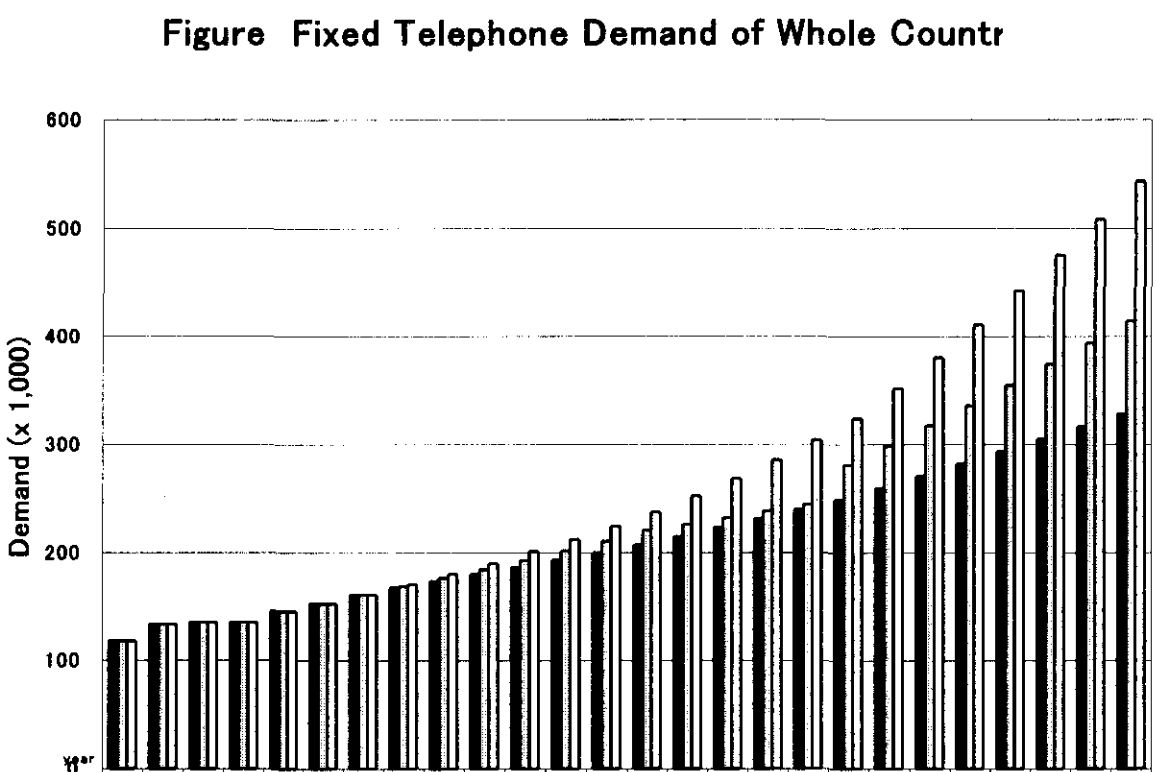


Figure 7.4-1 Fixed Telephone Density and GDP per Capita



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
■①	118.0	133.7	135.6	135.6	145.3	152.5	161.3	167.8	173.7	179.9	186.3	193.0	200.0
□②	118.0	133.7	135.6	135.6	145.3	152.5	161.3	169.0	176.5	184.4	192.8	201.6	210.8
□③	118.0	133.7	135.6	135.6	145.3	152.5	161.3	170.7	180.2	190.2	200.9	212.3	224.4

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■①	207.2	214.9	222.8	231.1	239.8	248.7	259.7	270.8	282.0	293.4	304.9	316.1	327.8
□②	220.5	226.3	232.3	238.3	244.5	281.0	298.9	317.1	335.7	355.0	374.8	394.2	414.6
□③	237.3	252.6	268.6	285.9	304.4	323.9	351.7	380.7	410.7	442.3	475.6	508.3	543.5

Figure 7.4-2 Fixed Telephone Demand of Whole Country

(2) Selection of Scenario

Out of three (3) scenarios of the whole country's demand forecast as described in Table 7.4-1, the Medium growth scenario is selected to be more appropriate one for the telecommunications demand forecasting of Mongolia. Because, those adopted basic data for population growth rate, GDP growth rate and teledensity growth rate in Mongolia are all considered reasonable as the results of the study.

(3) Variation of GDP/Capita Growth Rate

In the Medium Growth scenario (②), three (3) variations of GDP/GRDP growth rates are taken into consideration for further analyses and evaluation for the demand forecast as shown in Table 7.3-1. Finally the Medium growth rate of GDP/GRDP is selected as shown in Table 7.4-2.

Table 7.4-2 Selected GDP/GRDP for Demand Forecast in the Medium Growth Scenario (②)

Scenario	Formulae for Demand Forecast (Scenario ②)	Selected GDP/GRDP/Capita
Medium Growth	$y = 0.0439x^{0.7869}$	(1) National Base Medium Growth Rate - Annual Growth rate: 3.46% - GDP Growth Rate: 4.97% (2) Rural Base Medium Growth Rate of GRDP/Capita of Aimag - Annual Growth rate: 3.37% - GDP Growth Rate: 4.45%

(4) Forecasted Demand

The final forecasted demand is obtained through the above method and selection and shown in Table 7.4-3.

Table 7.4-3 Fixed Telephone Demand Forecast

	Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Demand	Total of Sum Centres	28,795	29,797	30,798	31,800	32,801	33,803	34,804	35,806	37,508	39,211
	Total of Aimag/Districts	92,138	95,540	98,943	102,345	105,747	109,149	112,552	115,954	121,389	126,824
	Ulaanbaatar	75,449	79,309	83,169	87,029	90,890	94,750	98,610	102,470	107,393	112,316
	National Total	167,587	174,849	182,112	189,374	196,637	203,899	211,162	218,424	228,782	239,139
GDP	Aimag	443	461	480	498	517	535	554	573	597	622
	Ulaanbaataar	892	913	934	955	976	997	1,018	1,039	1,073	1,106
	National Total	591	613	634	656	678	699	721	743	772	801
Pop.	Aimag	1,616,618	1,628,395	1,640,173	1,651,950	1,663,727	1,675,504	1,687,282	1,699,059	1,718,782	1,738,505
	Ulaanbaataar	750,840	774,820	798,801	822,781	846,761	870,741	894,722	918,702	938,977	959,252
	National Total	2,412,818	2,450,024	2,487,230	2,524,436	2,561,641	2,598,847	2,636,053	2,673,259	2,714,482	2,755,705
Teledensity	Aimag	5.70	5.86	6.02	6.18	6.34	6.50	6.66	6.82	7.05	7.28
	Ulaanbaataar	10.05	10.21	10.36	10.52	10.68	10.84	11.00	11.15	11.41	11.68
	National Total	6.95	7.12	7.30	7.47	7.65	7.82	8.00	8.17	8.41	8.66

	Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Demand	Total of Sum Centres	40,913	42,616	44,318	46,670	49,021	51,373	53,725	56,077	58,428	60,780
	Total of Aimag/Districts	132,258	137,693	143,128	150,701	158,274	165,847	173,421	180,994	188,567	196,140
	Ulaanbaatar	117,238	122,161	127,084	133,836	140,588	147,340	154,093	160,845	167,597	174,349
	National Total	249,497	259,854	270,212	284,537	298,863	313,188	327,513	341,838	356,164	370,489
GDP	Aimag	647	672	697	729	762	794	826	858	890	922
	Ulaanbaataar	1,139	1,173	1,206	1,273	1,340	1,407	1,474	1,541	1,607	1,674
	National Total	830	859	888	928	969	1,009	1,049	1,089	1,129	1,169
Pop.	Aimag	1,758,228	1,777,951	1,797,674	1,823,241	1,848,808	1,874,375	1,899,943	1,925,510	1,951,077	1,976,644
	Ulaanbaataar	979,528	999,803	1,020,078	1,036,729	1,053,381	1,070,032	1,086,683	1,103,334	1,119,986	1,136,637
	National Total	2,796,928	2,838,151	2,879,374	2,922,598	2,965,823	3,009,047	3,052,271	3,095,495	3,138,720	3,181,944
Teledensity	Aimag	7.51	7.73	7.96	8.24	8.52	8.80	9.08	9.36	9.64	9.92
	Ulaanbaataar	11.94	12.20	12.46	12.87	13.28	13.69	14.10	14.52	14.93	15.34
	National Total	8.90	9.14	9.38	9.71	10.03	10.35	10.68	11.00	11.32	11.64

7.4.3 Distribution Method to Aimags

(1) General

The calculated fixed telephone number of all Aimag (excluding Ulaanbaatar) in Mongolia are distributed to 21 Aimag and 2 districts of Nalaikh and Baganuur of Ulaanbaatar in relation to;

(a) Weighted ratio of GRDP per Capita between the national GDP per Capita and the rural GRDP per Capita
(b) Provisional telephone density with weighted ratio
(c) Provisional demand of Aimag with provisional telephone density, and
(d) Final distribution weight is determined, considering an adjusted macroscopic demand of national base.

(2) Distribution Method to Aimag

The actual distribution method to Aimag is shown in the following Table 7.4-4:

Table 7.4-4 Distribution Method to Aimag

Number	A	B	C	D	E	F
Aimag	Population	GRDP per Capita in US$	Weighted ratio of GRDP per capita	Provisional Telephone Density with Weighted Ratio	Provisional Demand with Provisional Telephone Density	Adjustment to Macroscopic Demand of National Base
A-Aimag	①	② =GRDP/①	③ =②/⑦	④ =③ x ⑧	⑤ =④ x ①	⑥ =⑤x⑩/⑨
Example	50,000	US$300	300/400 = 0.75	0.75x13.03 = 9.77%	4.885	3,338
B-Aimag						
Ulaanbaatar						
National base		⑦ National GDP per Capita : US$400		⑧ Macro density of national base for 2020	⑨ Total sum of ⑤	⑩ National Macroscopic Demand
Example of National base		*(400$)*		*(13.03%)*	*(600,000)*	*(410,000)*

The basic concept of the distribution method to Aimag are as follows;

(a) Correlation relationship between GRDP per Capita and telephone density

(b) Therefore, distributed weight of telephone density can be obtained from a ratio between the national GDP and the rural GRDP.

(d) Adjustment for national value of the macroscopic demand is made by a ratio between a provisional demand and obtained national demand value.

(3) Demand Distributed to Aimags

The forecasted demand of the fixed telephone distributed in each Aimag are shown in Table 7.4-5.

Table 7.4-5 Fixed Telephone Demand Distributed in Aimags

	Name of Aimag	2001	2005	2008	2013	2020
1	ARKHANGAI Aimag Total	3,856	4,818	5,540	6,871	9,426
2	BAYAN-ULGII Aimag Total	3,053	3,622	4,049	5,021	6,888
3	BAYANKHONGOR Aimag Total	4,981	5,909	6,605	8,192	11,238
4	BULGAN Aimag Total	3,214	3,813	4,262	5,285	7,251
5	GOBI-ALTAI Aimag Total	2,892	3,431	3,836	4,757	6,526
6	DORNOGOVI Aimag Total	2,732	3,241	3,622	4,493	6,163
7	DORNOD Aimag Total	2,250	2,425	2,557	3,171	4,351
8	DUNDGOBI Aimag Total	2,157	2,157	2,157	2,643	3,626
9	ZAVKHAN Aimag Total	2,732	3,241	3,622	4,493	6,163
10	UVURKHANGAI Aimag Total	3,777	4,419	4,901	6,078	8,338
11	UMNUGOBI Aimag Total	2,410	2,859	3,196	3,964	5,438
12	SUKHBAATAR Aimag Total	2,892	3,309	3,622	4,493	6,163
13	SELENGE Aimag Total	4,981	5,057	5,114	6,342	8,701
14	TUV Aimag Total	4,017	4,522	4,901	6,078	8,338
15	UVS Aimag Total	2,265	2,675	2,983	3,700	5,076
16	KHOVD Aimag Total	3,053	3,622	4,049	5,021	6,888
17	KHUVSGUL Aimag Total	6,266	7,069	7,671	9,513	13,051
18	KHENTII Aimag Total	3,696	4,141	4,475	5,550	7,613
19	DARKHAN-UUL Aimag Total	7,045	8,031	8,771	10,718	14,491
20	ORKHON Whole Total	17,512	20,533	22,798	28,274	38,789
21	GOBISUMBER Aimag Total	792	792	792	793	1,088
22	NALAIKH Aimag Total	2,421	2,916	3,287	4,077	5,593
23	BAGANUUR Aimag Total	3,144	3,144	3,144	3,601	4,941
	Aimag Total	92,138	105,747	115,954	143,128	196,140

The calculated results for three (3) variations of demand forecast for the fixed telephone are shown in attaché Annex 4.5.1 through Annex 4.5.9.

7.4.4. Demand Distribution Method to Aimag Centre and Sums in One Aimag Area

(1) Definition of Fixed and Mobile Telephone

The definition of fixed and mobile telephone for telecommunications are described in Table 7.4-6.

Table 7.4-6 Definition of fixed and mobile telephone for demand

Category	Access	System
Fixed TEL	Metallic	-----
		ADSL
	OFC	-----
	WLL	PHS
		GSM/CDMA
Mobile TEL		GSM
		CDMA
		IMT-2000

(2) Distribution Method to Sum Centres

(a) Assumption of distribution factors

(i) There is no GRDP for each Sum. (if it is available, it should be used)
(ii) No. of Sum Population reflects the size of the future demand, but does not necessarily express potential demand, because of no economic factor
(iii) Also existing demand(existing subscribers and waiters) reflects the existing potential demand, but does not necessarily express the size of future demand, because of no population factor.

