

MONGOLIA

Development of a Digital TERRESTRIAL TELEVISION MIGRATION ROADMAP FOR M O N G O L I A

Report



N O V E M B E R 2 0 1 1
Telecommunication Development Sector



Development of a Digital Terrestrial Television Migration Roadmap for Mongolia

Report

November 2011



This report has been prepared for the International Telecommunication Union and the Government of Mongolia by ITU expert, Mr Colin J Knowles.

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Table of contents

	Page
Executive Summary	v
1 Mission Brief and Objectives.....	1
2 Execution of the brief	1
3 Introduction to DTTB	2
3.1 Electronic programme guide	2
3.2 Multiplexing and transmission	2
4 Prevailing Environment and Context Feb 2011	3
4.1 Existing analogue television distribution	3
4.2 Satellite distribution	4
4.3 Cable/subscription television	5
5 Government Policy	5
5.1 Mobile digital television	6
5.2 Digital radio	6
5.3 Studio migration.....	6
5.4 Digital dividend.....	6
5.5 Migration objectives.....	7
6 Observations on the Government Plan	7
6.1 Approach and timetable.....	7
6.2 Resources	7
7 Suggested Framework for Migration	8
7.1 Policy and legislation.....	9
7.2 Policy development.....	9
7.3 Policy timeline	14
7.4 Spectrum and licence planning	14
7.5 Technology issues for migration	15
7.6 An approach to tendering implementation	16
7.7 Cost estimates	18
7.8 Roadmap guidance	19
8 Recommendations.....	20
References	21
Annex A: 275th Mongolian Government Resolution of 2010.....	22
General Article	22
Article 2 Formulations of the terminology.....	22

	<i>Page</i>
Article 3 Objectives, framework and structure of the National Program	23
Article 4 Main Principles of the Implementation	23
Article 5 Aims, framework and results of the National Programs.....	23
Article 6 Management, Organization, Finance and Period of the programme.....	25
Article 7 Control, analyzes and estimation of the National program.....	26
Annex B: ITU expert commentary on 275th Government Resolution.....	31
Article 6 Management Organization and Finance.....	38
Article 7 Research Analysis and Public Information	39
Annex C: System Standards	46
Annex D: Approaches to Transmission Network Design	49
Annex E: Draft framework for a tender document	56
Annex F: Indicative Costs of DTTB Migration for Mongolia (USD)	68
Annex G: Work Plan for DTTB Implementation in Mongolia	70

Table of Abbreviations

Aimag	Mongolian Province
ASI	Asynchronous Serial Interface
ASO	Analogue Switch Off
CMMB	China Multimedia Mobile Broadcasting
CRC	Communications Regulatory Commission
DMB	Digital Multimedia Broadcasting
DTTB	Digital Terrestrial Television Broadcasting
DVB-T	DVB Terrestrial Television Standard T1
DVB-T2	DVB Terrestrial Television Standard T2
EPG	Electronic Programme Guide
GE06	Geneva 06 Agreement
HD	High Definition
HDTV	High Definition Television
ICTPA	Information, Communications Technology and Post Authority
IPTV	IP Protocol Television
IRD	Integrated Receiver Decoder (eg Satellite Set-Top Box or Professional Receiver)
ITU	International Telecommunication Union
kW	Kilowatt
LW	Long Wave
Mbit/s	Megabits per second
MNB	Mongolian National Broadcaster
MRTBN	Mongolian Radio and Television Broadcasting Network
MPEG	Motion Picture experts Group (Television compression standards)
MW	Medium Wave
OFCOM	United Kingdom Office of Communications
SD	Standard Definition
SDTV	Standard Definition Television
Soum	Mongolian Local Government Area
SW	Short Wave
UHF	Ultra High Frequency
UK	United Kingdom
UPS	Uninterruptable Power Supply
VHF	Very High Frequency
WTDC10	World Telecommunication Development Conference 2010

Executive Summary

The World Telecommunication Development Conference 2010 initiated a programme of work to assist countries in the Asia-Pacific region to develop plans for the migration of their television services from analogue to digital technology. ITU Development Bureau selected Mongolia as one of five pilot countries for this programme and engaged ITU expert Mr Colin Knowles to undertake a mission to Mongolia. The project brief required two missions to Mongolia. The first directed at developing in-country knowledge of the roadmap process, and the second as a follow-up to finalize a roadmap. The first mission was carried out in February 2011, at which time the expert learned that the Mongolia Government had already taken key decisions on a timetable for migration and announced that all analogue television services would cease at midnight on 30 June 2014.

The first mission found that the agencies responsible for managing the project in Mongolia, had established a broad action plan for migration that was based on the ITU Migration Guidelines. The Mongolia administration was anxious to prepare specifications for the transmission systems that were to be acquired under the government project, and had determined this to be their highest priority. Development of a comprehensive roadmap and the engagement of stakeholders were scheduled to occur later in 2011 after the immediate priority of arranging supply of equipment for the first stage of the project was completed.

As a result, the parameters for the first mission were varied to provide guidance and recommendations to the Mongolia Administration on ways in which their project could be shaped to achieve the government timetable and objectives. In many ways, Mongolia is unique in the fact that there is one major city and television transmission is achieved using relatively low power transmitters in a configuration that makes replication in the digital environment relatively easy. This is a significant benefit to Mongolia, because without these factors, achievement of the proposed timetable would be extremely difficult, if not impossible.

Mongolia has set up a very ambitious programme for the migration. However, the limited practical experience of the key agencies in working with, and planning for, digital television transmission, suggests that the services of experienced systems integrators may be necessary to design and build the infrastructure and to train key personnel. This report recommends that the government seek tenders for an experienced systems integrators/suppliers to design and build the network and to manage all aspects of its implementation. This would remove the significant implementation risk that would exist if such assistance were not obtained.

A preliminary report prepared at the conclusion of the first mission recommended that Mongolia adopt the DVB-T2 transmission standard with MPEG-4 compression. This recommendation took into consideration the Mongolia preference for the DVB family of standards and the objectives established by the Mongolia Government for digital migration. By the time of the second mission in May 2011, these standards had been adopted by the government.

The second mission was to have taken place in April 2011, but at the request of Mongolia and with the agreement of ITU, the mission was delayed until May and the ITU expert was invited to present his recommendations to the National ICT Forum held in Ulaanbaatar, 25-26 May 2011.

During the second mission, the expert was advised that the National Working Group on Digital Migration would be established in mid-2011 and that a public forum was being planned for September 2011 as part of the public consultation for digital migration.

This report examines various delivery models for digital migration in Mongolia and includes budgetary estimates of the cost. The report also discusses a number of key questions that will need to be decided by the regulator and Administration in Mongolia and identifies some of the lessons learned by other countries that have already progressed with migration. These suggestions should be read in conjunction with the guidance provided in the ITU Guidelines on Transition from Analogue to Digital Broadcasting.

Because the Aimag and Soum transmission facilities are directly provided by government, they can be implemented ahead of Ulaanbaatar even though this is the opposite approach to that used in most countries, where DTTB is first established in the major population centres. The reason for this is the desire to have first transmissions in place by the end of 2011, and the time needed to resolve the potentially complex regulatory and licensing arrangements needed to accommodate the multiple broadcasters in Ulaanbaatar.

The Mongolia Government has made a strong commitment to complete migration and analogue switch off by 30 June 2014. Participants at the National ICT Forum, participants also expressed strong support for digital migration as an integral part of the ICT landscape.

The report makes the following recommendations:

1. The limited practical experience of the key agencies in working with and planning for digital television transmission, indicates that assistance should be obtained by seeking the services of experienced systems integrators to plan and implement at least the first stage of DTTB roll-out in Mongolia.
2. The systems integrator should be used to define the operating parameters for the MPEG-4 and DVB-T2 transmission system, to develop the critical national standards for transmission and consumer receivers, and to set up the management processes the Mongolia Communications Regulatory Commission (CRC) will need to assign Logical Channel Numbers etc.
3. Based on expressed Mongolian preferences to adopt the DVB terrestrial standard, the number of programmes to be delivered and the cost of infrastructure etc., DVB-T2 transmission with MPEG-4 compression would seem to provide the most cost-effective solution.
4. To achieve the desired migration timetable, digital transmissions should first be established in the Aimag centres and Soums to allow more time to establish the National Roadmap Team and to develop an appropriate regulatory framework for the highly competitive Ulaanbaatar market.
5. The CRC, in conjunction with the selected contractor, should review the minimum digital effective radiated power (ERP) levels for Ulaanbaatar and perhaps some Aimag centres to ensure that planned coverage extends to address any known areas of reception difficulty as well as the anticipated areas of city expansion over the next few years.
6. The diverse range of services currently operating in Ulaanbaatar in particular, suggests that a shared multiplex approach to digital delivery in all parts of Mongolia would be the most cost effective solution. This will require considerable work on regulations to ensure proper management of the multiplex and equitable access on reasonable commercial terms.
7. Once the National Roadmap Team completes its initial work on strategic policy, implementation planning and regulation, an analogue switch off organization should be established to manage all aspects of the switch off process.

1 Mission Brief and Objectives

The ITU expert undertook a mission to lead the Mongolia National Roadmap Team (NRT) through the needs analysis and preparation of a National Television Migration Roadmap. The timing and selection of Mongolia as a pilot country was based on the advice that the NRT was in place and the government committed to a migration timetable. The expert was tasked to:

1. undertake an eight day mission to Mongolia in February 2011 to meet with the members of the National Roadmap Team (NRT) and other stakeholders to: introduce the ITU Guidelines; discuss policy choices; and decide which parts of the roadmap will be developed by the expert and which parts by the nominees of the NRT. The expert was to assist the NRT determine the most appropriate approach to migration through collaborative workshops and to provide guidance and structure to the preparation of the roadmap (The brief contemplated active involvement of the NRT in the development of the roadmap);
2. using inputs from the first mission and material prepared by the NRT, draft a country specific road map around the policy and planning objectives and needs of Mongolia;
3. undertake a second mission of five days duration to finalize the road map with the NRT and the administration; and
4. send the roadmap endorsed by the Mongolia Administration to ITU by 30 April 2011.

2 Execution of the brief

The first mission was conducted in February 2011. The expert was accompanied on that mission by the ITU Project Officer, Ms Sireerat Bunnag, from the ITU Regional Office for Asia and the Pacific, Bangkok. By the time of the first mission the Mongolia Government had passed Resolution 275 of 2010 establishing a work programme and commitment to turn off analogue television in Mongolia by 30 June 2014.

This work plan had been developed by the NRT, comprising officers of the independent Information, Communications Technology and Post Authority of Mongolia (ICTPA) and the Mongolia Communications Regulatory Commission (CRC). In preparing the work plan set out in this resolution, the NRT had extensively reviewed the ITU Guidelines and incorporated its principles into the plan. The timetable is aggressive; seeking to have the first stations broadcasting in digital by October 2011. To achieve this, ICTPA planned to issue a request for tender in February 2011 for the supply of the necessary equipment. At the time first mission, tender preparation had just started and the expert was asked to assist in defining the requirement for the tender and system design.

To develop the detailed implementation plans and roadmaps, a representative working group of key stakeholders was to be established. The constitution and membership of this working group was still being developed at the time of the first visit. This meant that apart from briefing the ICTPA and CRC members of the NRT about aspects of the guidelines and the experience of other countries, there was no forum for the expert to debate and develop an agreed roadmap. The material used to prepare this report was gathered from meetings with officers of the ICTPA, CRC, the Network Company, and informal discussions with a few of the larger private broadcasters, and the Mongolian National Broadcaster (MNB).

At the request of the ICTPA and with the agreement of ITU, the focus of the mission moved to providing advice to the ICTPA on how to best achieve the objectives set out in the Mongolia Government resolution. A preliminary report covering these matters was delivered to ITU and the Mongolia Administration shortly after the mission.

Under the original plan, the second mission had been scheduled for April 2011, so that ITU could have the roadmap report available to present to a Regional Workshop in Hanoi in May 2011. Just before the second mission was to take place in April, the ITU agreed to a request from Mongolia that the second mission be delayed so that the expert could present his recommendations from the first mission to the

Mongolia National ICT Forum held in Ulaanbaatar, 25-27 May 2011. This forum put television migration into the wider context of Mongolia National ICT Policy. Participants in the forum came from all parts of Mongolia and included many key stakeholders. It showed that there was wide support for the digital migration plan.

The expert was advised that the working group would commence work in June/July of 2011 and one of the early initiatives would be a national forum on digital migration planned for September 2011.

Because it was not possible to develop the roadmap with stakeholders and the NRT, this report reflects the ITU expert's opinions based on information gathered from the two missions and his experience in digital migration elsewhere. This report is intended as an input to the detailed implementation policy and planning work of the CRC, ICTPA and the working group as they move forward to implement the migration plan outlined in the government resolution.

3 Introduction to DTTB

A description of Digital Terrestrial Television Broadcasting (DTTB) and its implementation can be found in the *ITU Handbook on the Migration of Television from Analogue to Digital*¹. Digital Terrestrial Television Broadcasting is simply a different way of delivering the signal to consumers using digital technology. The satellite DTH (direct to home) services in Mongolia already use digital technology. DTTB is designed to transmit wide-screen images in 16:9 aspect ratio.

DTTB can carry six or more television programmes on the radiofrequency channel currently occupied by one analogue television programme. The actual number depends on the compression system selected and the service quality required (e.g. High Definition Television (HDTV) or Standard Definition Television (SDTV)). The transmission efficiency of digital networks can be further enhanced where all services are multiplexed at a common point. This is achieved through a process known as statistical multiplexing. It dynamically assigns data bits between the programmes. By reducing the average bit-rate needed per programme, compared to fixed bit-rate allocation schemes, it allows more programmes to be sent within a specific fixed bit-rate transmission channel.

DTTB can also carry captions for those with hearing impairments, multiple sound channels (for multi-language broadcast), data services, electronic programme guide (EPG), and emergency broadcast text messages etc.

3.1 Electronic programme guide

The EPG helps viewers to navigate between the programmes on offer. This will be familiar to pay television users. The guide provides information about current and upcoming programmes (typically up to seven days in advance). When integrated into personal video recorders, the EPG can also be used to set the recorder to record a desired programme using a simple "point and click" approach. The EPG can be updated real time when programme schedules change and can also carry additional information about the programmes such as a synopsis, names of the actors etc. Before the days of digital television, viewers had to rely on often dated information contained in magazines or newspapers.

3.2 Multiplexing and transmission

The carriage of multiple programmes on a single radiofrequency channel raises new questions for regulators: should a single broadcaster control the channel and be allowed to transmit multiple programmes or data? Or should the channel be shared amongst a number of broadcasters. Both solutions have been adopted internationally. The UK adopted the shared channel approach because it lacked

¹ International Telecommunication Union, Handbook BT2140, Transition from Analogue to Digital Broadcasting, 2009

spectrum to assign each broadcaster a channel, and it already had some experience in channel sharing on analogue. In Australia and the USA, where there was a long tradition of strong independent commercial and public broadcasters, each broadcaster was assigned a full channel and permitted to transmit several channels of HDTV and SDTV under their licences.

Those countries which allocated a full channel to each broadcaster were early adopters and were obliged to use MPEG-2 compression. MPEG-2 can carry about four SDTV channels with the same perceived quality as analogue, or one HDTV and two or three SDTV programmes. In Australia, for the first few years, broadcasters were obliged to simulcast on DTTB, the same content as their analogue channel in both HDTV and SDTV formats. This was because when DTTB services started in Australia, HDTV receivers and set-top-boxes were considerably more expensive than SDTV models. Today virtually all receivers and set-top-boxes can receive both HDTV and SDTV. The restrictions have now been lifted. In the highly competitive USA market, broadcasters had programming freedom from the start because the regulator saw this as an incentive to early commencement of digital services. Using MPEG-4 and DTB-T2 technologies, around 20 SDTV channels can be carried in a standard television radiofrequency assignment.

4 Prevailing Environment and Context Feb 2011

Mongolia is a large country of approximately 1.6 million square kilometres and a population of 2.7 million (2009 census). The majority of the people (1 million) live in the capital Ulaanbaatar. The remainder are scattered through more than 400 settlements of varying size ranging from centres of provincial government (Aimag centres), local government centres (Soums), and smaller villages or in isolated dwellings. The population is well served by analogue television, and six programmes are delivered nationally via satellite, to almost 400 rebroadcast sites. Within Ulaanbaatar, there is one public television service and 15 private free-to-air (FTA) broadcasters.

4.1 Existing analogue television distribution

The terrestrial analogue television arrangements are of three distinct types which respond to the different sizes of the populations served:

1. Ulaanbaatar services;
2. Aimag centres services;
3. Soum services; and
4. DTH satellite services for remote and isolated people.

4.1.1 Television in Ulaanbaatar

Television in Ulaanbaatar is provided by the government funded national independent public broadcaster (Mongolian National Broadcaster (MNB)), and 15 private television broadcasters. These broadcasters operate from the central television transmission tower located within the city boundaries. The transmissions use VHF band I and band III, and UHF band IV and band V with 8 MHz channel spacing. They share the transmission antennas, and operate with an effective radiated power (ERP) of 5 kW.

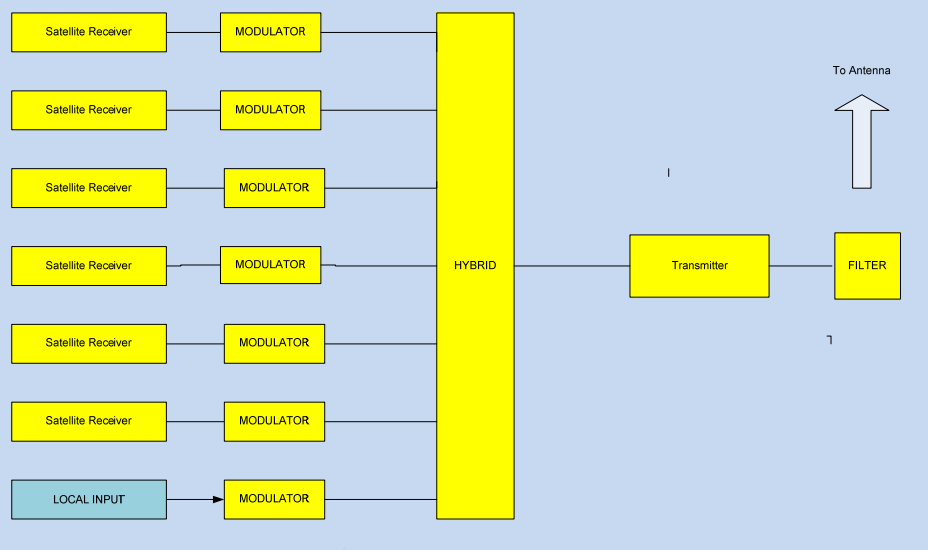
There is one UHF translator station that provides in-fill for the band I MNB Service within Ulaanbaatar. The urban area extends about 15-20 km radius from the transmitter, some residences have a partially obstructed path, and moderate high-rise development is taking place within the city centre.

4.1.2 Provincial centres (Aimag centres)

There are 21 provinces (Aimags) within Mongolia and each has its own Aimag centre. The population of these centres ranges from 50 to 90,000 people. The Aimag centres have terrestrial rebroadcast of the six core satellite delivered services, and some have one or two locally originated town only services, and share the same transmitter as the core services. The six satellite services are received by separate

domestic satellite receivers and decoders which provide analogue output only. Each of the analogue outputs is then fed to a PAL modulator; the output of these modulators is then combined and fed to a wideband amplifier. The amplifier power level varies depending on the required coverage and rated from 200-500W. As the amplifier is carrying the six services (and sometimes additional local services), the per-service power is perhaps around one eighth of the rated power of the amplifier (allowing for some back-off of the amplifier to prevent peak overload from the multiple services). The transmitters are generally locally and cover a radius of around 5-10 km. These services use band IV frequencies at 8MHz separation, and feed a panel antenna reported to be 18-20 m height above average terrain.

Figure 1: Typical Aimag/Soum transmitter configuration



4.1.3 Local government centres (Soums)

There are over 300 Soums, the largest of which have populations of about 9000 people. These are provided with an installation similar to that of the Aimag centres but with no local input and an output amplifier with a rated power of 50W (delivering the six services). Again UHF band IV channels are used and antenna heights are typically around 15-18 m above average terrain.

The transmitter sites, outside of Ulaanbaatar, are powered from the local mains supply without standby power. The quality of electric power (voltage stability and reliability), is variable depending on location. Installation, operation and maintenance of the transmitter network are provided by the Mongolian Radio and Television Broadcasting Network (MRTBN), an agency of the Information, Communications Technology and Post Authority (ICTPA).

4.2 Satellite distribution

The Mongolia Government pays USD 1.2 million per annum to the satellite pay television operator D-Dish Corporation for multiplexing, up-linking, and satellite capacity for the delivery of the six core television services. The DTH service uses Ku band transponders on an APSTAR satellite, and is transmitted using DVB-S technology and MPEG-2 compression. D-Dish is reported to have approximately 50,000 pay television subscribers.

4.3 Cable/subscription television

There are many cable television networks in Ulaanbaatar, in most of the Aimag centres and in some of the larger Soums. There does not appear to be any requirement for these cable systems to relay the FTA services although some reports suggest that many may do so. Cable take-up is reported to be high and predominates in the more densely settled areas.

