Project Completion Report

Name of project: Special Emergency Communications Network Via Satellite For Mongolia

Chief Researcher and Accounting coordinator:

B.AMGALANBAT. Msc

/Director General,PPD, ICTPA/

e-mail: amgalanbat@ictpa.gov.mn
bamgalanbat@yahoo.com

Researchers:

V.BOLORCHIMEG /Specialist, Policy and Planning Department, ICTPA/

KEIICHI KOYANAGI, Prof / Waseda Univ. Japan /

DAMDINSUREN LKHAGVAJANTSAN / Waseda Univ. Kitakiyushu. Japan/

October 2011

Contents

1. CURRENT SITUATION OF ICT SECTOR OF MONGOLIA

The information and communications technology sector of Mongolia is comprised of telecommunications, information technology, radio and television broadcasting, and postal services.

The national fiber optic network of Mongolia is now extended to reach all 21 aimag centers and over 151 soums. ICTPA is currently implementing a project to extend fiber optic network in the next 2 years, which will connect more 148 soums.

The information and communications technology sector of Mongolia is comprised of telecommunications, information technology, radio and television broadcasting, and postal services.

Four mobile operators currently provide mobile services to over 2 million subscribers throughout the territory of Mongolia and are currently expanding their services to provide Internet connections to schools at aimag and soum centers as well as extending further mobile content.

The Universal Service Obligation Fund (USOF) has enabled extension of backbone fiber optic network to rural and remote areas of Mongolia, thus allowing access to information and communications technologies and its services by rural population.

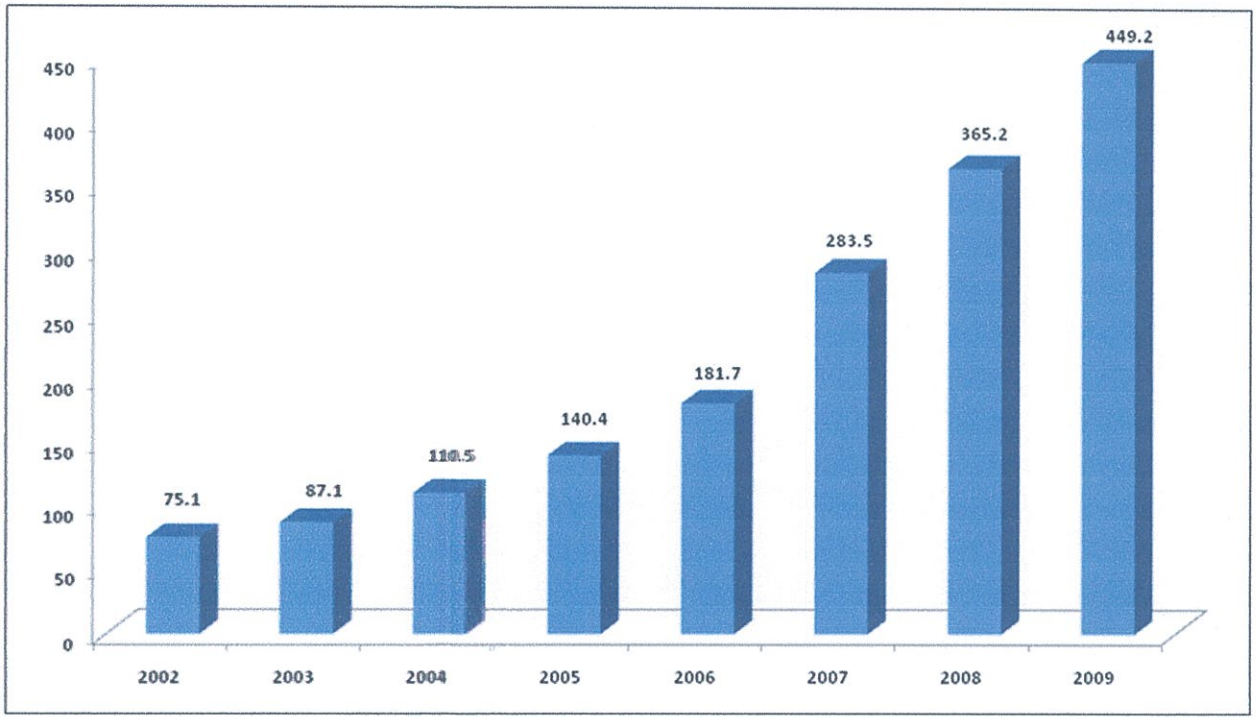
In order to successfully implement "Computers for all" component of "E-Mongolia Master Plan" in 2005-2007, the waiver policy from customs taxes for imported computers and spare parts for computers were introduced, which created favorable environment, resulting in more than doubling the number of computers purchased during this period compared to previous years.

The number of software and development companies has reached over 100, which currently develop software and applications for government organizations and private sector.

The number of websites has been increasing steadily for the last few years, with each organization getting domain names at .mn top-level domain (TLD) and outsourcing development of websites to local software development companies.

The number of students to apply and register at universities specializing in training on ICT areas has been steadily growing in the last few years, becoming a preferred choice of major for students to study. This includes not only system administration, hardware and software engineering courses, but also management of information systems, information systems engineering, and designing and multimedia applications development.

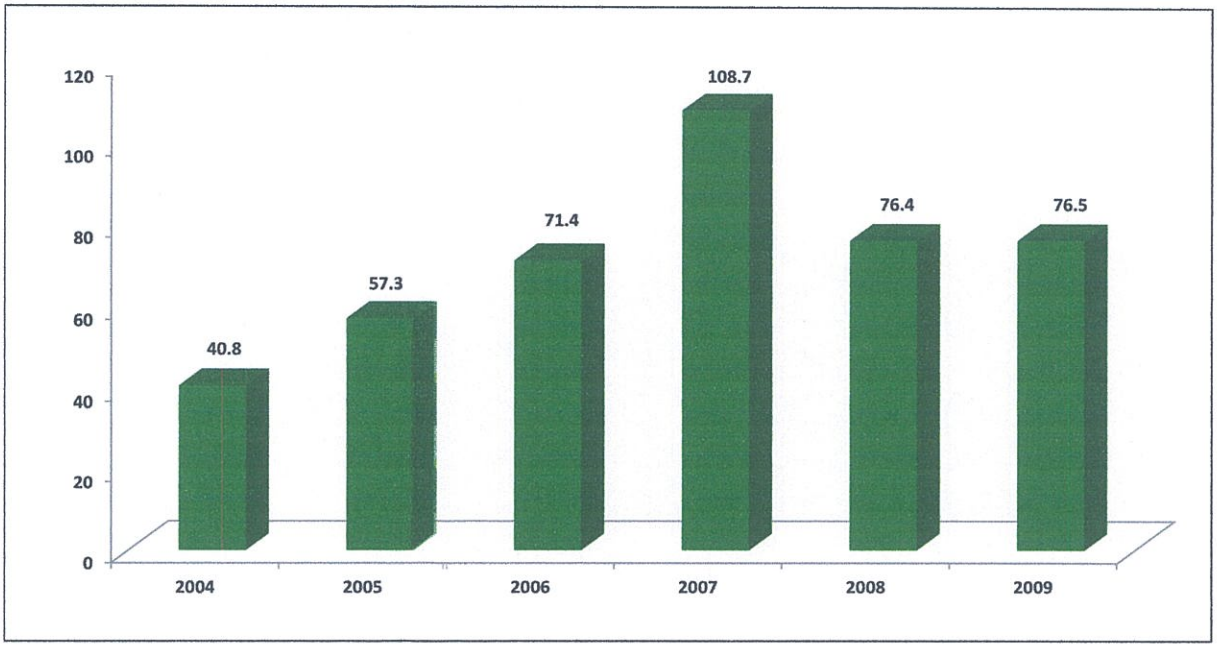
The following graphs show the total revenue of ICT sector for the period of 2005-2009, and tax contribution of ICT sector to the state budget and sector investments.