Therefore, the above (ii) and (iii) factors are used with equal weight.

(b) Distribution calculation method

(i) Population weight of each Sum is calculated as a ratio to the total population
(ii) Demand weight of each Sum is calculated as a ratio to the total demand
(iii) Provisional weight is calculated as the total of the above a. and b.
(iv) Adjusted weight is calculated as the above c. divided into 2(2 weights)
(v) Calculation method is listed in the table below:

The distribution factor calculation is shown in Table 7.4-7

Table 7.4-7 Distribution Factor Calculation Table

	Aimag Centre/Sum	① Population (2001)	② Population weight	③ Demand (Existing + waiters; 2001)	④ Demand weight	⑤ Provisional weight	⑥ Adjusted weight
Fixed or Mobile TEL	Aimag centre	P-1	P-1/ΣP-i	D-1	D-1/ΣD-i	(P-1/ΣP-i)+(D-1/ΣD-i)	⑤/2
	Sum-1	P-2	P-2/ΣP-i	D-2	D-2/ΣD-i	(P-2/ΣP-i)+(D-2/ΣD-i)	
	Sum-2	P-3	P-3/ΣP-i	D-3	D-3/ΣD-i	(P-3/ΣP-i)+(D-3/ΣD-i)	
	Sum-n	P-i	P-i/ΣP-i	D-i	D-i/ΣD-i	(P-i/ΣP-i)+(D-i/ΣD-i)	
	Total	ΣP-i	ΣP-i /ΣP-i=1	ΣD-i	ΣD-i /ΣD-i=1	(ΣP-i/ΣP-i)+(D-i/ΣD-i)=2	1
Example	Aimag centre	25,000	25,000/56,000=0.4464	900	900/1,700=0.5294	0.4464+0.5294=0.9758	0.9758/2 =0.4879
	Sum-1	3,500	3,500/56,000=0.0625	250	250/1,700=0.1471	0.0625+0.1471=0.2096	0.2096/2 =0.1048
	Total	56,000	1	1,700	1	2	1

(3) Demand Distributed to Sum Centres

(a) The distribution method with a weighted assumption to Sum centres will be applied for the actual calculation in relation to the population ration between Aimag centres and Sum centres and telephone density of sum centre based upon data and materials provided by PTA in May 2002.

(b) Existing subscribers and waiting List for Sum Centre
Through the first field in Mongolia, information and data on the number of existing subscribers for each Sum Centre are collected and confirmed correctly. On the other hand, a waiting list including potential waiters for each Sum Centre was not available. For some Sum centres in which the waiting list are not provided, the estimation of waiting list is made by using the collected and analysed data from the field survey.

Waiting list for Sum Centre = (Number of Existing Subscriber) x (Average Waiting Ration of Field)

As a result of the field survey, since an average value of 35.50% is acquired to supplement the existing demand as a basis, the waiting list is included in the existing number of subscriber as of the year 2001.

(c) Distributed Result to Sum Centres

The forecasted demand of the fixed telephone distributed are shown in Table 7.4.8 for whole Sum in Mongolia in relation to the target years of 2001, 2005, 2008 2013 and 2020.

The detailed distribution of whole sum are listed in Annex 4.6-1 to Annex 4.6-11 for the variation patterns of the scenario of Medium Growth Rate of Demand/Teledensity and Medium Rate of GRDP/Capita.

Table 7.4-8 Fixed Telephone Demand Distributed in Sum Centres

	Items	2001	2005	2008	2013	2020
1	ARKHANGAI Whole Sum	1,357	1,695	1,948	2,417	3,318
2	BAYAN-ULGII Whole Sum	760	901	1,007	1,250	1,714
3	BAYANKHONGOR Whole S	1,542	1,828	2,042	2,533	3,475
4	BULGAN Whole Sum	1,735	2,056	2,297	2,849	3,908
5	GOBI-ALTAI Whole Sum	1,203	1,427	1,595	1,978	2,712
6	DORNOGOVI Whole Sum	1,248	1,481	1,656	2,053	2,818
7	DORNOD Whole Sum	488	527	556	690	948
8	DUNDGOBI Whole Sum	884	884	884	1,081	1,484
9	ZAVKHAN Whole Sum	1,316	1,561	1,745	2,164	2,971
10	UVURKHANGAI Whole Sur	2,014	2,355	2,610	3,239	4,444
11	UMNUGOBI Whole Sum	596	708	792	979	1,344
12	SUKHBAATAR Whole Sum	967	1,107	1,212	1,502	2,063
13	SELENGE Aimag Whole Sur	3,410	3,460	3,498	4,337	5,951
14	TUV Whole Sum	2,136	2,403	2,603	3,228	4,425
15	UVS Whole Sum	552	653	728	904	1,241
16	KHOVD Whole Sum	881	1,044	1,167	1,448	1,984
17	KHUVSGUL Aimag Total	2,201	2,484	2,696	3,341	4,585
18	KHENTII Whole Sum	1,986	2,225	2,404	2,982	4,091
19	DARKHAN-UUL Whole Sur	945	1,015	1,068	1,306	1,765
20	ORKHON Whole Sum	2,161	2,534	2,813	3,488	4,786
21	GOBISUMBER Whole Sum	217	217	217	217	298
22	NALAIKH Whole Sum	196	237	268	332	455
23	BAGANUUR Aimag Total	2,138	2,576	2,904	3,601	4,941
	Whole Sum Total	28,795	32,801	35,806	44,316	60,780

7.5 Macroscopic Demand Forecast of Mobile Telephone

7.5.1 Forecast Method

The macroscopic demand forecast for the mobile telephone was made in the manner mentioned below:

As the forecast method, ITU Model (2001.2) of 43 Asia and Neighboring Countries Data) is used (Refer to attached Annex 4.7), assuming this country group economic growth rate has a similar development trend to that of Mongolia. The tendency of 43 Asian Countries for Mobile Telephone is as follows:

(a) Fix telephone demand forecast formula is simulated to the exponential curve in relation to GDP per Capita and telephone density as described in the above.

(b) In contrast to the fixed telephone case, a growth rate curve for mobile telephone in Asian countries can be simulated to an approximate Logarithm Curve.

(c) In this case, the growth rate of the mobile telephone is very sharp at the time of the introduction of mobile telephone services.

(d) For example, the correlation curve between GDP per Capita and telephone density starts at the point of US 500 and 1.00% and this growth rate curve has a very high gradient to reach until the point at US$ 800 and 7.00% within this range. But over this range, the growth rate gradient will become gradually gentle.

The correlation between GDP per Capita and telephone density for the 43 Asian countries is as follows;

$y=10.87ln(x)-66.463$, Correlation index ($R^2=0.5892$),
where "y" is telephone density and "x" is GDP per Capita.

7.5.2 Forecasted Macroscopic Demand

(1) Scenario of Demand Forecast

Based on the above (b) and the actual Mongolian GDP/Capita & Density, the following three (3) scenarios are formulated.

④ Low Growth Demand Forecast

This low growth demand forecast is estimated on the assumption of the growth rate of GDP per Capita (at 1955 constant price in US Dollar) at about 4%, including the following conditions;

(a) The demand forecast point of the mobile telephone curve in Mongolia starts at GDP per Capita (at 1995 constant price in US Dollar) of US$ 593 and telephone density of 6.86% in 2001. This Mongolian point is located already above the average curve of 43 Asian countries. But, in this case the demand growth rate of Mongolia is assumed rather lower as compared with the average growth rate of the Asian countries.

(b) Telephone density of mobile telephone in Aimag and Sum centres will not become so high.

(c) The growth rate of demand will become lower in the future, as compared with the past three year supply record from 1999 to 2001.

$y= 7.55 ln(x)-39.54$

where "y" is telephone density and "x" is GDP/capita

⑤ Medium Growth Demand Forecast

This medium growth demand forecast is estimated on the assumption of the average annual growth rate of GDP per Capita at 5% in Asian countries, based on the correlation curve of the above-mentioned item 7.4.1.

$y=14.63 ln(x)-84.74$

where "y" is telephone density and "x" is GDP per Capita.

⑥ High Growth Demand Forecast

This high growth demand forecast is estimated on the assumption of high growth rate of GDP per Capita (at 1995 constant price in US dollar) at about 7.5%, including the following conditions and reasons;

(i) The demand forecast point of mobile telephone of Mongolia starts at GDP per Capita of US$ 593 and telephone density of 6.86% in 2001, but the growth rate is estimated at rather higher level as compared with the average growth rate of Asian countries

(ii) The mobile telephone will be installed considerably so many in Aimag centre and Sum centres.

(iii) The growth rate of demand will be increased so much in the future, as compared with the past three years supply volume from 1999 to 2001 in Mongolia.

$y=21.71 ln(x)-129.90$

where "y" is telephone density and "x" is GDP per capita

Three (3) scenarios of the macroscopic demand forecast for the mobile telephone is shown in Table 7.5-1.

Table 7.5-1 Three Scenarios for Macroscopic Demand Forecast of Mobile Telephone

Scenario	Formulae for Demand Forecast	Results of Forecasted Demand at 2020 Number of Mobile Telephone/Telephone Density
Low rate	y=7.55*ln*(x)-39.54	2020; Mobile Telephone: 480,650 Density: 15.11
Medium rate	y=14.63*ln*(x)-84.74	2020; Mobile Telephone: 672,950 Density: 21.15
High rate	y=21.71*ln*(x)-129.90	2020; Mobile Telephone: 866,530 Density: 27.23

Note: The forecasted results are tentatively calculate by using a GDP/Capita growth rate similar to the High Growth Rate in Table 8.3-1.

Figure 7.5-1 shows mobile telephone graph for GDP per capita and teledensity for 43 Asian countries and demand forecast formulae which are simulated in relation to three (3) scenarios; low growth, medium growth and high growth.

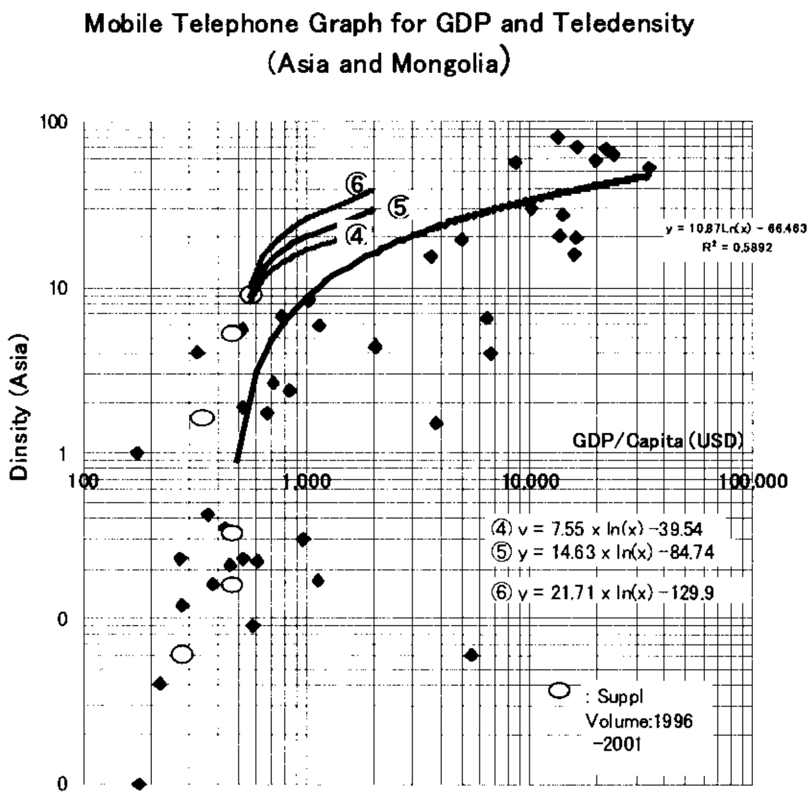
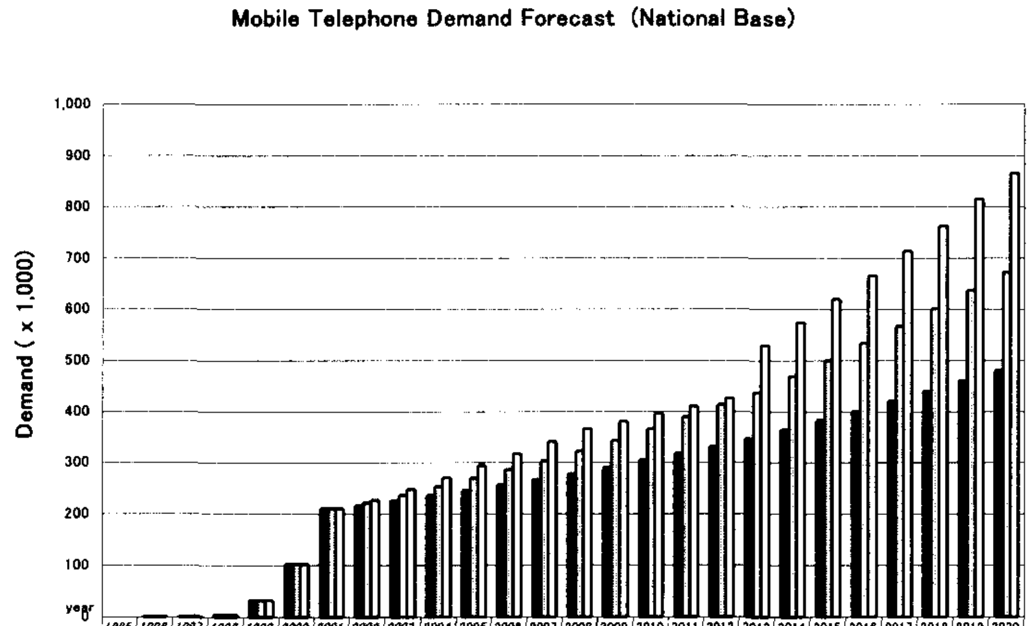


Figure 7.5-1 Mobile Telephone Density and GDP per Capita

The macroscopic demand forecast for mobile telephone is illustrated in Figure 7.5-2. The calculated results of three (3) formulae for mobile telephone on the national base are illustrated in this figure in relation to the variation of growth rates; low growth, medium growth and high growth.