While there are major cable operators who provide an international best practice standard of service and who are very well equipped with digital systems and networks, there are many low cost analogue services. Overall the services are very variable in size and technology. There was very little detailed information available to the expert on these networks, and because of their diversity, it is impossible to make any useful assessment of their capacity to carry additional services (e.g. the future digital services), of digital migration, of cable, or of subscriber dependence. Cable roll-out seems to have been market driven giving rise to competing networks.

5 Government Policy

The Mongolia Government has made a formal commitment to close ATV services at the end of June 2014. It has approved a budget for initial implementation of digital television services during 2011, and wants to have the facilities from this first stage operating by October 2011 (the start of the Mongolian winter). During the first mission, the ICTPA indicated that the government wanted to publish a tender for the supply of DTTB equipment in February/March 2011, to allow it to achieve this timetable.

The government decision² in Annex A of this report sets out four primary objectives for the migration project:

1. To create the legal environment necessary for transition of radio and television broadcasting to the digital technology.
2. To select the appropriate technology standards necessary to implement the transition.
3. To establish a migration framework setting out the transition plan for the country.
4. To carry out the training and communication activities necessary to implement the transition including the switch off of analogue services in the specified time-frame.

The planned implementation for 2011 will cover only the government funded core television services. From discussion with the CRC and some private broadcasters, several broadcasters have a strong interest in establishing HDTV services. MNB officers said that MNB hoped to obtain a second transmission channel within a digital multiplex to allow it to expand the diversity of its services. MNB's existing studio technology, and limited resources, place immediate constraints on its capacity to offer additional SDTV or HDTV services and it would require capital investment to upgrade its production capability for this.

Many of the private broadcasters have only analogue SDTV capability and would need to make a significant investment to provide digital SDTV or HDTV. Some more affluent and capable broadcasters are already fully equipped to provide HDTV widescreen output. The potential demand for HDTV in the short-term is likely to be variable. This will inevitably change as broadcasters replace their equipment. Most broadcast studio and consumer equipment will be rapidly moving to HDTV standards. However, the way seems to be open to the development of a full range of services once an appropriate policy framework and access principles have been established.

² Appendix No 1 of the 275th Mongolian Government Resolution of 2010

5.1 Mobile digital television

The China Multimedia Mobile Broadcasting (CMMB) and Digital Multimedia Broadcast (DMB) standards have been adopted in Mongolia for the provision of mobile digital television services. These services will be established by private companies who make the choice of technology between the systems. Other than the fact that they are most likely to operate within the band III television band, there is no specific need for them to be interoperable with the terrestrial broadcast standard. Mongolia has already decided that MTV will be a market driven implementation. It has also determined that licensees may select the most appropriate from CMMB or DMB for their services; therefore, no further guidance or roadmap is necessary so this report has not further addressed the topic. The expert was not able to obtain any more explicit information, during the missions, about this decision or the licence arrangements.

5.2 Digital radio

Mongolia has decided to use digital rights management (DRM) technology for the migration of the Mongolian long wave (LW), medium wave (MW) and domestic short wave (SW) radio services. There are no current plans for migration of FM radio services to digital.

5.3 Studio migration

The government directive on television migration states that broadcasters will be required to convert their studio equipment to digital technology. Government intervention at the studio level is unusual, because the motivation for the migration from analogue to digital television broadcasting is directed at providing more television channels, and making broadcasting spectrum available for other uses. Studio technology has little impact on this. The migration of studio technology to digital commenced a long time before the first DTTB transmissions commenced, the majority of studio equipment available today uses digital technology. Inevitably, whenever any existing analogue studio equipment is replaced, it will be replaced with digital equipment.

A broadcaster could launch DTTB services using existing analogue studio equipment with a small investment in digital interfaces for an SDTV service but delivery of widescreen content would be a problem for some. Apart from widescreen, digital migration in the studio could take place at any time, and be transparent to the viewers. Digital studio conversion offers considerable opportunity for achieving lower technical operating costs and greater ability to provide multiple programmes from a single facility so there is already a strong incentive for broadcasters to update their studio equipment.

This suggests that any government direction about television studio equipment should be confined to guidelines on best practice such as picture format and standards that directly impact on viewers rather than becoming involved in all aspects of studio equipment choices. Many broadcasters will need to maintain some analogue equipment to play-back the content of their archives. Archives will eventually need to migrate over time but it may be a slow and costly process. The expert is not aware of any other country where governments have mandated studio conversion as a precondition to migration of transmission from analogue to digital.

5.4 Digital dividend

The government has an objective of exploiting the benefits of the digital dividend (spectrum made available for other services through migration of television from analogue to digital), but no specific plans have been made yet about the use of this spectrum. Current planning principles are consistent with the ITU Recommendation on preserving the upper end of the UHF television spectrum for this purpose.

5.5 Migration objectives

The broad objectives for the Mongolia Government's migration plan can be summarized as follows

1. Analogue switch off will occur at midnight on 30 June 2014.
2. The government will fund conversion all existing 374 Aimag and Soum sites.
3. The target date for completion of the first stage of this project and the commencement of the first DTTB broadcasts is October 2011.
4. The DTTB service must provide at least ten SDTV programmes nationally.
5. There should be capacity to insert up to three local programmes into the multiplex for Aimag centre transmitters.
6. If possible the ten (or 13 counting the Aimag local programmes) should be transmitted over a single multiplex using a single broadcast transmitter in each Aimag and Soum.
7. Digital coverage should match the coverage of existing analogue transmissions and when necessary the DTTB coverage should be extended to cover growing urbanization, and to address any nine coverage deficiencies with the current analogue services.
8. Planning should allow options for competitive proposals for the provision multiplexing of up-linking and satellite capacity for distribution.
9. The establishment of DTTB services in Ulaanbaatar is part of the project, and it will proceed once the formal policy, licensing, and access arrangements for private broadcasters to migrate to DTTB are established.

6 Observations on the Government Plan

A detailed commentary on the government resolution for transition in Mongolia and attached work plan (including cross references to the ITU Guidelines) is included as Annex B to this report. In general the objectives and proposed activities and responsibilities are consistent with the recommendations set out in the ITU Guidelines. A few items have been highlighted where the division of responsibilities is not clear between ICTPA and CRC. This may be a problem of translation or simply points that may require refinement.

The work plan for considering the provision of subsidized set-top boxes to some consumers is shown as the year following analogue switch off. This needs review otherwise there may be a number of disenfranchised viewers who may be sufficiently influential with government to force a delay in analogue switch off.

6.1 Approach and timetable

The approach and schedule of activities set out in the Appendix 2 to the government resolution sets out the detailed plan and timetable for migration. There is a lot of work to be completed during 2011, but this should not delay the initial roll-out planned for a few Aimag centres and Soums, but will be of critical importance to implementation in Ulaanbaatar.

6.2 Resources

Once the policy framework, implementation roadmap and timetable is fully established, a dedicated group responsible for managing the transition process should be established under the ICTPA or CRC (or perhaps both). The work of this group will include management of the public information campaign, monitoring implementation against the agreed schedules, and surveying consumer take up.

7 Suggested Framework for Migration

The implementation of DTTB in developed countries was generally preceded by a lengthy period of debate about DTTB standards, the policy and legal framework, spectrum, channel, and detailed implementation planning. However, these countries (such as Australia, Germany, Singapore, USA, UK) started digital television very early and many aspects of the technology and science were new and unknown. Now that the technology and planning knowledge has matured, there are many competent and capable commercial suppliers and systems integrators for DTTB technology that can assist. There are no other countries which have completed DTTB roll-out which have such simple radiofrequency planning requirements. Likewise, there are few that have so many private broadcasters in a city the size of Ulaanbaatar.

The experience of other countries which have implemented DTTB is reflected in the ITU Guidelines on the migration from analogue to digital broadcasting³, and in the ITU handbook on the transition from analogue to digital terrestrial broadcasting⁴. These resources reflect a consensus view amongst the ITU member countries and the parameters contained in these documents have been well tested in planning for DTTB services in a wide range of situations.

Other valuable resources include the specific standards published in countries, like Australia and the UK, which specify the necessary operating parameters for MPEG and DVB-T transmission systems. Because Mongolia has adopted the MPEG-4 and DVB-T2 standards, the UK standards using MPEG-4 and DVB-T2 will be the most useful guide for formulation of a Mongolian National Standard.

The main constraints facing the rapid implementation of DTTB within Mongolia, is the lack of practical and theoretical experience with digital transmission technologies and signal compression. Mongolia has a well-educated engineering work force, but the timetable does not allow enough time for those engineers and other professionals to develop sufficient knowledge and experience to take full responsibility for design specification and implementation of Stage 1. To proceed on that basis would fail to draw upon the significant experience gained by systems integrators, suppliers and others who have implemented DTTB already. By engaging these resources, Mongolian engineers will be able to learn rapidly from the Stage 1 implementation and perhaps take greater responsibility for Stage 2 implementation, as well as responsibility for operations and maintenance of the new DTTB network. This can be achieved without the implementation risk and potential delays of doing all of the work internally.

Taking these factors into account, an effective strategy would be to engage a systems integrator to be responsible for the design, specification implementation and training for the Stage 1, and possibly Stage 2. If this recommendation is adopted, the systems integrator will work closely with planners, policy makers, regulators, and engineers to implement DTTB in a way which eliminate the implementation risk for the Mongolia Government.

7.0.1 Migration strategy

The arrangements in Mongolia allow for a different approach to that which would be used in a country where television transmission is provided through a mixture of private and publicly owned and operated transmitters. Outside of Ulaanbaatar, the transmission system is owned and operated by the government and its agency MRTBN. In Ulaanbaatar, the arrangements are mixed. The government will fully fund migration of the government owned facilities, but in Ulaanbaatar the plan must accommodate migration of both public and private broadcasters.

By separating these two parts (the areas outside of Ulaanbaatar from Ulaanbaatar itself), the migration strategy can be simplified. Such simplification will be necessary if the timetable set for the first stage of

³ ITU Guidelines on Migration from Analogue to Digital Broadcasting

⁴ ITU Handbook, BT2140, Transition from Analogue to Digital Broadcasting, 2009.

migration is to be achieved by October 2011. This timetable allows no time for resolution of the key policy development questions and consultation with stakeholders that will be required to complete a roadmap for DTTB in Ulaanbaatar. Implementation outside of Ulaanbaatar can take place without this.

Because the second stage implementation is expected to commence after winter, at least six months is available for consultation with stakeholders, development of policy and regulations for DTTB migration in Ulaanbaatar. The expert suggests that a target date for completion of this work be set at about October 2011 to allow sufficient lead time for private broadcasters to be able to make decisions about procurement and implementation of DTTB in time to start in early 2012. Services could be operating in Ulaanbaatar no later the end of 2012. This would allow for around 18 months of operation before the analogue switch off date of June 2014. This is considered an absolute minimum time for simulcast and migration by audiences.

7.1 Policy and legislation

At the time of the first visit to Mongolia, the DTTB working group membership and its terms of reference were still being prepared for approval. From discussion with the CRC about the membership, the planned representation of stakeholders seemed to reflect the best practice guidance of the ITU Guidelines.

Successful migration depends on convincing broadcasters to invest and the general public to purchase digital receivers at their own expense (even if there is an eventual subsidy for some groups of society). The cost of selling this message can be high and unified communication by all stakeholders is critical to ensure a smooth transition.

The priorities of the working group will change over time. Its initial focus will need to be on the policy and planning for Ulaanbaatar which could equally be translated to other parts of Mongolia, when and if the need arises later for expansion. Once the policy and legal arrangements are established, the focus will switch to implementation, and then to public communication and analogue switch off (ASO). This may necessitate progressive changes in the membership of the working group.

7.2 Policy development

The Mongolia Broadcasting and Radio Law establishes the ICTPA and the CRC as interdependent regulators and delegates policy and regulatory development to them.

Some of the areas of policy, regulation and perhaps legislation that need to be determined to support the nationwide implementation of DTTB include:

1. Broad policy:

- a. What are the national and public policy objectives to be advanced through digital migration?
- b. What are the major enabling factors (e.g. content, new types of services, specialist channels such as education and information services, etc.)?
- c. To what extent should cable IPTV and Internet services be considered in the framework? (They may be used to rebroadcast or allow replay of broadcast programmes.)
- d. What future changes in needs or services should be considered in formulation of the strategy so that they can be more easily accommodated later?
- e. What form of digital television is needed to deliver these objectives (e.g. multi-channel, HDTV, mobile television, associated data services, etc.)? How will this change over time? Should provision be made in the migration framework to enable such evolution in the future?
- f. Will the services be established on a shared multiplex basis, and what rights and obligations will apply to the multiplex provider, transmission provider, and individual broadcasters sharing the channel?

2. Licensing and access

- a. Will new types of services be considered in the strategy, including television, data, and other types of services? To what extent should broadcasters have freedom to use the data stream? For example, can they use the allocated data stream for additional services? Will they be required to hold separate licences for each service? What types of licence would be appropriate?
- b. Who may be permitted to own and operate a DTTB multiplex, transmitter, and / or provide a broadcasting DTTB service?
- c. Will there be separate licence types for HDTV and SDTV and will there be provision for migration?
- d. Will new DTTB licences be issued before the completion of migration?
- e. How would any new broadcasters be accommodated (e.g. digital only new services, new services commencing on analogue and migrating to digital, etc.)?

3. Assistance to broadcasters

- a. Will any assistance be provided to broadcasters to achieve the roll-out of digital services in a timely manner? What form should this take?
- b. Will any new licensees receive the same assistance?

4. National standards

- a. What technical standards should be adopted? And what elements of these standards need to be established as a national standard to ensure adequate protection to consumers and spectrum?
- b. What aspects of receivers should be mandated (e.g. capacity of all receivers to decode HDTV or any other format from the transmissions and display them on whatever device the consumer chooses such as ATV receiver, computer display, integrated DTTB screen)?
- c. Should HDTV and SDTV picture standards be mandated?

5. Analogue switch off

- a. What factors will determine the end of analogue transmissions and the end of any simulcast period?
- b. How will consumer migration to digital be accomplished (simulcast, subsidy, new programmes...)?
- c. What would be considered an appropriate penetration of receivers to consider migration sufficiently advanced to turn off analogue? (e.g. percentage of the current analogue television penetration? One per household? One per village? Multiple receivers per household?)
- d. Will assistance be provided to consumers? What form should that take? At what point would it be announced/decided?

6. Digital dividend

- a. What is to happen to the spectrum vacated by analogue transmissions?
- b. What other ICT and other services need to be considered in the spectrum and planning decisions? (E.g. mobile TV, next generation telephone networks such as 4G.)

7.2.1 Broad policy

The ITU Guidelines explain the many options available to broadcasters considering DTTB. Mongolia is well advanced on many of these questions, and key officers of the planning team have used the Guidelines in

formulating the positions set out in the government resolution. For that reason this paper will not attempt to lead the reader through the Guidelines. Instead it offers some general commentary and reference to other country experience of the questions set out above:

- a. National Policy Objectives. These have been articulated in the National ICT Plan and the government resolution. In short they are to provide the benefits of digital to all Mongolians through additional and enhanced television services and through the additional services that may be possible through the digital dividend. These objectives are generally shared with all countries who have implemented DTTB.
- b. Enabling Factors. The Mongolian plan calls for enhanced production and content as well as additional services. The immediate proposal calls for at least four additional national channels. Additional content has proven to be a major driver of consumer take-up in all countries. This is far more attractive to consumers than improved technical quality or the other enhancements made possible by DTTB.
- c. Role of Cable and IPTV. In the USA cable operators are required to carry the DTTB services. In Australia the pay television operator is not obligated to carry the services but has negotiated with broadcasters to carry basic services. The difference between these two is that in the USA many people are dependent on cable to receive any television. In Australia most viewers are able to receive free-to-air services off air so the incentive to be carried by the pay television operator is largely about making it easy for viewers to switch between the two. In Mongolia, there seems to be a high dependence on cable television delivery in many areas, and particularly in high-rise buildings. Therefore, there may be advantage in ensuring that the digital programmes are carried on these systems. However, as many of them are analogue, carriage will be problematic. Nevertheless, the working group will need to consider the implications of ASO on viewers who currently receive the analogue services on cable and how they will gain access to the services in digital in the future.
- d. Future Developments. The immediate question is how many new services should be planned, and what capacity might remain for additional services in the future. While in principle, all capacity could be sold off in an auction for new services, this assumes that the market is the best determinant of the public interest. At the same time if all capacity were allocated to SDTV, how would HDTV be accommodated in the future? Should therefore additional licences be made available in a phased approach? How many licences can the market sustain?
- c. HDTV. One option would be to commence all services in Mongolia as SDTV and to allocate HDTV capacity on new multiplexers once analogue channels had been released. All countries that have implemented DTTB have provided for HDTV in some form. In the USA and Australia, it was made a fundamental part of the initial implementation. In the UK, the services started as SD only but recently HDTV services have been added. HDTV has had an important place in Japan, Korea, and other countries in the region. The immediate needs of the regions outside of Ulaanbaatar require virtually all of the available capacity of say 20 SD channels to be used for delivery of the defined number of services to the Aimag centres and Soums. Therefore, there is little opportunity, and perhaps need, to immediately consider HDTV in that plan. In Ulaanbaatar, there is some private broadcaster interest in HDTV but more interest in SD. If HDTV is part of the mix, will there be provision for SD operators to move to HD in the future?
- d. Multiplex. The selection of MPEG-4 and DVB-T2 will enable the required numbers of services to be provided over a single multiplex. Multiplex ownership has already been decided for Aimag centres and Soums so it remains to determine arrangements for the mixed public and private broadcaster services in Ulaanbaatar. The numbers of broadcasters in operation and the available spectrum suggests that a shared multiplex is also the only option for Ulaanbaatar. Should this be operated by the National Network Company, or made available to a private operator, or a consortium of operators? In both instances access rights, the operational rights of broadcasters, and the rights of the multiplex and transmitter operator must be defined. In the UK the operation of the shared multiplex is by a private transmission provider. In Australia, television broadcasters

have a full multiplex but for radio, they share with other broadcasters and the multiplex is operated by a consortium. This has led to a rather complex set of rules that protect the interests of all parties and define responsibilities.

7.2.2 Licensing and access

- a. Licensing and Access. These arrangements are closely linked to the issue of multiplex management and can be managed under the legal and policy framework that currently exists in Mongolia. Firstly, the broadcasting licence is for the delivery of broadcast content and is not related to technology. The technology (transmitter licence model can continue to apply to the television transmitter and its operation. The multiplex is similar to the transmitter, but needs a different form of licence because the operator of the multiplex must be required to provide capacity to the nominated licensed content providers, must not carry content that is not so licensed and may be restricted as to how any spare capacity is used (e.g. it could be used to provide a data service or pay television service). The multiplexer licence should be separate from the transmitter licence so as to provide more options for licensing and operation. For example, for the satellite distributed services there will be a single multiplexer and many transmitters, for the terrestrial elements in Ulaanbaatar, there may be one multiplexer tied to a single transmitter. The rules need to define the amount of capacity to be assigned to each service, and in the case of statistical multiplexing the minimum and maximum bit rates to be provided.
- b. At present there seems to be no capacity to allow any additional analogue television services or licences. Given the short time between now and the closure of analogue television there should perhaps be a moratorium on the issue of new analogue licences. New DTTB licences could be allocated during the transition period and could provide an additional incentive for consumers to migrate. Additional service licences are envisaged in the move from six to ten channels for the core services, it therefore remains to consider what, when and how additional licences might be invited for Ulaanbaatar.

7.2.3 Assistance to broadcasters

In Australia, government assistance was provided to broadcasters through licence fee concessions and other arrangements. This was in recognition of the multi-million dollar investment they had to make to complete migration. The private investments in Mongolia are not as significant and any consideration of assistance would only apply to Ulaanbaatar. However, if the government were to establish the shared multiplex and transmitter arrangements for Ulaanbaatar then this may be sufficient assistance to the broadcasters.

7.2.4 National standards

The DVB and MPEG standards are generic standards for which national options need to be specified. The specifications for these national parameters are generally programmed into generic systems and the devices that are to be sold in the national markets. To ensure that all consumer products coming into the market work in Mongolia, a national standard needs to be determined so that suppliers can program the receivers properly. Examples of such standards are listed in the references to this paper.

The development of these standards requires a rather detailed knowledge of the MPEG and DVB standards so the most efficient solution for Mongolia would be to include the preparation of suitable standards as a task for the systems integrator the expert has suggested implementing the first stage of digital service establishment in Mongolia.

Between the first and second missions, Mongolia decided to accept the ITU expert's suggestion that it adopt MPEG-4 and DVB-T2 as its national standard for DTTB. Some discussion about this is included in Annex C to this report.

Broadcasters are obligated by their licences to set up equipment, multiplexers, and transmitters to deliver signals that conform to the transmission parameters prescribed in a national transmission standard. Minimum performance specifications for transmitters should be specified to ensure compliance with the

Radio Regulations, the MPEG transport stream and DVB parameters must also be specified so that both consumer receivers and the transmission chain can be set in a compatible way.