Bln, MNT/years

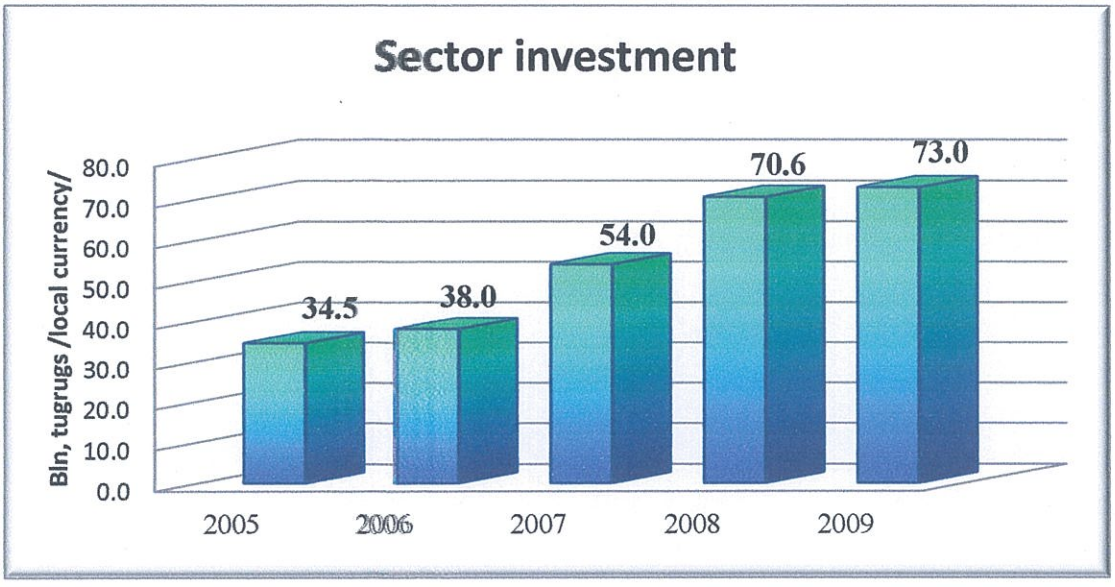
Graph 2. Total revenue of ICT sector (2005 – 2009)

Tax contributions to State budget
/2004 to 2009 bn.tugrugs/



Bln, tugrugs (local currency)/years

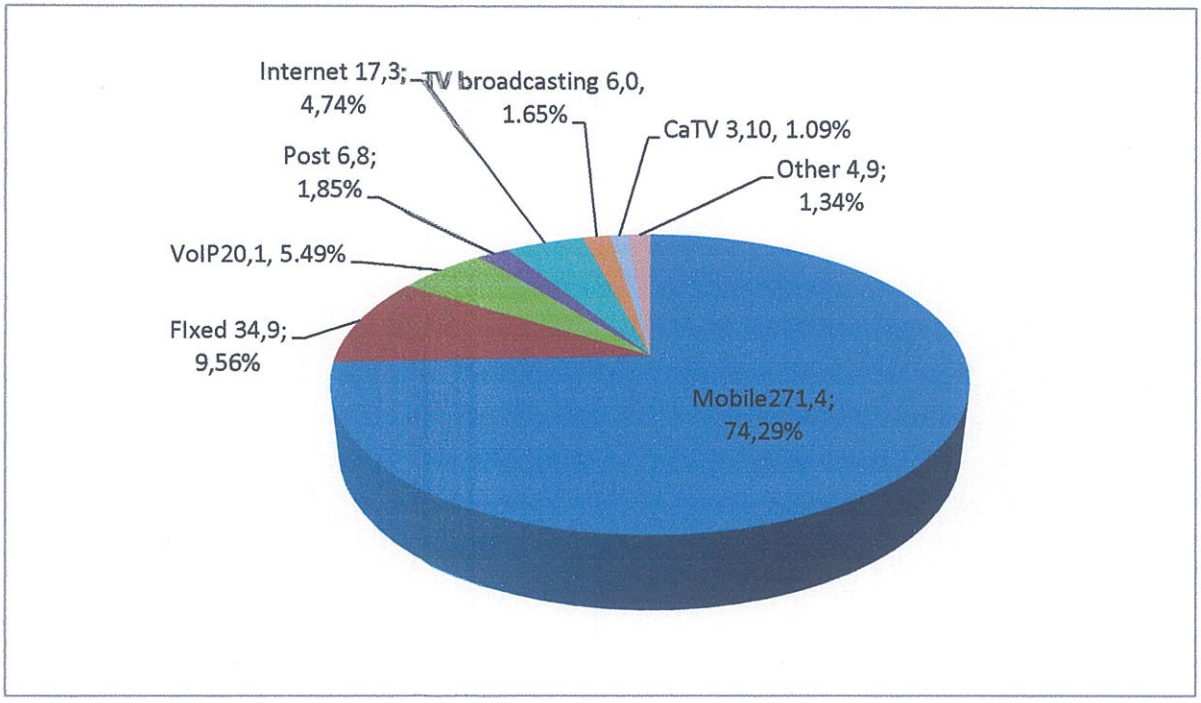
Graph 1. Tax contributions to State budget (2004 – 2009)



Bln, tugrugs (local currency)/years

Graph 2. Sector investment

The following graph represents composition of ICT sector revenues in 2009. It can be seen that about 74% of total revenues of the ICT sector are generated by mobile services and the remaining 26% are contributed by fixed telecommunications network, VoIP, Internet, Cable TV, broadcasting and other.



Graph 3. Composition of ICT sector revenues in 2009

1.1 Telecommunication Industry

Our country has become fully digitalized as far as switching and transmission equipment is concerned. The following graph represents the overall coverage of fiber optic and VSAT network of Mongolia. It can be seen that the backbone fiber optic network has reached all aimag centers and some soum centers. The Information Communication Network Company (www.icnc.mn) is the owner of the national backbone and access network of Mongolia including international, long distance, rural and local transmission networks and local loops. In addition, private operators such as Mobicom (www.mobicom.mn), Gemnet (www.gemnet.mn), Skytel (www.skytel.mn) and Mongolian Railway (www.railcom.mn) have installed fiber optic networks in some locations.

There are over ***188,875*** fixed telephone users in Mongolia constituting a ratio of 6.9 per 100 people.

There are over ***44,539*** users who are subscribed to WLL services and a ratio of WLL subscribers per 100 people has reached 1.52 in 2009, an increase by 0.22 compared to 2008. WLL services are provided by Skytel, Mobicom, and Mongolia Telecom (www.telecommongolia.mn).

