ETHIOPIA

Roadmap for the transition FROM ANALOGUE TO DIGITAL TERRESTRIAL TELEVISION IN ETHIOPIA

Assessment Report

APRIL 2012
Telecommunication Development Sector

Roadmap for the transition from analogue to digital terrestrial television in Ethiopia

Report

April 2012

This report has been prepared by ITU experts Mr Peter Walop, Mr Gu-Yean Hwang and Mr Jan Doeven. The ITU would like to thank to the Angola National Roadmap Team, the active support of the Ministry of Telecommunications and Information Technology (MTTI) and of the Korea Communications Commission (KCC) in facilitating the work of the ITU experts.

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Executive Summary

The roadmap for transition from analogue to digital television in Ethiopia has been prepared by the National Roadmap Team (NRT) and ITU experts from December 2010 to September 2011.

The main observations and conclusions of the roadmap are summarized below.

Scope of the roadmap

The roadmap for transition from analogue to digital television in Ethiopia covers the short term digital switch-over (DSO) objectives (until about one year after analogue TV switch-off, see also Table 1) and the activities managed by the National Roadmap Team. The roadmap does not include:

1. The introduction of Mobile TV, because Ethiopia does not foresee MTV services in the short term, because:
   - DTTB services have priority, taken into account the provisions of the GE06 Agreement;
   - Market developments in Africa and other parts of the world will be observed before taking decisions on MTV standards, services and frequency spectrum assignments.
2. The introduction of digital radio.

The Ethiopia television market is mainly a terrestrial TV market with ETV (public broadcaster) as the main player. The estimated number of TV viewers is 20.3 million, about a quarter of the population. In addition to analogue terrestrial TV, a free-to-air digital satellite TV service is provided by Arabsat with an estimated 1 million viewers. Pay-tv services are offered by broadcasting satellite provider DSTV with an estimated 10 000 subscribers.

The aim of the roadmap is to indicate how to facilitate the digital switch-over (DSO) objectives. The DSO objectives are divided in short term (about 1 year after analogue switch-off) and long term (5 to 10 years after analogue switch-off) objectives. The objectives are shown in the Table 1.

Table 1: DSO objectives

Objective	Short term (1 year after ASO)	Long term (5-10 years after ASO)
More channels	• 4 national PSB services • 11 regional PSB services • 8-12 commercial pay-tv services (Bridgetech) in Addis Ababa	• > 8-12 commercial pay-tv services, coverage extension to larger part of country • Number of commercial national services • Spectrum available to facilitate community TV; options to be investigated.
Lower costs	• One multiplex transmitted by the 54 ETV UHF transmitters, plus a number of additional transmitters (as far as needed)	
Smooth transition to DTTB	• Min. DTTB coverage = Any current analogue TV coverage • Areas served by analogue TV in VHF: simulcasting for maximum three years • Currently non-served areas: not yet decided • Viewer compensation: not yet decided • Phased switch-off however the exact phases not decided yet	

Objective	Short term (1 year after ASO)	Long term (5-10 years after ASO)
Regional and local networks	• ETV national • Regional services in respective regions or distributed nationally, depending on costs	
Coverage extension to 80 per cent geographical coverage	By means of 26 additional sites (on top of the 28 already installed) and some gap fillers	
End of transition	June 2015	
Better picture quality	At least as good as analogue TV under good reception conditions	
MTV services		Possibly one multiplex, or embedded in DTTB transmission (if DTTB standard allows)

The National Roadmap Team aims to launch DTTB in 2012 and to have switched off all analogue terrestrial television services by June 2015.

The scope of the activities involved in the roadmap depends on the licensing model that will be adopted. In the digital television value chain a new entity needs to be established: the multiplex operator. The multiplex operator combines the programme streams of the broadcasters into transport streams to be distributed to the transmitters. The tasks of the multiplex operator together with the tasks of the transmitter network operator can be assigned to each individual broadcaster (licensing model A) or to a common multiplex and network operator (licensing model B).

The Government of Ethiopia considers the adoption of model B and to establish a new company for the common multiplex and network operations of the public services. In this case, it is best to combine both the television *and* radio network activities into the common multiplex and network operator. From a point of view of having the lowest operational costs and the best digital network design, it is advisable to include the network activities and assets from the regional public service broadcasters (PSBs) into the common multiplex and network operator.

The roadmap consists of four phases:

- Phase 1: DTTB policy development;
- Phase 2: Analogue switch-off planning;
- Phase 3: DTTB regulation;
- Phase 4: DTTB implementation.

Input and output documents of the phases of the roadmap are summarized in the Table 2.

The decisions taken, partly taken and not yet taken on the key topics and choices regarding phases 1 to 4 of the roadmap and the activities required to prepare the decisions that are still pending, are indicated in Annexes 1 to 4.

The NRT will soon take a decision on the DTTB transmission standard, being either DTMB or DVB-T2. The choice is between a first generation standard (DTMB) and a second generation standard (DVB-T2). The second generation DTTB standards have considerably improved technical features compared to first generation standards (see Section 4.1 and Annex 5). The choice of transmission standard will have a major impact on the DSO objectives and on the costs of the network.

Table 2: Input and output documents of the phases of the roadmap for licensing model B

Roadmap phase	Input documents	Output documents
1. DTTB policy development	• International agreements • National telecommunication, broadcasting and media acts • Existing policy documents and objectives	• Digital terrestrial television broadcasting policy
2. Analogue switch-off planning	• Digital terrestrial television broadcasting policy	• Initial frequency plan • Analogue switch-off plan
3. DTTB regulation	• Digital terrestrial television broadcasting policy • Analogue switch-off plan	• National coordinated frequency plan • International coordinated frequency plan • Licence terms and conditions • Licensing procedure and planning
4. DTTB implementation	• International coordinated frequency plan • Licensing procedure and planning	• DTTB implementation plan • Detailed coverage presentations • Notification at EBA • Order to put DTTB site into operation • DTTB station approval by EBA • DTTB station recorded in ITU Master International Frequency Register

Recommendations

The NRT is recommended to carry out the following steps for a smooth transition to digital television broadcasting and analogue services switch-off:

1. Seek approval of the roadmap report at either ministerial level and/or political level.
2. After approval, acquire a mandate to plan and manage the analogue switch-over (ASO) process in accordance to with the phases of the roadmap. As indicated in the roadmap report, this mandate may come in stages.
3. After being mandated, prepare and take the following decisions as the first of the roadmap as these decisions are needed to determine the scope and duration of the roadmap planning:
   - determine ASO date and the date of the first DTTB transmissions;
   - stipulate the transmission standard (DVB-T2 or DTMB) and decide whether a mandatory Conditional Access System (CAS) is necessary (either in the case of ETV having pay-tv services or applying CAS for collecting television licence fees);
   - finalize licensing model, to include also (if decided to have an independent multiplex/network operator):
     - decision on which activities/assets to separate: this is to say the ETV radio activities as well as the network activities of the regional PSBs;
     - a model for assigning broadcast licences (and hence the bandwidth management/assigning slots), in particular for the common multiplex and network operator;
     - ONP rules for the common multiplex/network operator;
   - finalize and agree the DSO objectives (see Table 1 above) and determine the customer proposition (see Section 4.8);
   - if decided to have a network partner/supplier, determine the procedure and licence to be awarded to a network operator partner and/or supplier;

4. Form a project management office (PMO) and start drafting an initial detailed ASO planning and determine the progress reporting procedures and structures.
5. Start preparations for separating ETV (and possibly regional PSBs) network assets and establishing the common multiplex/network operator.