Minimum performance standards for consumer receivers should also be prepared to protect consumers from the sale of receivers that are not compatible with the national standard (eg DVB only receivers rather than DVB-T2). Some examples of typical national standards are shown in the references to this Paper. The standards should be prescribed under the National Standards framework of Mongolia. They do not need to reproduce the DVB-T2 and MPEG-4 standard but must specify the parameters necessary to describe the Mongolian implementation.

7.2.5 Analogue switch off

All successful ASO implementations have been driven by an organization dedicated to coordinating all of the stakeholder's actions towards switch off. It is a process that needs government support and on-going measurement of progress with implementation and consumer adoption of DTTB. This will drive decisions about the assistance that may be needed to ensure transition can occur on time. Some detailed examples of the types of activity associated with DTTB migration and ASO can be found in the references included in this report.⁵

7.2.5.1 Simulcast?

Broadcasters and the general public will need a period of simulcast of ATV and DTTB. During this period, some additional programme content or special programming on the DTTB service (which is not available on ATV) could serve as an incentive for consumers to migrate. If such a decision is made then this will need to be reflected in the regulations.

The simulcast period allows installers and planners to review coverage of DTTB, to make adjustments to viewer's installations, and for the regulator to properly assess coverage and address any gaps prior to the cessation of ATV. Most countries have allowed at least four years of simulcast to assist in migration, but now that DTTB technology and receiver supply is established, and the cost of receivers has fallen, a lesser period as proposed for Mongolia should be possible. The actual period for Mongolia has already been set by the ATV closure date. Early implementation of DTTB services will be critical to allow sufficient time to undertake proper communication of the switch-over process and to establish whatever arrangements and incentives may be necessary to achieve the target date for ASO completion.

7.2.6 Consumer subsidies

How and when to consider payment of consumer subsidies is a difficult question. The subsidies need to be directed towards supporting the significantly disadvantaged sector of the population for whom, digital migration may be an impossible or exceedingly difficult financial burden. To ensure this target population is reached, various models have been used. In the USA, vouchers were provided which could be used as part payment for a set-top-box (leaving the choice of box and its features in the hands of the consumer). In Australia, the identification of eligibility for subsidy was based on those persons who received certain types of government pensions. Upon application, the government, through a number of contractors, supplied and installed a basic set-top-box. In addition, the Australian Government provided a very large subsidy for additional satellite capacity to ensure that all Australians in the switch off area were able to obtain services that were relevant to the region they lived in. The UK has also established a scheme to support the lower income groups.

Unless a suitable scheme is provided then there will remain a number of low-income families who will not be able to convert. In turn, the cries for assistance will be heard by politicians and the closure date for

⁵ These include www.dbcde.gov.au/television/digital_television_switchover which sets out the activities undertaken in Australia, DIGITAG which reports much of the ASO activity in Europe www.digitag.org/ and <http://search.ofcom.org.uk> (search for analogue switch off).

analogue may be delayed. In the USA, closure was delayed for this reason. Experience everywhere shows that only a proportion of eligible viewers will take up the subsidy; however, this cannot be predicted in advance; nor should it be.

As an indicator of costs: a fully installed satellite receiver, including dish currently costs around USD 150-250 depending on the labour costs involved. A digital set-top-box for DTTB currently costs less than USD 50 (a little more for an MPEG-4/DVB-T2 box at present but the price for these is falling as more are produced). There may be some additional costs for installation if an external antenna must be provided and installed.

The policy needs to decide which groups of society will need assistance, how much assistance should be given, and where in the implementation timeline should this assistance be rolled out? Once the groups have been identified, then a scheme that directly identifies the eligible group must be established. The benefit of using an existing government recognized benchmark, such as pension eligibility, will give the ASO task force an objective criteria against which to hand out subsidies.

Given the very rapid deployment of DTTB in Mongolia and the early date for ASO, the subsidy decision will need to be made before the end of 2011 so that budget funds can be obtained for it and implementation will need to start no later than mid to late 2013 depending on the scale of the operation and the subsidy arrangement intended.

7.2.7 Digital dividend

The digital dividend for most countries is currently focused on providing capacity for next generation mobile telephony. Planning in Mongolia has already preserved this section of spectrum. Any further possible dividend will depend on the detailed planning of DTTB implementation and transition. The immediate dividend objective is preserved, analogue switch off will leave the way open for further expansion of DTTB services such as HDTV, or for other services that can use the vacated spectrum. If a further dividend for non-broadcast services is required then this could involve restacking of the spectrum to provide contiguous channels that can be properly protected. In countries with complex planning, such as Australia, Japan, USA, and UK, the achievement of the digital dividend is complex and will involve moving a significant number of broadcasting transmissions to other channels. This is not likely to be necessary in Mongolia because of the low powers involved and relatively few transmitters outside of Ulaanbaatar.

7.3 Policy timeline

The policy questions, regulations and rules need to be established before the end of 2011 in order to provide sufficient time for DTTB services to be fully established to allow closure of ATV by the due date. Private broadcasters need certainty of the regulatory environment and access arrangements before they make their investment in DTTB.

7.4 Spectrum and licence planning

While frequency assignment and service planning in the Aimag centres and Soums should be straight forward, rapid growth of Ulaanbaatar both in terms of multi-story high-rise buildings in the central business district, and the growing urbanization of the valleys, suggests that the planning for Ulaanbaatar must take a long-term view and be preceded by a detailed engineering study of optimal transmission arrangements to meet the current and future coverage requirements. There are a number of companies who have highly developed software modelling tools who could undertake such a coverage assessment and plan in a very short time. This is far more cost effective than extensive field surveys. Similar planning may benefit the larger Aimag centres, if they have analogue coverage deficiencies.

7.4.1 Frequency planning

Frequency planning for Mongolia is not particularly complicated because of the isolation of the transmitters, low power necessary to achieve appropriate coverage. Ulaanbaatar can use adjacent channels to existing UHF assignments, so the major planning questions concern the level of DTTB power needed at the completion of migration and the interference issues to be managed during the transition period. Co-siting of all transmitters serving a common area should be mandated, so that adjacent channels to ATV can be used and interference problems minimized.

Planning for the Aimag and Soum services should, if possible, assign channels that are at least two channels removed from the existing six services block at the sites. This is to simplify the design and to reduce the cost of antenna sharing.

7.4.2 Interference management

Experience in other countries has shown that there can be issues of interference where DTTB and telephony services are in close proximity. This interference usually results from increases to the radio noise floor at the site which reduces the performance of the receivers for the mobile services. It is usually cured by additional filtering (filtering which may be more demanding than the standard ITU requirements for suppression of intermodulation and out-of-band products). Other interference can also occur which, despite best practice planning, is site specific. The planning and implementation rules need to establish the specific responsibilities of licensed operators (transmitter operators) to address such interference and to ensure that appropriate assessment is made at the time of commissioning.

7.5 Technology issues for migration

During the first mission, the expert discussed several different technical approaches to DTTB transmission in Mongolia. This substance of these discussions is contained in [Annex D](#) to this report. The recommended approach can be summarized as follows:

1. DTTB programmes should be distributed nationally through a single shared multiplex.
2. A shared national multiplex should be established separate to the satellite uplink so as to provide improved flexibility.
3. MPEG-4 encoding with DVB-T2 transmission should be used so as to achieve the required number of services on a single transmitter.
4. One transmitter should be established in each Aimag centre and Soum this should be able to deliver up to 20 SDTV channels or a mix of HDTV and SDTV if required.
5. Local insertion into the MPEG bit stream should be provided at Aimag centre transmitters.
6. Services in Ulaanbaatar should be established on the basis of shared multiplex with the number of multiplexes to be determined by the total capacity required for HDTV, SDTV and other services.
7. All transmitters should be co-sited and where possible share antenna infrastructure.

7.5.1 Satellite up-link

Because all existing DTH viewers combine FTA and Pay-TV viewing using MPEG-2 technology, it may be difficult to stop the FTA service on this platform. Should it remain the preferred DTH service, there may be no need to consider DTH viewing of the new DTTB distribution. In this case, the only constraint on the choice of satellite would be the desire to share the existing Ku band receive dishes at the remote transmitter sites. The advantage of using the same satellite is that the receive dishes at rebroadcast sites could use a single dish for ATV and DTTB which reduces cost. In the longer term, Mongolia may want to consider whether the FTA service should be available as a DTH service separate to the pay television delivery.

The up-link could be arranged with an up-link provider such as D-Dish, or any other provider, or possibly a separate single channel up-link could be operated by the National Radio and Television Broadcast Network or any other party. The choice will therefore come down to strategic concerns and cost. By owning the multiplex, there will be considerably more options available for up-linking and space segment.

The costs of the satellite component of distribution should be similar to that of the current channel multiplex; however, the prices could be lower if competitive tenders were sourced. However, if a separate satellite were selected, then there will need to be an adjustment to the fixed capital costs for the Aimag and Soum installations to provide for a separate receive dish. Over the longer term, this could be financially beneficial. In any event, a competitive tender may also see improved pricing from the incumbent satellite suppliers if they wish to retain the business.

7.5.2 Transmission planning for Ulaanbaatar

Planning for Ulaanbaatar must take account of the immediate and future development needs of DTTB in Ulaanbaatar. A range of questions need to be answered (this list is not exhaustive but is representative of the major questions to be addressed):

1. How many DTTB channels are to be ultimately available in Ulaanbaatar?
2. Are these to be SD/HD or both?
3. Under what arrangements will broadcasters gain access to DTTB capacity?
4. What will be the minimum bit rate allocated to broadcasters for SD/HD services within any shared multiplex?
5. How will access to the multiplex be regulated/licensed?
6. What conditions/limitations if any will apply to DTTB licences?
7. How will antenna sharing be managed?
8. How will interference to services, current and future from DTTB transmissions be managed?
9. What provision needs to be made for future expansion of the city of Ulaanbaatar and how should this be accommodated within the DTTB specifications?
10. Will the six to ten core services distributed throughout the rest of Mongolia be similarly available on a single transmission in Ulaanbaatar?
11. What is to happen to the spectrum currently used by broadcasters when ATV ceases?
12. What regulations/legislation is necessary to give effect to the decisions on these questions?

7.6 An approach to tendering implementation

During the first mission, the ICTPA asked for assistance in defining the best way to reduce implementation risk and achieve the timetable. In response, Annex E to this report was prepared on the basis of the following assumptions:

1. DTTB services should be operational by October 2011.
2. A budget of 10,000 million MNT has been established for the establishment of DTTB nationwide.
3. An initial budget has been provided by the government to fund activities in 2011, and the budget needs in future years have been identified.
4. The objective is to establish a network of up to ten SDTV channels in all locations and with the same coverage as the existing six station analogue TV network.
5. This initial network will be fully funded by the Mongolian Government.
6. The multiplex will be distributed to transmission sites via satellite.

7. There is a requirement to make provision for local input of up to three services into the ten channel multiplex (which leads to a target requirement for 13 channel capacity in the multiplex).
8. The regional SDTV service should if possible be carried on a single multiplex and transmitter.
9. There is limited knowledge and no practical experience of the DVB terrestrial systems and associated multiplexing and encoding systems design within Mongolia and training of Mongolian experts will need to be part of the contract.
10. The timetable for initial implementation does not provide sufficient time for local experts to become sufficiently proficient to undertake detailed design work for this project.
11. Digital receiver and network system specifications will need to be defined for Mongolia covering transmission and receiving equipment, operating parameters (service information etc.) and logical channel numbers for the network.
12. Site specific engineering work will need to be undertaken to incorporate the DTTB transmissions into the existing analogue sites at lowest cost.
13. ICTPA expressed interest in having a single supplier/systems integrator for the total project and for that supplier to have full responsibility for end to end performance of the system.
14. There is some interest in using this project to try to establish a more competitive position than that of the current analogue distribution where D-Dish has a monopoly for the provision of encoding and multiplexing of the up-link/satellite segment.

7.6.1 Discussion

In places where there is sufficient technical expertise, the tenders for provision of the DTTB service would normally be divided into:

1. Transmission installations and design for Soum and Aimag.
2. Transmission installation and design for Ulaanbaatar central television transmitters.
3. Encoding and multiplex design and management including service information and electronic programme guide.
4. Satellite up-link and space segment.

The engagement of a systems integrator/systems designer to take full responsibility for the establishment of service, including supply and installation of equipment, would remove much of the implementation risks that would otherwise exist.

The budget established for the service is modest but should be sufficient based on the cost analysis and other recommendations set out in this report. The selection of equipment must however be based on building the system to budget rather than specifying a system and obtaining a price. Unless potential providers are given clear guidance on the budgetary constraints tender prices submitted almost certain to exceed the budget.

The best approach would be to define the maximum amount of budget that can be devoted to the project and to instruct providers to develop solutions within that constraint. The selection of systems integrator/supplier would then be made on which proposals provide the best outcome for Mongolia, and on the demonstrated competency of the systems integrator. This is the reverse approach normally used where a detailed specification is established and suppliers provide prices against the specification. In the present circumstances, there is neither the time nor the expertise to develop such detailed specifications without the risk of describing solutions which will not be effective or will be too costly. This is a task which is better left to experienced systems designers.

It may be difficult for an integrator at tender stage, to fully evaluate and price up-link and satellite services. The proposed DTTB services should, if possible, be carried on the same satellite as the analogue TV so that existing receiving dishes at the transmitting stations can be used. However, alternative up-link

arrangements should be possible depending on the way in which capacity is shared on the satellite. The integrator would be able to advise on the best solutions and could work closely with the Mongolian Government to establish specifications for the supply of this part of the service. ICTPA will need to clarify what part of the proposed budget should be identified to cover the costs of the up-link and satellite operation (as distinct from the capital costs of establishing the multiplex and encoding system), or whether this will be separately funded.

A further advantage of this full system approach is that the tender need specify only what the Mongolian Government is seeking to achieve. Those responding will be required to provide sufficient technical information to allow proper assessment of the proposal and to define what will be delivered by the successful tenderer. The basis for assessment should also be described in the tender (eg. selection will be made on the best value for money outcome for Mongolia that best achieves the defined objectives within the available budget.

7.6.2 Outline tender document

Annex E to this report provides suggestions about how such a tender document could be prepared.

7.7 Cost estimates

Table 1 is an indicative estimate of the range of costs associated with the establishment of the DTTB services as suggested in the above discussion. A more detailed breakdown of costs is set out in Annex F. Figures are USD and represent typical costs for system design, equipment supply including spares delivery installation and associated commissioning of representative sites and training of local staff.

The cost estimates are based on the typical catalogue prices of a basket of professional grade broadcast equipment from a representative cross-section of suppliers. Bulk discounts should be available for a contract of this size, so the actual costs could be up to 25 per cent lower. However, this will depend on the purchase quantities and on additional requirements for remote installation work etc. The estimates should therefore be taken as a rough guide of the cost of high reliability equipment from established, highly-reputed suppliers and systems integrators who have a demonstrated track record.

Table 1:
Estimated costs of DTTB implementation programme
including Installation and training etc.

Item	Non-Redundant Configuration unit cost	Redundant Configuration unit cost	Total Cost = cost x units
Head-end equipment (Not including modulator) one unit	Not recommended	USD 400,000	USD 400,000
Satellite modulator	Not recommended	USD 40,000	
Aimag installation including transmitter x 21 units	USD 130,000	USD 175,000	USD 3,675,000
Soum installation including transmitter x 350 units	USD 18,000	Not recommended	USD 6,300,000
UB transmitter 1 unit including combiners	Not recommended	USD 180,000-200,000	USD 200,000
Total Cost			USD 10,575,000

7.8 Roadmap guidance

A roadmap is a plan that matches short-term and long-term goals and indicates the main activities needed to meet these goals. Developing a roadmap has three major uses:

1. It helps to reach consensus about the requirements and solutions for transition to DTTB.
2. It provides a mechanism to help forecast the key milestones for transition.
3. It provides a framework to help plan and coordinate the steps needed for transition.

Specific guidance of the establishment of migration roadmaps are contained in Part 6 of the ITU *Guidelines for Transition from Analogue to Digital Broadcasting*.

The roadmap for transition to DTTB by a regulator is divided in four phases:

1. DTTB and MTV policy development; based on the existing national telecom, broadcast and media acts and international agreements.
2. Analogue switch-off (ASO) planning; taking into account the DTTB policy, analogue switch-off.
3. Licensing policy and regulation; based on the DTTB policy and the ASO planning, the licensing policy and regulations.
4. Licence administration; after licences have been granted, the fulfilment of the licence conditions has to be verified.

Each phase has a number of functional blocks (see Figure 1.2.1. of chapter 1.2 of the ITU Guidelines) to address. Guidelines on key topics and choices within these functional blocks are described in the ITU Guidelines.

7.8.1 Work plan

A broad work plan for the steps needed to achieve the goal of ASO on 30 June 2014 is Annex G to this report. This work plan has been derived from both the plan set out in the government resolution, and from the tasks identified within the ITU Guidelines.

The practical aspects of stakeholder consultation, licence process development, and service planning etc. are well established in Mongolia. DTTB planning involves the same processes but because of the different capability and new issues such as multiplexer management for terrestrial television, DTTB raises a few new policy questions. Resourcing the task may be a challenge.

The technology requires the development of new skills amongst both the engineering staff and the regulators. These skills can be developed in parallel with implementation by drawing upon the resources of an experienced DTTB system integrator/designer. The more challenging task will be to engage with broadcasters and consumers to convince them to quickly adopt DTTB technology. Early establishment of transmissions will be a critical first step because without that consumers have no motivation to switch. A carefully coordinated communication campaign involving all stakeholders will be essential. This needs to involve not only consumers and broadcasters, but also equipment suppliers and retailers. They need to have a shared message so that consumers are not provided with conflicting information.

Amongst the tasks ahead, the management of ASO is the most complex. To manage this, a dedicated ASO organization should be established that can devote 100 per cent of its resources to this task. Most countries have taken 6-10 years for this process, Mongolia has only three years. Although the task is easier in some ways, the general hesitancy of consumers to take up DTTB must be recognized. A task made more difficult by the low income of some of the target consumer group where a USD 50 investment in a set-top box may be a large discretionary investment.

7.8.2 Key milestones for implementation

The major milestones for DTTB implementation are set out in the government decision and work plan. From examination of the work plan and based on experience elsewhere the following milestones will need to be met to achieve ASO by 30 June 2014:

1. Issue tenders and decide on suppliers by June 2011 (the original April deadline was missed).
2. Establish migration working group: July 2011.
3. Working group to advise and CRC/ICTPA to define policy on DTTB licences, access, etc. as discussed in section 7.2, no later than December 2011.
4. Agree policy on subsidy arrangements for assistance and seek government funding agreement so that funds are available for allocation no later than December 2013.
5. Determine digital dividend policy (including potential allocation of vacated analogue channels for future HDTV multiplex) by June 2012 (earlier if possible so that broadcasters know about HDTV and what happens to the analogue channels early).
6. Issue tenders and secure multiplex and satellite capacity to support Stage 1 no later than two months before Stage 1 terrestrial installation is completed.
7. Implement Stage 1 in Aimag and Soum pilot installation by October 2011 (this may be difficult given the delay in Item 1, and winter conditions may delay the installations until February/March 2012).
8. Issue tenders/orders for Stage 2 Aimag and Soum installations immediately government funding is approved (understood to be late 2011).
9. Decide on any additional licences to be granted for transmission on the new national DTTB multiplex by December 2011.
10. Proceed with Stage 2, completion of Aimag and Soum installations as soon as practical after completion and acceptance of Stage 1.
11. Grant licences for Ulaanbaatar multiplex, transmitters, and service conversions no later than February 2012 - this is to allow 6-9 months construction and commissioning.
12. Ulaanbaatar services commence no later than June 2012 – ideally this should be December 2012 to provide more incentive to viewers to purchase receivers during the simulcast period.
13. Services should be permitted to simulcast, and if approved, new licences to commence broadcast as soon as the services are operational.
14. Complete Stage 2 Aimag and Soum no later than June/July 2013 – services should progressively switched on as they are completed.
15. Commence allocation of subsidized equipment from December 2013, or earlier, so that all allocations are completed at least three months before ASO.
16. Analogue switch off at midnight on 30 June 2014.
17. Allocate vacated channels per digital dividend policy and in accordance with the agreed timetable arrange allocation of licences etc.

8 Recommendations

Based on the information gathered from two missions to Mongolia, adoption of the following recommendations should help Mongolia to achieve ASO by 30 June 2014.

1. The limited practical experience of the key agencies in working with and planning for digital television transmission, indicates that assistance should be obtained by seeking the services of

experienced systems integrators to plan and implementation at least the first stage roll-out of DTTB in Mongolia.