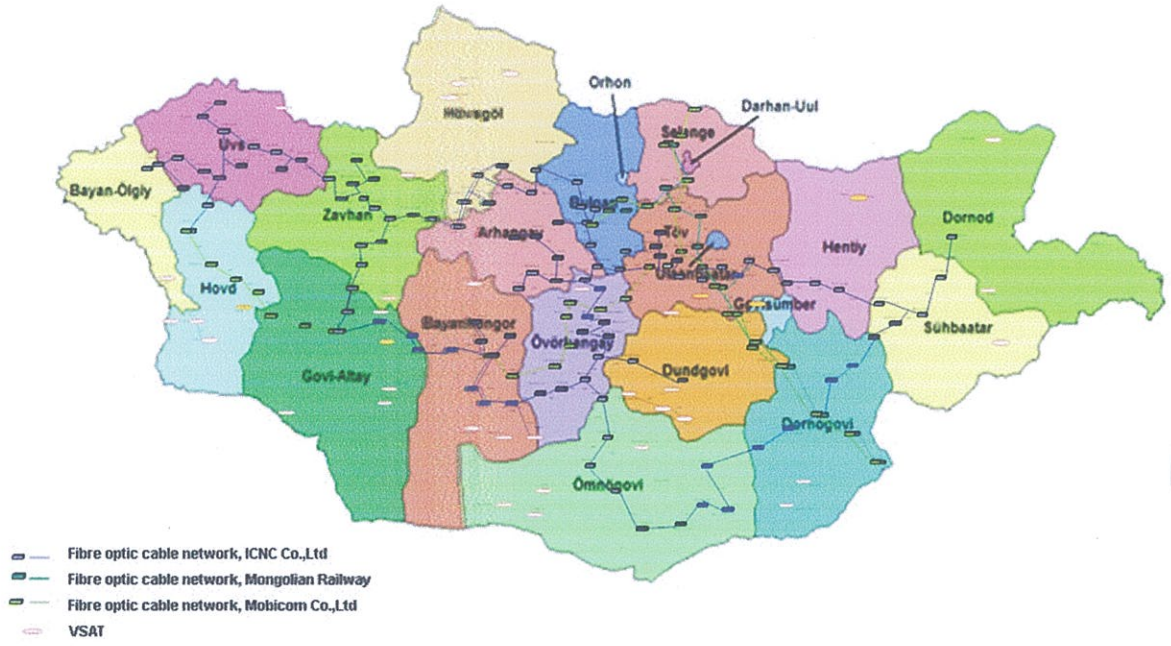
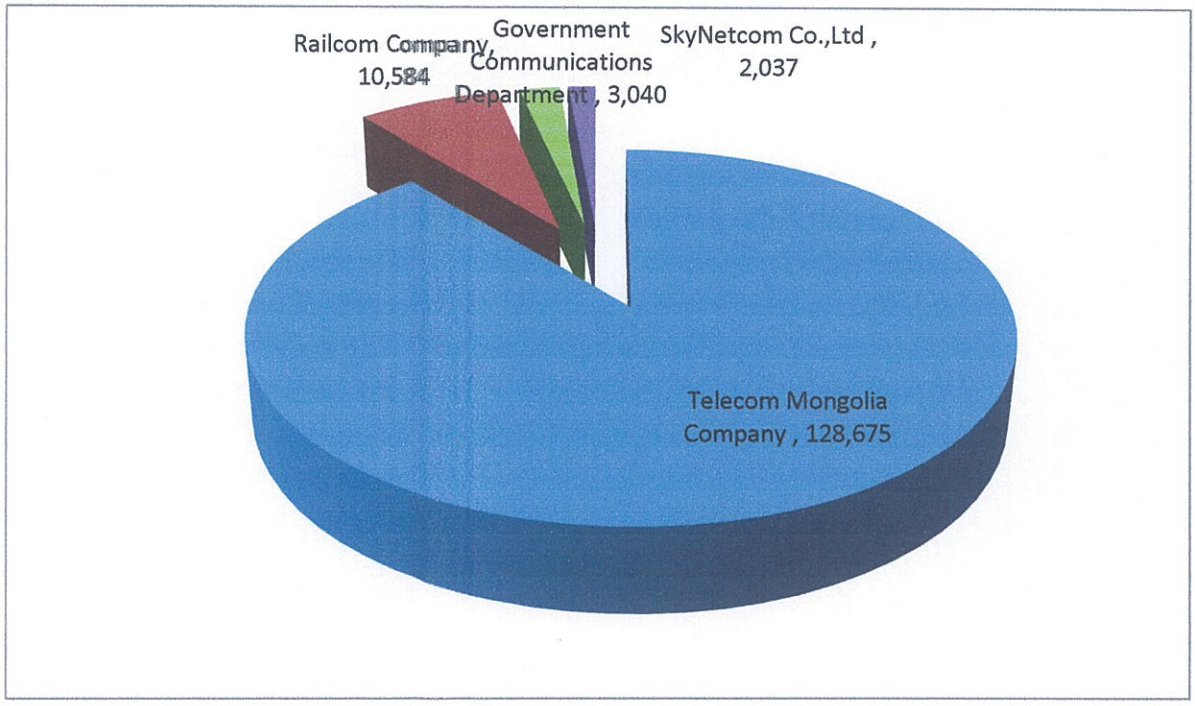


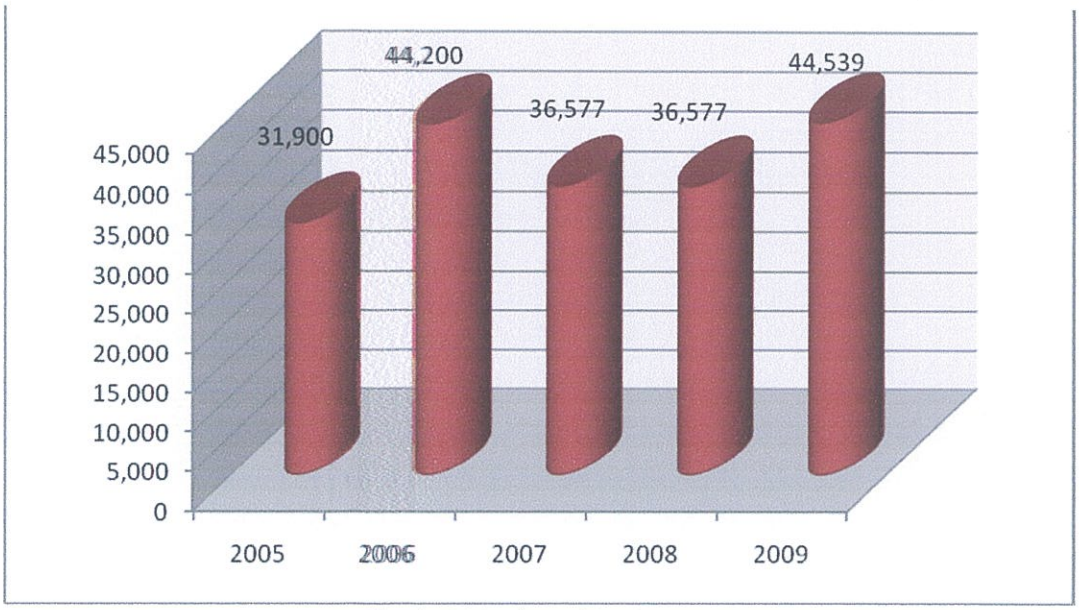
Figure 1. National transmission network

Out of total of 188,875 fixed telephone users, the majority (89% or 128,675 users) are users of Mongolia Telecom, and the rest are users subscribed to the Government Communications Department, RailCom and SkyNetCom.



Graph 4. Number of fixed telephones

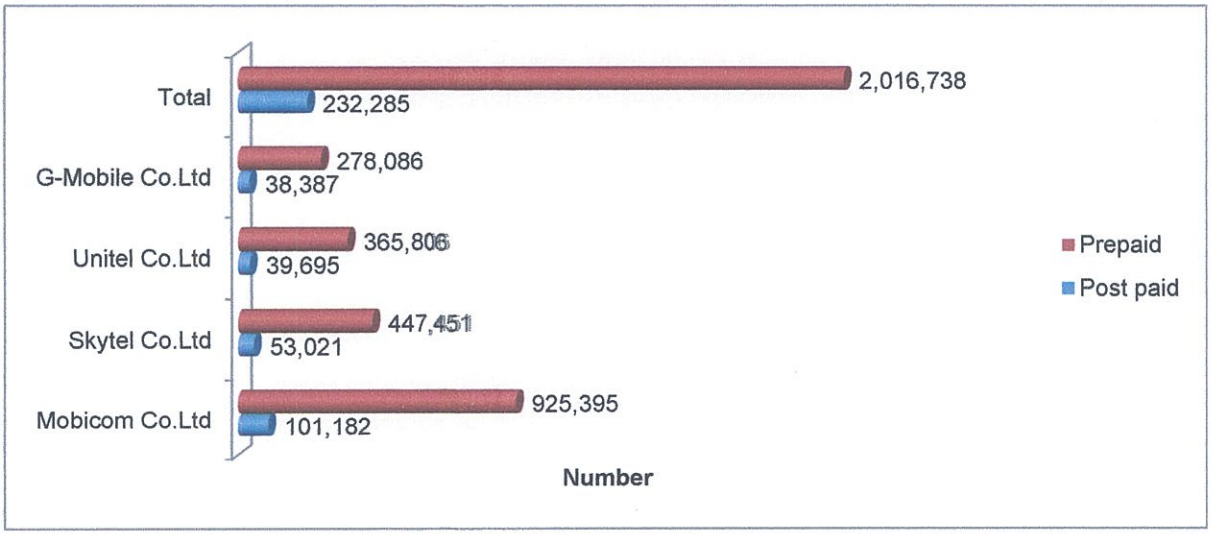
Of all 44,539 users, who are subscribed to WLL services, the majority of subscribers use services offered by Mongolia Telecom, representing 88% of subscribers (39,443 subscribers), and the remaining subscribers use services offered by Mobicom and Skytel Companies. The following graph represents an increase of the number of WLL services in Mongolia.