Apart from these steps, some additional recommendations can be provided which seem to be evident for the situation in Ethiopia:

1. Have market research carried out covering the key elements as indicated in this roadmap report (see phase 1). As indicated some key research data should be collected, including data on the current analogue viewers and the ability/willingness to pay for STBs.
2. Carry out detailed frequency and service planning (see phase 2 and 3). Extensive and profound frequency planning will be required to see what is possible, especially considering the minimum requirement to cover at least the existing analogue television coverage (including the regional PSBs).
3. Reserve capacity for future MTV services. Without such a capacity reservation it will be difficult (or even impossible) to introduce these services at a later date or only against very high costs.
4. Investigate the possibilities of auctioning Mobile (IMT/LTE) spectrum as an important mean for financing the ASO process. This also includes the investigation of the possibilities of advancing the ASO costs as the proceeds of the auction will become available after ASO.

1. Introduction

ITU has published guidelines for the transition from analogue to digital broadcasting[1]. The ITU Guidelines provide assistance to member countries to smoothly migrate from analogue to digital broadcasting. In a further effort to help countries to switch over to digital broadcasting ITU has selected countries to help them drafting a national roadmap for this digital switch-over (DSO) process. Ethiopia is one of the beneficiary countries for further assistance.

The roadmap for transition from analogue to digital terrestrial television in Ethiopia has been jointly developed by a team of ITU experts consisting of Peter Walop and Jan Doeven and the National Roadmap Team (NRT). The NRT is chaired by H.E. Dr. Debre Tsion Gebre-Michael, Minister of Communication and Information Technology. The NRT consists of representatives from the following organisations:

- Ethiopian Broadcasting Authority (EBA);
- Government Affairs Office;
- Ministry of Communication and Information Technology;
- Ministry of Finance;
- Information Network Security Authority;
- Ethiopian Radio and Television Agency (national PSB).

In addition to representatives from the above mentioned organizations, also representatives of regional public broadcasting organizations and Bridgetech (licence holder of DTTB pay-tv services) attended the meetings with the ITU experts.

The ITU assistance to Ethiopia consisted of four key activities:

1. Preparation and first country visit to collect information.
2. Drafting of the roadmap report.
3. Second country visit to present and discuss the draft roadmap report.
4. Drafting final roadmap report.

The experts who prepared the guidelines for the transition to digital broadcasting visited Ethiopia from the 30 November to 9 December 2010 and from 14 to 20 of September 2011. The meetings were also attended by ITU project coordinator Mrs Mihret Woodmatas.

During the first visit the experts together with the National Roadmap Team (NRT) prepared:

- an analysis of the TV market and regulatory situation;
- an overview of short term and long term digital switch-over objectives;
- an inventory of decisions (partly) taken regarding key objectives and choices with respect to the functional building blocks in scope.

After the first visit the ITU experts prepared a draft roadmap report. During the second visit the draft report and contributions made by the NRT were discussed and evaluated, resulting in an agreed list of changes leading to this report.

[1] The ITU Guidelines for transition from analogue to digital broadcasting – www.itu.int/publ/D-HDB-GUIDELINES.01-2010/en. In this report referred to as the ITU Guidelines.

In the following sections, first the current situation and digital switch-over (DSO) objectives will be addressed (Section 2). Section 3 shows the national roadmap for achieving the DSO objectives. Section 4 gives considerations regarding the top-ten key topics and choices.

Annexes 1 to 4 show in detail the decisions taken, partly taken and not yet taken on the key topic and choices regarding the DSO process in Ethiopia. Also the activities required to prepare the decisions that are still pending, are indicated.

Information regarding DTTB transmission standards is given in the Annex 5.

2. Current TV market and DSO objectives

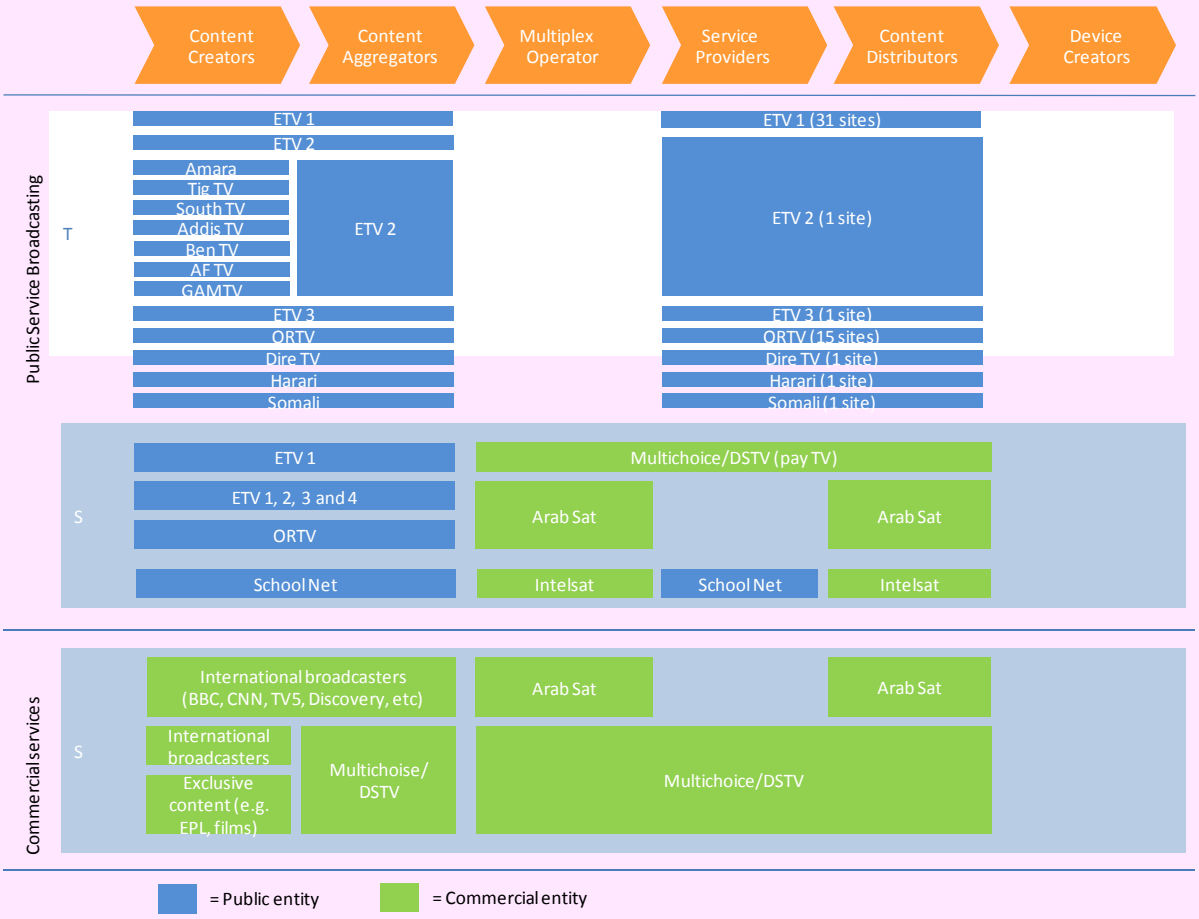
Before addressing the Ethiopia roadmap for the transition from analogue to digital terrestrial broadcasting, the current TV market and regulatory situation are described in Sections 2.1 and 2.2.