2. The systems integrator should be used to define the operating parameters for the MPEG-4 and DVB-T2 transmission system, to develop the critical national standards for transmission and consumer receivers, and to set up the management processes the CRC will need to assign logical channel numbers etc.
3. Based on expressed Mongolian preferences to adopt the DVB terrestrial standard, the number of programmes to be delivered and the cost of infrastructure etc., DVB-T2 transmission with MPEG-4 compression would seem to provide the most cost-effective solution.
4. To achieve the desired migration timetable, digital transmissions should first be established in the Aimag centres and Soums to allow more time to establish the National Roadmap Team and to develop an appropriate regulatory framework for the highly competitive Ulaanbaatar market.
5. The CRC, in conjunction with the selected contractor, should review the minimum digital ERP levels for Ulaanbaatar and perhaps some Aimag centres to ensure that planned coverage extends to address any known areas of reception difficulty as well as the anticipated areas of city expansion over the next few years.
6. The diverse range of services currently operating in Ulaanbaatar in particular, suggests that a shared multiplex approach to digital delivery in all parts of Mongolia would be the most cost effective solution. This will require considerable work on regulations to ensure proper management of the multiplex and equitable access on reasonable commercial terms.
7. Once the National Roadmap Team completes its initial work on strategic policy, implementation planning and regulation, an analogue switch off organization should be established to manage all aspects of the switch off process.

References

Australian broadcasting and radiocommunication legislation and regulations can be found at www.austlii.edu.au/au/legis/cth/consol

Mongolian Government, 275th Mongolian Government Resolution of 2010, Appendix 1 and 2.

International Telecommunication Union: Guidelines for the transition from analogue to digital broadcasting, 2010.

International Telecommunication Union, Handbook BT2140, Transition from Analogue to Digital Broadcasting, 2009.

Information on digital migration including handbooks on digital migration multi-unit dwellings prepared by the Digital Switch Over Task Force in Australia can be found at: www.digitalready.gov.au which contains much valuable guidance on one approach to analogue switch off. Equivalent information about digital switchover in the UK can be found at: www.digitag.org

SAI Global Australia: Australian Digital Transmission and Television Receiver Standards: AS 4599.1-2011 Digital television – Terrestrial broadcasting – Characteristics of digital terrestrial television transmissions; and AS 4933.1-2010 Digital television – Requirements for receivers – VHF/UHF DVB-T television broadcasts, see www.saiglobal.com.au.

United Kingdom legislation can be found at www.legislation.gov.uk.

Annex A:

275th Mongolian Government Resolution of 2010

This English translation of the Mongolia decision was arranged at short notice by the CRC during the first mission. In the interests of preserving its integrity and to avoid any risk of misinterpretation, it is presented in its original form apart from some editorial formatting of the original for this report. Annex B provides a commentary on the document and endeavours to better define the meanings which may have been lost in this translation.

According to appendix No 1 of the
275th Government Resolution in 2010

NATIONAL PROGRAM FOR TRANSITION OF RADIO AND TELEVISION BROADCASTINGS TO THE DIGITAL TECHNOLOGY.

General Article

The complex of activities, which will be implemented, such as definition of the regulation of measures, service preparation for television and digital radio broadcasting, policies, which are staged to convert from the systems of analogue radio and television broadcasting to the digital technology, are covered in the National Program.

The decision/GE-06/ was made at the conference of International Telecommunication Union, which was held in 2006, about the transition of network and service of the world countries' broadcasting to the digital technology until 2015. At the present time more than 10 foreign countries terminated the analogue radio, television broadcasting and transmitted to the digital broadcasting. In 2015 the European countries and in 2013 Asian Pacific countries such as Australia, Japan, People's Republic of Korea, People's Republic of China, Taiwan, Malaysia, New Zealand Philippines were announced officially to terminate the analogue radio and television broadcasting.

According to decision, recommendation, experiences of foreign countries, broadcasting service, approaches of network technology development and in terms of the implementation of the objectives of the act 2.4.26 of the program of Mongolian Government during 2008-2012 year, which is mentioned as "The creation of the opportunities to accept the TV channels through the country and transition of the radio and television broadcasting to digital technology" and also, the National Program was drafted.

Article 2 Formulations of the terminology

Below-mentioned formulations have such meanings:

- 2.1 "System of radio and television broadcasting" is preparation, process of the broadcasting programs in studio, transfer, spread of network and reception of the user's equipments.
- 2.2 "User's equipment" is radio, television and other converting equipments, which are necessary for the users to receive the programs.

Article 3 Objectives, framework and structure of the National Program

- 3.1 The main objectives of the National Program is innovating new kinds of media, creating qualitative service to the public and increasing consumptions in the transitional way of the Mongolian broadcasting system to digital technology.
- 3.2 Radios, Televisions, which run activities in Mongolia, its stations, transmitted installations, user's equipments, projects, programs are concerned to the National Program for transition to digital technology.

Article 4 Main Principles of the Implementation

The below-mentioned main principles are necessary to implement the project.

- 4.1 It was based on the participation of the Professional Unions, relevant Nongovernmental organizations, State and Local Administration Institutions.
- 4.2 It was based on the State and Private beneficial cooperation.
- 4.3 To increase the participation of the citizens.
- 4.4 To perform and inform about the significance and fecundation to the public according to the National Program.
- 4.5 To improve the knowledge and skills of the staffs.

Article 5 Aims, framework and results of the National Programs

The below mentioned aims will be used for the implementation of the program.

- 5.1 The first aim: To create the legal environment for transition of radio and television broadcastings to the digital technology.
- 5.2 The second aim: To make technological solution for transition of radio and television broadcastings to the digital technology.
- 5.3 The third aim: To organize framework for transition of radio and television broadcastings to the digital technology according to the unified plan in terms of the geographical position partly and step by step.
- 5.4 The fourth aim: To organize the training and advertise about the program to the citizen, institutions and economic entity.

According to the aims the below-mentioned framework will be implemented.

- 5.5 According to the first aim /transition of radio and television broadcastings to the digital technology and creation of the legal environment/ below-mentioned framework will be implemented.
 - 5.5.1 Mongolian digital radio and television, network structure, classifications, standards which will be adopted based on the research of the network structure, classifications, standards, international approaches, digital radio and television.
 - 5.5.2 Policies for the transition of digital radio and television system will be complied.
 - 5.5.3 The order, related to the digital radio and television system, will be worked out.
 - 5.5.4 The conditions and requirements, related to the digital radio, television equipments, will be created.
 - 5.5.5 The plan and allocation of the range frequencies, used for the digital radio and television will be created.

Results: Legal and regulating environment for transition of radio and television broadcastings to the digital technology will be created.

5.6 According to the second aim /the solution of the technology creating the digital radio television broadcasting system/ below-mentioned framework will be implemented.

5.6.1 To organize the land digital network, to supply the preparation and digital radio television service.

- a. To identify the technical conditions and requirements to the stations while transmitting digital radio television broadcasting.
- b. To identify the policies and approaches of the analogue broadcasting system in the transition period.
- c. To design the model of the digital technological network and structure in the Aimag, Soum and settled areas.
- d. To organize the unified schedule for the transiting network of the digital radio and television broadcasting.
- e. To establish the network and structure in Aimags, Soums and settled areas according to the schedule and model of digital radio and television broadcasting.

5.6.2 To establish digital studios and to provide the preparation framework of the digital radio and television broadcasting service.

- a) To research the progressive technology and to innovate equipment of the stations according to the chosen standards.
- b) To make the unified schedule of the innovation of the equipments and to get the opportunities for transition of digital system.
- c) To set the technical conditions and requirements demanded to the equipments.

5.6.3 To provide the preparation of the digital radio television service, to study researches, to take measures.

- a) To set the member of people/householders, who will be bought the digital radio, television and set top boxes.
- b) Set top boxes will be bought supporting by the Government regulations.
- c) To assign the conditions, requirements of user's equipments and to establish its confirmation of structures.

5.6.4 To implement the unified plan for transition of the digital radio and television broadcasting system, to identify the stages for the transitions of the television broadcasting of the land networks in Mongolia.

Results: The unified plan will be created in the digital radio and television broadcasting system, and the technological opportunity will be appeared.

5.7 According to the third aim /organization of framework for transition of radio and television broadcastings to the digital technology according to the unified plan in terms of the geographical position partly and step by step/ below-mentioned framework will be implemented.

5.7.1 To organize activities and draft the experienced project of the land network of digital radio and television broadcasting.

5.7.2 According the unified plan to lead the organizational activities for transition of radio and television broadcastings to the digital technology and to process the Analogue and Digital system instantaneously in terms of geographical position partly and step by step.

5.7.3 Network, which is transmitting the system of Analogue technology in Mongolia now, will be terminated at 12 a.m, 31st June, 2014, and the digital technology system will start in use.

5.7.4 Other terms

Results: According unified plan, Mongolia will be transmitted to the digital radio and television broadcasting system.

5.8 According to the fourth aim /organization of the training and advertise about the program to the citizen, state institutions and economic entity/ below-mentioned framework will be implemented.

5.8.1 To implement all necessary projects and programs about transition to the digital radio and television broadcasting system among the public.

5.8.2 To take advice from foreign and domestic countries, to disseminate the experiences of the foreign countries, which have been already transmitted to the digital radio and television broadcasting system.

5.8.3 To formulate the instructions and recommendation and to advertise to the public.

5.8.4 To improve the projects, which are relevant to the digital radio and television broadcasting system, relationships between the programs, avoid the geminate investment and gather the information.

5.8.5 To organize the training for the high- specialized cadres, who will work in the sphere of radio and television digital system.

5.8.6 To organize the training and advertisement among the citizen about the transmitting to the radio and television digital system.

5.8.7 To held the meeting and conferences about the process and results of the implementation of the program.

Result: Cooperation and participation of the Institutions and economic entity will be promoted, acquirement of knowledge about the transition to the radio television digital broadcasting system and provision the information.

Article 6 Management, Organization, Finance and Period of the programme

6.1 Information, Communication Technology and Post Authority (ICTPA) will be responsible for the issues, which will be organized the management and implementation of the program, regulate partnership's activity, control its implementation, and it will be informed to the Government.

6.2 To take support from the nongovernmental organizations, entities, citizens, donor countries, implementing the National Program

6.3 To amount the finance from the below-mentioned financial resources.

6.3.1 Budget

6.3.2 Foreign and Domestic investment, loans, assist.

6.3.3 Other resources

6.4 To support state and private sector according to the legislation of the Concession in the framework of the transition to the radio and television digital broadcasting technology.

6.5 The National program of transition to the radio and television broadcasting digital technology will be implemented in 2010-2015.

Article 7 Control, analyzes and estimation of the National program

- 7.1 Information, Communication Technology and Post Authority will be unified and collect information of implementation of National Program. It will be analyzed the policies, informed and presented to the Mongolian Government. Information, Communication Technology and Post Authority will be officiated in advertising to the public.

According to appendix No 2 of the
275th Government Resolution in 2010

THE ACTION PLAN OF IMPLEMENTATION OF
NATIONAL PROGRAM FOR TRANSITION
OF RADIO AND TELEVISION BROADCASTINGS
TO THE DIGITAL TECHNOLOGY

No	Objectives of the National Program	Action sphere	Period	Institutions	Capital /million ₮/	Source
1	To create the legal environment for transition of radio and television broadcastings to the digital technology.	1.1 Mongolian digital radio and television, network structure, classifications, standards will be adopted based on the research of the network structure, classifications, standards, international approaches, digital radio and television.	2010-2011	ICTPA, CRC	5.0	Financing of CRC
		1.2 The order, related to the digital radio and television system, will be worked out.	2010-2011	CRC	-	-
		1.3 The conditions and requirements, related to the digital radio, television equipments, will be created and followed.	2010-2011	ICTPA,CRC	5.0	Financing of CRC
		1.4 The plan and allocation of the range frequencies, used for the digital radio and television will be created.	2010-2011	CRC	-	-
2	To make technological solution for transition of radio and television broadcastings to the digital technology.	2.1 To identify the technical conditions and requirements to the stations which is transferred the digital radio television broadcasting.	2010-2011	ICTPA,CRC	5.0	Financing of CRC
		2.2 To identify the policies and approaches of the analogue broadcasting system in the transition period.	2010-2011	ICTPA,CRC	-	-
		2.3 To design the model of the digital technological network and structure in the aimag, soum and settled areas.	2010-2011	ICTPA	-	-

		2.4 To organize the unified schedule for the transiting network of the digital radio and television broadcasting.	2010-2011	ICTPA,CRC	-	-
		2.5 To establish the network and structure in aimags, soums and settled areas according to the schedule and model of digital radio and television broadcasting.	2010-2015	ICTPA, Information and Communication Network Co.Ltd	10.000.0	State budget
		2.6 To establish the network and structure in aimags, soums and settled areas according to the schedule and model of digital radio and television broadcasting.	2010-2015	ICTPA	23.000.0	Foreign aids and grants
		2.7 To research the progressive technology and to innovate equipment of the stations according to the chosen standards.	2010-2011	ICTPA,CRC	2.5	Investment of private partnership
		2.8 To make the unified schedule of the innovation of the equipments and to get the opportunities for transition of digital system.	2011-2014	ICTPA,CRC	4.000.0	Investment of private partnership
		2.9 To set the technical conditions and requirements demanded to the equipments of digital system	2011-2012	CRC		
		2.10 To set the member of people/householders, who will be bought the digital radio, television and set top boxes.	2011-2015	ICTPA,CRC	5.0	Financing of CRC
		2.11 Set top boxes will be bought supporting by the Government regulations.	2015	ICTPA	10.000.0	Foreign aids and grants
		2.12 To assign the conditions, requirements of user's equipments and to establish its confirmation of structures.	2011-2012	CRC		

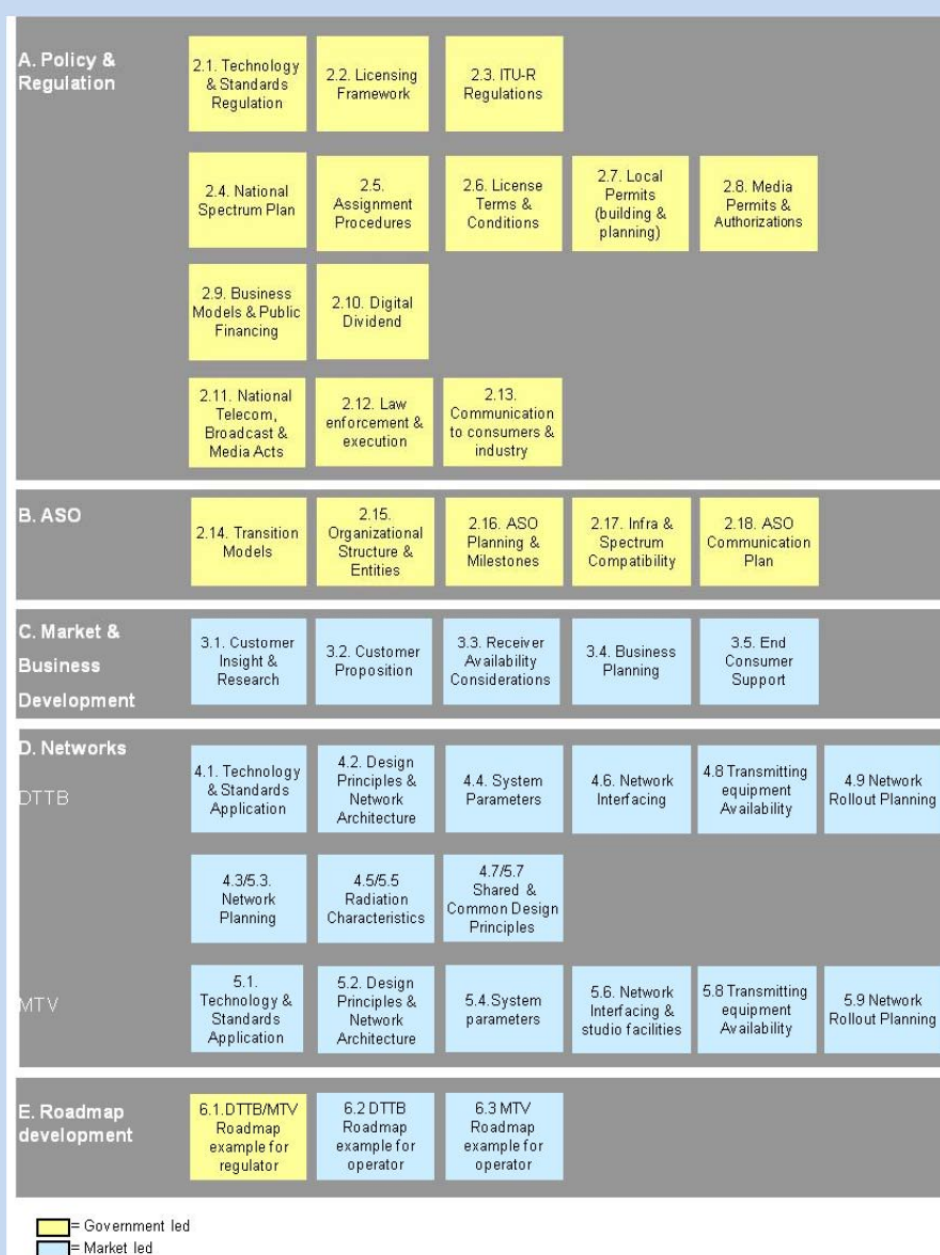
		2.13 To implement the unified plan for transition of the digital radio and television broadcasting system, to identify the stages for the transitions of the television broadcasting of the land networks in Mongolia.	2010-2011	ICTPA,CRC		
3	To organize framework for transition of radio and television broadcastings to the digital technology according to the unified plan in terms of the geographical position partly and step by step.	3.1 To organize activities and draft the experienced project of the land network of digital radio and television broadcasting.	2011	ICTPA,CRC	300.0	free grant by private partnership
		3.2 According the unified plan to lead the organizational activities for transition of radio and television broadcastings to the digital technology and to process the Analogue and Digital system instantaneously in terms of geographical position partly and step by step.	2011-2015	ICTPA		
		3.3 Network, which is transmitting the system of Analogue technology in Mongolia now, will be terminated at 12 a.m , 31 st June, 2014, and the digital technology system will start in use.	2014	ICTPA,CRC		
4	To organize the training and advertise about the program to the citizen, institutions and economic entity.	4.1 To take advice from foreign and domestic countries, to disseminate the experiences of the foreign countries, which have been already transmitted to the digital radio and television broadcasting system.	2011-2013	ICTPA,CRC	15.0	Financing of CRC
		4.2 To formulate the instructions and recommendation and to advertise to the public.	2011-2015	ICTPA,CRC	40.0	Financing of CRC
		4.3 To organize the training for the high-specialized cadres, who will work in the sphere of radio and television digital system.	2011-2012	ICTPA,CRC	3.0	Investment of private partnership

		4.4 To organize the training and advertisement among the citizen.	2011-2015	ICTPA,CRC	15.0	Financing of CRC
		4.5 To held the meeting and conferences about the process and results of the implementation of the program.	2011-2012	ICTPA,CRC	5.0	Financing of CRC

Annex B: ITU expert commentary on 275th Government Resolution

This section has been prepared at the specific request of the ICTPA and it is structured to provide commentary on particular elements of the Mongolian Government directive. For ease of reference it takes relevant extracts (shown in the text boxes) from the decision shown in Annex A to this report. Immediately following each text box is the ITU expert interpretation of the meaning of the extract, and links to the particular parts of the ITU Guidelines which will assist in completing these objectives. That is followed by further commentary or suggestions. The analysis framework is based on the overall functional framework and layered approach of the ITU Guidelines as reproduced below.

Layered model of roadmap development from ITU Guidelines



Main Objectives

- 5.1 *The first aim: To create the legal environment for transition of radio and television broadcastings to the digital technology.*
- 5.2 *The second aim: To make technological solution for transition of radio and television broadcastings to the digital technology.*
- 5.3 *The third aim: To organize framework for transition of radio and television broadcastings to the digital technology according to the unified plan in terms of the geographical position partly and step by step.*
- 5.4 *The fourth aim: To organize the training and advertise about the program to the citizen, institutions and economic entity.*

Objectives:

1. Establish the policy and legislative framework [**Guidelines Functional Layer A: Policy and Regulation; and E: Roadmap Development**].
2. Select and determine a digital broadcasting system standard [**Guidelines Functional Block D: Networks**].
3. Establish a transition framework and implementation plan based on the location of services and a progressive migration [**Guidelines Functional Blocks B. and D: Roadmap Development**].
4. Build awareness of digital technology amongst all stakeholders including viewers, retailers, installers, broadcasters and equipment suppliers to support a smooth transition to digital [**Guidelines Functional Block C**].

Commentary

The four major objectives appear to cover all of the required steps for completion of a transition action plan. The ITU Guidelines provide an expanded analysis of each of these steps and set out questions that will assist the working group and the Administration in their decision making.

First Objective

- 5.5 *According to the first aim /transition of radio and television broadcastings to the digital technology and creation of the legal environment/ below-mentioned framework will be implemented.*
 - 5.5.1 *Mongolian digital radio and television, network structure, classifications, standards which will be adopted based on the research of the network structure, classifications, standards, international approaches, digital radio and television.*
 - 5.5.2 *Policies for the transition of digital radio and television system will be complied.*
 - 5.5.3 *The order, related to the digital radio and television system, will be worked out.*
 - 5.5.4 *The conditions and requirements, related to the digital radio, television equipments, will be created.*
 - 5.5.5 *The plan and allocation of the range frequencies, used for the digital radio and television will be created.*
- Results:** *Legal and regulating environment for transition of radio and television broadcastings to the digital technology will be created.*

This first objective seeks to define the policy and regulatory framework for migration.