Graph 5. Number of WLL users

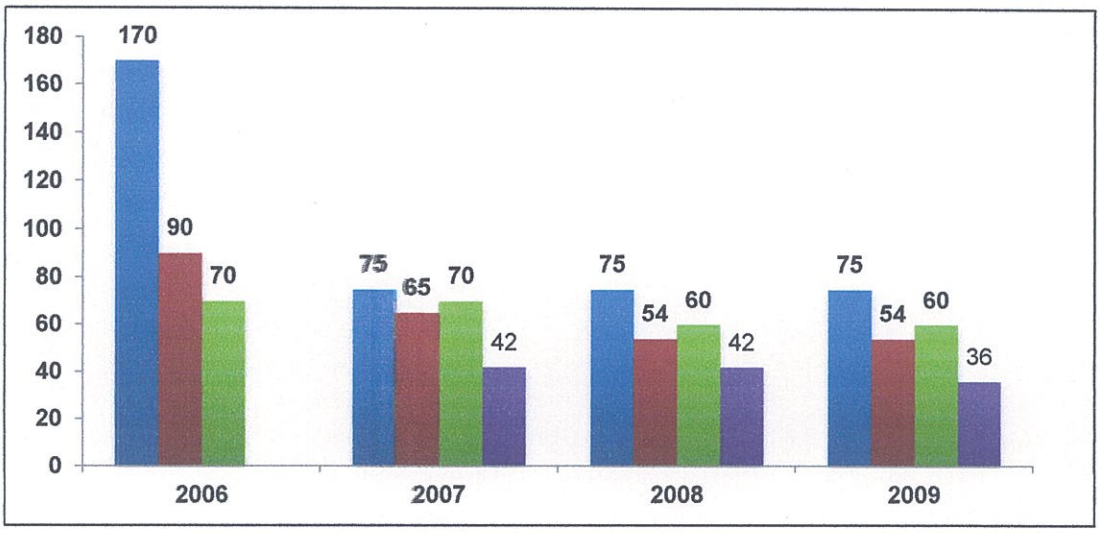
2.2 Mobile Communications Service

There are four mobile phone operators in Mongolia, which provide services to over 2 million subscribers of Mongolia, with penetration of more than 80% of the total population of Mongolia by 2009. Two mobile service providers use GSM system and the other two operators use CDMA system. The following graph represents the number of subscribers by each mobile service operator including pre-paid and post-paid services. (CRC, 2009)



Graph 6. Number of subscribers by each mobile service operator

As it can be seen from the following graph, the charges for mobile communications have been reduced more than twice since 2006. As of the end of 2009, 1 minute charge for a call with a mobile operator is average 56MNT. This shows that Mongolia is in the 91st place among 161 countries (ITU, 2010), having charges lower than the Asian average. (ITU, 2010)



Graph 7. Mobile communications charges per 1 min

1.3 3G services

Since 2009, MobiCom, Skytel and Unitel (www.unitel.mn) have launched 3G - high-speed mobile broadband services in Mongolia, offering new services to their customers, such as Video call, Mobile broadband with high speed connection through mobile phones or special modems, and watching TV programs. All subscribers of these mobile service providers can have access to these services with the condition that their mobile phones supports these services.

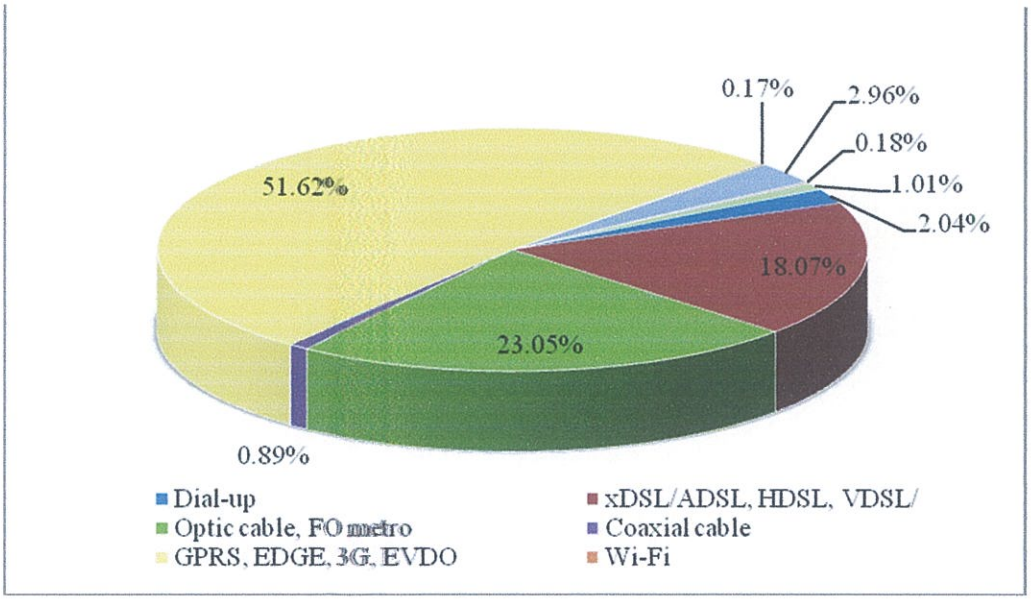
1.4 Internet Service

The first Internet Service Provider (ISP) started providing Internet services in Mongolia in 1996 with 64kbps through VSAT technology.

Nowadays, there are 56 companies, which were granted with for Internet access and service provision by CRC. (CRC, 2009)

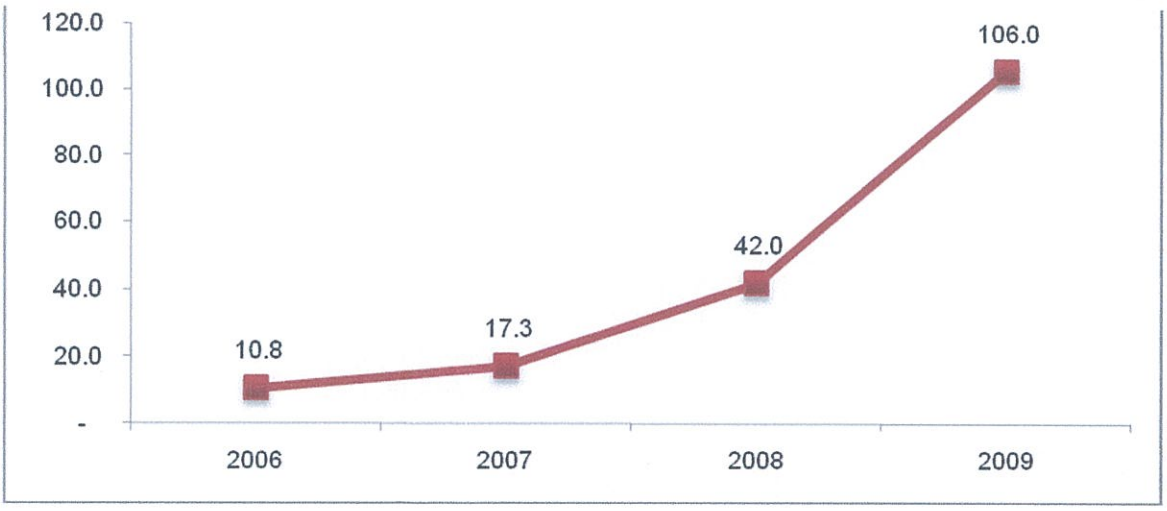
The overall bandwidth of Mongolia is downloading 7.8Gbps and uploading 7.8Gbps. The Internet connections are made through fiber optic cable network going along the railway lines to the north to the Russian Federation, and to the south to the People's Republic of China.

At present, internet services in Mongolia are distributed via xDSL, Fiber optic, GPRS, WiMax and WiFi technologies. The following graph represents different types of technologies used for access to Internet, and as it can be seen the majority of users access Internet through GPRS, 3G, EVDO and EDGE technologies.



Graph 8.Different types of access to internet

In 2009, the number of Internet subscribers was over 106,048 constituting an increase of over 61% compared to 2008, which is shown in the following graph.