	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
■④	0.00	0.89	2.42	5.37	32.58	102.8	210.0	216.8	226.2	236.1	246.2	256.4	266.8
□⑤	0.00	0.89	2.42	5.37	32.58	102.8	210.0	221.3	236.8	252.9	269.8	286.2	303.4
□⑥	0.00	0.89	2.42	5.37	32.58	102.8	210.0	226.8	248.3	270.7	294.0	317.1	341.1

	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
■④	277.8	290.7	304.1	317.8	331.9	346.3	364.1	382.3	401.0	420.2	439.9	460.0	480.6
□⑤	321.7	343.5	366.0	389.1	413.1	437.4	468.8	500.4	533.1	566.8	601.3	636.7	672.9
□⑥	368.5	380.5	395.0	410.3	425.8	529.8	574.2	619.8	666.5	714.7	764.0	814.7	866.5

Figure 7.5-2 Macroscopic Demand Forecast of Mobile Telephone

(2) Selection of Scenario

Out of three (3) scenarios of the whole country's demand forecast as described in Table 8.5-1, the medium growth scenario is selected to be more appropriate one for the telecommunications demand forecasting of Mongolia. Because, those adopted basic data for population growth rate, GDP growth rate and teledensity growth rate in Mongolia are all considered reasonable as the results of the study.

(3) Variation of GDP/Capita Growth Rate

In the Medium Growth scenario (⑤), three (3) variations of GDP/GRDP growth rates are taken into consideration for further analyses and evaluation for the demand forecast as shown in Table 7.3-1 mentioned above. Finally the Medium growth rate of GDP/GRDP is selected as in the same way as in case of the Fixed telephone.

(4) Forecasted Demand

The final forecasted demand is obtained through the above method and selection and shown in Table 7.5-2.

Table 7.5-2 Mobile Telephone Demand Forecast

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total of Sum Centres	35,525	37,987	40,448	42,910	45,372	47,834	50,295	52,757	56,064	59,371
Total of Aimag/Ddistricts	110,367	118,323	126,278	134,234	142,189	150,145	158,100	166,056	176,452	186,848
Ulaanbaatar	97,716	105,735	113,755	121,774	129,794	137,813	145,833	153,852	163,485	173,119
National Total	208,083	224,058	240,033	256,008	271,983	287,958	303,933	319,908	339,937	359,966

	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Total of Sum Centres	62,678	65,985	69,292	73,348	77,405	81,461	85,518	89,574	93,631	97,687
Total of Aimag/Ddistricts	197,243	207,639	218,035	230,796	243,558	256,319	269,080	281,841	294,603	307,364
Ulaanbaatar	182,752	192,386	202,019	213,843	225,667	237,491	249,315	261,139	272,963	284,787
National Total	379,996	400,025	420,054	444,639	469,225	493,810	518,395	542,980	567,566	592,151

7.5.3 Distribution Method to Aimags

The distribution method to each Aimag is the same as those described in the fixed telephone.

7.5.4 Demand Distributed in Aimags

The forecasted demand of the mobile telephone distributed in each Aimag are shown in Table 7.5-3.

The calculated results for three (3) variations of demand forecast for the mobile telephone are shown in attached Annex 4.8.1 through Annex 4.8.9.

Table 7.5-3 Mobile Telephone Demand Distributed in Aimags

	Name of Aimag	2001	2005	2008	2013	2020
1	ARKHANGAI Aimag Total	4,994	6,893	8,318	10,922	15,396
2	BAYAN-ULGII Aimag Total	3,954	5,168	6,079	7,981	11,251
3	BAYANKHONGOR Aimag Total	6,451	8,432	9,917	13,022	18,357
4	BULGAN Aimag Total	4,162	5,440	6,398	8,401	11,843
5	GOBI-ALTAI Aimag Total	3,746	4,896	5,759	7,561	10,659
6	DORNOGOVI Aimag Total	3,538	4,624	5,439	7,141	10,067
7	DORNOD Aimag Total	2,913	3,442	3,839	5,041	7,106
8	DUNDGOBI Aimag Total	1,457	2,453	3,200	4,201	5,922
9	ZAVKHAN Aimag Total	3,538	4,624	5,439	7,141	10,067
10	UVURKHANGAI Aimag Total	4,162	5,988	7,358	9,662	13,620
11	UMNUGOBI Aimag Total	3,122	4,080	4,799	6,301	8,883
12	SUKHBAATAR Aimag Total	3,746	4,713	5,439	7,141	10,067
13	SELENGE Aimag Total	6,451	7,152	7,678	10,081	14,212
14	TUV Aimag Total	5,202	6,436	7,358	9,662	13,620
15	UVS Aimag Total	2,913	3,808	4,479	5,881	8,291
16	KHOVD Aimag Total	3,954	5,168	6,079	7,981	11,251
17	KHUVSGUL Aimag Total	8,115	10,059	11,517	15,122	21,317
18	KHENTII Aimag Total	4,786	5,890	6,718	8,822	12,435
19	DARKHAN-UUL Aimag Total	3,746	4,896	5,759	7,561	10,659
20	ORKHON Whole Total	22,680	29,279	34,229	44,945	63,359
21	GOBISUMBER Aimag Total	833	906	960	1,260	1,777
22	NALAIKH Aimag Total	3,155	4,164	4,935	6,480	9,135
23	BAGANUUR Aimag Total	2,769	3,678	4,360	5,725	8,070
	Aimag Total	110,367	142,189	166,056	218,035	307,364

7.5.5 Demand Distributed to Aimag Centre and Sums in one Aimag area

The demand forecast of the mobile telephone for Sum centres is made as in the same way as in the case of the Fixed telephone.

The forecasted demand of the mobile telephone distributed in each sum Centre are shown in Table 7.5-4.

The detailed distribution of whole sum are listed in Annex 4.9-1 to Annex 4.9-10 for the variation patterns of the scenario of Medium Growth Rate of Demand/Teledensity and Medium Rate of GRDP/Capita.

Table 7.5-4 Mobile Telephone Demand Distributed in Sum Centres

	Items	2001	2005	2008	2013	2020
1	ARKHANGAI Whole Sum	1,757	2,426	2,928	3,843	5,414
2	BAYAN-ULGII Whole Sum	983	1,285	1,512	1,985	2,798
3	BAYANKHONGOR Whole Sum	1,995	2,606	3,065	4,027	5,677
4	BULGAN Whole Sum	2,246	2,932	3,447	4,528	6,385
5	GOBI-ALTAI Whole Sum	1,558	2,036	2,394	3,143	4,432
6	DORNOGOVI Whole Sum	1,618	2,112	2,483	3,263	4,599
7	DORNOD Whole Sum	632	748	835	1,094	1,543
8	DUNDGOBI Whole Sum	597	1,004	1,309	1,719	2,422
9	ZAVKHAN Whole Sum	1,705	2,229	2,622	3,439	4,851
10	UVURKHANGAI Whole Sum	2,220	3,193	3,922	5,151	7,262
11	UMNUGOBI Whole Sum	770	1,007	1,184	1,556	2,195
12	SUKHBAATAR Whole Sum	1,254	1,577	1,819	2,390	3,370
13	SELENGE Aimag Whole Sum	4,412	4,892	5,251	6,893	9,721
14	TUV Whole Sum	2,765	3,416	3,905	5,129	7,231
15	UVS Whole Sum	711	929	1,092	1,438	2,028
16	KHOVD Whole Sum	1,140	1,489	1,750	2,299	3,243
17	KHUVSGUL Aimag Total	2,852	3,532	4,042	5,314	7,486
18	KHENTII Whole Sum	2,573	3,166	3,610	4,742	6,684
19	DARKHAN-UUL Whole Sum	456	596	701	922	1,299
20	ORKHON Whole Sum	2,798	3,612	4,223	5,545	7,817
21	GOBISUMBER Whole Sum	228	247	262	345	486
22	NALAIKH Whole Sum	255	338	401	527	744
23	BAGANUUR Aimag Total	0	0	0	0	0
	Whole Sum Total	35,525	45,372	52,757	69,292	97,687

7.6 Fulfillment Plan of the Forecasted Sum Demand

Based on the frame work and facility plan in Chapter 5 and Chapter 9, the forecasted demand in Sums will be fulfilled as described in the followings;

7.6.1 Priority of Sums

Priority of the Sums are made as follows:

The following three factors are merged by applying "AND condition" and "OR condition" and with the priority order "P-1", "P-2", "P-3", "P-4" as follows.

(1) Comprehensive Evaluated Score Points by the Study Team

Evaluation by the available data obtained from the 1st survey in Mongolia such as rural development projects, economic indicators, demand forecast and technical factors (for example; cost effective investment, power supply)

(2) PTA's Evaluation

Evaluation by category A/B/C/D is made by PTA's expertise persons who know the detailed information such as size, development possibility, etc. through the experience.

(3) Planned Inter-Sum Centres (Integration Sums)

Mongolian Government has a future plan that some Sums will be integrated as certain "Inter-Sum Centres" and these integrated "Inter-sum centres" are evaluated as important Sums

7.6.2 Relation between priority and fulfilment

Facilities will be implemented and the demand will be fulfilled according to priority of Sums during the following period:

- **Sums of P-1**: facilities are implemented between 2004 and 2006, and the demand in 2006 will be fulfilled

- **Sums of P-2**: facilities are implemented between 2007 and 2010 and the demand in 2010 will be fulfilled

- **Sums of P-3**: facilities are implemented between 2011 and 2013 and the demand in 2013 will be fulfilled

- **Sums of P-4**: facilities are implemented between 2014 and 2020 and the demand in 2020 will be fulfilled

Priority of Sums and Demand ratio in 2020 is shown in Table 7.6-1.

Table 7.6-1 Priority of Sums and Demand Ratio

Priority	No. of Sums & Ratio		Demand Ratio(2020)
P-1: Priority-1	120	32.5%	59.6%
P-2: Priority-2	126	37.2%	26.2%
P-3: Priority-3	39	11.5%	9.3%
P-4: Priority-4	54	15.9%	4.9%
Aimag/District Centre	23	---	---
Total	362	100%(339)	100%

7.6.3 Fulfilment Plan

According to the priority of Sums and implementation years, Fulfilment Plan of the Sum demand will be in Table 7.6-2 and Figure 7.6-1.

The new connection summary are described in attached Annex 4.10 up to the year 2020 by year an by areas.

Table 7.6-2 Fulfilment Plan of Sums

Year	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Demand	28,795	29,797	30,798	31,800	32,801	33,803	34,804	35,806	37,508	39,211
Existing	10,521									
New connection	0	0	0	6,682	3,443	2,198	3,460	2,998	3,045	2,060
Working Sub.	10,521	10,521	10,521	17,203	20,646	22,844	26,304	29,302	32,347	34,407
Fulfilment Ratio	36.5%	35.3%	34.2%	54.1%	62.9%	67.6%	75.6%	81.8%	86.2%	87.7%

Year	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Demand	40,913	42,616	44,318	46,670	49,021	51,373	53,725	56,077	58,428	60,780
Existing										
New connection	3,004	2,424	2,557	2,664	2,686	2,663	2,670	2,624	2,597	2,486
Working Sub.	37,411	39,834	42,391	45,055	47,741	50,404	53,074	55,698	58,294	60,780
Fulfilment Ratio	91.4%	93.5%	95.7%	96.5%	97.4%	98.1%	98.8%	99.3%	99.8%	100.0%

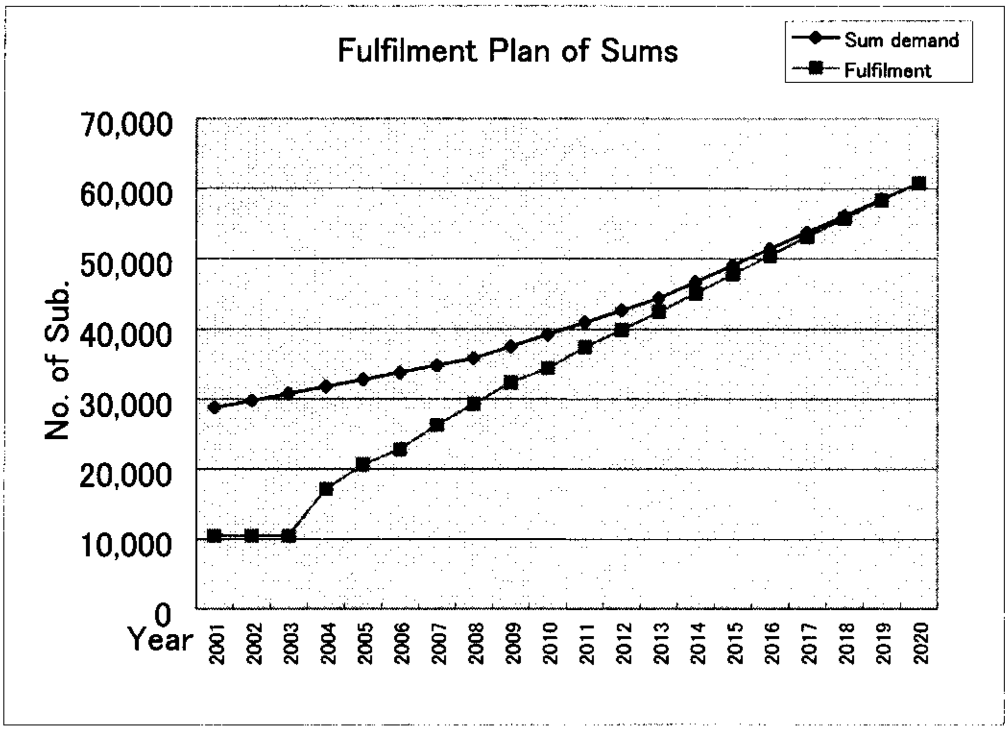


Figure 7.6-1 Fulfilment Plan of Sums

7.7 Demand Forecast of IT

7.7.1 Preconditions

All fixed telephones and mobile phones will be connected by IP (Internet Protocol) by the year 2020. This means the telephones and Internet are operated on the same IP network, and then all telephone subscribers become the Internet subscribers in a wide sense.