The aim of the roadmap is indicated by the DSO objectives, as described in Section 2.3.

2.1 Market structure

The Ethiopian television market structure is shown in Figure 2.1.

Figure 2.1: Ethiopian TV market structure



Source: Adapted from NRT data

The dominant platform is the analogue TV platform with an estimated 20.3 million viewers of the national ETV service. Regional public services have a share of 5 to 50 per cent (of television set owners). A number of regional broadcasters, currently broadcasting via the ETV2 service, will soon operate their own TV transmitter.

An indication of the current national and regional services is given in Table 2.1. Figure 2.2 shows a map of the regions in Ethiopia. Figure 2.3 gives an indication of the services areas.

Table 2.1: Current national and regional services and the numbers of sites

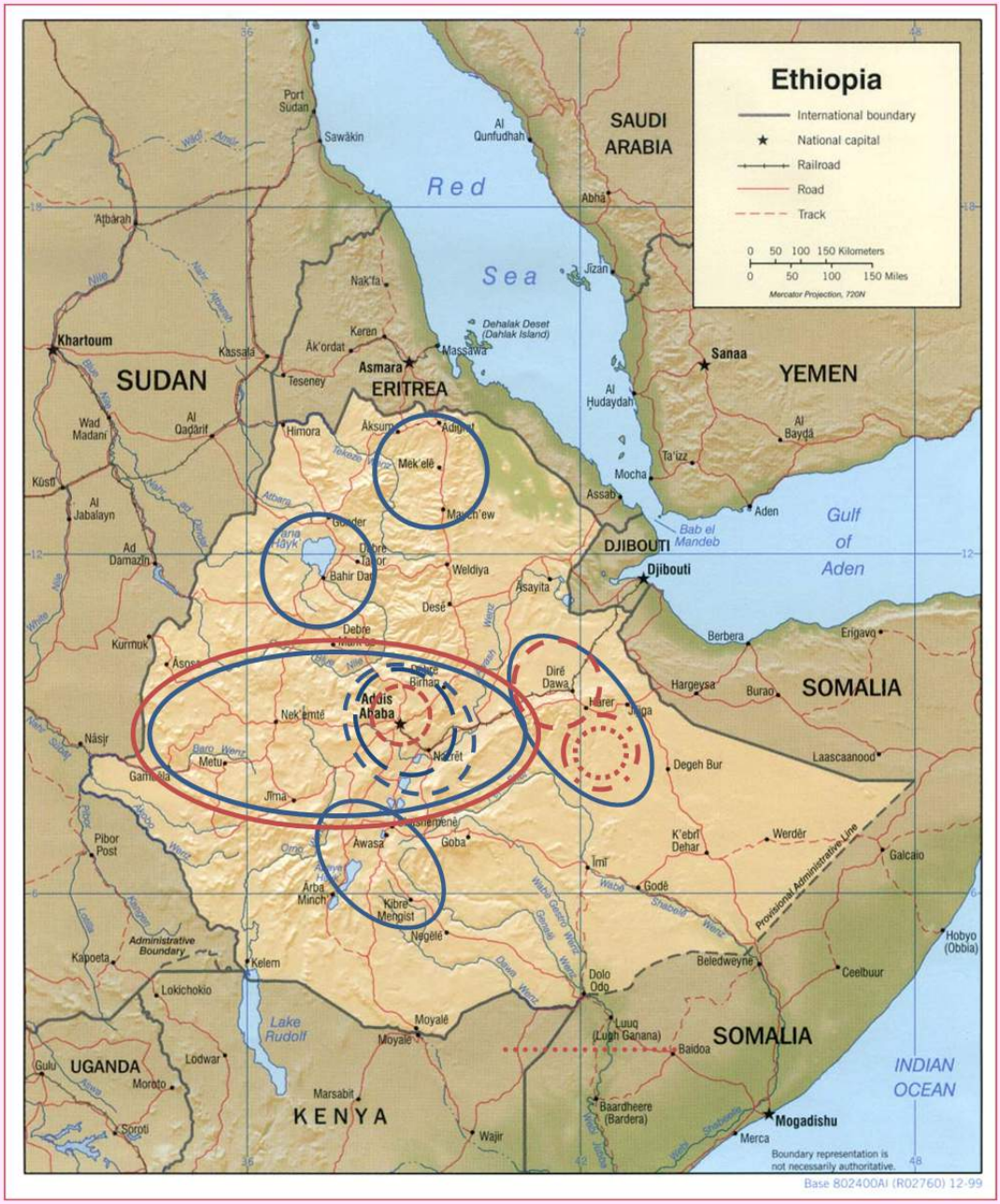
Broadcaster	National/ Regional (see Figure 2.2)	Number of sites	Band	Indication of coverage area (see Figure 2.3)
ETV1	National	31	VHF	
ETV2	National	1	VHF	
ETV3	National	1	UHF	
ETV4	National	–		No analogue TV coverage
Addis TV	Region 1	1	UHF	not yet operational
AF TV	Region 2	–		Part of ETV2 service
Amara TV	Region 3	–		Part of ETV2 service
Ben TV	Region 4	–		Part of ETV2 service
Dire TV	Region 5	1	VHF	
GAM TV	Region 6	–		Part of ETV2 service
Harari TV	Region 7	1	UHF	
ORTV	Region 8	15	VHF	
Somali TV	Region 9	1	UHF	
South TV	Region 10	–		Part of ETV2 service
Tig TV	Region 11	–		Part of ETV2 service

Figure 2.2: Regions in Ethiopia

1. Addis Ababa
2. Afar
3. Amhara
4. Benishangu-Gumuz
5. Dire Dawa
6. Gambela
7. Harari
8. Oromia
9. Somali
10. Southern Nations, Nationalities, and People's Region
11. Tigray

Source: Wikipedia

Figure 2.3: Indication of current national (blue lines) and regional (red lines) coverage areas



Source: Adapted from NRT data / Wikipedia

ETV ordered 54 new UHF TV transmitting stations of which 28 have already been installed at existing sites. It is expected that the remaining 26 will come into operation in the first part of 2012. With the additional 26 transmitter sites analogue TV coverage will be extended from about 40 to 80 per cent geographical coverage.