Graph 9.Internet subscribers

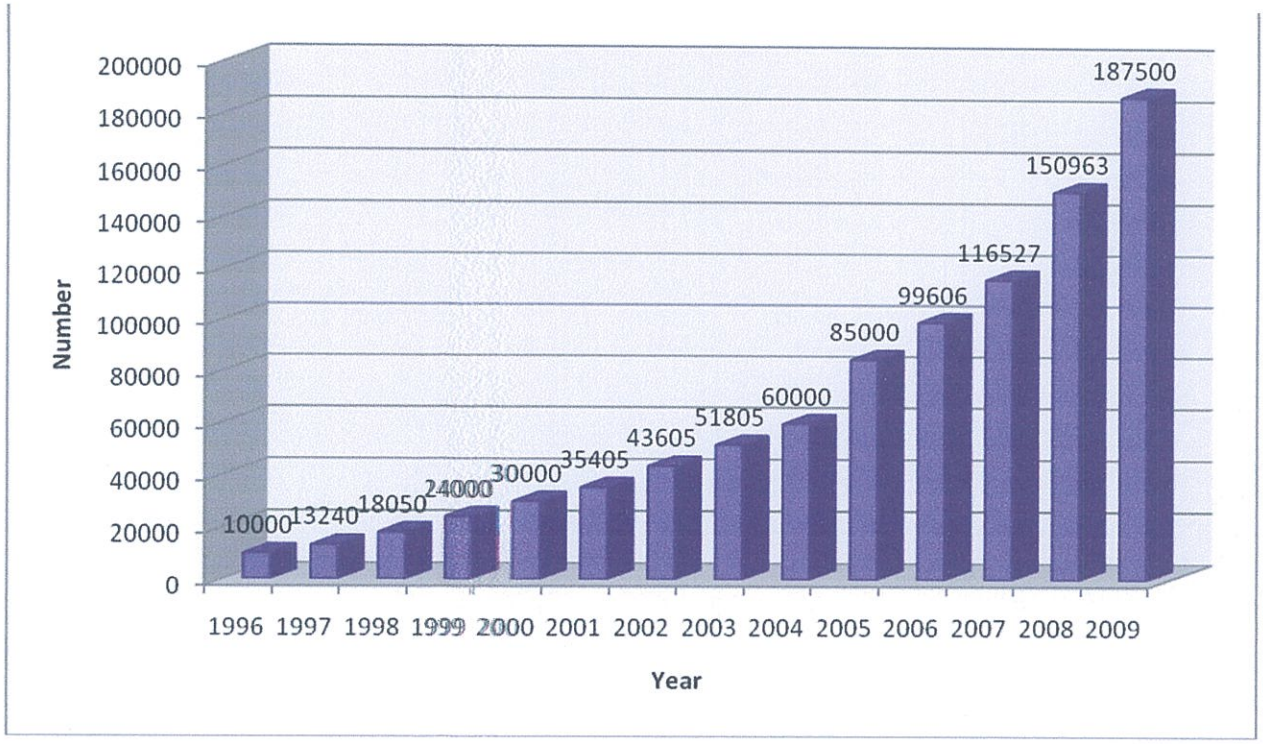
The cost of connection to Internet services fell down tremendously in the last year. The Internet connection for corporate organizations is starting from 180.000MNT for 1Mpbs for dedicated leased line for monthly basis. The number of users connecting to Internet through dial-up is reduced to almost none as preference is given to affordable ADSL and wireless EVDO/3G modem connections. The Internet connections for small office and small home (SOHO) solution nowadays is 27,900MNT for monthly fee of 1 Mbps.

1.5 Voice over Internet Protocol (VoIP)

There are a number of companies, which offer pre-paid international calling cards services through Internet protocol. The costs of calling cards starts from 2,000MNT allowing over 1 hour of phone call.

1.6 Hardware supply

There are over 30 companies in Mongolia, which supply computers and equipment to the market. There were a total of 187,500 computers in 2009, consituting an increase of 20% compared to 2008, according to the 2009 Annual Statistical Yearbook of the National Statistical Office (NSO, 2009).



Graph 10. Number of computers (2005-2009)

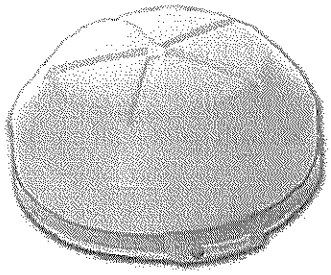
2. STUDY ON GLOBAL DISTRESS AND SAFETY SYSTEM

The biggest satellite company such as Iridium, Thuraya, Qualcomm, COSPAS-SARSAT and Inmarsat provide the global distress and safety application all over world.

2.1 StreamSat-Prima

Using the latest in terminal technology, the StreamSAT – Prima uses an innovative concept that operates over existing Global C band satellites using small antennas.

The terminal can be easily pole mounted and is fully ruggedized for marine environment.
StreamSAT – Prima terminal and services is designed to operate with a range of maritime and other mobile applications with flexibility to address specific service features and requirements. StreamSAT – Prima is currently configured to support GPS position reporting, telemetry, and messaging applications. The network will be upgraded in the future to support other services including standard E-mail, and FTP applications.

	**Applications** • Position Reporting with Report Rates > 1 p/hr Operation -10 to +50°C / 95% humidity Non operations -20 to +70°C / 99% humidity Waterproof IP 65 compliant • Telemetry at 200 bytes p/min
Power Power when transmitting <40 Watts Power Standby <12 Watts Power Supply 11 to 32 Volts	**Option** Date Rate 600 - 3000 bps Battery Back-up option with intergrated charger Height 240mm Diameter 470mm Weight Less than 10kg

2.2 COSPAS-SARSAT

The International Cospas-Sarsat Programme provides accurate, timely, and reliable distress alert and location data to help search and rescue authorities assist persons in distress.

The objective of the Cospas-Sarsat system is to reduce, as far as possible, delays in the provision of distress alerts to SAR services, and the time required to locate a distress and provide assistance, which have a direct impact on the probability of survival of the person in distress at sea or on land.

To achieve this objective, Cospas-Sarsat Participants implement, maintain, co-ordinate and operate a satellite system capable of detecting distress alert transmissions from radiobeacons that comply with Cospas-Sarsat specifications and performance standards, and of determining their position anywhere on

the globe. The distress alert and location data is provided by Cospas-Sarsat Participants to the responsible SAR services.

International Beacon Registration Database (IBRD)

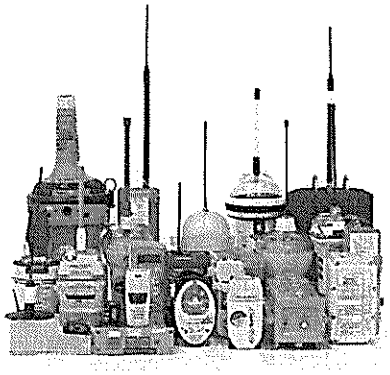
Cospas-Sarsat implemented a new web interface for its International Beacon Registration Database (IBRD), effective June 2011. The IBRD website is a place where:

-beacon owners can directly register a beacon, when the beacon's country code corresponds to that of an Administration that allows registration on the IBRD ; and

-Search and rescue services can easily upload or retrieve beacon registration information.

National administrations that wish to authorize direct registration on the IBRD by beacon owners (coded with its national country code(s)), may request the Cospas-Sarsat Secretariat to enable that IBRD function for their country. This minimizes the burden to a government of maintaining its own registration facility, and provides easy, centralized access to beacon registration data by search-and-rescue (SAR) authorities. A template for the appropriate letter to the Secretariat can be found on the Cospas-Sarsat website. With the latest improvements, government authorities can now work offline to create a database that can later be uploaded to the IBRD, with no need to install software.

Cospas-Sarsat Distress Alerts



Since its inception in 1982 the Cospas-Sarsat System has provided distress alert information which has assisted in the rescue of 28,375 persons in 7,746 distress situations.

In 2009 only, the System provided information which was used to rescue 1,596 persons in 478 distress situations.

2.3 INMARSAT

IsatM2M is a global, very low data rate service providing a two-way short burst data service for machine-to-machine communications. It currently serves customers who need to track and monitor mobile or fixed assets, wherever they are in the world, such as a fleet of trucks.

Performance

IsatM2M is a global, short burst data, store and forward service that will deliver messages of 10.5 or 25.5 bytes in the send direction, to 100 bytes in the receive direction. It also gives users the ability to broadcast to multiple terminals, increasing the cost and efficiency of managing your fleet.

Global Coverage

All three satellites cover all surfaces of the earth, except for extreme polar regions. It is one network meaning you can monitor your fixed operations wherever they are located in the world.

Service Access

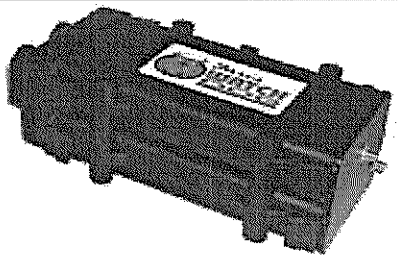
The service is delivered to market via two partners - Skywave and EMS. Each has their own solutions to integrate the service into customers' infrastructure.

Typical Applications

- non-IP SCADA
- Fixed and mobile asset monitoring
- Personnel tracking
- Telemetry

2.4 IRIDIUM

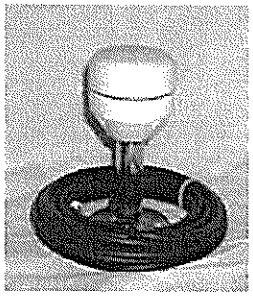
A rugged, compact, low-power draw Iridium satellite MTU (Mobile Transmitting Unit). The Faria WatchDog® 750VMS SB is designed to meet the National Marine Fisheries Service near real-time position reporting requirements.

	The Faria WatchDog® 750 VMS SB is a cost effective messaging, e-mail and Activity Code Declaration and Catch & Notification Forms reporting solution. Built to meet the demanding requirements of the commercial fishing industry.