However in this report, as a matter of convenience, Internet subscribers (and their number) are to be specified as who access to Internet contents, i.e., users who use e-mail, www and/or home-page only pointed out as, a narrow sensed, Internet users. Subscriber whose telephone terminal is capable to connect to IP net but he does not access to Internet contents, should not be regarded as Internet subscriber.

Diffusion of Internet depends on; a) what kind of benefit or interest (say "contents") can be given to user; b) what speed (or capacity) of subscriber line (includes inter-city and international lines, in other word "throughput speed") can be prepared to user; and c) what amount user should pay. Those are closely interacted to crate Internet demands. If one of those is not enchanted for user, only limited users will use Internet.

Demand forecast in this Clause is executed under the provision that the above expectancies especially for contents and payable fee by Mongol peoples be realized.

Note:

For example, in Dalkhan aimag centre, there is an access point. However user have to pay long-distance Internet connection fee 20 Tg (approx. 0.02 US$) per minute in addition to local fee 7 Tg and the Internet provider's fee (approx. 10 US$ for 10 hours/month, or 40US$ for 100 hours/month). These fees are very expensive for ordinary peoples in Dalkhan area, consequently only limited peoples use Internet even Internet there is.

In Ulaanbaatar hundreds Internet cafés seems to open. Each Internet café furnishes several PCs up to forties PCs, and connects to ISP by a 56 kbps dial-up link after gathering the PCs data by a local router. Customer can enjoy e-mail and www access basically at the Internet Cafe. But less than 10 % customers are using e-mail and the others use PC as the machine of computer-games. No one access to www site at the time of an observation. This case means that the line speed is not enough for each customer, then nobody wants to access to www.

7.7.2 Method of Demand Forecast

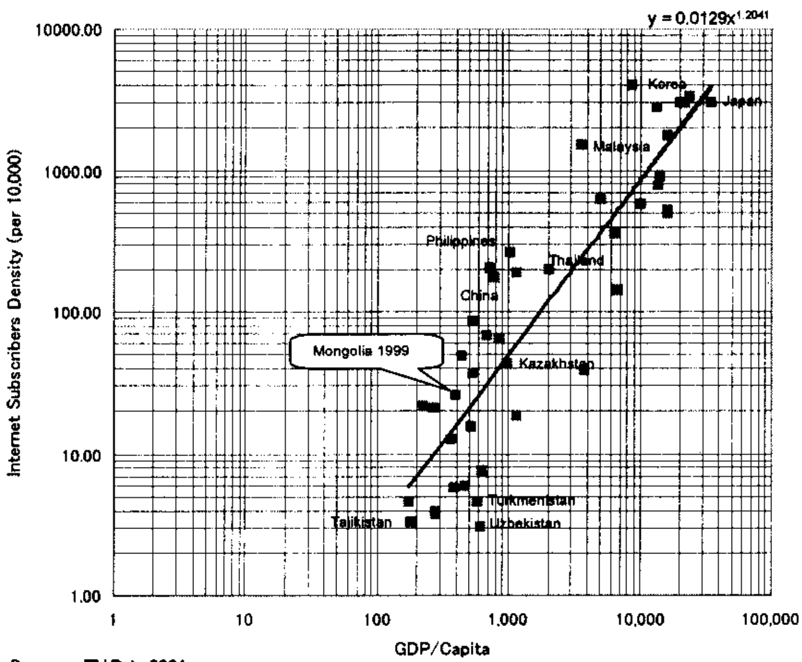
There is no universal forecast method for Internet demand since the Internet is a recent technology system, and its network introduction and expansion are much influenced by provider's strategies and government policies.

In this report, following three forecasting methods are tried to obtain an appropriate future's demand:

- Forecasting by Asian and Mongolian Internet trends (statistical data)
- Forecasting by density of fixed telephone subscribers
- Forecasting by feature of household and their GDP/Capita

(1) Demand forecast by Asian countries and Mongolian trends

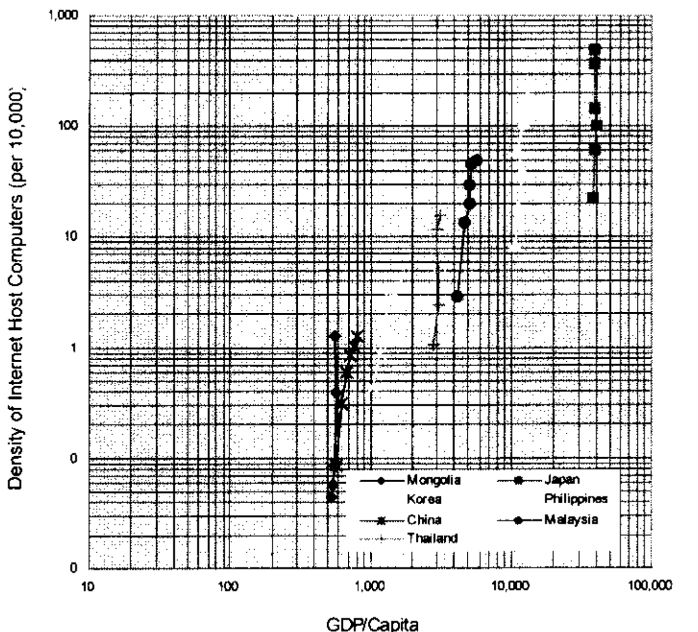
Figure 7.7.2-1 shows GDP/Capita vs. Internet subscribers densities in Asian countries as of 1999.



Source: ITU Data 2001

Figure 7.7.2-1 Relation between GDP/Capita and Internet Density

As shown in Figure 7.7.2-1 there is a strong correlation between GDP/Capita and the Internet density. However this correlation (expressed by the formula $y=0.0129(x)^{1.2401}$) is applicable to 1999 analysis only because the densities of Internets in the world are rapidly growing even the countries GDPs stay on the same levels.



Source: GDP/Capita; IMF Yearbook 2001
Host PC; ITU Internet Report 2001

Figure 7.7.2-2 GDP/Capita vs. Host PC Density

This phenomenon can be observed in Figure 7.7.2-2 which shows growth of host computers vs. GDP/Capita from the year 1995 through 2000. There are very small or minus (-) growth of GDP but all countries' host computers have been increased.

As far as these growing trends of host computers are observed, Internet will grow up without ceiling in no relation with the GDP.

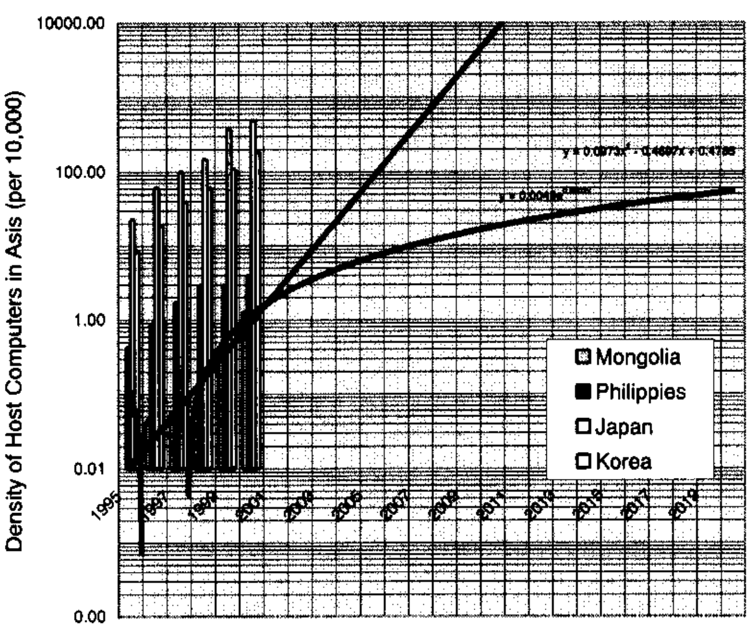


Figure 7.7.2-3 Growth of Host PC in Mongolia

But some limitation or relation among them should exist, as shown in Figure 7.7.2-1.

Figure 7.7.2-3 shows the yearly growth of Mongolian host computers. And in the Figure, Two (2) approximate formulae computed from the data are illustrated. First one is drawn by a exponential function, and the second one by multinomial function.

The first, exponential, formula more conforms to existing data. But if this formula is applied for the forecast, it means that all Mongolian peoples become Internet subscribers by 2009.

If the second, multinomial, formula is applied, the density of host computers in Mongolia is estimated around 70 hosts per 10,000 peoples in the year of 2020. This figure will be reasonable and realistic, than the first one. In this case, from the number's ratio between host and subscriber's computers (Mongolia: subscribers number is approximately 10 times bigger than the number of host computers), total number of subscribers in Mongolia in 2020 is estimated as 222,736.

3181,944 (total population in 2020) x 7/100 = 222,736 (Internet subscribers)

(2) Demand forecast by fixed telephone subscriber's number

This is a very rough estimation method. Marketing analysts in the most aggressive Asian countries, Korea and Japan, say when the subscriber's number (who connect to the net from home) becomes the ratio of around one by two (1/2), the number will be saturated. If so, following number will be the subscribers in year 2020.

370,489 (number of fixed telephone subscribers) x 1/2 + 6,290 (number of *subscribers belong to public and private organizations) = 191,534 (Internet subscribers)*

(3) Demand forecast by households and their GDP/Capita

For forecasting a future number of fixed Internet subscribers, several reports are discussing based on the number and feature of household where Internet access terminal (PC) is installed.

In Chapter 2 and Chapter3, populations, features of household and GDP/GRDP at all Aimags and Sums as well as Ulaanbaatar are clarified.

Detail assumptions and calculations are stated in the later paragraphs, but from the result of this forecasting method, it will be of 210,042 *(Internet subscribers).*

Figure 7.7.2-4 shows the resulted figures obtained from the above three methods.

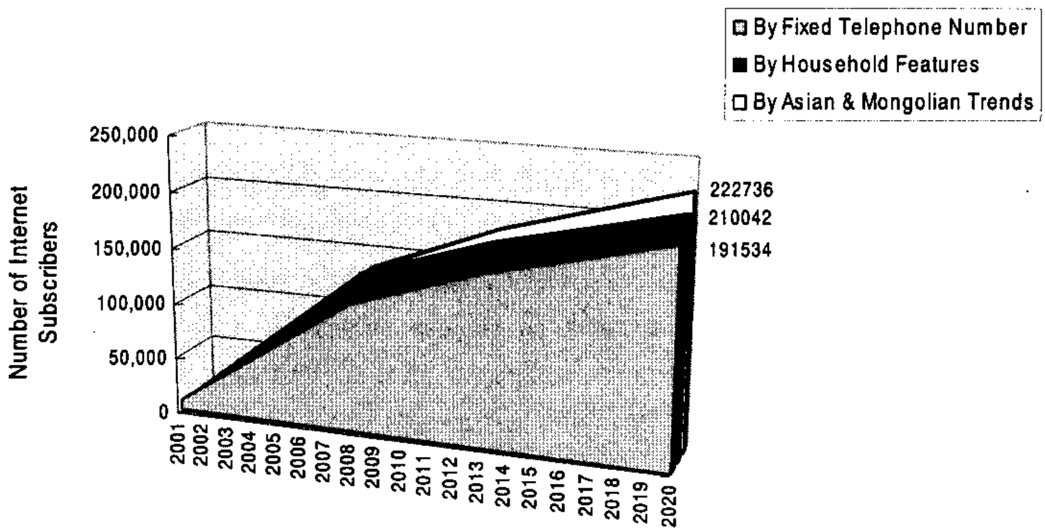


Figure 7.7.2-4 Number of Internet Demand Forecasted by Three Aspects

Among these three methods, the forecast by "households features" should be adopted in this report since it involves more actual situations of Mongolian societies than the others.