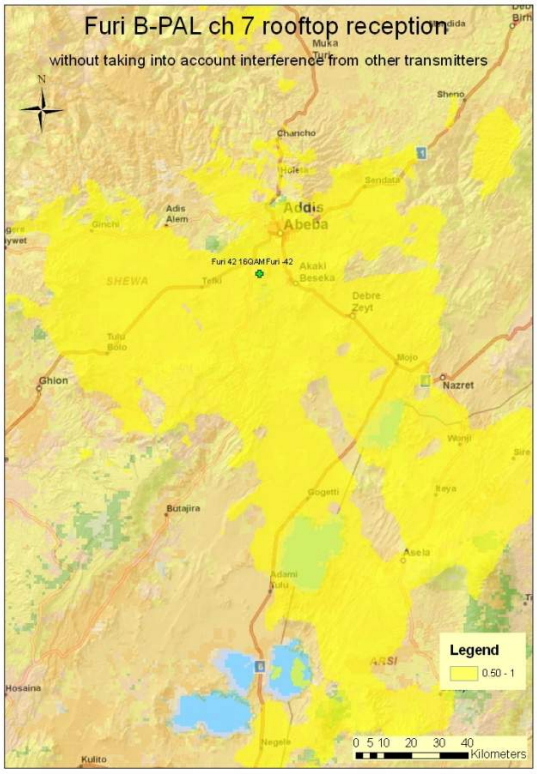
The main TV transmitting station is located at Mount Furi; coverage includes the 3.4 million inhabitants of Addis Ababa (see also Section 4.10 below). At the Mount Furi site three TV transmitters are in operation:

1. VHF, B/PAL, estimated ERP 25 kW, transmitting the ETV1 service;
2. VHF, B/PAL, estimated ERP 25 kW, transmitting the ETV2 service;

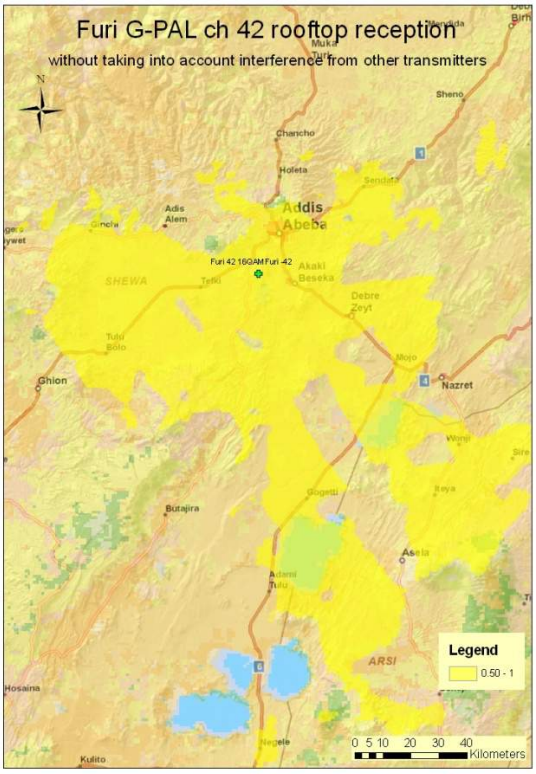
3. UHF, G/PAL, estimated ERP 10 kW, temporally transmitting the ETV3 service.

The analogue TV coverage areas of the VHF and UHF transmission from Mount Furi are shown in Figure 2.4[2].

Figure 2.4: Coverage of B-PAL (ch 7) and G-PAL (ch 42) with rooftop reception



20969 km²



14370 km²

Source: Giraplan (made available by courtesy of Progira Communications)

Currently there are no digital terrestrial TV services on air. However, the 54 UHF TV transmitting stations are also able to transmit in the DVB-T standard. One commercial digital television service provider (Bridgetech) has been granted a licence for DTTB pay-tv services in Addis Ababa, but the roll out has not started yet.

From the satellite platforms the free-to-air service of Arabsat is by far the most popular with an estimated 1 million viewers. Multichoice/DSTV, a pay-tv service, has an estimated 10 000 subscribers. The basic service package of Multichoice/DSTV costs USD 10 per month.

It should be noted that the indicated numbers on television viewers per platform and/or services are all estimates. Also the total spend on television advertising is not currently known.

[2] The broadcast planning software package Giraplan, has been made available for preparing the coverage plots by courtesy of Progira Communications.

2.2 Regulatory framework

The regulatory framework with regard to television broadcasting is shown in Table 2.2.

Table 2.2: Regulatory framework

Relevant legislation	Arranges/Covers	Regulatory body	Assigned rights
Ethiopian RTV Act	• Legal establishment of ETV • Mission • Objectives		
Broadcasting Act	• Cross ownership rules • Foreign ownership rules (only ETH ownership is allowed) • Content requirements • Aim to maximal coverage (qualitative description of coverage requirements) • No limitation to number of channels	EBA	Spectrum rights Broadcasting rights Principal building permission (in one licence)
Mass Media and Press Freedom Act	• No foreign investment • Content requirements • Diversification of content		
Telecommunications Act	• Telecommunications regulation	Ministry of communication and IT	Spectrum rights of non-broadcasting services
Commercial Registration and Business Licence Proclamation	• Business registration	Ministry of Trade	Business licence
Local planning regulations	• Use of local governmental properties	Local councils	Detailed permission for use of local government properties

The Ethiopian Broadcast Authority (EBA) is the main regulatory body regarding television broadcasting.

With regard to the transition to digital television, the following observations can be made:

- Ethiopia is a federal state; national broadcasting is regulated by federal laws as indicated in Table 2.2. Regional broadcasters are regulated by regional laws.
- Private Public Partnerships are sources of financing the transition to digital TV in a number of countries (see Chapter 2.9 of the ITU Guidelines). This possibility is likely to be limited in Ethiopia as foreign investments in broadcasting entities are not allowed.
- There are two basic licensing models for digital television (i.e. model A or B, see Chapter 2.2 of the ITU Guidelines). The current broadcast assignment model, whereby broadcast and spectrum rights are assigned in one licence, may need revision if model B is selected.
- Coverage requirements are not quantified, although this provides a degree of freedom for the Regulator, it may require political confirmation.

2.3 Digital switch – over objectives

Section 2.3.1 indicates the short and long term DSO objectives in Ethiopia. The emphasis in these objectives is on DTTB services. As mobile television (MTV) provides a different broadcasting service, the MTV objectives are described separately in Section 2.3.2.

2.3.1 Short and long term objectives

The start of digital terrestrial TV is set to take place in 2012. It is the ambition that the analogue TV switch-off (ASO) should be completed by June 2015, although no date has been set with political endorsement.

The objectives for digital switch-over (DSO) are shown in Table 2.3.

Table 2.3: DSO objectives

#	Objective	Short term (1 year after ASO)	Long term (5-10 years after ASO)
1	More channels	• 4 national PSB services • 11 regional PSB services • 8-12 commercial pay-tv services (Bridgetech) in Addis Ababa	• > 8-12 commercial pay-tv services, coverage extension to larger part of country • Number of commercial national services • Spectrum available to facilitate community TV; options to be investigated.
2	Lower costs	• One multiplex transmitted by the 54 ETV UHF transmitters, plus a number of additional transmitters (as far as needed)	
3	Smooth transition to DTTB	• Min. DTTB coverage = Any current analogue TV coverage • Areas served by analogue in VHF: simulcasting for maximum 3 years • Currently non-served areas: not yet decided • Viewer compensation: not yet decided • Phased switch-off however the exact Phases not decided yet	
4	Regional and local networks	• ETV national • Regional services in respective regions or distributed nationally, depending on costs	
5	Coverage extension to 80 per cent geographical coverage	By means of 26 additional sites (on top of the 28 already installed) and some gap fillers	
6	End of transition	June 2015	
7	Better picture quality	At least as good as analogue TV under good reception conditions	
8	MTV services		Possibly one multiplex, or embedded in DTTB transmission (if DTTB standard allows)

With regard to the DSO objectives the following observations can be made:

a. In the short term the DTTB package should include the services indicated in Table 2.4:

Table 2.4: DTTB services

#	Broadcaster	National/Regional (see Figure 2.2)	Number of sites		
			DTTB (UHF)	ATV (VHF and UHF) to be replaced	
1	ETV1	National	54	31	VHF
2	ETV2	National	54	1	VHF
3	ETV3	National	54	1	UHF
4	ETV4	National	54	–	
5	Addis TV	Region 1	*)	1, not yet operational	UHF
6	AF TV	Region 2		–	
7	Amara TV	Region 3		–	
8	Ben TV	Region 4		–	
9	Dire TV	Region 5	*)	1	VHF
10	GAM TV	Region 6		–	
11	Harari TV	Region 7	*)	1	UHF
12	ORTV	Region 8	*)	15	VHF
13	Somali TV	Region 9	*)	1	UHF
14	South TV	Region 10		–	
15	Tig TV	Region 11		–	
16	Bridgetech	Addis Ababa	1	–	UHF

*) It needs to be investigated if the 54 ETV UHF transmitters cover the existing analogue regional coverage and if additional transmitters are needed.

b. In the long term, frequency spectrum should be available to accommodate:

- additional pay-tv services and coverage extension;
- a number of commercial national services;
- community TV services;
- mobile TV (MTV).

Also account should be taken of:

- the allocation of the frequency range 790 MHz to 862 MHz (channels 61 to 69) to International Mobile Telecommunication (IMT) services after 2015 at WRC-12;
- future T-DAB requirements in Band III.

c. The NRT will soon take a decision on the DTTB transmission standard, being either DTMB or DVB-T2. The choice is between a first generation standard (DTMB) and a second generation standard (DVB-T2). Second generation DTTB standards have considerably improved technical features compared to first generation standards (see Section 4.1 and Annex 5). The choice of transmission standard will have a major impact possibilities to realize the DSO objectives and on the costs of the network.

d. The NRT is considering the establishment of a common network operator. As the launch of DTTB services is envisaged in 2012, this new operator should be in place before the launch.

2.3.2 MTV objectives

MTV networks provide services for handheld and mobile receiving devices, using a dedicated MTV transmission standard. The international market prospective of MTV is variable. MTV services are successfully implemented in Korea using the T-DMB standard and Japan using the ISDB-T 1-seg standard. Angola started test transmissions using the ISDB-T 1-seg standard. In Europe a number of countries started MTV services using the DVB-H standard; due to limited market take up, these services have already been stopped or will stop soon. On the other hand multimedia services via mobile communication networks seem to be promising.

Ethiopia does not foresee MTV services in the short term, because:

1. DTTB services have priority, taken into account the provisions of the GE06 Agreement.
2. Market developments in Africa and other parts of the world will be observed before taking decisions on MTV standards, services and frequency spectrum assignments.
3. If the DVB-T2 standard is chosen, there is in principle the possibility to consider MTV in “Physical Layer Pipes”.

In the long term, possibly one MTV multiplex is foreseen (see Table 2.3). In order to be able to make a future decision on MTV, MTV services should be taken into account in:

1. The considerations about the Digital Dividend.
2. Assigning channels to DTTB services in Band IV/V.
3. Assigning the multiplex capacity in case the DVB-T2 is chosen.
4. Allow the common network operator, if so decided, to operate MTV services.

After ASO, Band III will be free of TV services. A spectrum review of Band III will therefore be necessary, taking account of T-DAB, DTTB and possible T-DMB requirements.

3. National roadmap

After having determined the aim of the roadmap as described in Section 2, this section will describe the roadmap itself. Section 3 starts with an introduction on the concept of a roadmap, followed by the description of the construction of the roadmap (Section 3.2). In Section 3.3 the selected functional building blocks of the Ethiopia roadmap are shown. Section 3.4 describes each of the phases of the Ethiopia roadmap.

3.1 General

A *roadmap* is a management forecasting tool and is directed to the implementation of strategy and related to project planning.

A roadmap 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 the transition to DTTB.
3. It provides a framework to help plan and coordinate the steps needed for transition to DTTB.

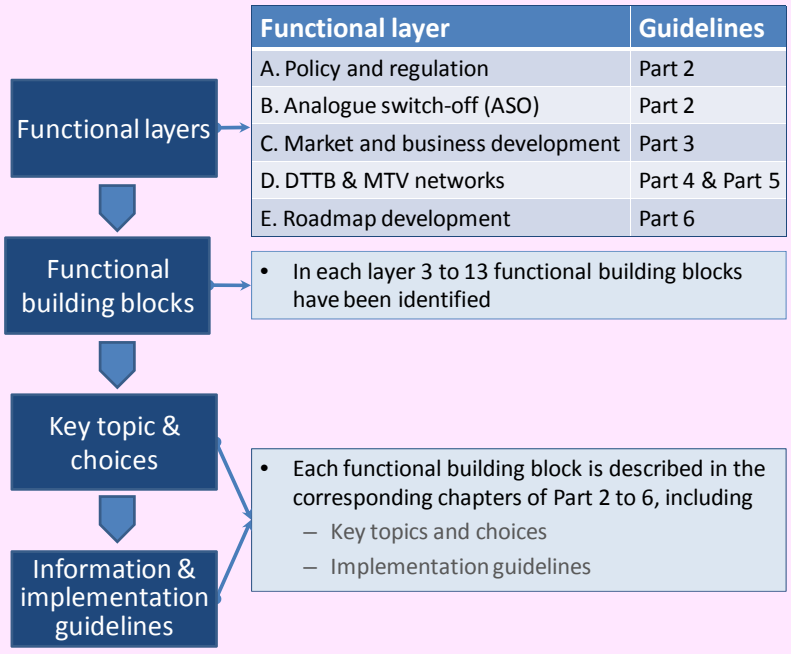
A roadmap consists of various phases, normally related to preparation, development and implementation of the strategy. A roadmap is often presented in the form of layers and bars, together with milestones on a time scale.

3.2 Roadmap construction

Part 6 of the ITU Guidelines describes a method for developing a roadmap. Also a set of generic roadmaps regarding the whole process of transition to DTTB and introduction of MTV is given. The methodology described in Part 6 of the ITU Guidelines will be followed in the development of the national Ethiopia roadmap.

The basis is a functional framework consisting of five layers as indicated in Figure 3.1.

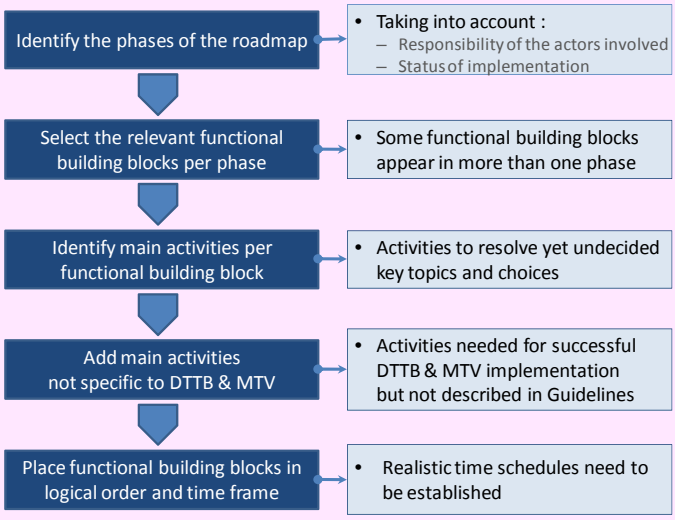
Figure 3.1: Functional framework



Source: Adapted from the ITU Guidelines

The roadmap is constructed by placing the relevant functional blocks in each phase in a logical order and in a time frame. For each of the functional building blocks the decisions already taken and the main activities to resolve not yet decided key topics and choices are identified. Figure 3.2 illustrates the construction process.