Approved for Long Range Identification Tracking Systems

The Faria WatchDog 750 has passed Iridium's Compliance and Test Requirements and meets all performance standards for LRIT Systems outlined in IMO Resolution 81/210.

WatchDog provides Worldwide LRIT Tracking systems for all required vessels operating in near-coastal Sea Area A2 and in polar Sea Area A4 via the Iridium Satellite Network



All vessels of 300 gross tonnage and above on international voyage will need to be compliant with LRIT regulations. Long-Range Identification and Tracking (LRIT) regulation will apply to the following ship types engaged on international voyages:

- All passenger ships including high speed craft
- Cargo ships, including high speed craft of 300 gross tonnage and above
- Mobile offshore drilling units.

All ships operating in polar Sea Area A4 above 70 degrees latitude will require a non-Inmarsat terminal that operates in conjunction with a low-earth orbit Communication (Iridium) Service Provider (CSP) approved by the Flag in conjunction with its appointed Application Service Provider (ASP).

3. TEST OF DISTRESS AND SAFETY SYSTEM FOR MONGOLIA

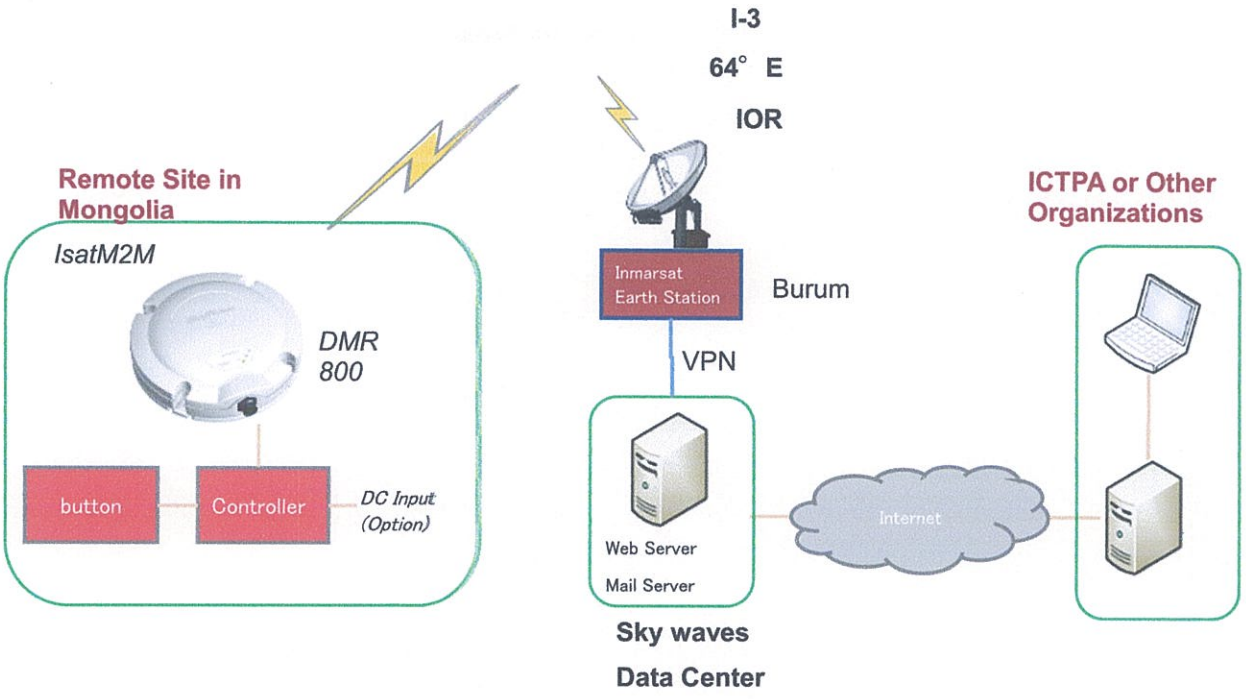
Our team has worked with Sky Perfect JSAT Corporation team for studying two cases as follows:

1. Studying about technology and application market price of INMARSAT global distress and safety system
2. Field test in Ulaanbaatar, Mongolia

3.1 IsatM2M application

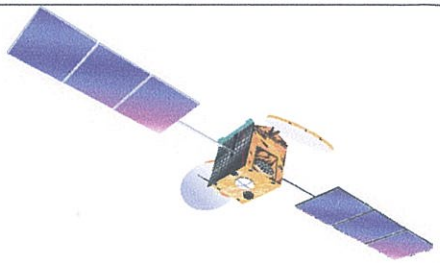
When user occur the emergency situation, user push the SOS button of user DMR800 terminal. SOS Information transmitted from DMR800 terminal is stored at the SkyWave's data center and sent to the user by e-mail. Also, user can access the SkyWave's Web server to check the SOS information. IsatM2M network design is shown Figure 1.

Figure. 1 IsatM2M network design.



IsatM2M application is taken by I-3 satellite constellation. I-3 satellite constellation has 5 satellite for covering globally. I-3 Satellite information is summarized in table.1

Table. 1 I-3 satellite constellation description

	• 5 satellites in orbit • Space position: 64degE • +- 2000 kgs / 4400 lbs • Platform/payload manufacturer: Lockheed Martin/ Astrium • Solar array wingspan: 21m • 2 antenna: +- 2m in diameter • 1 global beam & up to 7 spot beams

Technical specification of user terminal DMR800 is shown below:

- Two way communications
- Global Coverage
- Frequency
  - Rx: 1525.0 to 1559.0 MHz; 32-FSK
  - Tx: 1626.5 to 1660.5 MHz; 2-FSK

- EIRP: 9dBW max
- Elevation angle: 0 – 90 degree
- Size: 160 mm (diameter), 47 mm (height)
- Mass: 500 gram
- Operating temp: - 40^0C ~ +70^0C
- Input voltage: 9VDC – 32VDC

3.1.1 IsatM2M application price

The SOS signal is received by Burum Inmarsat earth station in Netherland and transferred to and stored in the SkyWave's data center.

- SOS information is sent to the user in Mongolia by e-mail.
- User in Mongolia can check the SOS information by accessing the SkyWave's Web server.

The application tariff is shown in table 2.

Table. 2 IsatM2M application tariff in current market.

№	Description	Tariff /USD/
1	Control station set up	130$
2	User terminal activation	26$
3	Monthly fee per user terminal	7$
4	User terminal (DMR800D)	715$

Comment: If one user will use this IsatM2M application, totally 870$ is needed initially. It seems like quite expensive for Mongolian people comparing with average income of household in Mongolia.

3.2 FIELD TEST IN ULAANBAATAR, MONGOLIA

We have chosen the available satellite terminal in market of Mongolia.

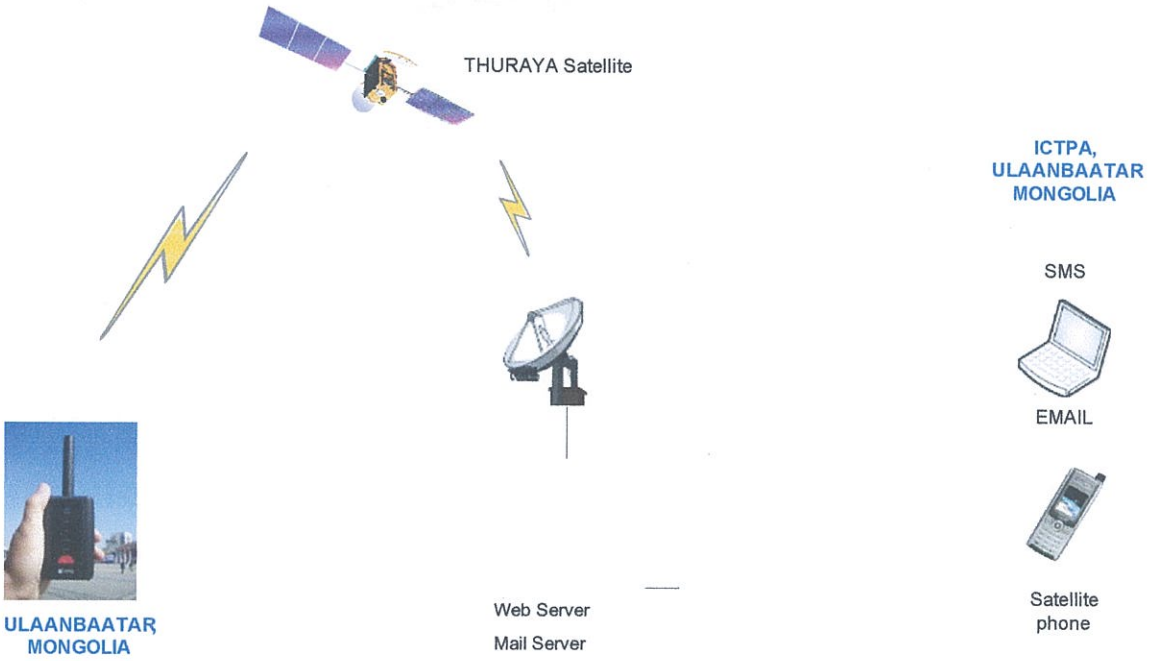
	Five user terminals of APSI have tested in Ulaanbaatar Mongolia.