1. Develop the standards and operational framework and structure for digital broadcasting based on international practice, and standards **[Guidelines Layer A Part 2.1, 2.2 and 2.3 and reference to Layer B Parts 2.14, and 2.15, a timetable per Part 2.16, and consideration of consumer and business impacts in Layer C]**.
2. Develop transition policies **[Guidelines Layer A, Part 2.2, Layer B, Parts 2.14 through 2.18, Layer D Part 4.8]**.
3. Preparation of relevant Regulations and other Legislation **[Guidelines Layer A Parts 2.2, 2.6, 2.8, 2.11, 2.12, Layer D Part 4.1 and 4.4]**.
4. Select, specify and codify relevant parameters for the Mongolian digital television transmission system and receiver specification **[Guidelines Layer D Part 4.1 and 4.4, Layer A 2.12]**.
5. Spectrum planning service planning and frequency assignment **[Guidelines Layer A Part 2.3, 2.4, 2.5, 2.6, Layer D Parts 4.4, 4.9, 4.3, 4.5 and 4.7]**.

Commentary

The actions defined for this objective appear to comprehensively encompass the essential components that define the policy and regulatory environment that will enable digital migration.

Second Objective

- 5.6 According to the second aim/the solution of the technology creating the digital radio television broadcasting system/below-mentioned framework will be implemented.
- 5.6.1 To organize the land digital network, to supply the preparation and digital radio television service.
- To identify the technical conditions and requirements to the stations while transmitting digital radio television broadcasting.
 - To identify the policies and approaches of the analogue broadcasting system in the transition period.
 - To design the model of the digital technological network and structure in the Aimag, Soum and settled areas.
 - To organize the unified schedule for the transiting network of the digital radio and television broadcasting.
 - To establish the network and structure in Aimags, Soums and settled areas according to the schedule and model of digital radio and television broadcasting.
- 5.6.2 To establish digital studios and to provide the preparation framework of the digital radio and television broadcasting service.
- To research the progressive technology and to innovate equipment of the stations according to the chosen standards.
 - To make the unified schedule of the innovation of the equipments and to get the opportunities for transition of digital system.
 - To set the technical conditions and requirements demanded to the equipments.
- 5.6.3 To provide the preparation of the digital radio television service, to study researches, to take measures.
- To set the member of people/householders, who will be bought the digital radio, television and set top boxes.
 - Set top boxes will be bought supporting by the Government regulations.
 - To assign the conditions, requirements of user's equipments and to establish its confirmation of structures.
- 5.6.4 To implement the unified plan for transition of the digital radio and television broadcasting system, to identify the stages for the transitions of the television broadcasting of the land networks in Mongolia.
- Results:** The unified plan will be created in the digital radio and television broadcasting system, and the technological opportunity will be appeared.

This second objective is concerned with the detailed planning and design of the network, although there is some overlap with the policy and regulatory questions.

1. Establish the planning and design of terrestrial facilities and networks to address the specific needs of different population groups in Aimags, Soums, and settled areas **[Guidelines Layer A Part 2.7 Layer D Parts 4.1 to 4.7, and Layer E Parts 6.1 and 6.2 are relevant, are relevant]**. To establish standards for digital studios and studio equipment **[The guidelines do not cover studio equipment except in terms of the system transmission standards because studio construction and systems are generally not considered part of the regulatory environment]**.
2. Consumer equipment research, consideration of subsidies, and minimum performance criteria for consumer receivers (i.e. consumer receiver standards) **[Guidelines Layer A, Part 2.12, Layer C, Parts 3.1 through 3.5 are relevant]**.

3. Prepare a transition roadmap [**Guidelines Layer E Parts 6.1 and 6.2**] and to carry out that plan.

Commentary

There is some overlap between defining policy and implementing the policy which is the purpose of the second objective.

1. Article 5, subsection 5.6.1 b., should be included in the policy considerations of subsection 5.5 and redefined in 5.6.1 to cover the implementation plan for transition against the policy established in 5.5.
2. Article 5, subsection 5.6.1 e., covers Aimag and Soum which is relevant given these are the parts funded directly by government. However, the present document does not mention transition in Ulaanbaatar. Inclusion of a new subsection, 5.6.1 f., to cover Ulaanbaatar would be useful. A separate subsection is warranted because of the considerable complexity of planning for transition in Ulaanbaatar because of the large number of broadcasters to be accommodated and the mix of government and privately funded transmission facilities.
3. While regulators in the past would define minimum equipment standards for studios and regularly inspect them for compliance, most have now realized that this is unnecessary and the objective of ensuring that the spectrum is used efficiently and that the technical quality of signals received by consumers is appropriate. As a result, the usual approach in most countries is to define the transmission standards and minimum performance standards for transmitters (to ensure other users adequate protection from interference). Some also define the minimum picture standard for SDTV and HDTV in terms of pixels per line and numbers of lines. Otherwise, studio equipment standards are not regulated. The range of studio equipment is very diverse and very much a broadcaster choice. Regulation should perhaps stop at transmission parameters and standards (e.g. Channel frequencies and bandwidth, MPEG-4, DVB-T2 systems and associated parameters such as guard intervals, forward error correction rates, logical channel numbers and other technical parameters that impact consumers, coverage planning, and interference protection), and the parameters for image and sound (so that consumers can be assured of being able to receive all services as broadcast). How these parameters and standards are achieved within the studio should preferably be left to the broadcaster. The only possible reason for a more interventionist approach would be if the government, wanted to raise the general standard of studio quality by using this as a precondition to migration. In this case, a transitional arrangement might be appropriate. In short, the policy objectives for this need to be reviewed in detail and perhaps reflected in an addition to the schedule of activities under the first objective.
4. Consumer Research and Receiver Performance Standards
 - a. The specification of minimum performance standards for DTTB receivers is important to protect consumers. The receiver specification and transmission standard must work in harmony. The generic DVB and MPEG standards are insufficient to define all of the required parameters because they provide a wide choice. The choices for a particular country need to be defined. A good example of the way to do this is set out in the Australian Digital Television standards AS4599 and AS4933 cited in the references to this report. Similar examples can be found in the national standards of the UK and other European countries. The national standard should be confined to essential electrical safety, and transmission parameters and refer to the generic standard for other elements. This is critical information that receiver manufacturers need to programme the receivers to the channel and service parameters of Mongolia.
 - b. Consumer subsidies are a critical part of successful transition. The objective is to try to limit the number of consumers eligible for subsidy so as to constrain the cost to government. In most countries, services have been established well ahead of any consideration of subsidies. Subsidies have then been determined so as to provide a safety net to those who have finally to be moved to allow analogue switch off. The USA provided vouchers as a contribution to

- the purchase of set-top boxes. Many of these were not used because consumers had acquired equipment themselves. In Australia, the lowest income earners were provided with a free basic installation including set-top-box. The eligible consumers were all current recipients of social welfare pensions or related benefits which meant eligibility was clearly defined.
- c. There is no mention of possible assistance to broadcasters. This may be necessary but may be better left until transition requirements and eligibility are fully determined. In Australia, the commercial and national broadcasters faced considerable costs because of the need to replicate very extensive networks. The Australian Government provided various forms of subsidy (e.g. through licence fee concessions through the transition period) to assist the broadcasters make the necessary investment. The costs in Mongolia are likely to be much lower, because the government is directly meeting the costs outside of Ulaanbaatar, and depending on the transmission arrangements determined for Ulaanbaatar, the government may meet the transmission costs through provision of shared multiplex and transmitter.
5. The preparation of a roadmap/transition plan is critical to proper management of transition. It is a vehicle for communication to all stakeholders of the timetables, obligations, and expectations of each actor with responsibilities in the process.
 6. All of these plans need to consider the economic and financial implications for all stakeholders and the nation.

Third Objective

5.7 According to the third aim /organization of framework for transition of radio and television broadcastings to the digital technology according to the unified plan in terms of the geographical position partly and step by step/ below-mentioned framework will be implemented.

5.7.1 To organize activities and draft the experienced project of the land network of digital radio and television broadcasting.

5.7.2 According the unified plan to lead the organizational activities for transition of radio and television broadcastings to the digital technology and to process the Analogue and Digital system instantaneously in terms of geographical position partly and step by step.

5.7.3 Network, which is transmitting the system of Analogue technology in Mongolia now, will be terminated at 12 am , 31st June, 2014, and the digital technology system will start in use.

Results: According unified plan, Mongolia will be transmitted to the digital radio and television broadcasting system.

The third objective is concerned with actual transition implementation plans

1. Prepare a project plan [Guidelines Layer D Part 5.9, Layer E Parts 6.1 and 6.2].
2. Define the sequence and scheduling of migration including simulcast requirements for each region [Guidelines Layer B Part 2.16, Layer D Part 5.9].
3. Defines the closure date for analogue transmission (Midnight 30 June 2014) [Guidelines Layer B Par 2.16].

Commentary

There is some overlap between this objective the second objective, however; this is not consequential. There is benefit in having clearly defined steps of implementation. The definition of a final closure date for analogue is a powerful tool in driving transition.

Because the end date has been clearly defined, the project plan must work backwards from that date and inevitably a number of steps will need to be taken to expedite some of the steps. If the final closure date is to be achieved there should be at least 18 months between the time the last transmitter becomes operational in a market and the closure date. During this period digital and analogue simulcast will be needed. If the simulcast period is shorter, then the demand for subsidy will inevitably increase. One way to assist consumers to migrate early without subsidy is to provide more programmes on digital during the simulcast. Simulcast alone provides no incentive.

Fourth Objective

5.8 According to the fourth aim /organization of the training and advertise about the program to the citizen, state institutions and economic entity/ below-mentioned framework will be implemented.

5.8.1 To implement all necessary projects and programs about transition to the digital radio and television broadcasting system among the public.

5.8.2 To take advice from foreign and domestic countries, to disseminate the experiences of the foreign countries, which have been already transmitted to the digital radio and television broadcasting system.

5.8.3 To formulate the instructions and recommendation and to advertise to the public.

5.8.4 To improve the projects, which are relevant to the digital radio and television broadcasting system, relationships between the programs , avoid the geminate investment and gather the information.

5.8.5 To organize the training for the high- specialized cadres, who will work in the sphere of radio and television digital system.

5.8.6 To organize the training and advertisement among the citizen about the transmitting to the radio and television digital system.

5.8.7 To held the meeting and conferences about the process and results of the implementation of the program.

Result: Cooperation and participation of the Institutions and economic entity will be promoted, acquirement of knowledge about the transition to the radio television digital broadcasting system and provision the information.

Objective four is concerned with communication with stakeholders and their engagement in a unified approach to convincing the public to migrate to digital and is generally covered by **[Guideline Layer B Part 2.18]**:

1. Plan the ASO and consumer information strategy.
2. Draw upon the ASO experience of other countries.
3. Determine the publicity and consumer information strategy and campaigns (which should involve all broadcasters, regulators, government, and other media in a joint effort).
4. Encourage investment and development of new content that will assist in promoting DTTB.
5. Arrange training of engineers, production staff, and others who will be responsible for production, operation, and support of the digital television content and systems.

6. Conduct consumer awareness campaigns directed as their understanding of DTTB and migration to DTTB.
7. Conduct conferences and workshops to inform stakeholders about directions and progress with the migration project.

Commentary

All of these are necessary steps in the migration. One critical consideration that is missing from this is the budget. The experience of the Australia, Europe, and USA has shown that the cost of managing and implementing the consumer awareness campaign is considerable. All countries that have moved forward with analogue switch off have established a dedicated task force to oversee and manage this complex process. It needs to use all available media to reach consumers, and effective measurement of the success of the campaigns. The messages need to be targeted and adapted to the needs of each group of stakeholders. Costs can be reduced where there is tight collaboration between broadcasters, government, regulators and consumer equipment suppliers. It follows an agreed common strategy, where the risk of confusing consumers is considerably reduced.

Article 6 Management Organization and Finance

Article 6 Management, Organization, Finance and Period of the program

- 6.1 *Information, Communication Technology and Post Authority (ICTPA) will be responsible for the issues, which will be organized the management and implementation of the program, regulate partnership's activity, control its implementation, and it will be informed to the Government.*
- 6.2 *To take support from the nongovernmental organizations, entities, citizens, donor countries, implementing the National Program*
- 6.3 *To amount the finance from the below-mentioned financial resources.*
 - 6.3.1 *Budget*
 - 6.3.2 *Foreign and Domestic investment, loans, assist.*
 - 6.3.3 *Other resources*
- 6.4 *To support state and private sector according to the legislation of the Concession in the framework of the transition to the radio and television digital broadcasting technology.*
- 6.5 *The National program of transition to the radio and television broadcasting digital technology will be implemented in 2010-2015.*

Commentary

This article gives clear authority to ICTPA over all aspect of management and funding of the project and for communication with government. Perhaps it does not adequately define the role of the CRC. Nevertheless, the CRC's role is spelt out fairly completely within the work programme. It may be useful to reflect its role in this article as well.

Article 7 Research Analysis and Public Information

Article 7 Control, analyzes and estimation of the National program

7.1 Information, Communication Technology and Post Authority will be unified and collect information of implementation of National Program. It will be analyzed the policies, informed and presented to the Mongolian Government. Information, Communication Technology and Post Authority will be officiated in advertising to the public.

Commentary

This article gives the ICTPA a clear mandate to assess the benefits, conduct research, manage publicity and report progress. This is an appropriate role for the government's policy advisors.

Commentary on Appendix 2 of the 275th Government Resolution in 2010							
No	Objectives of the national programme	Action sphere	Period	Institutions	Capital /million ₮/	Source	Commentary by ITU expert
1	To create the legal environment for transition of radio and television broadcastings to the digital technology.	1.1 Mongolian digital radio and television, network structure, classifications, standards will be adopted based on the research of the network structure, classifications, standards, international approaches, digital radio and television.	2010-2011	ICTPA, CRC	5.0	Financing of CRC	Nil – Choice of MPEG-4 and DVB-T2 noted Work will need to be undertaken to define specific parameters for Mongolia and include them in a national transmission and receiver standard and specification. Under the implementation model recommended by the expert, this detailed work could be undertaken by the systems integrator under CRC guidance.
		1.2 The order, related to the digital radio and television system, will be worked out.	2010-2011	CRC	-	-	This logically flows from step 1.1 and relates to the broadcast system and transmission standard.
		1.3 The conditions and requirements, related to the digital radio, television equipments, will be created and followed.	2010-2011	ICTPA,CRC	5.0	Financing of CRC	This is intended to identify any mandatory standards for transmission and reception equipment and flows from step 1.1.
		1.4 The plan and allocation of the range frequencies, used for the digital radio and television will be created.	2010-2011	CRC	-	-	This is a normal CRC function. From discussion with CRC much of the preliminary work on frequency assignment has been completed. Note the suggestions in this report about assignment channels in the Aimags and Soum to simplify installation design (7.4.1).

Commentary on Appendix 2 of the 275th Government Resolution in 2010							
No	Objectives of the national programme	Action sphere	Period	Institutions	Capital /million ₮/	Source	Commentary by ITU expert
2	To make technological solution for transition of radio and television broadcastings to the digital technology.	2.1 To identify the technical conditions and requirements to the stations which is transferred the digital radio television broadcasting.	2010-2011	ICTPA,CRC	5.0	Financing of CRC	Given the relative simplicity of transmission arrangements in Aimag and Soum this should not be complex. However, it may be more complex in Ulaanbaatar when the needs of private broadcasters must be considered and final resolution will depend on policy determinations.
		2.2 To identify the policies and approaches of the analogue broadcasting system in the transition period.	2010-2011	ICTPA,CRC	-	-	These issues are flagged in the report. in particular matters of any new analogue licences, rights of transition by existing analogue broadcasters etc. need to be resolved early
		2.3 To design the model of the digital technological network and structure in the Aimag, Soum and settled areas.	2010-2011	ICTPA	-	-	Requirements for Ulaanbaatar need to be separated out from Aimag and Soum because they are more difficult to resolve from a policy perspective. Once the policy is settled then planning should be straightforward. Ulaanbaatar may need more detailed coverage planning to ensure the digital coverage is sufficient for future needs.
		2.4 To organize the unified schedule for the transiting network of the digital radio and television broadcasting.	2010-2011	ICTPA,CRC	-	-	The timetable must be driven by the end date for analogue and the need for some simulcast period to ensure consumers do not loose services. It is important that the timetable be established early as it will drive all other aspects of the schedule
		2.5 To establish the network and structure in Aimags, Soums and settled areas according to the schedule and model of digital radio and television broadcasting.	2010-2015	ICTPA, Information and Communication Network Co.Ltd	10.000.0	State budget	Assume this relates to actual construction. Once again Ulaanbaatar needs to be mentioned specifically

Commentary on Appendix 2 of the 275th Government Resolution in 2010							
No	Objectives of the national programme	Action sphere	Period	Institutions	Capital /million ₮/	Source	Commentary by ITU expert
		2.6 To establish the network and structure in Aimags, Souns and settled areas according to the schedule and model of digital radio and television broadcasting.	2010-2015	ICTPA	23.000.0	Foreign aids and grants	Assume this is a separate line for construction because of the different source of funding.
		2.7 To research the progressive technology and to innovate equipment of the stations according to the chosen standards.	2010-2011	ICTPA,CRC	2.5	Investment of private partnership	Not clear what this means. It would seem that it should be part of the implementation mentioned in 2.5 and 2.6 except for the fact that the funding identifies <i>Private Partnership</i> . This task may need better definition. Can only assume that this relates to the desire for studio and equipment upgrades by broadcasters and that this is the research stage of item 2.8.
		2.8 To make the unified schedule of the innovation of the equipments and to get the opportunities for transition of digital system.	2011-2014	ICTPA,CRC	4.000.0	Investment of private partnership	See comments on item 2.7. Also comments on the need to define the objective for government intervention at studio level. Once that objective has been defined than this action may become clear. At present it is not clear (it may have been lost in translation).
		2.9 To set the technical conditions and requirements demanded to the equipments of digital system	2011-2012	CRC			Standards setting: once again note the need to determine just what standards are needed. See comments against the Second Objective item 2.3 above.
		2.10 To set the member of people/householders, who will be bought the digital radio, television and set top boxes.	2011-2015	ICTPA,CRC	5.0	Financing of CRC	The first step is to identify the likely consumers who will need assistance. Given ASO occurs on 30 June 2014, 2015 seems too late for this activity to be completed

Commentary on Appendix 2 of the 275th Government Resolution in 2010							
No	Objectives of the national programme	Action sphere	Period	Institutions	Capital /million ₮/	Source	Commentary by ITU expert
		2.11 Set top boxes will be bought supporting by the Government regulations.	2015	ICTPA	10.000.0	Foreign aids and grants	The date needs to be brought forward from 2015 to early 2014 at the latest to be effective otherwise there will be many disenfranchised viewers who may put pressure on government to delay ASO.
		2.12 To assign the conditions, requirements of user's equipments and to establish its confirmation of structures.	2011-2012	CRC			If this refers to consumer receive standards and specifications, it needs to be done as early as possible to ensure that equipment coming into the market confirms to the agreed standard and retailers cannot pass off equipment intended for other standards to unsuspecting viewers. Some form of marking may be necessary to inform the public which receivers meet the local standards.
		2.13 To implement the unified plan for transition of the digital radio and television broadcasting system, to indentify the stages for the transitions of the television broadcasting of the land networks in Mongolia.	2010-2011	ICTPA,CRC			This is the development of the roadmap and schedule for migration. Timing is a high priority.
3	To organize framework for transition of radio and television broadcastings to the digital technology according to the unified plan in terms of the geographical position partly and step by step.	3.1 To organize activities and draft the experienced project of the land network of digital radio and television broadcasting.	2011	ICTPA,CRC	300.0	free grant by private partnership	Also part of the roadmap/action plan.
		3.2 According the unified plan to lead the organizational activities for transition of radio and television broadcastings to the digital technology and to	2011-2015	ICTPA			This will be an on-going role for the agencies and the working group, and may need a dedicated group within ICTPA to manage the process and funding allocations.

Commentary on Appendix 2 of the 275th Government Resolution in 2010							
No	Objectives of the national programme	Action sphere	Period	Institutions	Capital /million ₮/	Source	Commentary by ITU expert
		process the Analogue and Digital system instantaneously in terms of geographical position partly and step by step.					
		3.3 Network, which is transmitting the system of Analogue technology in Mongolia now, will be terminated at 12 am , 31 st June, 2014, and the digital technology system will start in use.	2014	ICTPA,CRC			This is the key objective.
4	To organize the training and advertise about the program to the citizen, institutions and economic entity.	4.1To take advice from foreign and domestic countries, to disseminate the experiences of the foreign countries, which have been already transmitted to the digital radio and television broadcasting system.	2011-2013	ICTPA,CRC	15.0	Financing of CRC	Information gathering and lessons from others.
		4.2 To formulate the instructions and recommendation and to advertise to the public.	2011-2015	ICTPA,CRC	40.0	Financing of CRC	Development of communications plan - overall this will require central management. There is potential confusion between the CRC and ICTPA roles in this given Article 7 prescriptions. This should be clarified.
		4.3 To organize the training for the high-specialized cadres, who will work in the sphere of radio and television digital system.	2011-2012	ICTPA,CRC	3.0	Investment of private partnership	The training of engineers can be part of the technical implementation. Separate arrangements will be needed to train production people and others concerned with making DTTB a success.