7.7.3 Assumptions and Calculation of Internet Demand

(1) Number of subscribers in 2020

Ulaanbaatar:	0.4	subscribers per total households of Ulaanbaatar
Aimag centre:	0.33	subscribers per total households of Aimag centre
Sum Centre:	0.1	subscribers per total households of Sum centre
Other rural:	0.05	subscribers per total households of the rural area

(2) Fulfilment plan (100% demand will be fulfilled by following scenario/ratio)

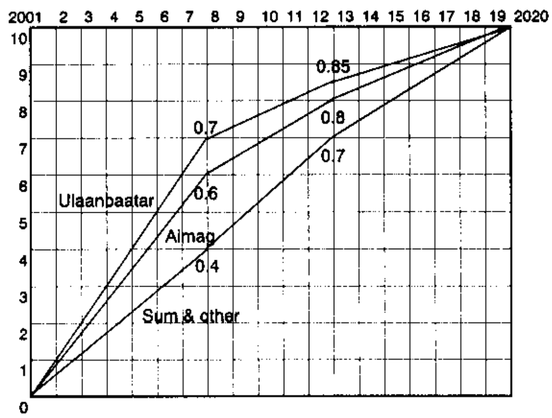


Figure 7.7.3-1 Scenario of Fulfilment Plan

(3) Adjustment by GRDP

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

(4) Adjustment by the results of microscopic study.

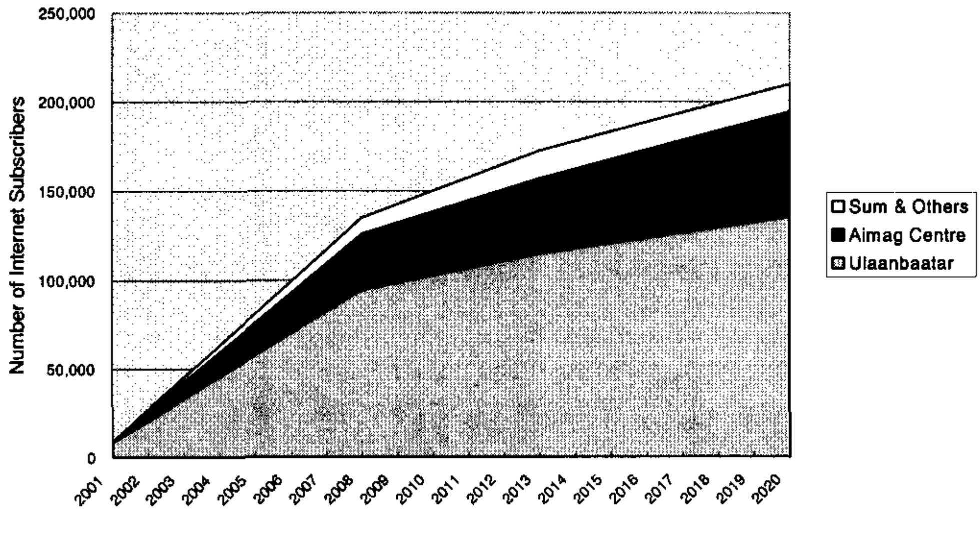
The number of organization such as public organizations and private firms are more than the figures of previous study. Then this portion's figures are to be adjusted.

(5) Results of calculation

The results of the calculations are shown in Table 7.7.3-1 and Figure 7.7.3-1.

Table 7.7.3-1 Macroscopic Demand Forecast of Internet

No	Name of Aimag	Population (2020) (Except Rural)	Population (2020) (Rural)	Number of HH (2020) (Except Rural)	Number of HH (2020) (Rural)	Number of Sub. (2008) (Aimag)	Sub. (2008) (Sum & Other)	Number of Sub. (2013) (Aimag)	Sub. (2013) (Sum & Other)	Number of Sub. (2020) (Aimag)	Sub. (2020) (Sum & Other)	Number of Sub. For (Organization)
1	Arkhangai	41,014	67,661	9,422	16,110	689	543	919	950	1,099	997	410
2	Bayan-Ulgii	66,126	72,675	15,098	17,304	740	382	986	669	1,183	676	330
3	Bayankhongor	36,735	63,819	8,383	15,195	929	599	1,239	1,049	1,499	1,113	435
4	Bulgan	33,071	37,937	7,718	9,033	383	491	511	860	589	918	360
5	Govi-Altai	28,416	36,939	6,522	8,795	568	410	757	718	897	685	390
6	Dornogovi	44,776	21,679	10,320	5,162	730	395	973	691	1,167	697	340
7	Dornod	63,177	22,170	14,347	5,279	814	244	1,086	426	1,307	364	295
8	Dundgovi	20,797	38,063	4,753	9,063	301	246	402	430	452	365	300
9	Zavkhan	39,122	49,229	9,026	11,721	476	440	635	771	743	686	465
10	Uvurkhangai	54,997	83,171	12,696	19,803	562	549	749	961	886	928	494
11	Umnugovi	27,279	33,235	6,229	7,913	559	330	746	578	882	536	340
12	Sukhbaatar	27,110	36,904	6,218	8,787	534	351	712	614	840	642	285
13	Selenge	108,794	21,694	25,454	5,165	723	792	964	1,385	1,105	1,306	773
14	Tuv	59,721	55,658	13,920	13,252	508	635	678	1,111	797	1,062	575
15	Uvs	40,150	44,436	9,181	10,580	532	351	710	615	837	508	420
16	Khovd	55,968	56,332	12,750	13,412	812	389	1,082	681	1,303	653	370
17	Khuvsgul	63,184	78,875	14,482	18,780	1,172	723	1,563	1,266	1,904	1,348	510
18	Khentii	49,759	32,672	11,581	7,779	575	546	766	955	908	979	435
19	Darkhan-Uul	116,445	7,478	26,021	1,780	2,045	150	2,727	263	3,309	241	235
20	Orkhon	115,594	7,045	25,583	1,677	13,628	201	18,170	352	22,613	483	120
21	Govisumber	13,297	3,440	2,997	819	273	41	365	71	406	71	80
	Aimag Total (1)		1,976,644		460,104	27,555	8,809	36,740	15,415	52,686	15,260	incl. in Aimag
22	Nalaikh	36,457	0	8,140	0	1,864	82	2,485	143	3,056	170	85
23	Baganuur	32,206	0	7,109	0	1,925	0	2,567	0	3,159	0	50
	District Total (2)		68,663		15,249	3,789	82	5,052	143	6,350	170	incl. in Aimag
	Aimag & Dist Total (1)+(2)		2,045,307		475,353	31,344	8,891	41,792	15,559	59,037	15,430	incl. in Aimag
24	Ulaanbaatar	1,136,637	0	247,095	0	94,903	0	115,239	0	133,075	0	2,500
	UB Total (3)		1,136,637		247,095	94,903	0	115,239	0	135,575	0	incl. in Aimag
	Mongolia Total (1)+(2)+(3)		3,181,944		722,448	126,247	8,891	157,031	15,559	194,612	15,430	
		3,181,944		722,448		135,137		172,590		210,042		



Nuber of Internet Subscribers

	2001	2008	2013	2020
Ulaanbaatar	8,550	94,903	115,239	135,575
Aimag Centre	450	31,344	41,792	59,037
Sum & Others	-	8,891	15,559	15,430
Total	9,000	135,138	172,590	210,042

Figure 7.7.3-2 Estimated Growth of Internet Demand in Mongolia

CHAPTER 8

TRAFFIC FORECAST

CHAPTER 8

TRAFFIC FORECAST

8.1 General

8.1.1 Scope of Traffic Forecast

The traffic forecast was focused to the telecommunications network between Aimag centre and Sum centres in the relevant Aimag Area. However, national network traffic was also forecast for reference in order to relieve the relationship of Aimag centres in the national telecommunications network.

The traffic study included that of telephony service, the Internet service, mobile terminal service, etc. The Internet service traffic through dial-up connection was calculated being included in the telephony traffic and others through exclusive use link was calculated being separated. Mobile terminal traffic was also calculated separately.

In the traffic forecast most attention was paid to the telephony traffic. It was because the telecommunications infrastructure was left outmoded in most of the rural areas and thus its infrastructure modernisation should be a forerunner to provide steps to such additional or advanced services as the data communication on the Internet or new communication services on the IP-based network. The Internet services will be available first trough dial-up connection making use of the fundamental telephony network. The Internet services and mobile terminal services will be developed being overlaid on the infrastructure provided for the telephone service. The conventional voice communication traffic of land line may be overtaken by the mobile media when the cost becomes affordable.

8.1.2 Data Used in Forecast

The traffic was forecast based on the factors taken out of or estimated from the data provided by MT and/or PTA, found in publications, and in the world wide web (www) sites. Empirical data were also employed where the local statistic data were unavailable or inapplicable. The traffic data related to the Internet network and voice on Internet protocol (VoIP) network now in operation in Mongolia were not available, thus it was estimated in reference to the recent trends seen in publications, internet web sites, etc.

In the traffic forecast, the number of subscriber lines was given by the demand fulfilment plan based on the demand forecast. Other elements essential for the traffic forecast, for instance, the traffic density per line, call duration, and the traffic distribution by call category, were calculated out of traffic data provided by the organisations concerned principally. Where applicable data were unavailable, the factors were estimated by applying reference values presented in ITU-T GAS handbook, experience in similar operating entities, or consultant experience.

8.1.3 Purpose of Traffic Forecast

The traffic was forecast for calculating the number of circuits between exchanges. The calculation was done in order to obtain the number of circuits required a) between Sum centre switch node and Aimag centre exchange; and b) between Aimag centres. The number of circuits of individual sections presented here shall be reviewed based on the practical conditions or existing circuit plans before deciding the network for equipment purchase.

8.1.4 General Conditions on Estimation

The PSTN traffic was estimated on the conditions that:

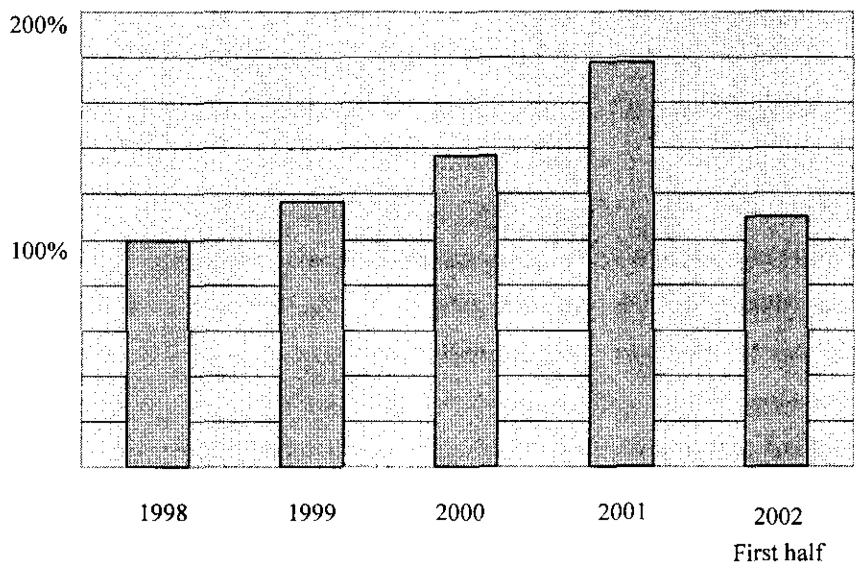
a) Traffic density per line would not change by year;
b) Traffic distribution by call category would not change by year;
c) Network configuration would not change till the end of Phase 3;
d) Traffic should be estimated by node, regardless to the kind of the node.

8.2 Traffic Forecast of PSTN

8.2.1 Reference Traffic Data

(1) National Trunk Traffic

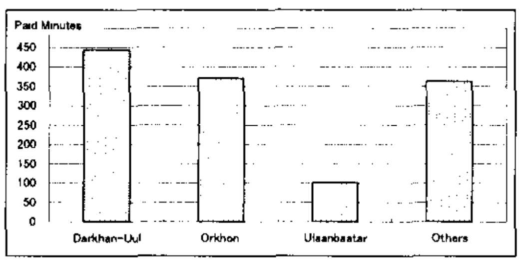
The telephone traffic is increasing steadily every year. According to MT's data, the trunk call traffic expressed in paid minutes were 17.7 million minutes in 1998, 20.7 million minutes in 1999, 24.1 million minutes in 2000, 31.4 million minutes in 2001, and 19.4 million minutes in the first half of 2002. In other words, the annual growth recorded around 117.1% in 1999, 136.7% in 2000, 177.9% in 2001, respectively, when compared with the year 1998. During the period from 1998 to 2001, the number of telephone lines/terminals increased from 86 thousand (PTA data) to 358 thousand (estimation by JICA Study Team) as a total of land lines, WLL terminals and mobile terminals as shown in Table 3.4.3-2. Figure 8.2.1-1 shows the summary of telephone traffic in paid minutes to/from Aimag centres. Annex 6 shows traffic data.



Source: PTA.

Figure 8.2.1-1 Trunk Telephone Traffic Increas in Paid Minutes

Figure 8.2.1-2 shows trunk call paid minutes of the national capital Ulaanbaatar and selected cities in 2000. The figures show that the traffic per subscriber in paid minutes in the national capital Ulaanbaatar is lower than others. This was caused by the fact that more than the half of the national total of subscribers were concentrated in Ulaanbaatar, accordingly the subscribers in areas other than Ulaanbaatar had destined subscribers not within the Aimag area, but out of the Aimag area mainly in Ulaanbaatar.



Source: PTA

Figure 8.2.1-2 Paid Minutes by Area

The paid minutes data were useful for financial analysis in the operating entity. However, comprehensive and complete traffic data from technical point of view were unavailable; especially local call traffic data were not found. This was due to limited function of Aimag centre switching systems, which have been replaced with digital one now. The switching systems in Aimag centre were

Russian-made cross-bar system which were not equipped with the function of own-exchange traffic measurement.

(2) Traffic of Sum Centres

Paid minutes data of Sum centres of selected Aimags were found available during field survey at some Aimag centre telecommunication offices. Table 8.2.1-1 shows calls originated and terminated to the Sum centres, not including the traffic in a same Sum centre. According to the limited data, people originate and terminate the traffic of 12 to 23 minutes of call per year.