The field test is made the following purpose:

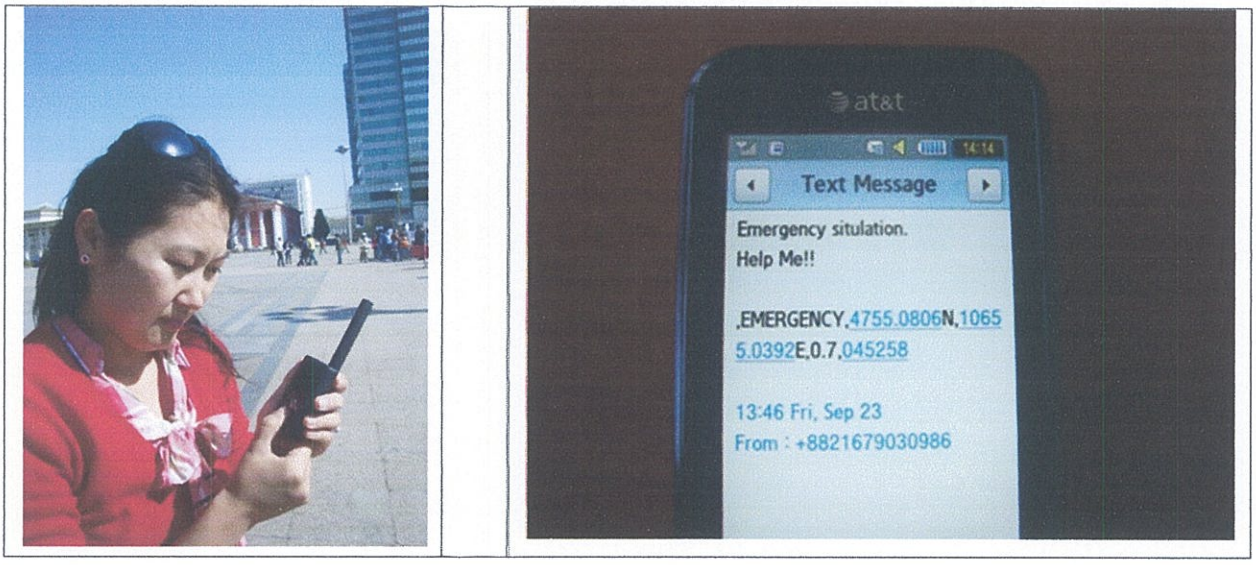
1. SOS information will be received by short message (SMS) to local GSM phone.
2. SOS information will be received by email to Mongolian user.
3. SOS information will be received by short message to Thuraya satellite phone which is worked in Mongolia.

The field test configuration is described Figure 2.

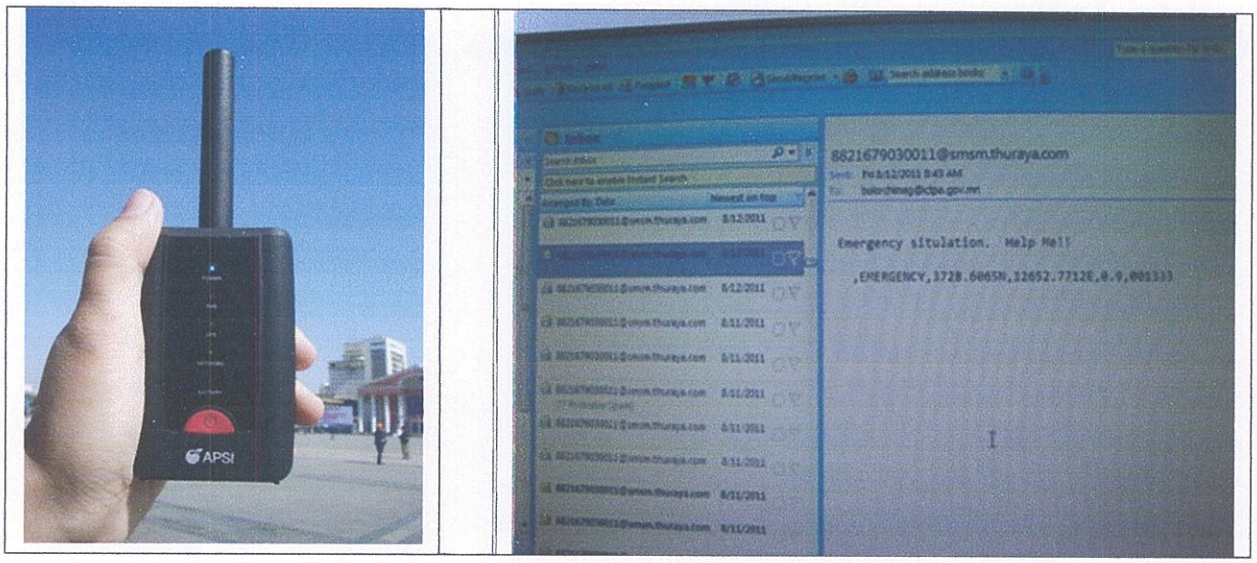
Figure. 2 Network diagram of the Field Test.



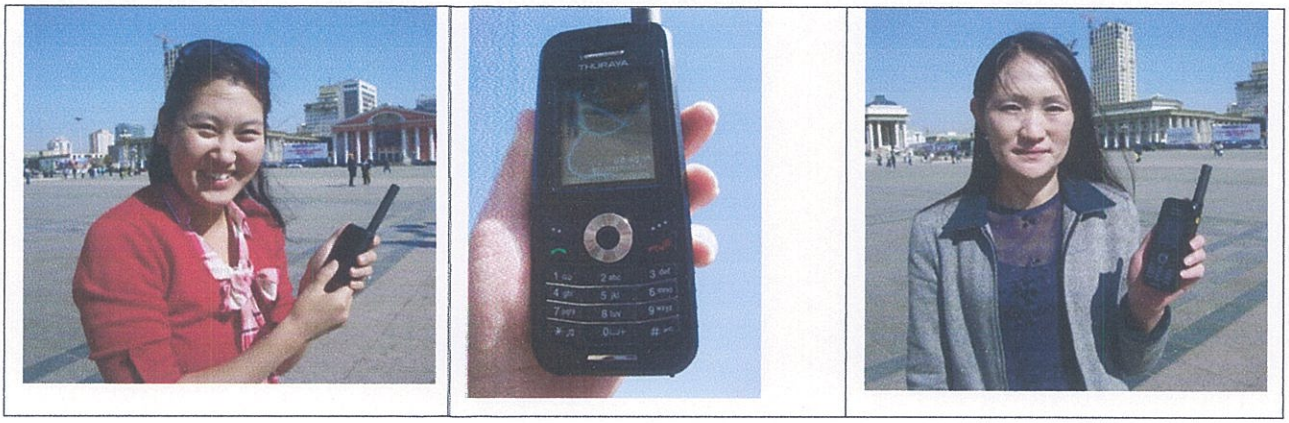
1. SOS information will be received by short message (SMS) to local GSM phone.



2. SOS information will be received by email to Mongolian user.



3. SOS information will be received by short message to Thuraya satellite phone which is worked in Mongolia.



Test Result:

All three kinds of test were made successfully that APSI terminal worked through Thuraya satellite. Therefore, it is possible to establish satellite based emergency network for Mongolia.

4.Implementation of System Level Simulation

4.1 System Modeling Requirements

System Modeling requirements are being formulated below.