Commentary on Appendix 2 of the 275th Government Resolution in 2010							
No	Objectives of the national programme	Action sphere	Period	Institutions	Capital /million ₮/	Source	Commentary by ITU expert
		4.4 To organize the training and advertisement among the citizen.	2011-2015	ICTPA,CRC	15.0	Financing of CRC	Again there is confusion between this task for CRC and the ICTPA responsibility set out in Article 7. Clarification is needed.
		4.5 To held the meeting and conferences about the process and results of the implementation of the program.	2011-2012	ICTPA,CRC	5.0	Financing of CRC	As for item 4.4, some activities like the ICT Forum were ICTPA organized and the proposed DVT workshop may be CRC. Perhaps this can be clarified for all parties when the communication strategy is defined.

Annex C: System Standards

By the time of the first ITU expert mission in February 2011, Mongolia had made a provisional decision to use the DVB-T series of standards for DTTB implementation (aligning with choices made for satellite).

The next question was: *What compression standard to adopt, MPEG-2 or MPEG-4?* New services commencing now can take advantage of technology improvements that were not available to the early adopters of DTTB. These include MPEG-4 and DVB-T2 technologies. While there remains some hesitancy about DVB-T2 virtually all new implementations of DTTB are adopting MPEG-4 to take advantage of the additional carriage capacity it provides. The productivity benefits of MPEG-4 are compelling. One subscription television operator, using over-the air terrestrial carriage in Tonga, has been reported to provide up to 22 programmes over a single 8 MHz bandwidth television channel, using statistical multiplexing⁶. While this is perhaps pushing the technology to its limits, MPEG-4 would easily deliver the ten SDTV channels required by the government's DTTB brief for Mongolia. There is no reason why the current usage of MPEG-2 on the satellite DTH service should influence the decision. Appendix 1 to this Annex is a summary of the migration timetable for many countries of Europe including their decisions on whether to adopt MPEG-4. Most planning analogue switch off within the same timeframe as Mongolia, have opted for MPEG-4.

The maximum overall bit-rate for a standard DVB-T channel of 8 MHz bandwidth is around 24 Mbits/sec. DTTB is very flexible in the way the available channel capacity can be used. For DVB-T1 technology the available bit rate is around 25Mbits/sec, using DVB-T2 technology the available bit rate increases to over 30Mbit/s. Typically using MPEG-4, a SDTV channel will use about 2Mbits/s and a HDTV channel around 5Mbits/s or higher. HDTV and SDTV programmes can simultaneously share the channel and further capacity increases are usually available using statistical multiplexing.

At present DVB-T2 implementation is focused on delivery of HDTV in Europe. Although some smaller countries have been reported to have decided on DVB-T2, they are yet to implement. The DVB organization's own web site provides the following guidance:

What are the implications of DVB-T2 for countries that have not yet decided which DTT transmission system they will adopt?

In some countries, notably in Latin America, parts of Asia, and Southern Africa, debate continues as to which of the available DTT transmission systems should be adopted and deployed. The DVB Project believes that the adoption of DVB standards in such territories would bring maximum benefit for all stakeholders, including broadcasters, regulators, manufacturers and, perhaps most importantly, viewers. Regardless of which analogue transmission system is used, and regardless of the channel bandwidth used, both DVB-T and DVB-T2 offer a uniquely flexible solution that will enable a smooth transition to DTT. For the time being, the key factor, particularly in countries with a high penetration of terrestrial TV and relatively low average incomes, will be the price and range of receivers.

The same choice between affordability (DVB-T) and technical performance (DVB-T2) mentioned above applies to these countries. The further away the ASO date, the lower the DVB-T2 receiver prices will have dropped by the time that receivers are deployed

www.dvb.org/technology/dvbt2/

⁶ Information from private conversation with suppliers involved in the implementation.

The same source suggests that DVB-T2 receiver prices have fallen since implementation of DVB-T2 in the UK and a scan of suppliers suggests that these receivers (or set top boxes) are now becoming more common. However, it remains that DVB-T2 is in its early stages of implementation and while there is no evident technology risk in adopting DVB-T2, there may be a cost and availability penalty for consumer receivers in the short-term. Advice from transmitter manufacturers suggest that while DVB-T2 is available on a limited range of transmitters at this time, they expect that most transmitters will be set up for both DVB-T1 and DVB-T2 within the next year and that there should be no cost penalty for DVB-T2. The transmitter and receiver availability questions could be further investigated during the tender phase.

DVB-T2 and MPEG-4 is the system that is best able to meet the specified service requirements.

Appendix 1 to Annex C

Migration timetable in Europe and decisions re MPEG4 adoption in various countries

Switching off analogue television

In many European countries, planning for analogue switch-off is well underway with several countries having already completed the process.

It is expected that most European countries will have switch-off their analogue services by 2015, if not earlier. The European Commission recommends that its Member-States complete the process by 2012.

Announced digital switchover dates

Country	Launch date	Compression format	Completion of ASO
UK	1998	MPEG-2	2012
Sweden	1999	MPEG-2	Completed
Spain	2000/ 2005	MPEG-2	Completed
Finland	2001	MPEG-2	Completed
Switzerland	2001	MPEG-2	Completed
Germany	2002	MPEG-2	Completed
Belgium (Flemish)	2002	MPEG-2	Completed
NL	2003	MPEG-2	Completed
Italy	2004	MPEG-2	2012
France	2005	MPEG-2/MPEG-4 AVC	2011
Czech Republic	2005	MPEG-2	2011
Denmark	2006	MPEG-2/MPEG-4 AVC	Completed
Estonia	2006	MPEG-4 AVC	Completed
Austria	2006	MPEG-2	2011
Slovenia	2006	MPEG-4 AVC	Completed
Norway	2007	MPEG-4 AVC	Completed
Lithuania	2008	MPEG-4 AVC	2012
Hungary	2008	MPEG-4 AVC	2011
Ukraine	2008	MPEG-4 AVC	2014
Latvia	2009	MPEG-4 AVC	Completed
Portugal	2009	MPEG-4 AVC	2012
Croatia	2009	MPEG-2	Completed
Poland	2009	MPEG-4 AVC	2013
Slovakia	2009	MPEG-2	2012
Ireland	2011	MPEG-4 AVC	2012
Russia	TBC	MPEG-4 AVC	2015

Source: www.digitag.org.

Annex D: Approaches to Transmission Network Design

During the first ITU expert mission to Mongolia, the merits of a number of options for implementing DTTB were discussed. These are briefly summarized here for completeness. These options can be broadly described as:

- a. Rebroadcast on a terrestrial DTTB of the six core programmes using as the input source, the MPEG-2 services currently being distributed by satellite.
- b. Establishment of a new MPEG-4 satellite distribution dedicated to feeding 10 or more programmes, to the terrestrial DTTB transmitters.
- c. Terrestrial input via optical fibre link. A possible option, not explored during the ITU expert mission, would be for the input to be delivered to each site by the national optical cable network which would replace the IRD input in Option 3. This might eliminate the need for a satellite up-link and satellite. The expert understands the optical network currently reaches only about 300 of the total 400 transmitter localities so for that reason may not be a practical option. Its cost-effectiveness over satellite would depend on the ease of access to the optical drop points in the Aimag/Soum, and the relative cost of access/carriage on the optical network compared with on-going satellite up-link and space segment costs. It also assumes that the current MPEG-2, D-Dish distribution, would remain for those viewers unable to access terrestrial services. This optical network connection option will not be further discussed in this report.

Configuration discussion

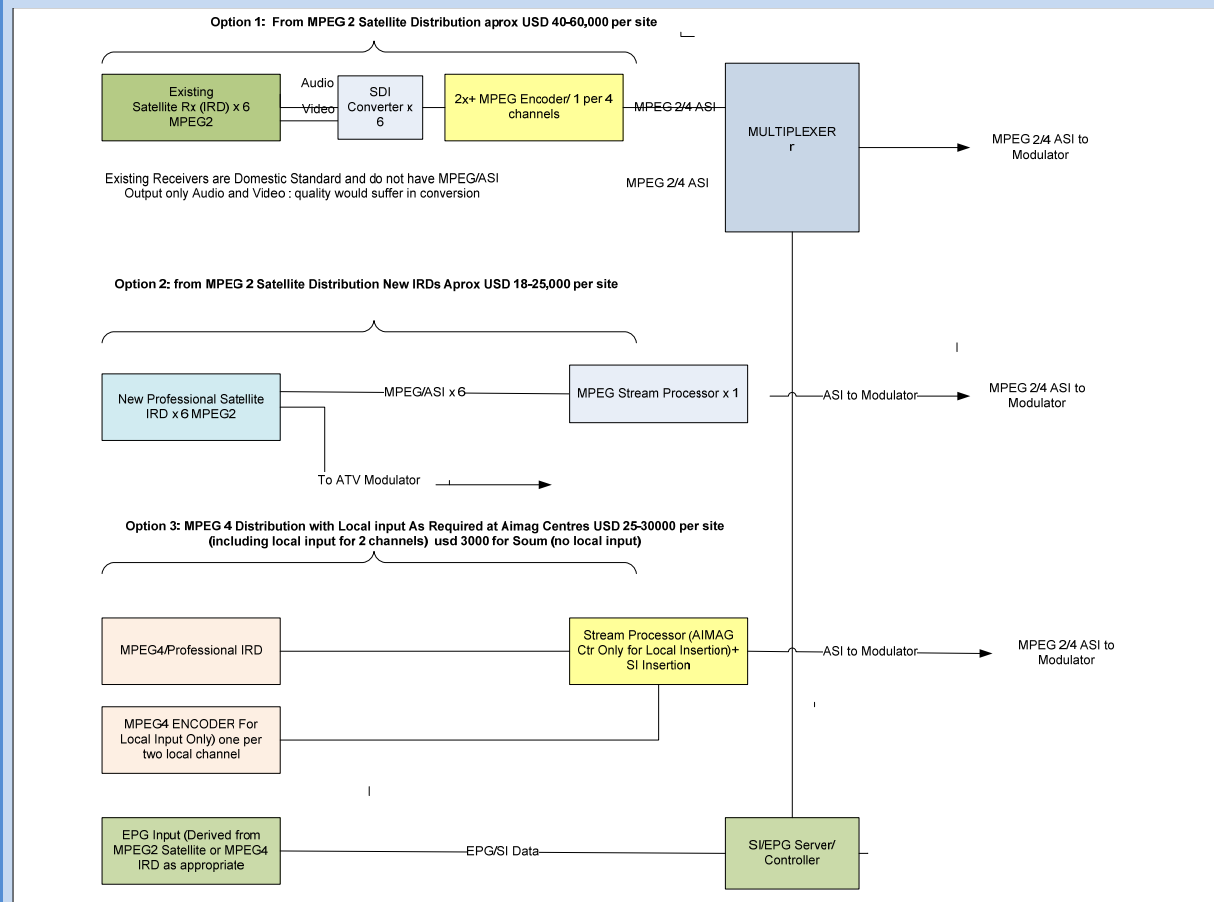
The options reproduced here reflect the discussions with the NRT during the first mission and not post the decision to adopt MPEG-4 and DVB-T2. Because they provide useful background to the considerations leading to the decision they have been included here in their original form. The matters covered include:

- a. Configuration of Ulaanbaatar services to use shared antenna systems.
- b. DTTB services sharing existing Aimag/Soum ATV facilities where possible, including antenna, feeder and satellite dish.
- c. DTTB services being collocated with the existing ATV facilities but using a separate antenna and feeder.

Input of locally originated programmes at Aimag centres:

Figure 2 depicts three different types of input configuration in simplified form. The first using the existing satellite receivers, the second using the existing satellite with new professional receivers, and the third a new separate composite DTTB distribution using a separate satellite channel. Local input at Aimag could also be achieved by encoding the channel locally and feeding a separate modulator and transmitter. The estimated cost of this solution is slightly more than the multiplexed solution and should only be considered if the use of MPEG-2 for DTTB were unavoidable. With MPEG-2 the channel capacity on the primary multiplex would be limited to a maximum of 6-8 programmes. All of the solutions could use MPEG-4 by transcoding MPEG-2 or by MPEG-4 at origin. However, transcoding at the transmitter location adds considerably to complexity and cost and should be avoided for remote unattended sites.

Figure 2: Alternative input signal configurations for Aimag/Soum transmitters



The most cost effective solution is to encode and multiplex all channels at the up-link centre (logically Ulaanbaatar). Aimag local inputs would be achieved as above by insertion of local content into the MPEG-4 stream using a stream processor/multiplexer. These devices also serve to translate system information (SI) and EPG but do need some local management peripherals (dedicated PC processor for configuration purposes).

No redundancy has been shown in the above simplified diagrams. However, the costs for a redundant system are reflected in the upper range of indicative costs. The Soum ATV facilities have no redundancy at present and this would be difficult to justify, at least in the initial installation, but redundant installations in the Aimag centres should be considered.

For DTTB all ten channels would be processed through a single IRD, modulator and amplifier the failure of any one of these will result in the loss of all services. A similar situation exists if the common linear amplifier fails in a Soum/Aimag ATV installation. Redundancy should be considered for larger Aimag centres and could be installed with the initial installation or added later. From a cost and design perspective it would be better to implement redundancy with the original installation if the budget allows because the equipment cost will be lower because of bulk purchase discounts.

Use of existing IRDs to derive input for DTTB

If the existing MPEG-2 distribution via the D-Dish satellite were to be used, the simplest option would be to extract an MPEG-2/Asynchronous Serial Interface (ASI) data stream from the IRD and re-multiplex the services at the transmitter site. Unfortunately, the existing installations use domestic IRDs which have

component/composite video output and no access to the MPEG/ASI stream or SI/EPG data. This would require either re-encoding the analogue video/audio output of the IRD before re-multiplex, or replacement of the IRDs with professional IRDs. However, this introduces the complexity of a multiplexer at each transmitter site plus some additional management and SI/EPG input arrangements.

It is possible to transcode from MPEG-2 to MPEG-4 from the ASI stream but the transcoder adds to the cost. At the same time the number of services would be limited to the number available from the D-Dish satellite service.

Costs and practical operating considerations suggest that derivation of the DTTB service from the existing MPEG-2 DTH satellite service is perhaps not practical. Table 3 provides an indication of the differential range of costs of implementing different input solutions (these exclude Modulator, Transmitter, Antenna Systems, and Satellite Receive Antenna). These comparative costs are provided to illustrate the relative costs of different options only and are based on a simplified implementation. More detailed estimates of the costs of the total system are provided in Annex F to this report.

Table 3:
Comparative minimum cost of alternative options
for signal input to modulator for Soum/Aimag

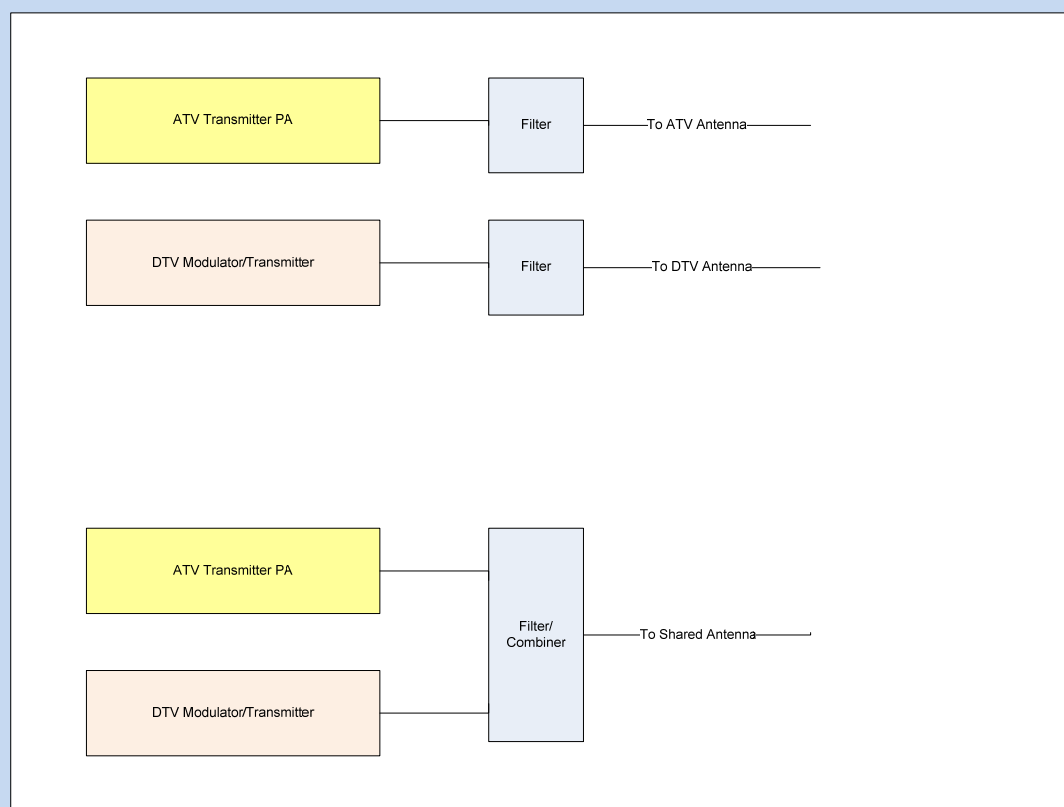
	Option 1	Option 2	Option 3	Separate Transmitter for Aimag Local
Cost for a Soum installations	USD 50,000	USD 20,000	USD 3,500	
Cost for an AIMAG with two local inputs	USD 85,000	USD 40,000	USD 27,000	20,000 + transmitter etc. 10,500= 30,500
360 Soum sites	USD 18 m	USD 7.2 m	USD 1.26m	
21 Aimag sites	USD 1.79 m	USD 0.84 m	USD 0.576 m	USD 0.71 m
Approximate Total	USD 20 m	USD 8 m	USD 1.8 m	

Clearly the arrangements necessary to use the existing MPEG-2 distribution impose a significant cost penalty, and at the same time they limit the practical number of programmes on the DTTB service to those available from the D-Dish distribution arrangement (currently six).

Transmitters for Soums and Aimags

The current Aimag/Soum arrangement, of combining all services before the output power amplifier, imposes constraints on the way in which the DTTB and ATV services may share the antenna system (antenna and feeder). In most sites, the physical arrangement of the tower may prevent satisfactory installation of a second antenna on the tower to provide an independent DTTB transmission arrangement. Even if this were possible, additional filters would need to be installed in the antenna feeds of both ATV and DTTB transmitters to prevent power to be fed back from coupling of the antennas back into the ATV/DTTB transmitters. This would cause transmitter operating problems. Figure 3 depicts the two possible arrangements.

Figure 3: Indicative transmitter arrangements



Taking into account the approximate size of transmitters generally available in the market, only one or two different sizes of DTTB transmitter would be needed to cover the necessary output requirements (the transmitter power outputs are adjustable over the range) 379 small size transmitters (approximately 10W max) will be required to cover the range of needs given DTTB channel power will be about one quarter of the power of the ATV channel providing the same coverage. This suggests that around 20W per channel would suffice to achieve equivalent coverage in the larger Aimag centres which use a single 500W amplifier for the six existing channels combined. The actual power requirements should be verified if there is any doubt about existing of future coverage needs in the larger Aimags where the transmitter power would be at about the top of the range for a low power transmitter. There are six 500W combined ATV services and the next step up in a typical transmitter range is 25-100W for which the cost is about USD 10,000 compared with USD 6,000-8,000. The difference in cost is not significant for the purposes of broad assessment of potential costs for which the options are set out in Table 4.

An early assessment should be made of any current or expected coverage issues for analogue transmissions in the larger Aimags and if necessary more detailed propagation and coverage assessments should be made to optimize the digital power levels. In some instances, it may be necessary to consider any longer term requirements for fill-in translators where urban spread is extending into shadow areas.

Table 4:

Indicative transmitter and antenna network costs Soum and Aimag

	Unit Cost	Option 1 Qty	Option2 Qty
Transmitter Modulator	USD 6,000-8,000	1	1
Filters for ATV Transmitter	USD 1,500	1	
Filter for DTTB Transmitter	USD 400	1	
Combiner	USD 2500		1
Antenna OD Panel	USD 3000	1	Existing Antenna
Feeder	USD 500	1	Existing Feeder
Per Site Cost		USD 13,400	USD 10,500
Number of Sites		USD 379	USD 379
Total Cost		USD 4.2 - 5.078 m	USD 3.1- 3.9 m

Table 4 is intended to illustrate the benefits of sharing the antenna system. Sharing of the satellite receive dish is assumed as common to all options.

Given the large number of installations involved, any savings make a considerable difference to the bottom line (approximately USD 400 saving for each USD 1 saved). Subject to an assessment of the capacity, power handling, bandwidth, and performance of the existing antennas, there is merit in sharing these with the DTTB service. If the existing ATV antennas are not satisfactory, then they could be replaced with antennas suitable for carriage of both services. The above estimate assumes all existing antennas are panel antennas and that they can be shared. The estimates also assume that for Soum and Aimag, CRC will be able to allocate a DTTB channel that is at least 16MHz removed from existing channels operating at the location. If this is not possible, then combiner/filter costs may increase by 100-200 per cent.