Table 8.2.1-1 Paid Minutes of Selected Sum Centres (in 2001)

Name	Population in centre	Paid minutes	Paid minutes per inhabitant
Bulgan	20,485	433,161	21
Govi-Altai	15,204	181,106	12
Khentii	28,459	444,412	16
Umnugovi	22,235	508,946	23
Total	**86,383**	**1,567,625**	**18**

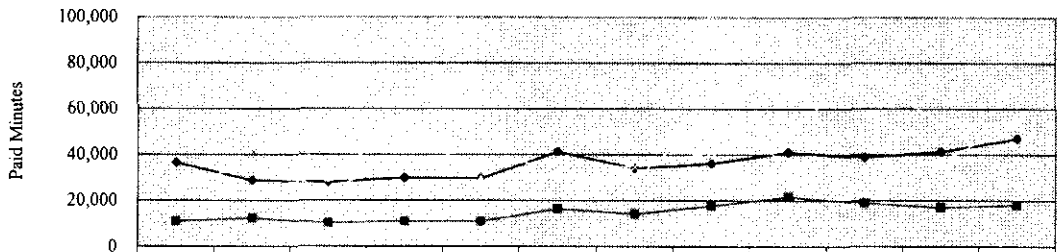
Source: PTA.

Figure 8.2.1-3 shows fluctuation of paid minutes by month in Khenti and Umnugovi in the year 2001. The line went almost flat for the year, though there were low peaks. The peaks should not be noteworthy, as the total traffic was low and no official events were reported that time. The peak could be caused by sporadic private needs.

Comprehensive traffic data of Sum centre switching equipment have not been found, though trunk traffic data of high traffic Sums of every Aimag centres were collected. This was because the measurement of traffic data was not possible due to limited function of Sum switch equipment. The switching equipment in Sum centres is mostly Russian made crossbar PBX switch, few digital PBXs, and manual connection which are not equipped with traffic measuring function. The data of high traffic Sums, which collected the traffic of selected Sums of all Aimags, are not adequate for technical point of system design, because:

a) The data indicate neither total, nor local traffic density;
b) The measured Sum centres differ by month,
c) The links between Aimag and Sum centres are not trunk links but subscriber lines.

d) The number of links of each section is only one (1) or two (2), the traffic capacity of which is not match that actually required.



	1	2	3	4	5	6	7	8	9	10	11	12
Bulgan	36,659	28,824	28,111	29,955	29,622	41,253	34,151	36,228	41,143	38,827	41,302	47,086
Govi-Altai	11,166	12,451	10,414	11,192	11,042	16,494	14,223	17,832	21,813	19,052	17,184	18,243
Khentii	26,854	25,526	30,159	54,144	29,421	31,204	29,607	56,582	36,232	33,275	36,903	54,505
Umnugovi	28,316	34,743	25,013	37,405	36,583	36,639	34,653	41,316	49,892	77,270	52,815	54,301

Month

Source: PTA.

Figure 8.2.1-3 Seasonal Fluctuation of Paid Minutes 2001

8.2.2 Factors for Traffic Forecast

(1) Constancy of Calling Rate

The followings were analysed through the given data for telephony service network. The telephony service traffic was forecast on the supposition that the traffic density by line (calling rate) would not decline even after the voice on IP (VoIP) has taken over the existing voice communication on PSTN. IP-based network traffic forecast is discussed in Paragraph 8.3.

(2) Estimated Factors

The cross bar switch did not have the function to measure intra-exchange traffic data and, thus, a) calling rate; b) density by call category were estimated based on the data analysis of given fragment data, consultant experience, in addition to ITU-T GAS manual reference data. It should be noted that the total traffic of exchange by operator command started a few years ago since the Aimag centre switches were replaced with digital exchanges.

(3) Total Traffic of Exchange

The total traffic of exchange was not available because of the reason that the Aimag centre switching system did not have the function to measure its own exchange traffic. The Sum centre PBX exchange did not have the function of traffic measurement.

The total traffic of exchange is calculated multiplying the switching system capacity in subscriber line by calling rate.

Total traffic of exchange: (Switch capacity) x (Calling rate)

(4) Traffic Density by Subscriber Line

Raw print-out 5-days data of traffic of ATC "6" and ATC "3" were available. The output indicates average traffic density by line (calling rate) at 0.08 Erlang at ATC "6", 0.06 Erlang at ATC "68". Table 8.2.2-1 shows the calling rate in Erlang of two (2) switching systems in Ulaanbaatar. It should be noted that many subscriber modules (URAL), which can accommodate 256 subscriber lines per unit, recorded at more than 0.12 Erlangs in ATC "3" exchange located in business area.

Table 8.2.2-1 Calling Rate of Selected Exchanges

Exchange	Calling Rate in Erlang	Measured	Note
ATC "3"	0.08	Five week days in February 2001	Business, public institutions, and residence area
ATC "68"	0.06	Five week days in June 2002	Small shops and residence area

Source: PTA.

The traffic density by subscriber or calling rate of fixed line was set here at 0.10 Erlang for normal telephony service under comprehensive consideration, that is, the existing conditions, consultant experience, and the purpose that it was applied in order to design the network. This value was reviewed in reference to ITU-T GAS manual data. In addition to this, 0.01 Erlang was counted for dial-up Internet service access.

Calling rate for fixed line: 0.11 Erlang per line

Regarding the calling rate for mobile terminals, it was set here at 0.07 Erlang per line in consideration of the existing cellular phone network conditions in Mongolia and learning from consultant experience. This is a value for network design which includes 0.01 Erlang of Internet access traffic.

Calling rate for mobile terminal: 0.07 Erlang per line

(5) Traffic Distribution by Call Category

The traffic distribution by call category was not available, because the Aimag centre switching system were analogue and such measurement was not routine. The Sum centre switching system were analogue PBX, which is usually not equipped to measure such traffic.

The traffic distribution by call category was set at as shown below in reference to ITU-T GAS manual value and consultant experiences. Figure 8.2.2-1 shows the estimated traffic distribution by call category. Table 8.2.2-2 shows the basis of traffic by call category applied to design the network under this Master Plan.

Traffic distribution (in %) by call category:

Sum Centre:	Own Exchange:	0.312;
	Others:	0.688
	Total:	1.000
Aimag Centre:	Own exchange:	0.305;
	Within Aimag:	0.140;
	Others =	0.555.
	Total:	1.000

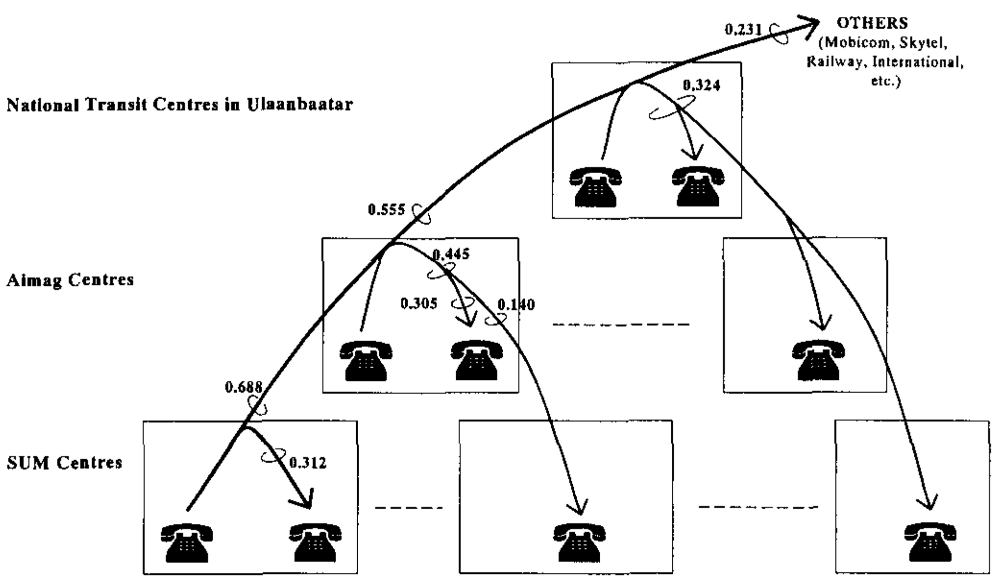


Figure 8.2.2-1 Estimated Traffic Distribution by Call Category

Table 8.2.2-2 Traffic by Call Category of Aimag

No.	Name of the Aimag	Name of the Capital	Own Exchange	Within Aimag	Trunk and Others				Total
					MTC	Mobile	Railway	Subtotal	
1	Arkhangai	Tsetserleg	0.300	0.144	0.390	0.162	0.005	0.556	1.000
2	Bayan-Olgii	Olgii	0.303	0.202	0.358	0.136	0.000	0.494	1.000
3	Bayankhongor	Bayankhongor	0.303	0.147	0.358	0.192	0.000	0.550	1.000
4	Bulgan	Bulgan	0.304	0.183	0.330	0.184	0.000	0.514	1.000
5	Govi-Altai	Altai	0.302	0.171	0.291	0.236	0.000	0.527	1.000
6	Govisumber	Choir	0.315	0.043	0.391	0.251	0.000	0.642	1.000
7	Darkhan-Uul	Darkhan	0.304	0.028	0.238	0.430	0.000	0.668	1.000
8	Dornogovi	Sainshand	0.308	0.211	0.382	0.098	0.000	0.480	1.000
9	Dornod	Choibalsan	0.304	0.121	0.347	0.228	0.000	0.575	1.000
10	Dundgovi	Mandalgovi	0.303	0.197	0.266	0.234	0.000	0.500	1.000
11	Zavkhan	Uliastai	0.310	0.163	0.363	0.163	0.000	0.526	1.000
12	Orkhon	Erdenet	0.304	0.019	0.291	0.386	0.000	0.677	1.000
13	Uvurkhangai	Arvaikheer	0.305	0.196	0.353	0.145	0.000	0.498	1.000
14	Umnugovi	Dalanzadgad	0.316	0.212	0.243	0.229	0.000	0.472	1.000
15	Sukhbaatar	Baruun-Urt	0.303	0.243	0.323	0.132	0.000	0.454	1.000
16	Selenge	Sukhbaatar	0.308	0.101	0.275	0.316	0.000	0.590	1.000
17	Tuv	Zuunmod	0.304	0.082	0.222	0.392	0.000	0.614	1.000
18	Uvs	Ulaangom	0.302	0.132	0.351	0.214	0.000	0.566	1.000
19	Khovd	Khovd	0.303	0.139	0.335	0.224	0.000	0.558	1.000
20	Khuvsgul	Muren	0.305	0.210	0.294	0.192	0.000	0.486	1.000
21	Khentii	Undurkhaan	0.304	0.230	0.315	0.150	0.000	0.465	1.000
22	Nalaih	---	0.302	0.020	0.321	0.357	0.000	0.678	1.000
23	Baganuur	---	0.303	0.017	0.423	0.257	0.000	0.680	1.000
	Average		**0.305**	**0.140**	**0.324**	**0.231**	**0.000**	**0.555**	**1.000**

Regarding the traffic by call category of Ulaanbaatar, it was estimated in consideration of its share in the number of subscribers in the country, the distribution ratio in large cities near the national capital, etc., as reliable data were not available. It was estimated as 59% to MT subscribers in capital, 8 % to MT subscribers in areas other than the capital, and 33% to subscribers of networks other than MT.

8.2.3 Traffic Forecast of Sum Centres

This is forecast based on the demand fulfilment plan, using traffic density by line and the number of lines to be provided, at 2008, 2013 and 2020. Table 8.2.3-1 shows the traffic and number of circuits of fixed line telephones of Arkhangai and Bayan-Ulgii as example. Annex 6-1 shows the fixed line traffic density between the Aimag centre and all Sum centres. Annex 6-2 shows the mobile terminal traffic density between the Aimag centre and Sum centres.

Table 8.2.3-1 Traffic and Number of Cirucits (1/2)
Arkhangai Sum

No.	Aimag/Sum	Switch capaicty			Traffic to/from Aimag (Erlang)			Circuits between Aimag and Sum		
		2008	2013	2020	2008	2013	2020	2008	2013	2020
1	Aimag center	5,540	6,870	9,430	---	---	---	---	---	---
2	Battsengel	260	260	260	19.7	19.7	19.7	30	30	30
3	Bulgan	120	120	120	9.1	9.1	9.1	17	17	17
4	Jargalant	160	160	160	12.1	12.1	12.1	21	21	21
5	Ikhtamir	240	240	240	18.2	18.2	18.2	28	28	28
6	Ugiinuur	120	120	120	9.1	9.1	9.1	17	17	17
7	Ulziit	180	180	180	13.6	13.6	13.6	22	22	22
8	Undur-Ulaan	200	200	200	15.1	15.1	15.1	24	24	24
9	Tariat	220	220	220	16.6	16.6	16.6	26	26	26
10	Tuvshruuleh	330	330	330	25.0	25.0	25.0	36	36	36
11	Tsakhir	0	100	100	0.0	7.6	7.6	0	15	15
12	Tsenkher	180	180	180	13.6	13.6	13.6	22	22	22
13	Tsetserleg	170	170	170	12.9	12.9	12.9	22	22	22
14	Chuluut	48	130	130	3.6	9.8	9.8	9	18	18
15	Khairkhan	250	250	250	18.9	18.9	18.9	29	29	29
16	Khangai	20	130	130	1.5	9.8	9.8	6	18	18
17	Khashaat	0	90	90	0.0	6.8	6.8	0	14	14
18	Khotont	270	270	270	20.4	20.4	20.4	31	31	31
19	Erdenemandal	250	250	250	18.9	18.9	18.9	29	29	29
	Total	8,558	10,270	12,830	228.2	257.1	257.1	---	---	---

Note: The outcome of traffic and number of circuits calculation of all Sums is shown in Annex 6. Switch capacity zero (0) means that new switch is not introduced by that Phase.