Figure 3.2: Roadmap construction



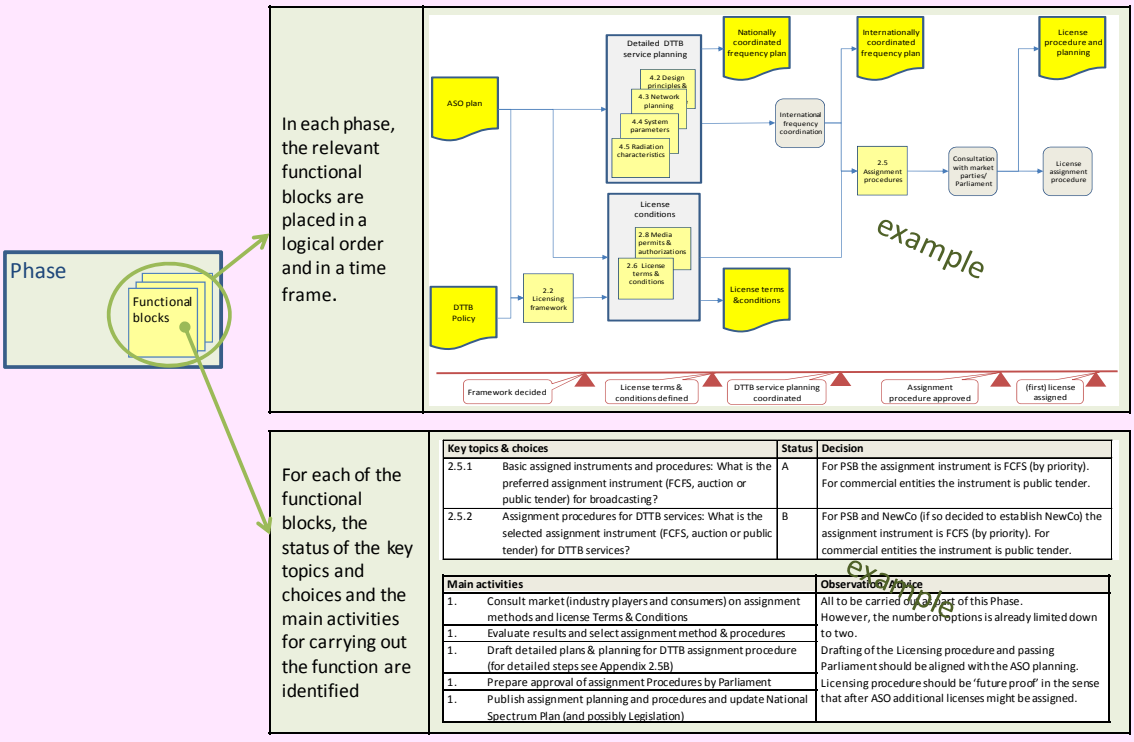
Source: Adapted from the ITU Guidelines

The result is a roadmap that consists of three levels:

1. Phases of the roadmap with the selected functional building blocks per phase.
2. For each phase, the functional building blocks placed in a logical order and time frame.
3. For each functional building block in a phase, the status of key topics and choices and the main activities to be carried out.

The roadmap structure is illustrated in Figure 3.3.

Figure 3.3: Roadmap structure



Key topics & choices		Status	Decision
2.5.1	Basic assigned instruments and procedures: What is the preferred assignment instrument (FCFS, auction or public tender) for broadcasting?	A	For PSB the assignment instrument is FCFS (by priority). For commercial entities the instrument is public tender.
2.5.2	Assignment procedures for DTTB services: What is the selected assignment instrument (FCFS, auction or public tender) for DTTB services?	B	For PSB and NewCo (if so decided to establish NewCo) the assignment instrument is FCFS (by priority). For commercial entities the instrument is public tender.

example

Main activities		Observations/Advice
1.	Consult market (industry players and consumers) on assignment methods and license Terms & Conditions	All to be carried out as part of this Phase. However, the number of options is already limited down to two.
1.	Evaluate results and select assignment method & procedures	
1.	Draft detailed plans & planning for DTTB assignment procedure (for detailed steps see Appendix 2.5B)	Drafting of the Licensing procedure and passing Parliament should be aligned with the ASO planning.
1.	Prepare approval of assignment Procedures by Parliament	Licensing procedure should be 'future proof' in the sense that after ASO additional licenses might be assigned.
1.	Publish assignment planning and procedures and update National Spectrum Plan (and possibly Legislation)	

Source: Adapted from the ITU Guidelines

The selected relevant functional building blocks are shown in Figure 3.4 in Section 3.3. Key topics and choices related to the selected functional building blocks of functional layers A (Regulation), B (ASO) and C (Market and Business Development) D (Networks) have been considered and it has been identified which decisions have (partly) been taken and which still need to be taken.

An overview of the decisions taken, partly taken and not yet taken on the key topic and choices regarding phases 1 to 4 of the roadmap and the activities required to prepare the decisions that are still pending, are indicated in Annexes 1 to 4.

This section contains a number of graphs. The symbols used in these graphs have the following meaning:

Functional building blocks described in the Guidelines; the number in the blocks refer to the functional block numbers in Figure 3.3 and to the corresponding Chapter numbers in the Guidelines

Input or output document

Non-specific DTTB main activity; not described in the Guidelines

Important milestone in relation to time scales

Sequence

Time line

Interrelation between groups of activities

3.3 Functional building blocks relevant to Ethiopia

Of the five functional layers shown in Figure 3.1, layer E is “Roadmap development” and hence covered by this report. The other functional layers “Policy and Regulation”, “ASO”, “Market and Business Development” and “Networks” contain in total 38 functional building blocks (see Figure 3.4). Out of the 38 functional building blocks, 25 blocks were selected to construct the Ethiopia roadmap. The roadmap covers:

1. The short DSO objectives as defined in Table 2.3.
2. Activities managed by the NRT.

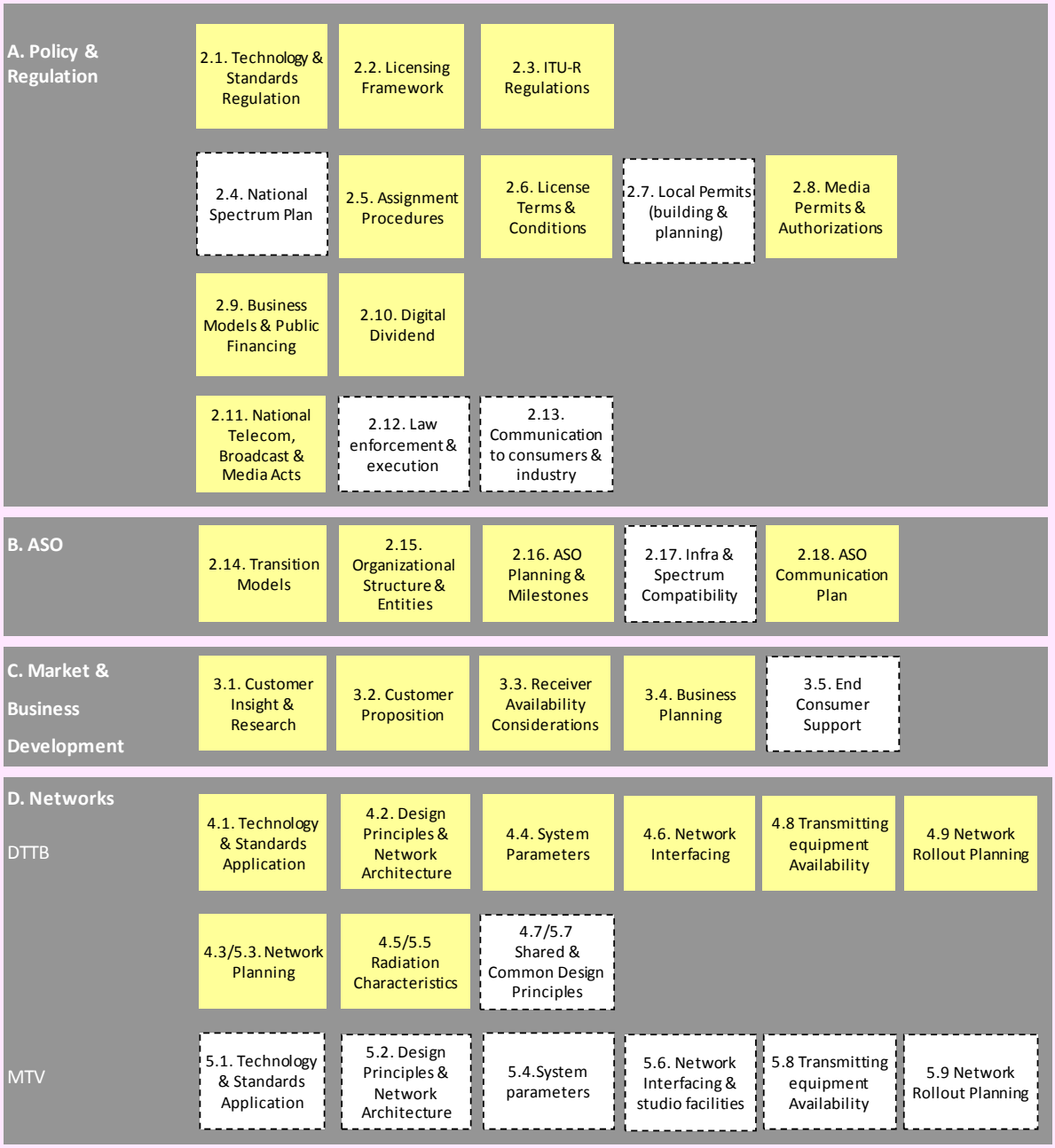
The selected 25 functional building blocks are coloured yellow in Figure 3.4.These blocks are described in the chapters of the ITU Guidelines with corresponding numbering. The white blocks with a dashed frame are not included in the Ethiopia roadmap.

3.4 Description of the Ethiopia roadmap

In this section the roadmap for Ethiopia is outlined. The roadmap is segmented in four phases. After presenting the overall roadmap each phase is discussed in the subsequent subsections.

The detailed activities and considerations for each phase and its associated functional building blocks are included in Annexes 1 to 4 of this report.

Figure 3.4: Selected functional building blocks (yellow) for Ethiopia roadmap



Source: Adapted from the ITU Guidelines

3.4.1 Overall roadmap

As discussed previously, Ethiopia has the ambition to switch-off all analogue terrestrial television services by June 2015. With the objective to launch the first DTTB transmissions in 2012, the simulcast period will span a maximum of three and a half years.

Roadmap phases

A key decision, having a great impact on the roadmap, is the decision on the licensing model. The ITU Guidelines distinguishes two basic models: model A or B[3]. In Ethiopia both models, including combinations, are still under consideration. If a common multiplex/network operator is established (model B) and the activities are separated into a newly established company, the scope of the overall roadmap will change. Additional activities have to be carried out.

In model B, the NRT will establish a common multiplex/network operator who will be responsible for delivering all public service broadcaster (PSB) digital television services in Ethiopia (and perhaps at a later stage MTV services). In this model the regional broadcasters, intending to provide digital television services too, will have to acquire network capacity from this common multiplex/network operator.

The decision to select model B does not necessarily imply separated network operations. Theoretically it is possible to have the common multiplex/network operations carried out as part of PSB (ETV). In practice this is not advisable as it will be difficult to establish a network operator which can operate in a transparent and non-discriminatory way. Regional PSBs and other commercial service providers/broadcasters might be reluctant to accept such an integrated model (content and network provisioning together in one entity).

For this reason (and for reasons of efficiency) many countries have opted to separate the network operations from the content provisioning activities. In Western Europe, most PSBs have separated their network activities many years ago. In this way PSBs would focus on what is considered as their core business; producing relevant and varied content. Providing network services is considered a specialist activity best addressed in a specialist firm; the broadcast network operator. Recent network separations have been seen in countries like Belgium, Kenya and Serbia. These countries separated their PSB network activities just before introducing DTTB services (and eventually switching-off their analogue services). Deploying a DTTB network for just the PSB was considered too expensive and not efficient because a single DTTB platform (i.e. one multiplex) can carry more than only the PSB services.

Currently ETV owns/rents and maintains the distribution networks and the various transmitter sites for broadcasting its *national* analogue terrestrial television and radio services across the country. It is best to separate the television *and* radio network activities into a newly established company (common multiplex and network operator). Leaving the radio network activities in ETV will result in sharing people and probably assets between the new operator and ETV. This situation may lead to conflicts when both companies are operational and priorities have to be agreed for resolving network interruptions and replacing shared equipment. In addition overhead costs (for maintaining two network organizations) are generated twice.

A subsequent decision for the regulator(s) to take is whether the network assets and activities of the regional PSBs should be transferred to the new operator, too. This may take a considerable effort as the regional PSBs are financed and governed under an independent legal framework. However from a point of view of having the lowest operational costs and the best digital network design, including the network activities and assets from the regional PSBs is advisable. Having access to the regional PSB sites will make it easier to ensure that all current analogue coverage is copied onto the digital platform.

The new operator will act as a common multiplex/network operator for only the multiplexes that will be financed from public sources (DSO objective Table 2.3 indicates one multiplex in the short term). Consequently the one multiplex for commercial operations will be financed and rolled-out by the private operator/service providers (BridgeTech). The role of the new operator for these commercial multiplexes will be limited to providing site and antenna sharing, if decided to stipulate a coordinated network roll-out between the PSB and the commercial operators (e.g. BridgeTech). In a shared or coordinated network deployment costs will be reduced (by avoiding infrastructure duplication) and hence the success rate of

[3] See the ITU Guidelines page 26/27.

the entire DTTB platform increased. Also activities for promoting and informing potential DTTB viewers can be shared (see also Section 4.7).

Furthermore, the NRT can look for a partnership with investors and/or equipment suppliers who can help the new common multiplex and network operator in rolling out the common digital terrestrial network. Considering that designing and rolling out a DTTB network requires specific knowledge, establishing a partnership with an experienced partner can significantly contribute to a successful switch-over. If whished for, the NRT will have to issue a tender procedure for selecting a partner/supplier for the common multiplex/network operations.