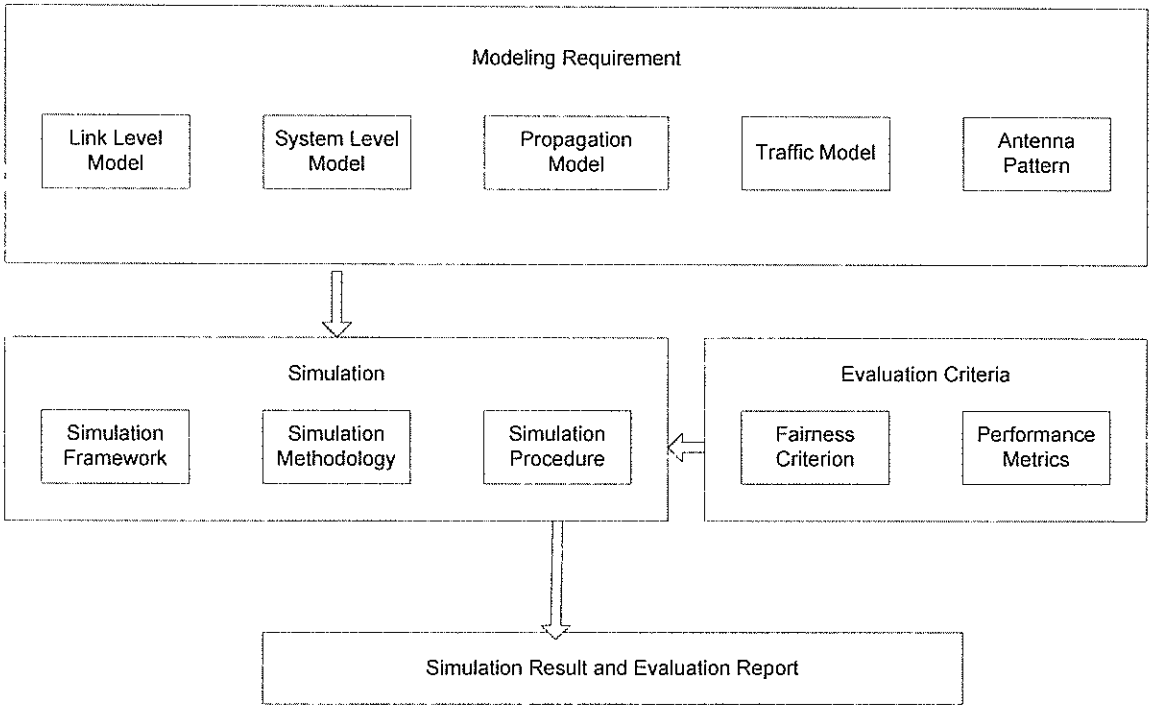


Figure 2.1 Simulation Result and Evaluation Report

System level simulation has been widely used to evaluate system performances. System level simulation is based on link level simulation methods.

4.2 System Simulation Requirements

System simulation requirements of subscriber terminal and satellite uplink/downlink model are assumed in the following tables.

Table 2.1 System Simulation Requirements of Subscriber Terminal

Subscriber terminal Model		
Parameters	**Description**	**Value**
P_{ST}	Transmit Power of subscriber terminal	23dBm
H_{ST}	Subscriber terminal height	1.5m
G_{ST}	Gain (boresight)	0dBi
B_R	Bite Rate	144bps

Table 2.2 System Simulation Requirements of the Satellite

Satellite Model		
Parameters	**Description**	**Value**
G/T	Gain/Thermal temperature	>30 dB/K
BER	Bit Error Rate	Better than 1 E -06
F	Frequency band	2100MHz
QPSK	Modulation	

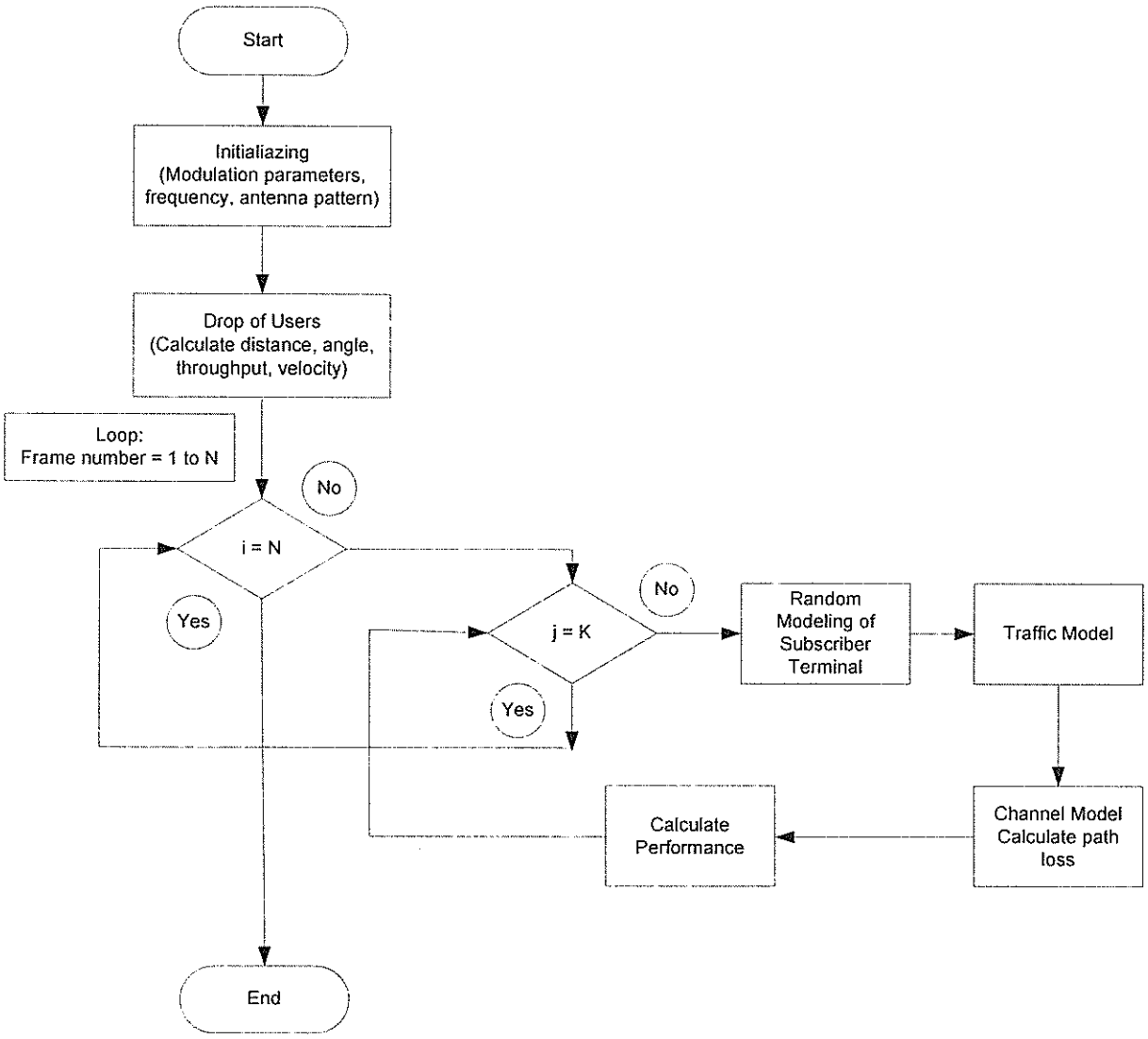


Figure 2.2 Emergency Network SLS Flowchart

4.3 SIMULATION EVALUATION

The simulation was provided into two parts:

1. User terminal design
2. Link budget calculation (Uplink budget, Downlink budget, Power budget)

The following data were used in the simulation:

1. The saturated EIRP and saturated flux density of the transponder
2. The satellite G/T figure appropriate to your planned uplink location.
3. Satellite transponder bandwidth
4. Satellite transponder output backoff or attenuation
5. Satellite transponder input backoff or attenuation
6. The receiving antenna diameter and gain of earth station

User Terminal design.

The objective of the simulation was the development of a miniature satellite communications user terminal platform. This platform is aimed at L-band emergency services, including hand held only. The technologies and components developed for user terminal were also intended for wider commercialization for further application.

Link budget calculation.

The link budget was calculated on APSI user terminal, Thuraya satellite and Earth station of thuraya satellite.

The system simulation was developed on MATLAB programming. Based on the simulation result and final outcome described in final report shows that both communication and remote sensing satellite can be used for disaster communication such as Dzud, Flood, Forest Fire, Yellow Sand, Earthquake and etc.

The study shows that the best emergency network for Mongolia is using SOS signal via satellite and reducing satellite terminal or manufacturing satellite terminals are essential in Mongolia for Nomadic people in Mongolia. See attachment.

5. Accounting Report

Total project budget: USD 54,000

Actual Expenditure: USD 49,642

(Please see the attachment)

[Overview of Satellite Solution for Mongolia]