Table 8.2.3-1 Traffic and Number of Cirucits (2/2)
Bayan-Ulgii Sum

No.	Aimag/Sum	Switch capaicty			Traffic to/from Aimag (Erlang)			Circuits between Aimag and Sum		
		2008	2013	2020	2008	2013	2020	2008	2013	2020
1	Aimag center	4,050	5,030	6,890	---	---	---	---	---	---
2	Altai	48	90	90	3.6	6.8	6.8	9	14	14
3	Altantsugts	48	48	90	3.6	3.6	6.8	9	9	14
4	Baynnuur	48	180	180	3.6	13.6	13.6	9	22	22
5	Bugat	0	100	100	0.0	7.6	7.6	0	15	15
6	Bulgan	0	120	120	0.0	9.1	9.1	0	17	17
7	Buyant	0	0	80	0.0	0.0	6.1	0	0	13
8	Deluun	140	140	140	10.6	10.6	10.6	19	19	19
9	Nogoonnuur	16	170	170	1.2	12.9	12.9	5	22	22
10	Tolbo	32	110	110	2.4	8.3	8.3	7	16	16
11	Ulaankhus	150	150	150	11.3	11.3	11.3	20	20	20
12	Sagsai	150	150	150	11.3	11.3	11.3	20	20	20
13	Tsengel	150	150	150	11.3	11.3	11.3	20	20	20
14	Khotgor	0	80	80	0.0	6.1	6.1	0	13	13
15	Tsagaannuur	180	180	180	13.6	13.6	13.6	22	22	22
	Total	5,012	6,698	8,680	72.8	126.1	135.4	---	---	---

Note: The outcome of traffic and number of circuits calculation of all Sums is shown in Annex 6. Switch capacity zero (0) means that new switch is not introduced by that Phase.

8.2.4 Traffic Forecast of Aimag Centres

This is forecast based on the demand fulfilment plan, using traffic density by line and the number of lines to be provided, at 2008, 2013 and 2020. Table 8.2.4-1 shows the fixed line traffic density of Aimag centres and the mobile traffic density of Aimag centres.

Table 8.2.4-1 Traffic Density of Aimag Centre Level

No.	Name of Aimag	Name of Capital	Fixed Line Traffic (Erlang)			Mobile Terminal Traffic (Erlang)		
			2008	2013	2020	2008	2013	2020
1	Arkhangai	Tsetserleg	838	1,013	1,294	588	769	1,084
2	Bayan-Olgii	Olgii	518	679	893	395	519	730
3	Bayankhongor	Bayankhongor	696	891	1,123	631	828	1,165
4	Bulgan	Bulgan	513	569	669	375	493	692
5	Govi-Altai	Altai	383	481	601	337	441	622
6	Dornogovi	Sainshand	363	477	587	329	431	606
7	Dornod	Choibalsan	291	334	451	253	332	466
8	Dundgovi	Mandalgovi	234	256	326	185	240	336
9	Zavkhan	Uliastai	371	464	584	328	431	603
10	Uvorkhangai	Arvaikheer	532	654	772	434	569	800
11	Umnugovi	Dalanzadgad	324	429	558	313	410	577
12	Sukhbaatar	Baruun-Urt	403	482	612	343	452	634
13	Selenge	Sukhbaatar	580	627	766	429	559	786
14	Tuv	Zuunmod	565	648	776	436	570	802
15	Uvs	Ulaangom	328	395	522	295	385	540
16	Khovd	Khovd	438	541	696	390	513	720
17	Khuvsgol	Moron	816	1,031	1,286	722	947	1,333
18	Khentii	Ondorkhaan	481	616	729	396	519	729
19	Darkhan-Uul	Darkhan	943	1,170	1,534	389	510	719
20	Orkhon	Erdenet	2,422	3,005	4,103	2,304	3,025	4,265
21	Govisumber	Choir	92	88	111	62	82	115
22	Nalaikh		336	434	602	338	444	625
23	Baganuur		344	397	545	305	401	565

8.2.5 Traffic Matrix between Aimag Centres

Traffic between Aimag centres is calculated applying the call distribution ratio presented in previous paragraph for traffic distribution by call category in line with the procedures presented in ITU-T GAS Manual. Table 8.2.5-1 shows the traffic matrix between Aimag centres.

Table 8.2.5-1 Traffic Matrix between Aimag Centres (1/2)

From/To	Arkhangai	Bayan-Olgii	Bayankhong	Bulgan	Govi-Altai	Dornogovi	Dornod	Dundgovi	Zavkhan	Uvurkhanga	Omnogovi	Sukhbaatar	Selenge
Arkhangai	0.00	6.82	17.58	4.71	7.33	3.70	2.39	2.07	7.96	9.81	4.88	3.16	2.99
Bayan-Olgii	6.83	0.00	6.71	1.71	6.83	2.62	1.92	1.08	6.43	3.22	3.43	2.40	1.72
Bayankhongor	17.58	6.71	0.00	2.67	9.25	4.41	2.38	2.56	6.67	16.32	7.63	3.29	2.23
Bulgan	4.71	1.71	2.67	0.00	1.33	1.07	0.83	0.56	1.43	1.73	1.16	1.04	1.84
Govi-Altai	7.33	6.83	9.25	1.33	0.00	2.04	1.27	0.95	8.28	3.51	3.19	1.67	1.18
Dornogovi	3.70	2.62	4.40	1.07	2.04	0.00	2.75	2.16	1.67	2.85	4.99	5.27	1.25
Dornod	2.39	1.92	2.38	0.83	1.27	2.75	0.00	0.79	1.12	1.48	1.81	7.17	1.20
Dundgovi	2.07	1.08	2.56	0.56	0.95	2.16	0.79	0.00	0.79	2.07	2.09	1.25	0.57
Zavkhan	7.97	6.43	6.67	1.43	8.28	1.67	1.12	0.79	0.00	2.89	2.33	1.45	1.19
Uvurkhangai	9.81	3.22	16.32	1.73	3.51	2.85	1.48	2.07	2.89	0.00	4.31	2.09	1.43
Omnogovi	4.88	3.43	7.63	1.16	3.19	4.99	1.81	2.09	2.33	4.31	0.00	2.74	1.18
Sukhbaatar	3.15	2.39	3.29	1.04	1.67	5.27	7.17	1.25	1.45	2.09	2.74	0.00	1.40
Selenge	2.99	1.72	2.23	1.84	1.18	1.25	1.20	0.57	1.19	1.43	1.18	1.40	0.00
Tuv	0.06	0.03	0.05	0.02	0.02	0.03	0.03	0.02	0.02	0.03	0.03	0.04	0.03
Uvs	3.84	20.52	3.53	1.00	3.36	1.39	1.06	0.58	3.57	1.73	1.76	1.30	1.00
Khovd	5.45	28.37	5.46	1.27	6.47	1.92	1.35	0.81	5.94	2.53	2.61	1.71	1.23
Khuvsgul	15.47	10.15	9.74	5.26	6.60	3.58	2.83	1.66	8.57	5.29	4.18	3.47	4.20
Khentii	2.90	1.94	2.88	1.03	1.40	3.65	3.88	1.19	1.24	1.92	2.16	6.62	1.44
Darkhan-Uul	7.52	4.51	5.57	4.54	3.03	3.06	2.97	1.38	3.10	3.50	2.94	3.43	26.85
Orkhon	30.82	13.57	19.76	39.50	10.07	9.03	7.45	4.51	10.57	12.81	9.29	9.18	23.10
Govisumber	0.47	0.28	0.51	0.15	0.22	0.78	0.32	0.33	0.19	0.36	0.41	0.57	0.18
Nalaikh	0.43	0.22	0.39	0.17	0.17	0.30	0.22	0.16	0.16	0.29	0.24	0.31	0.21
Baganuur	0.98	0.56	0.91	0.38	0.42	0.81	0.67	0.38	0.38	0.64	0.59	0.95	0.53
Ulaanbaatar	68.04	19.93	51.92	34.97	18.91	36.12	27.33	25.10	18.75	44.17	26.49	38.72	47.53
TOTAL	209.39	144.94	182.41	108.35	97.48	95.46	73.20	53.06	94.70	124.97	90.44	99.22	124.50

Table 8.2.5-1 Traffic Matrix between Aimag Centres (2/2)

From/To	Tuv	Uvs	Khovd	Khuvsgul	Khentii	Darkhan-Ul	Orkhon	Govisumber	Nalaikh	Baganuur	Ulaanbaatar	TOTAL
Arkhangai	0.06	3.84	5.44	15.46	2.91	7.52	30.87	0.47	0.43	0.98	67.75	209.13
Bayan-Olgii	0.03	20.53	28.37	10.16	1.94	4.51	13.60	0.28	0.22	0.56	19.86	144.96
Bayankhongor	0.05	3.53	5.46	9.73	2.89	5.58	19.80	0.51	0.39	0.91	51.72	182.25
Bulgan	0.02	1.00	1.27	5.26	1.03	4.54	39.59	0.15	0.17	0.38	34.84	108.34
Govi-Altai	0.02	3.36	6.46	6.60	1.40	3.03	10.09	0.22	0.17	0.42	18.85	97.46
Dornogovi	0.03	1.39	1.92	3.58	3.66	3.06	9.04	0.78	0.30	0.81	35.96	95.30
Dornod	0.03	1.05	1.35	2.83	3.89	2.97	7.46	0.32	0.22	0.67	27.21	73.09
Dundgovi	0.02	0.58	0.81	1.66	1.20	1.38	4.52	0.33	0.16	0.38	24.97	52.91
Zavkhan	0.02	3.57	5.94	8.58	1.24	3.10	10.59	0.19	0.16	0.38	18.68	94.68
Uvurkhangai	0.03	1.73	2.53	5.28	1.92	3.50	12.82	0.36	0.29	0.64	43.97	124.76
Omnogovi	0.03	1.76	2.61	4.18	2.17	2.94	9.30	0.41	0.24	0.60	26.39	90.36
Sukhbaatar	0.04	1.30	1.71	3.46	6.63	3.43	9.19	0.58	0.31	0.95	38.55	99.06
Selenge	0.03	1.00	1.23	4.20	1.44	26.85	23.13	0.18	0.21	0.53	47.32	124.32
Tuv	0.00	0.02	0.02	0.05	0.05	0.07	0.21	0.01	0.03	0.03	124.62	125.50
Uvs	0.02	0.00	9.46	6.51	1.07	2.66	7.96	0.15	0.12	0.31	11.74	84.62
Khovd	0.02	9.46	0.00	7.52	1.40	3.23	10.01	0.21	0.16	0.41	15.39	112.91
Khuvsgul	0.05	6.50	7.52	0.00	3.10	11.43	39.32	0.44	0.41	1.00	57.15	207.93
Khentii	0.05	1.06	1.39	3.10	0.00	3.42	9.22	0.67	0.41	1.52	64.96	118.04
Darkhan-Uul	0.07	2.65	3.23	11.43	3.43	0.00	55.09	0.43	0.49	1.21	97.54	247.95
Orkhon	0.21	7.94	9.98	39.24	9.22	55.01	0.00	1.28	1.52	3.47	335.95	663.48
Govisumber	0.01	0.15	0.21	0.44	0.67	0.43	1.28	0.00	0.06	0.17	9.63	17.82
Nalaikh	0.03	0.12	0.16	0.41	0.41	0.48	1.52	0.06	0.00	0.33	90.43	97.23
Baganuur	0.03	0.31	0.41	0.99	1.52	1.21	3.46	0.17	0.33	0.00	71.49	88.11
Ulaanbaatar	125.76	11.78	15.44	57.36	65.33	97.97	337.91	9.68	91.22	72.04	0.00	1,342.49
TOTAL	126.65	84.62	112.91	208.03	118.48	248.32	665.99	17.88	98.04	88.71	1,334.96	4,602.71

8.2.6 Circuit Quantity Required between Aimag Centre and Sum Centre

Number of circuits required between exchanges of Aimag centre and Sum centres is calculated applying the loss probability of 0.01 per link to the forecast traffic.

8.2.7 Circuit Matrix between Aimag Centres

Circuit matrix between Aimag centres is calculated applying the loss probability of 0.01 per link to the forecast traffic. Table 8.2.7-1 shows the number of circuits required between Aimag centres in 2020.