The normal configuration of quality DTTB transmitters is to have the modulator and amplifier tightly coupled together electrically so that they both operate together to maintain stability and linearity of the transmission chain, which ensures less variability in signal coverage with climate changes. For this reason, amongst the others already mentioned, suggestions made by the national radio and television network engineers to combine the DTTB and ATV signals at low level and share the linear amplifier are not recommended. Under such an arrangement it would not be possible to provide dynamic adjustment of linearity of the system and is likely to generate unexpected and unwanted interference products.

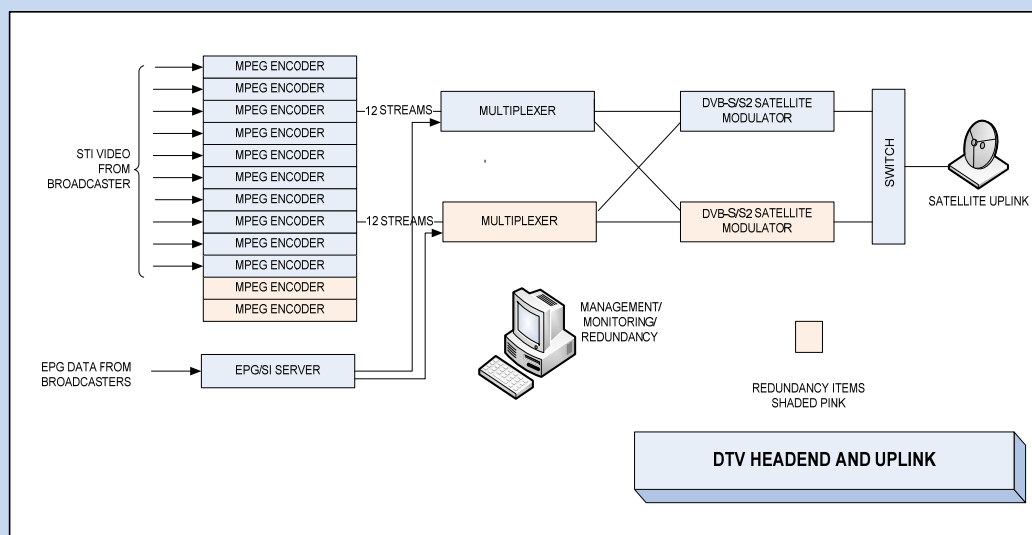
Distribution

As mentioned earlier, the choice of MPEG-2 versus MPEG-4 is effectively determined by the objective to deliver at least ten DTTB programmes per channel. Therefore, for the purposes of further discussion MPEG-4 is assumed. This has little impact on pricing even though the licences for MPEG-4 encoders are a little more expensive than MPEG-2 the number of encoders needed is fairly small (ten for the head-end, plus one or two per Aimag).

The most logical arrangement is to bring all of the proposed programmes (except local Aimag centre programmes) to one location (head-end) for encoding and multiplexing. The programmes could be encoded at the studio and transmitted to the head-end as an ASI stream but for the purposes of this discussion the use of central encoding and multiplex has been assumed. Broadcasters would transmit their signals to the head-end in STI form or MPEG/ASI plus EPG information. These broadcaster inputs can be multiplexed at the head-end and the appropriate system information and EPG data inserted at the multiplexer stage.

There would be advantages in owning and managing the multiplex and encoding systems as part of the national radio and television network. This would allow changes to be made in future at minimal cost and complexity, it opens up more opportunities for up-link and satellite segment, and the capital and support costs are likely to be quickly recovered compared with the fees charged to having this service provided commercially.

Figure 4: Basic head end configuration



General Observations on Design of Ulaanbaatar Transmission Facilities

The ITU expert understands that detailed coverage assessments for digital television in Mongolia was carried out some time ago by the French company ATDI as part of an investigation related to the distribution of educational programmes. This information was obtained from informal conversations within the industry and no specific details of the study or the results have been seen by the expert. However, this would be useful information in the planning and implementation of future DTTB services for Ulaanbaatar as the computer modelling used by ATDI has been proven in many countries to provide very reliable predictions of coverage for planning purposes. ICTPA or CRC might wish to review this report if it is available to them.

The expert has been able to witness the rapid expansion of Ulaanbaatar in terms of central business district high-rise and urban spread up the surrounding valleys over the past two years. This suggests that if the current coverage is adequate now (perhaps unlikely since it was most likely planned for a much smaller city), then it will certainly have issues in the future. The installation of digital is an opportunity to take care of the future and if necessary plan translators to extend coverage or fill-in gaps from the main transmitter. At the same time the radiated power of the new digital transmissions can be optimized to achieve the most cost effective coverage of greater Ulaanbaatar into the foreseeable future. This assessment could be assigned to be part of the role of the systems integrator, or could be undertaken separately by CRC.

The expert recommends engaging one of the expert planning organizations that have well proven computer based propagation and modelling tools for digital television to conduct such a study. This is much more cost effective than field surveys, and for the limited requirements in Mongolia, it would not be cost-effective for CRC to invest in such tools for broadcasting alone.

The future DTTB services in Ulaanbaatar are expected to be in the UHF band and that they will be assigned frequencies that are adjacent to existing UHF ATV services. Because of limitations on the tower

structure at the central television facility, the ATV and DTTB services will need to share a common antenna. Therefore, high-performance combiners will need to be installed to allow the services to coexist. It might also be necessary to impose some maximum power restrictions on the DTTB service initially to avoid interference to the ATV programmes. As the time for ATV closure approaches the power of the DTTB services could be increased and cause ATV interference convincing viewers to switch to DTTB.

From the experience of those countries which have already migrated to DTTB, it would be unlikely that all broadcasters would transmit all of their services in HDTV. From observations of the large number of broadcasters operating in Ulaanbaatar many would be challenged to implement HD in the immediate future and the content they produce may not look much different on HD or SD.

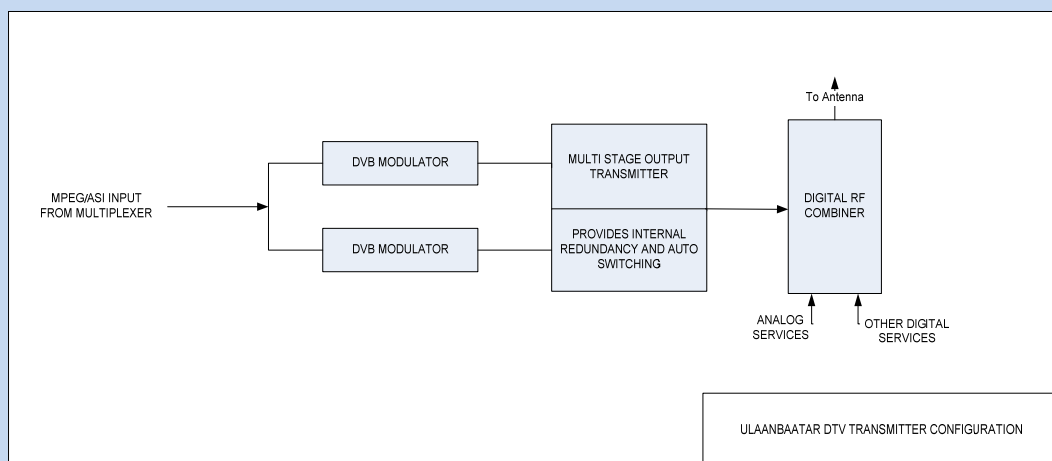
In Australia, where there were typically five programs being broadcast on ATV in each market, every broadcaster was allocated a full television channel for DTTB. The legislation required them to transmit both HD and SD services, but they were committed to establish additional services within the constraints imposed by the maximum data rate on the channel. Therefore each broadcaster operated its own multiplex and was not permitted to carry the programmes of other broadcasters. By contrast, in the United Kingdom digital television was established by creating a shared multiplex operated by a third party, and broadcasters obtained access to this multiplex for the delivery of their digital services. Several multiplexes were established in each market. This was done because of the shortage of spectrum available for digital television. With the closure of analogue services further multiplexes are being established using DVB-T2 technology and MPEG-4 compression to establish HDTV services throughout the country.

Without the benefit of detailed discussion and dialogue about the possible objectives that the Mongolian Government policy makers and regulators may wish to achieve through DTTB, the most practical option for establishing DTTB Ulaanbaatar would seem to be to provide one or more shared SDTV multiplexes, and one or more shared HDTV multiplexes, or to mix both SDTV and HDTV within a multiplex. The allocation of a complete television channels to each broadcaster seems to have the potential to waste spectrum and also to limit the opportunities for innovative services and new licenses to be accommodated over time.

The development of a shared multiplex solution would ensure efficient use of spectrum, and licensing arrangements could be established so that those wishing to broadcast in HD were able to obtain suitable channels, perhaps at a different fee, then those using more limited resources may prefer SDTV channels. Provided there were some flexibility provided within the licensing framework, it should be possible for broadcasters to migrate from SDTV to HDTV over time in response to audience demand and technology.

Figure 5 illustrates a generalized configuration of Ulaanbaatar transmission facilities.

Figure 5: Ulaanbaatar transmitter configuration



Annex E: Draft framework for a tender document⁷

Statement of objectives and timetable

The Government of Mongolia has decided to migrate its analogue television services to digital transmission and cease analogue transmissions by 31 July 2014. As the first step of this transition, the government will fund replication of the core network of six standard definition services nationwide and hopes to increase the capacity of this network to ten standard definition services by way of digital transmission.

Budget has been approved for the first phase of this migration, which will establish signal encoding multiplexing, uplink services and will establish an initial number of transmitters. Nationwide distribution will be via dedicated satellite channel with the ensemble of nationally distributed services being assembled in Ulaanbaatar.

The target date for completion of the first stage is October 2011 (before the start of the Mongolian winter). The second stage funding is scheduled to be approved in the next financial year and implementation will proceed immediately that funding is approved.

The level of skill and knowledge in Mongolia about DTTB and its implementation is limited. To achieve this aggressive timetable and to reduce the implementation risk, the government has decided to establish a single contract with a competent systems integrator/DTTB systems design and implementing company who will advise the government on system configuration and design and supply, deliver, install and commission the transmitting facilities and all other parts of the broadcast chain from the encoder/multiplexer onward.

This tender covers the establishment of up to ten core free-to air services designated by the government/regulator to be carried on a single multiplex. The full migration of other services operating in Mongolia will be subject to separate arrangements to be determined shortly.

There are almost 400 sites to be equipped with DTTB transmission. Most serve very small population groups so the transmission design will need to be based on the lowest cost solutions. To that end, an indication of the available budget has been included in this tender and responses will be evaluated on the extent to which they provide best value for money and best achieve the objectives set to replicate the existing analogue television coverage with digital transmission.

A decision has been taken that the solution will be from the DVB-T family of standards and will need to use MPEG-4 encoding to provide the maximum possible number of SDTV services. While consideration has been given to the use of DVB-T2 there are concerns that this standard may make the system transmission and consumer receivers more costly and put at risk the achievement of the objective from the available budget. Tenders are required to make recommendations on the costs and benefits of approaches using DVB-T1 or DVB-T2 technology for this project.

The successful tender will be required to advise the government on the most cost effective approach to establishing multiplexing, uplink and satellite segments for this project and to assist in specifying and evaluating solutions that may require separate contracts (e.g. uplink, and space segment).

General description of services required

This tender seeks to engage a single contractor to take full responsibility for the design, supply, and installation and commissioning of the DTTB core DTTB network described in this tender.

⁷ This annex for a draft framework for a tender document is an outline draft prepared as guidance to the Mongolia Government concerning the process to seek tenders for the supply of the system. Because the specific details were not resolved at the time of the missions, nor was the tender formulation process agreed to by the various agencies at that time, the dates, capacities, sizes, etc. were left open for the Mongolia Government to incorporate as appropriate to the local tender rules and processes.

Details of current analogue infrastructure

Analogue terrestrial television broadcasting in Mongolia ranges from multiple private television licence holders in the capital Ulaanbaatar, through to small low power stations carrying only the six core government funded services in the smaller towns and villages (Soums). The provincial centres (Aimags) are larger and have higher power transmitters and some have locally generated services. Details about the different classes of station are provided in Appendix 1

The present tender is concerned only with the core network comprising the current six core services with the possible addition of four more services which are to be made available free of charge across the country, essentially replicating the current analogue arrangement for these core services.

The core analogue services are currently part of the package of services provided by D-Dish pay television operator who provides encoding multiplexing uplink and satellite capacity for carriage of the services using DVB-S/MPEG-2. The government pays for the services and satellite capacity and the services which include those of the national public broadcaster (MNB) are carried free of charge, and are available free of charge to any DTH viewer as well as viewers that receive them through terrestrial rebroadcast.

The core services are received at each rebroadcast site using domestic IRDs and the audio and video then passed through a PAL modulator and output on the selected channel frequency. The six modulator outputs are then combined and pass through a single linear amplifier. These are all UHF and radiate through a panel antenna typically about 18 m above average terrain. The majority of stations use a 50W linear amplifier to carry the six combined outputs, larger centres use 200W or 500W linear amplifiers as set out in Appendix 1. In some installations additional filtering has been installed to reduce interference to telecommunications/GSM services which typically operate from the same tower. The panel antennas installed have a rated capacity of [xxxx] W. The transmission equipment is generally located in a single rack. Some of these racks may have sufficient spare space for the DTTB equipment.

The central transmitting station in Ulaanbaatar has a [xxxx]m tower which provides [good coverage] of the city using an ERP of [5kW] on UHF, [Check with Network and/or CRC for specific details] and a typical UHF Analogue transmitter power input to the combiner of [xxx kW]. At present the UHF Antenna carries [x] services and has a rated input capacity of [xxkW]. The proposed DTTB signal for Ulaanbaatar will be assigned a frequency in the [UHF] Band adjacent to the existing UHF transmissions. The Mongolian TV channel plan is based on 8MHz channel spacing and Analogue assignments in Ulaanbaatar are based on a single channel separation between them. Therefore the DTTB service will need to operate with upper and lower adjacent analogue transmissions on the same antenna by way of a suitable channel combiner. This combiner will also need to be designed to allow expansion to cover additional DTTB channels to be added later up to the limit of power handling capacity of the antenna. Details of the current antenna are included in Appendix 1. [This assumes that the antenna is owned by Network Co and likewise the combiner. If it is privately owned then this will need to be said and an arrangement with the private broadcaster owner worked out to allow the use of the antenna and replacement of the combiner].

The DTTB network is expected to remain in operation for many years so the design of the transmission system must take into account any current analogue coverage problems and anticipated growth that may require wider coverage. The locations where this is a consideration for computation of DTTB ERP levels, are highlighted in Appendix 1.

Specific details about the digital service

The DTTB service to be established under this tender is required to replicate the analogue coverage (or extend it where so indicated in Appendix 1. At present the plan is to implement this in two stages the first for ensemble multiplexing, uplink, satellite to provide the programme feed, and for the establishment of the number of transmitters that can be practically acquired within the initial budget allocation, in accordance with the priority of installation set out in Appendix 2. The balance of stations will be established in Stage 2 once funding is approved for this stage.

A decision has been taken to adopt the DVB family of standards for terrestrial transmission but a final decision has not been made on whether to adopt DVB-T1 or DVB-T2. The answer depends on the relative

costs taking into account broadcast and consumer costs, as well as of the number of SDTV programmes that can be accommodated on a single transmission channel. The objective is to if possible carry a maximum of ten SDTV channels which may comprise satellite delivered core programmes (the current six plus perhaps some other), and any local input programmes.

Because MPEG-2 encoding will not provide sufficient programmes in the available 8MHz channels bandwidth an in principle decision has been taken that the system should be based on MPEG-4. Respondents should advise on whether they believe this is the best approach or provide alternative approaches.

Depending on decisions yet to be made about future services, one possibility would be that local input might use time within a national programme feed when this was not required so as to ensure maximum use of the capacity, or to accommodate part time services where there was not sufficient programme capacity within a multiplex ensemble.

Taking account of this need respondents to this tender should recommend whether MPEG bit stream processing to allow insertion or splicing of local input is more cost effective than the establishment of a separate local DTTB transmitter for local input.

Taking into consideration the poor quality of mains power at most locations consideration should be given to installing uninterruptable power supplies (UPS) to provide clean power to the IRD, multiplexer, and modulator equipment to reduce power related issues and provide system stability.

Redundant transmission systems should be provided for the larger centres starting from the Ulaanbaatar Central Transmitting Station, but will most likely not be practical for budget reasons in the smaller stations. Respondents should advise on the cost implications of transmitter redundancy and make appropriate recommendations.

The design of the multiplexing should provide for electronic programme guide (EPG) to be inserted . The design shall establish an EPG server and define the protocols and equipment broadcasters need to send EPG information to the EPG server. The cost of providing EPG should be shown in the response.

Respondents are required to provide advice on the cost and availability of consumer receivers that will work with the system. While HDTV is not included in the present project, HDTV transmission will be considered in later policy development. There is a preference for all consumer receivers to be able to receive HDTV programmes but for the output to be HDTV or SDTV depending on the capability of the display. This would mean that any broadcaster providing HDTV would be viewable on any receiver and would not require simulcast of a standard definition version. This should apply to both set top boxes and integrated receivers. Respondents are asked to provide information about any cost penalty for consumer receivers if the Mongolian Television Receiver Standard were to mandate HDTV decode capability.

The current arrangement of analogue distribution through D-Dish TV results in a monopoly supply of services. The government would like to be able to test the market for alternative competitive arrangements for satellite uplink and space segments for the DTTB service. Such arrangements would need to take account of the fact that existing satellite receive-only dishes at the transmitting stations currently point at the [APSTARxx] satellite located at [xxxx degrees]. The dish size(s) in use are identified in Appendix 2.

There is a provisional preference for the encoding and multiplexing equipment required for this initial rollout to be owned and operated by the Mongolian Government's network management and maintenance organization so as to perhaps provide greater freedom of choice of uplink arrangements.

Budget constraint

The nominal total budget available for this project has to be divided between:

1. Supply and installation of all terrestrial transmitters.
2. Supply and installation of multiplexing and encoding equipment (including EPG).
3. Associated design, delivery, commissioning, and training required under the contract.

4. Supply of an appropriate range of spares and test equipment.

[Separate budget arrangements will be made for the operational cost of the satellite [and if appropriate encoding and multiplex]]

Because overall cost is an important factor in the design of the systems and in the choice of equipment to support this requirement, respondents should build their proposals around a total budget of [zzz million Mongolian Tugrik xxx USD] for the total project should structure Stage 1 around a total budget not greater than [yyy million Tugrik USD xxx].

The Stage 1 installations should be completed and initial services operating no later than [30 October 2011]. The Mongolian Government expects that it would award a contract for the services [xxx weeks] after the closing date for tenders. Preference for installations to be completed in Stage 1 are listed in order in Appendix 2.

Orders for Stage 2 installation will be placed with the successful contractor shortly after financial approval is obtained [expected by xxxx date] and the target date for completion of Stage 2 (the balance of the installations) is [date or as shown in Appendix 2] subject to placement of orders not later than [xxxx months] before the target date.

Design

System recommendations and design should be based on optimal life-cycle cost capability and on receiver availability to achieve DTTB implementation at the lowest life-cycle cost to the Mongolian nation (i.e. government and consumers).

Once the systems design recommendations are accepted, the contractor will be required to prepare a complete receiver specification (the definition of relevant parameters necessary to define the national implementation of the DVB standard) for Mongolia, and a complete transmission specification. The Communications Regulatory Authority of Mongolia has responsibility to approve such specifications which are then sent to the national standards body for promulgation as a national standard.

In preparing the transmission specification the contractor will define all of the necessary variable elements such as guard interval, FEC rates, SI tables, logical channel numbers etc. to enable full implementation of the service, and shall advise the CRC on the management of this information into the future.

Role of integrator/supplier

The successful tenderer will provide the following services:

1. Recommendation and documentation of the transmission and receiver standard for DTTB in Mongolia based on the DVB family of standards (this includes country specific receiver characteristics, transmission operating parameters, service information, logical channel numbering, electronic programme guide and other parameters) as may be required to enable proper establishment and operation of the network, and the supply of fully functional receivers.
2. Liaise with the Communications Regulatory Commission of Mongolia on frequency assignments and final transmission specifications for each site.
3. Design of transmitter station solutions for the several classes of station required in different localities. The design should provide at least equivalent coverage to existing analogue transmissions from the same location and should where practical share antenna systems with the analogue service.
4. Design of multiplex and encoding systems including possible systems for insertion of local services in some locations. The design should provide the most cost effective way to provide this local service(s) and maintain some flexibility for later enhancement/modification of the arrangements.
5. Specify and assist the government with contracting for satellite uplink and space segment capacity.

6. Advise, specify and assist the government as appropriate with the optimal way to establish ensemble multiplexing (whether to be part of the government-owned network for the core services or whether this service might be better contracted separately in which case assistance would be required with contracting for the service. At this stage there is some preference for the multiplexing system to be owned and operated by the Mongolian National Radio and Television Network (the government agency which operates and maintains the network being migrated to digital under this project).
 7. Supply and install and commission all equipment need to deliver the solution. This will particularly be the case for Stage 1, but for Stage 2 installations, network operational staff may be able to assist if they have been adequately trained in Stage 1. Comments on this as a potential cost saving measure are required in the tender.
 8. Provide full technical maintenance and operating documentation for the system and all equipment.
 9. Provide training for technical support and operating personnel.
- Supply all necessary equipment needed to maintain the equipment (e.g. test equipment, jigs,).
11. Supply initial stock of operating and maintenance spares and recommendations on spares holdings and maintenance arrangements.
 12. Provide a minimum [twelve months] warranty on all equipment and software starting from the date the equipment is commissioned.

Requirement for tender response

1. Respondents are required to provide as a minimum the following information in their response to this tender. [A list of requirements for which a response is mandatory is Appendix 3 to this tender].
2. Proposals as to how objectives can be met within described budget or where this is not achieved what is the maximum benefit that can be achieved and recommendations about it to include:
 - a. Recommended system (DVB-T1or DVB-T2, MPEG2 or MPEG-4) and reasons for the recommendation, including information about receiver availability/cost.
 - b. Full specifications for the proposed equipment to be delivered under this project
 - c. Nominal digital ERP and transmitter output power proposed for each class of station and suggested transmitter/antenna configuration to accommodate DTTB with existing ATV
3. Detailed price breakdown for different classes of service (noting that there may be some adjustment for site specific elements in implementation (e.g. unsuitable antennas longer cable etc.). The tender should provide an overall price estimate with prices for specific components, and allowance for site adjustments and those things that can only be discovered in detailed design. The detailed price breakdown required is shown in Appendix 4.
4. Delivery schedule and ability to meet the required Stage 1 timetable and capability that can be delivered in Stage 1 including establishment of multiplex, satellite segment, and number of stations [suggest Ulaanbaatar, and some Aimag, plus a few Soum so as to have all aspects covered this should be in the priority list mentioned earlier to be include as Appendix 2 based on ICTPA /Government policy objectives.
5. Statement of previous experience with DTTB design and implementation and references.
6. Company profile and capability statement.
7. Expected terms of trade-payment arrangements, price validity, any indexation of prices for supply of equipment beyond the first order (e.g. if the order is 12 months time the price may have changed up or down and if you ask supplier to take the risk they will load the price)

Evaluation criteria

This tender seeks the provision of specified services against a nominated price ceiling. Responses will be evaluated against the level of capability offered, the suitability of the solutions to be provided within that limitation of funding, and the assessed capability and experience of the tenderer to deliver the required services.

General requirements for tenders

Insert standard purchasing requirements and terms of contract etc.

Closing Date for Submissions and place Submissions Must Be Lodged

[Insert date and point of delivery etc. and form of submission – i.e. electronic, numbers of hard copies etc.]

Appendices

1. Details of Existing Analogue TV Installations.
2. Required Digital Stations Implementation Priority and Frequencies.
3. Items for Responses to the Tender Must Be Provided.
4. Detailed Price Breakdown Required.
5. Standard Contract Conditions.

DETAILS OF EXISTING ANALOGUE TV INSTALLATIONS

Should include as a minimum:

1. List of all stations with power levels and frequency and antenna specifications and details of any local input arrangements.
2. Current linear amplifier specification, and antenna specifications, satellite antenna size and details and specs of any filters, etc. between PA and the antenna, plus feeder information, size type and age.
3. Details of any current analogue TV coverage issues, or places where you think that the coverage needs to be greater (e.g. expanding Ulaanbaatar etc.).
4. For UB need to supply comprehensive information about site, antenna specification (UHF if the DTTB is on UHF) details of all ATV stations sharing the antenna, power limits on the antenna, and details about current combiner, filters etc. in the RF side of the transmitter/antenna network.

REQUIRED DIGITAL STATIONS IMPLEMENTATION PRIORITY AND FREQUENCIES

1. Full list of stations in order of priority for implementation (perhaps population served approximately) and identify Stage 1 priorities and Stage 2 separately. Expect that for Stage 1 representative installation of each type from UB to small station may be required.
2. List those places where local input is desired and number of local channels immediately needed and perhaps may be needed later (keep total below ten for preference at this point).
3. List frequencies nominated for each station if available.
4. Ask respondent to indicate the proposed DTTB ERP for each location.
5. Add anything else you would like to provide

ITEMS FOR RESPONSES TO THE TENDER MUST BE PROVIDED

Need to produce a table for this to serve as a check list for the respondent to ensure they include as a minimum the answers we want.

The information against each item should be referenced in the response against each item shown.

No	Details	Reference to where this information is to be found in Tender Response
1	Detailed description of proposed system standards and recommendations.	
2.	Detailed description of how the capital costs have been allocated across the different parts of the system: Encode/Multiplex, Uplink, Aimag, Soum transmitters and any trade-off with the transmitter system design such as transmitter power versus antenna gain, additional antenna versus combiner etc.	
3.	Comments on any limitations on the services imposed by budget constraint or technical constraints/cost.	
4	Detailed description and proposed specification for the Transmitter stations and their source of supply for the stations listed as priority for Stage 1: Aimag Soum [UB – suggest we leave out of Stage 1 and do in Stage 2 once private broadcaster arrangements resolved] The description required in the tender is a general description of each class of service currently covered by ATV: e.g. 50W 6 channel ATV, 200W 6 channel ATV. The description should indicate the proposed transmitter power antenna and combining arrangement.	
5	Detailed description and proposed specification for Encoding and Multiplexing system including SI and EPG server	
6	Detailed description of the most cost effective arrangement to permit local program input to the MPEG stream at Aimag where local input is required.	
7	General proposals and recommendations concerning satellite up-link and space segment.	
8	Proposed delivery and installation plan against the requested timetable.	
9	Proposed arrangement for providing warranty support and recommendations on longer term support of the equipment within Mongolia	
10	Recommendations on numbers of spare equipment and spare parts and test equipment needed to support the maintenance and operation of the network and equipment.	

11	Training proposal for training of Mongolian instructors.	
12	Detailed description of company experience in design and supply installation and commissioning of DTTB networks.	
13	Company profile and financial capability.	
14	Company client references that can conform DTTB experience and expertise.	
15	Basis upon which the labour/consultancy costs have been established covering the aspects of design, purchasing, configuration, installation etc.	
16	Terms of trade and basis upon which any price variation will be established for subsequent purchases of equipment/expertise beyond Stage 1.	
17	Identification of which prices with the tender are fixed prices and which are variable and if they are variable why and on what basis will pricing will be established. In principle, the government requires fixed pricing, but where there are variable elements pending detailed discussion, then these would need to be turned into fixed prices at the point of order placement.	
18	Details of satellite capacity required for the system and any suggestions about how this should be acquired.	
19	Proposals as to the most cost effective solutions for the provision of multiplex, uplink and space segment, including any proposals for purchase of equipment for independent uplink if that is practical and affordable [in principle there is a preference for the multiplex to be owned and managed independent of any uplink provider].	
20	Details of how support will be provided during the warranty period and any options proposed for this.	

DETAILED PRICE BREAKDOWN REQUIRED

Need to make a list of what prices we should get to properly evaluate the offer and to lock in prices for

Ref	Details	Unit Price	Number required for Stage 1	Total Price
1	Cost breakdown of the engineering design, management services involved in delivery of the contract services			
2	Detailed price breakdown for each transmitter type including IRD, modulator/transmitter, combiner/filter, and any proposed antenna system components, e.g. feeder, connectors, antennas; UPS, racks and path panels as may be required.	Equipment should be individually listed and shown in price breakdown		
3	Detailed price breakdown for all of the equipment making up the network encoding system and multiplexer including SI/EPG server and any associated equipment such as UPS, racks, etc.			
4	Estimated cost of any uplink equipment proposed (price breakdown) if independent uplink is suggested in your proposal.			
5	Detailed price breakdown for local input equipment proposed to allow insertion of local programmes in Aimag.			
6	Proposed arrangement for providing warranty support and recommendations on longer term support of the equipment within Mongolia.			
7	Recommendations on numbers of spare equipment and spare parts and test equipment needed to support the maintenance and operation of the network and equipment.			
8	Detailed price breakdown for the costs of transport, and installation of the transmitters, multiplex and other equipment as may be required including system testing and commissioning and proof of performance. Including any incidental costs such as accommodation for installation staff.			
9	Price for comprehensive demonstration testing and proof of performance of first of type equipment installation for each type of installation (assume the installation will be a permanent installation at its final site).			
10	Price for production and supply of full drawings and other documentation for each system and facility including supply of equipment manuals, based on one set of relevant manuals for each			

	site – this may be adjusted later once final maintenance arrangements etc. are determined so please show unit cost for each type of documentation package.			
11	Price per training course for training a. Instructors, b. Engineers/technicians, c. Operators as may be necessary, including breakdown of instructor cost, and training materials and any other costs.			
12	Price basis for assisting with definition/tender of satellite uplink and or multiplex and satellite capacity, if required.			
13	Indicative cost estimate of the cost of space segment for carriage of the DTTB signal, and where available, estimates of uplink costs.			
14	Detailed price breakdown for supply of spare modules/equipment/test equipment and spare parts as recommended.			
15	Detailed price breakdown of any costs associated with providing 12 month warranty support for the systems and equipment supplied.			
16	ANY OTHER COSTS NOT OTHERWISE COVERED to be added here			

Annex F: Indicative Costs of DTTB Migration for Mongolia (USD)

Quantity	Description	Unit Cost Range		Total Cost Range		Total Cost Range	
		Low	High	Low	High	Low	High
	<i>Main Head End for Contribution over Satellite (Including Modulator DVB-S)</i>					241,200	402,000
12	Encoding for 10 Channels + Spare including licences	9,600.00	16,000	120,600	201,000		
	<i>Multiplexing for DVB-S and EPG Insertion</i>						
2	MPEG Stream Processor/Multiplexer x 2 (redundancy)	17,400.00	29,000	34,800	58,000		
1	EPG Generator	18,000.00	30,000	18,000	30,000		
1	Automatic Redundancy Switcher	6,000.00	10,000	6,000	10,000		
1	Management and Redundancy Controller	44,400.00	74,000	44,400	74,000		
2	<i>DVB-S Modulator for Up-Link if Required (Redundant)</i>	15,600.00	26,000	15,600	26,000		
1	<i>UPS Unit for Multiplex and Modulator</i>	2,000.00	3,000	1,800	3,000		
21	<i>Aimag Centre Head End with Insertion Capacity for 2 Channels</i>					2,440,620	4,067,700
63	MPEG Encoder x3 (1 spare and 2 Operational) with licences	9,600.00	16,000	604,800	1,008,000		
42	Stream Processor/multiplexer/Splicer (1+Spare)	14,400.00	24,000	604,800	1,008,000		
21	Automatic Change Over Switcher	6,000.00	10,000	126,000	210,000		
21	Monitoring and Redundancy Control System	38,400.00	64,000	806,400	1,344,000		
21	DVB-S Professional IRD	2,000.00	3,000	37,800	63,000		
21	20W Transmitter and Modulator (Not Redundant)	10,200.00	17,000	214,200	357,000		
	For redundant transmitter with auto switching would need to go to around 300W at unit cost of around USD 36,000						
21	Transmitter Filter Unit 20W	720.00	1,200	15,120	25,200		
21	Combiner	1,500.00	2,500	31,500	52,500		
	<i>Soum Head End</i>					4,645,080	7,741,800

Quantity	Description	Unit Cost Range		Total Cost Range		Total Cost Range	
		Low	High	Low	High	Low	High
374	DVB-S Professional IRD	1,800.00	3,000	673,200	1,122,000		
374	10W Transmitter and Modulator (Not Redundant)	7,000.00	14,000	3,141,600	5,236,000		
	For redundant transmitter with auto switching would need to go to around 300W at unit cost of around USD 36,000						
374	Transmitter Filter Unit 20W	1,000.00	1,200	269,280	448,800		
374	Combiner	2,000.00	2,500	561,000	935,000		
	Total Aimag and Soum Plus Uplink Hardware					7,326,900	12,211,500
	Miscellaneous Installation Materials and Installation Costs including UPS units @ 15% of total hardware costs					1,099,035.00	1,835,368
	Design and Training and Documentation etc @ 20% of Hardware Cost					1,465,380.00	2,447,158
	Estimated Total Aimag, Soum and Uplink					9,891,315	16,494,026
	Ulaanbaatar Installation One DVB Transmitter (Fully Redundant)						
1	1-2 kW Redundant drive transmitter			50,000	60,000		
1	UHF RF Filter			3000	4000		
1	Multi-Channel Combiner for Adjacent Channel Operation Would support several adjacent channel services with ATV/DTTB			50,000	60,000		
1	Control and Monitoring			20000	25000		
2	MPEG Multiplex Inputs/Redundant			5,000	6,000		
						128,000	155,000
	Design and Implementation including Training and Documentation @ 25%					32000	38750
	Total for one combined DTTB Transmission at UB					160,000	193,750

Annex G: Work Plan for DTTB Implementation in Mongolia

DIGITAL TELEVISION MIGRATION ACTION PLAN				
Line Ref		Action	Information	Status
1	Policy and Regulation	Decision to Migrate	Legislation Passed	
2		Closure Date for Analogue	30 June 2014 has been mandated	
3				
4				
5		Number of Services	10+	
6		Type of Services (HD/SD/Data etc)	SD initially	
7		Define Core Services - National Coverage (if same or different to current 6)	6+ at least 4 new	
8		Delivery Mode: Shared or Own Multiplex	Shared	
9		Licence Fee arrangement for DTV (Content/multiplex/transmission)		
10		Access to HDTV transmission capacity	TBD	
11		Other Core Services (Local/Regional) how and when to implement	TBD	
12		New Services/licences in Transition Period	TBD/Suggest Digital Only	
13		Coverage expected of different licence classes	at least = analogue	
14		What licence fee will apply to existing services in simulcast period	TBD	
15		Simulcast Requirements	TBD - min 18 mths	
16		Commencement of Services (Earliest and Latest dates etc)	ASAP	
17		Closure of Analogue Considerations	TBD	
18		Closure Date Determination	30-Jun-14	
19		What will happen to Analogue Channel after switch off	TBD	
20		Digital Dividend Expectation (to be taken into account in planning)	Upper UHF	
21		Decisions about Replanning spectrum-assignment of frequencies timing etc	TBD	
22		Local input expectation/requirement in Aimag/UB for DTV	Yes	
23		Timing of implementation of local input	TBD	
24		Electronic Program Guide (Minimum Requirements)	Yes	
25				
26	Access Policy and Arrangements	Shared Transmission Sites	Mandate	
27		Shared Multiplex	Yes	
28		Shared Distribution (Satellite)	Yes	
29		Arbitration/Dispute Resolution Process	TBD	
30		Who may obtain licences	TBD	
31		Ownership and Control Provisions	TBD	
32				
33		Access to HDTV Transmission		
34		As new/additional service	TBD	
35		For transmission of existing service	TBD	
36	Technical Planning and Construction Rules	Availability of HD content to all viewers	not in initial stage	
37		Transition from SD to HD (if applicable) for license holders	TBD	
38		Compression Standard (MPEG2/MPEG4)	MPEG-4/DVB-T2	
39		Minimum Bit Rate Allocation for different types of channel (SD, HD, Sound, EPG, SI)	around 2Mb/s TBD	
40		Statistical Multiplexing	Yes essential	
41		Sound Standard (Multi-Channel, Surround, Multi-Language Support)	TBD	
42		Captioning	Yes	
43				
44		General Standards and Basic Requirements	TBD	
45		HD Reception Capability	Yes	
46	Laws and Regulations	Definition of National System Information Parameters	TBD	
47		Consultation with Suppliers on Standards	TBD	
48		Submission of Standards for National Approval	TBD	
49		Co-Siting Requirements	Yes	
50		Transmission Technical Performance Requirements	TBD	
51		Minimum Performance Requirements	TBD	
52		Transitional Performance Requirements (if reduced power required to minimize ATV interference)	TBD	
53		Interference Management Regime	TBD	
54		Testing and Commissioning	TBD	
55				
56	Coverage Requirements	Transitional	TBD if necessary	
57		Final if initial coverage is constrained by ATV interference etc	TBD if necessary	
58				
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DIGITAL TELEVISION MIGRATION ACTION PLAN				
<div> <div></div> <div></div> <div></div> </div>				
Line	Tasks	Action or Decision Required	Information	Status
1	<div> <div>Technical Planning</div> <div>Transition Planning</div> </div>	Identify any issues to be addressed in planning (eg improved coverage over ATV etc)	TBD	
2		Frequency Assignment Rules - Including provision for Digital Dividend	Ongoing	
3		Coverage Requirements for Planning Purposes and assumptions about translators	TBD	
4		Assignment Principles for DTV channels	Adjacent Analogue except Regional where 2 removed preferred	
5		Assignment Assumptions and Requirements such as co-siting of DTV/ATV	Yes	
6		Minimum Field Strength Requirement for Planning (assumptions about antennas etc)	Per ITU Recommendations	
7		General provision for required number of frequencies to deliver specified DTV channels	TBD	
8		Document assumptions about multiplexes etc	TBD	
9				
10		Determine Current ATV arrangements and infrastructure		
11		Determine number of frequencies required including translators if necessary		
12		Specific Frequency Allotments for all markets (UB, Aimag, Soum)	TBD	
13		Interference Protection Assessment	TBD	
14		Maximum ERP specification for each area and proforma specifications	TBD	
15				
16				
17				
18				
19				
20		Issue Stage 1 Licences		
21		Stage 2 Final Frequency Assignments (for all stations to Migrate)		
22		Frequency Assignment for new DTV Services		
23		Multiplex Channel Assignments/If applicable		
24		Allocation of Logical Channel Numbers to Services (essential Service Information)		
25		Issue Stage 2 Licences		
26		Issue Other Licences		

DIGITAL TELEVISION MIGRATION ACTION PLAN				
<div> <div></div> <div></div> <div></div> </div>				
Line	Tasks	Action or Decision Required	Information	Status
1	<div> <div>Implementation</div> </div>	Determination of Sites to be Implemented and sequence	Depends on Budget and Tender	
2		Determine Receiver Supply Requirements for Stage 1 (eg will any demonstration or other receivers be procured)	Tender	
3		Confirm site requirements for nominated sites (eg feeder lengths, current service specifications etc)	for Tender/Contractor	
4		Establish requirements and timetable (will commencement be progressive)	TBD	
5		Tender Specifications		
6		Proposals from Suppliers		
7		Evaluation of Proposals		
8		Award Contracts		
9		Equipment Delivery		
10		Installation		
11		Testing Stage 1		
12		Commissioning		
13		Training of Personnel		
14				
15		Determine how Multiplex to be managed	Network Co	
16		Tender Specification		
17		Proposals from Providers		
18		Evaluation of Proposals		
19		Confirm Funding against Proposals		
20		Adjust Requirements to Budget if necessary		
21		Award Contracts		
22		Equipment Delivery		
23		Installation		
24		Establish links to Broadcaster and Uplink		
25		Commissioning		
26		Training of Personnel (if Required)		
27		Performance and Coverage Assessment		
28				
29		Requirement Specification and Operational Performance Requirements		
30		Proposal from Provider		
31		Award Contract		
32		Establish Service from Satellite		
33				
34				
35		Determination of Sites to be Implemented and sequence		
36		Establish requirements and timetable (will commencement be progressive)		
37		Confirm site requirements for nominated sites (eg feeder lengths, current service specifications etc)		
38		Specifications for Equipment		
39		Review with Supplier		
40		Confirm Funding and adjust requirement phasing if necessary		
41		Order from supplier		
42		Equipment Delivery		
43		Installation		
44		Testing Stage 1		
45		Commissioning		
46		Performance and Coverage Assessment		
47		Determine if any changes needed and progress as required to implement		
48		ATV Services Terminate		
49		Recover ATV Equipment		
50		Cancel ATV Licences		
51				
52		Receive applications		
53		Review applications and assign frequencies and specifications		
54		Determine Commencement Dates		
55		Issue Licences/Permits		
56		Obtain Access/Construction Approvals as required		
57		Facility Construction		
58		Testing and Commissioning		
59		Commencement Approval		
60		Services Commence		
61		ATV Services Terminate		
62		Cancel ATV Licences		

DIGITAL TELEVISION MIGRATION ACTION PLAN				
Determined may need to be documented				
Substantially determined				
To be undertaken				
Line	Tasks	Action or Decision Required	Information	Status
1	Analogue Switch Off (ASO)	Establish ASO Organization		
2				
3				
4				
5				
6		Determine ASO Strategy and Sequence		
7		Communication Campaign	Broadcasters	
8			Suppliers	
9			Consumers	
10			Other	
11		Implement Communication Plan		
12		Monitor and Report on Implementation against Timetable		
13		Intervene as necessary to address delays/issues in roll-out		
14		Assess Consumer Digital Take-up		
15		Review Strategy in light of Take-up		
16		Decide if assistance program required		
17		Obtain approval/funding for assistance		
18		Implement Assistance program		
19		Oversight switch off arrangement		



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