Table 8.2.7-1 Number of Circuits between Aimags in 2020

From/To	Other Networks	UB-Transit Stage	Bayankhongor	Uvurkhangai	Uvs	Khovd	Khuvsgul	Darkhan-Uul	Orkhon	UB-Local Stage	TOTAL
Other Networks	0	0	0	0	0	0	0	0	0	0	0
UB-Transit	60	0	0	0	0	0	0	0	0	0	60
Arkhangai	330	210	30	0	0	0	30	0	60	150	810
Bayan-Olgii	240	210	0	0	30	60	0	0	0	30	570
Bayankhongor	300	210	0	30	0	0	0	0	30	120	690
Bulgan	180	150	0	0	0	0	0	0	60	60	450
Govi-Altai	180	210	0	0	0	0	0	0	0	30	420
Dornogovi	150	180	0	0	0	0	0	0	0	60	390
Dornod	120	120	0	0	0	0	0	0	0	60	300
Dundgovi	60	120	0	0	0	0	0	0	0	30	210
Zavkhan	150	210	0	0	0	0	0	0	0	30	390
Uvurkhangai	210	180	0	0	0	0	0	0	0	90	480
Omnogovi	150	180	0	0	0	0	0	0	0	30	360
Sukhbaatar	180	180	0	0	0	0	0	0	0	60	420
Selenge	210	120	0	0	0	0	0	30	30	120	510
Tuv	210	30	0	0	0	0	0	0	0	270	510
Uvs	150	180	0	0	0	0	0	0	0	0	330
Khovd	180	180	0	0	0	0	0	0	0	30	390
Khuvsgul	330	270	0	0	0	0	0	0	60	150	810
Khentii	210	150	0	0	0	0	0	0	0	150	510
Darkhan-Uul	390	210	0	0	0	0	0	0	150	210	960
Orkhon	960	360	0	0	0	0	0	0	0	690	2,010
Govisumber	0	90	0	0	0	0	0	0	0	0	90
Nalaikh	180	30	0	0	0	0	0	0	0	210	420
Baganuur	150	60	0	0	0	0	0	0	0	180	390
Ulaanbaatar	6,540	240	0	0	0	0	0	0	0	0	6,780
TOTAL	11,820	4,080	30	30	30	60	30	30	390	2,760	19,260

8.3 Traffic Forecast of IT

8.3.1 Internet Traffic

All the Internet traffics for Aimag and Sum subscribers will flow to/from Ulaanbaatar. This star connection style will be continued for the time being, and no direct circuit among Aimags will be required.

(1) Volume of Internet contents vs. its download time

Figure 8.3.1-1 shows the required download time vs. volume of contents, and required circuit speed vs. useful or enjoyable real time contents.

From the figure, followings can be say:

- Endurable limit time for download of contents for a user will be 20 minutes usually. Then;
- e-mail or a mail with 100s kB to 1 MB (mega bite) attachments requires 56 kbps speed circuit, or if there is a 56 kbps circuit, usual data can be transferred.
- If user wants to view still pictures in www, 500 kbps is preferably required.

- To watch TV pictures, even poor quality, 1.5 Mbps speed is necessary.
- If throughput speed can be kept more than 6 Mbps, user will enjoy usual TV quality picture on the net.

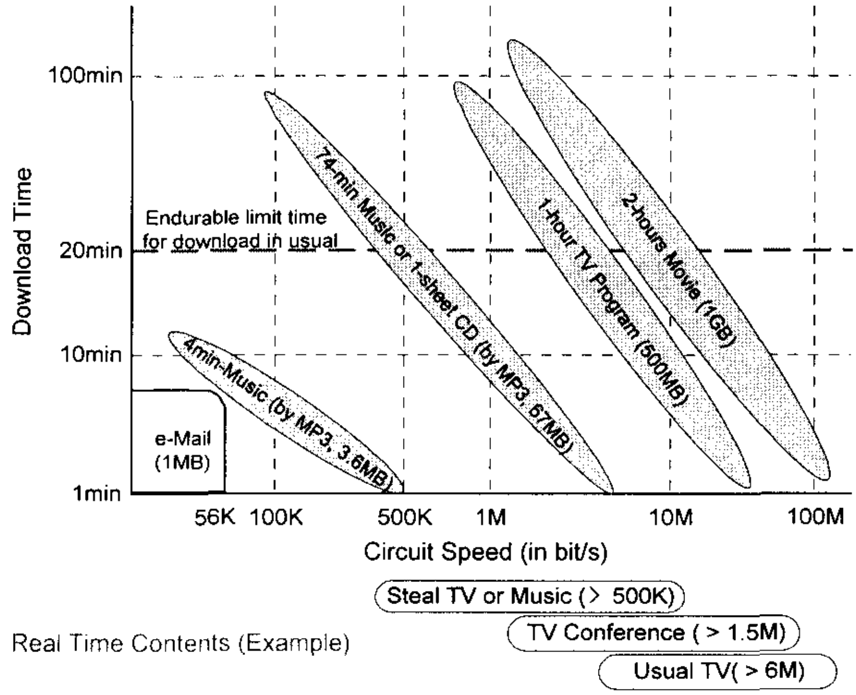


Figure 8.3.1-1 Relation between Contents vs. Download Time

(2) Estimation of traffic

Following the framework discussed in Chapter 5, the below-mentioned assumptions are given to the calculation for each segment's traffic.

Table 8.3.1-1 Subscriber's Ratio in Each Phase and at Each Area

		56 kbps (Dial-up connection)	10 Mbps (xDSL connection)	100 Mbps (xDSL or HDSL connection)
		Connection Time: 10 hours/(month·person)	Actual Connection Time: 25 hours/(month·person)	Actual Connection Time: 25 hours/(month·person)
Phase 1	Ulaanbaatar	100%	-	-
	Aimag centre	100%	-	-
	Sum & other rural	100%	-	-
Phase 2	Ulaanbaatar	70%	30%	-
	Aimag centre	80%	20%	-
	Sum & other rural	90%	10%	-
Phase 3	Ulaanbaatar	20%	60%	20%
	Aimag centre	50%	45%	5%
	Sum & other rural	70%	30%	-

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

(a) Traffic of each subscriber using 56 kbps

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

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

(b) Traffic of each subscriber using 10 Mbps

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

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

(c) Traffic of each subscriber using 100 Mbps

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

$(25^{hours/month} \div 24^{houre} \div 30.5^{days}) \times 0.2 \times 1.5 \times 2 \times 100^{Mbps} = 2052$ *kbps/subscriber*

Table 8.3.1-2 is an example (Arkhangai Aimag) of the calculation results, and Table 8.3.1-3 is that of the accumulated traffics gathered from all Aimags and Ulaanbaatar.

Table 8.3.1-2 Aimag Base Calculation Results (example for Arkhangai)

		Estimated Data Speed (kbps)						Required Capacity (Mbps)	
		(2008) Aimag	(2008) (Sum & Other)	(2013) Aimag	(2013) (Sum & Other)	(2020) Aimag	(2020) (Sum & Other)	Minimum (2020)	Recommend (2020)
1	Aimag centre	791	0	38,566	0	224,630	0	155	310
2	Battsengel		34		1,131		4,676	4	10
3	Bulgan		23		766		3,168	4	10
4	Zargalant		35		1,163		4,808	4	10
5	Ikhtamir		46		1,508		6,233	4	10
6	Ugiinuur		28		913		3,773	4	10
7	Ulziit		28		927		3,830	4	10
8	Undur-Ulaan		44		1,434		5,926	4	10
9	Tariat		42		1,394		5,761	4	10
10	Tuvshruuleh		35		1,165		4,814	4	10
11	Tsakhir		22		718		2,968	2	10
12	Tsenkher		40		1,308		5,405	4	10
13	Tsetserleg		35		1,140		4,712	4	10
14	Chuluut		31		1,030		4,256	4	10
15	Khairkhan		32		1,062		4,391	4	10
16	Khangai		29		943		3,898	4	10
17	Khashaat		31		1,029		4,253	4	10
18	Khotont		41		1,356		5,606	4	10
19	Erdenemandal		45		1,495		6,179	4	10
		791	623	38,566	20,481	224,630	84,657		
			1,415		59,046		309,287		

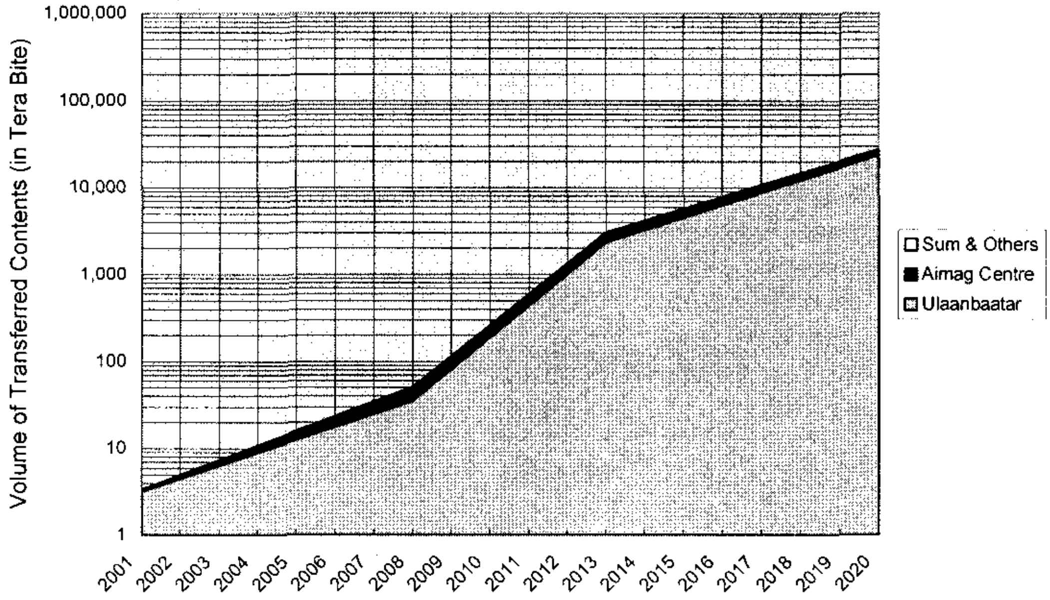
For other Aimags, the results of traffic calculation are shown in Annex 6.6.

Table 8.3.1-3 Accumulated Traffics gathered from all Aimags and Ulaanbaatar

Unit: kbps

No	Name of Aimag	(2008) Aimag	(2008) (Sum & Other)	(2013) Aimag	(2013) (Sum & Other)	(2020) Aimag	(2020) (Sum & Other)
1	Arkhangai	791	623	38,566	20,481	224,630	84,657
2	Bayan-Ulgii	849	439	41,385	14,424	241,054	59,624
3	Bayankhongor	1,067	688	51,999	22,606	302,878	93,443
4	Bulgan	440	564	21,447	18,528	124,923	76,586
5	Govi-Altai	652	471	31,776	15,469	185,082	63,941
6	Dornogovi	838	453	40,843	14,884	237,895	61,524
7	Dornod	935	280	45,554	9,186	265,337	37,970
8	Dundgovi	346	282	16,850	9,278	98,145	38,349
9	Zavkhan	546	506	26,629	16,612	155,106	68,668
10	Uvurkhangai	645	630	31,422	20,707	183,022	85,593
11	Umnugovi	642	379	31,281	12,465	182,200	51,523
12	Sukhbaatar	613	403	29,867	13,234	173,965	54,705
13	Selenge	830	909	40,448	29,860	235,594	123,425
14	Tuv	584	729	28,445	23,937	165,680	98,945
15	Uvs	611	403	29,787	13,251	173,501	54,772
16	Khovd	932	447	45,404	14,676	264,459	60,665
17	Khuvsgul	1,346	830	65,576	27,280	381,957	112,763
18	Khentii	660	626	32,147	20,581	187,243	85,071
19	Darkhan-Uul	2,348	173	114,422	5,675	666,465	23,458
20	Orkhon	15,645	231	762,394	7,587	4,440,667	31,360
21	Govisumber	314	47	15,294	1,529	89,082	6,322
	Aimag Total (1)	31,633	10,112	1,541,535	332,250	8,978,882	1,373,366
22	Nalaikh	2,140	94	104,266	3,090	607,310	12,773
23	Baganuur	2,210	0	107,710	0	627,372	0
	District Total (2)	4,350	94	211,976	3,090	1,234,682	12,773
	Aimag & Dist Total (1)+(2)	35,983	10,207	1,753,510	335,340	10,213,564	1,386,139
24	Ulaanbaatar	108,948	0	7,186,729	0	72,363,360	0
	UB Total (3)	108,948	0	7,186,729	0	72,363,360	0
	Mongolia Total (1)+(2)+(3)	144,931	10,207	8,940,239	335,340	82,576,923	1,386,139
		155,138		9,275,579		83,963,062	

Figure 8.3.1-2 shows total volume of contents transferred in Mongolia in a month (30.5 days). From the figure, it becomes clear that almost all information is exchanged by Ulaanbaatar subscribers, and less information flows in Aimag centre. Information in Sum area is extremely limited.



(Unit: Tera Bite)

	2001	2008	2013	2020
Ulaanbaatar	3.2	35.9	2,367.3	23,836.5
Aimag Centre	0.2	11.9	577.6	3,364.3
Sum & Others	0.0	3.4	110.5	456.6
Total	3	51	3,055	27,657

Figure 8.3.1-2 Volume of Contents Transferred in Mongolia in a Month

Basically a line speed (or capacity) should be determined by the user side requirements (or traffic). However, except for the cases such using Internet telephone and receiving the real time contents, Internet system is not always prepared to cope with full traffic demand, because the Internet is in a so-called best effort world.

At Sum area in Phase 1 and Phase 2, amount of the Internet transaction will be limited since there are 56 kbps basis connections only, then the planned facilities can cater for those transaction. But in Phase 3 stage, some big Sums will require more large transmission lines to receive 10s Mbite contents. Therefore it is preferable to install the large capacity line to such Sum centres as much as possible.

8.3.2 Leased Circuit Traffic

Leased circuit traffic is supposed to be low, as current MT's leased circuit business is less than 3.5% in its earnings. A same feature is observed in the leasing circuit businesses of

NTT Japan: it does not exceed 5% in its earnings always resulting in low traffic. The share will not be changed in future too.

As mentioned in Chapter 3 and Chapter 9, future's leased line, if arises, will be provided in a form of virtual private network (VPN). And the required volume (or circuit capacity) to the transmission system will be within the redundancy of the IT circuit, then it can be negligible in the long term design.