After selecting the network operator partner/supplier, the NRT will develop the network roll-out planning together with the common multiplex and network operator and this newly selected partner (phase 4 of the roadmap). The NRT, in close cooperation with the common multiplex and network operator, will assume the responsibility of rolling out the DTTB network.

Figure 3.5 illustrates the various phases of the NRT roadmap (i.e. the yellow shaded blocks) in case it is decided to separate ETV (and possibly the regional PSB) network activities and to establish the common multiplex and network operator. The figure shows that preparations are needed for splitting off the network operations from ETV and establishing a new company. This effort may impact the critical path because rolling out the DTTB network without the new common multiplex and network operator is not really possible. It advisable that the (remaining) DTTB network deployment is carried out under the responsibility of the common multiplex and network operator's newly appointed management. Otherwise there is a risk that significant pieces of planning work will be redone or the new network operator's management cannot resume responsibility for the network deployment.

This effort of establishing the common multiplex and network operator should not be underestimated. Such operations include extensive financial audits/due diligence, assets inventory, legal preparations (for establishing the new operator with the right statute), social plan (people may be made redundant) and drafting a business plan (including the redefining of business processes, defining service portfolio and levels, organizational structure and financing). Also appointing management may be a delicate and intricate process.

It is important to note that the new operator without spectrum rights cannot effectively build-up DTTB experience, design and roll-out the required network. Hence special attention is needed for assigning the spectrum rights to it. As experience has shown in other countries, legislation should be checked extensively and the legal preparations should not be underestimated[4]. In addition, the open network provisioning (ONP) rules for the common multiplex and network operator should be defined, taking care of equal and non-discriminatory access to the DTTB platform and fair/transparent pricing of network capacity[5].

In Figure 3.5 the preparations for splitting off the network activities from ETV and establishing the new operator are indicated in blue as it is assumed that these activities will be carried out under the direct responsibility of ETV management. However, this will require a formal decision. In either way the NRT will have to get progress reports on the establishment of the common multiplex and network operator and ultimately its management will have to participate in the NRT.

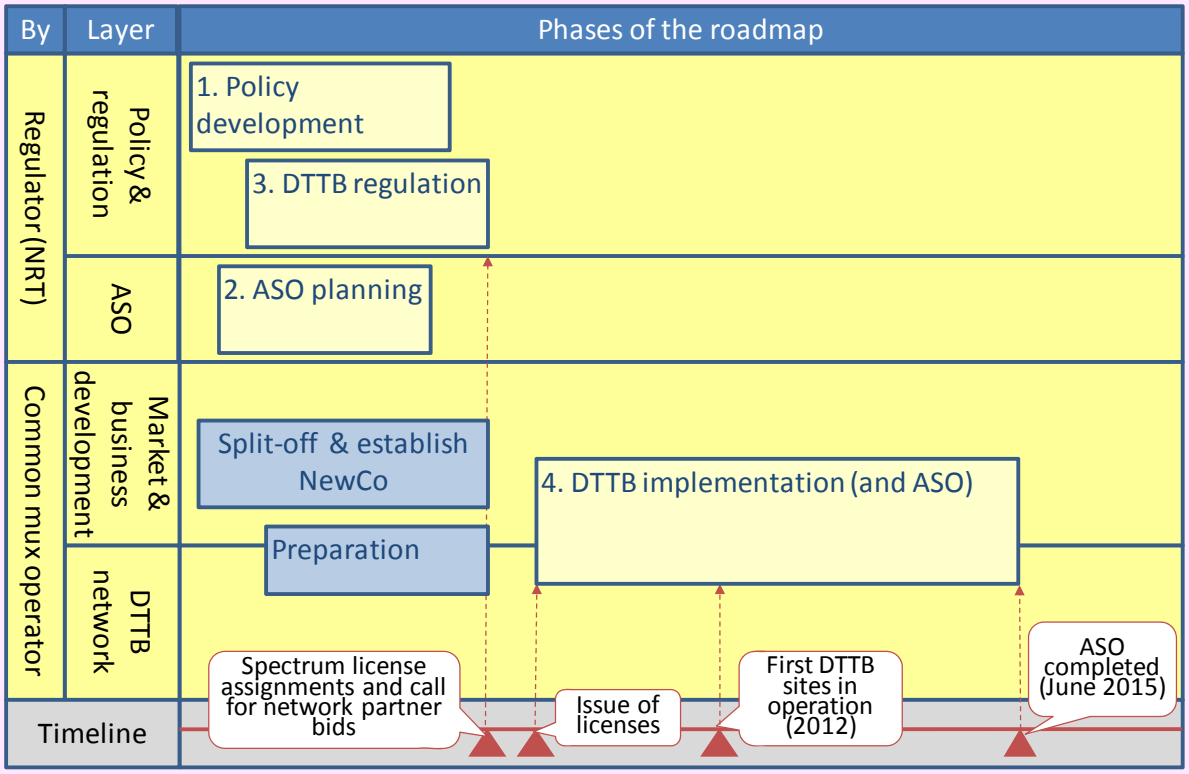
As Figure 3.5 shows, the Ethiopia roadmap includes four phases. The first three phases are likely to be carried out partly in parallel because of the interrelationships between the issues and the limited time

[4] In 2008 in Belgium the public broadcaster also split-off its network operations and established a new company (to be put for sale). Initially the plan was to directly assign the DTTB/MTV spectrum to this new company. However, this turned out to be impossibility as European competition law didn't allow such an operation. Only after a public tender procedure the new company acquired these rights.

[5] For more information on ONP see Modules 5 and 6 of the "Telecommunications Regulation Handbook", The World Bank, 2000. Free download available on: www.infodev.org/en/Publication.22.html.

that is available. As discussed previously, the Ethiopia policy makers intend to commence the DTTB services in 2012 and switch-off the last analogue transmitters in June 2015.

Figure 3.5: Top level Ethiopia roadmap (with the new common multiplex and network operator)



Source: adapted from the ITU Guidelines
Note: NewCo = the common multiplex and network operator

Functional building blocks to be included

In either model, A or B, the NRT will have to carry out activities and decisions typical for a multiplex/network operator. In the case where the NRT will resume responsibility for the establishment of a common multiplex/network operator, it will have to endorse which services will be offered on the market. In the case where the radio network activities will also be transferred to the common multiplex/network operator, the service bouquet and its pricing will include radio services too. In case of model A, the NRT has to decide the services for ETV and the regional PSBs, too. Without such service definition licensing is not possible. Hence the Ethiopia roadmap will include in both models the typical activities and decisions for a multiplex/network operator:

1. Market and business development layer:
    a. Customer insight and research (functional building block 3.1): the NRT will have to investigate what distribution services the multiplex/network operator is going to offer and how they are going to research this market demand.
    b. Customer proposition (functional building block 3.2): the NRT will have to establish the exact attributes of the distribution services, such as coverage areas, number of services, conditional access (in case of pay-tv services) and price tables for the various services (including multiplex capacity reservations).

c. Receiver considerations (functional building block 3.3): in line with the DSO objective to have a single cheap STB for the Ethiopia market, the NRT will have to determine what functionality this STB will have. This will include aspects such as the transmission and compression standard as well as the conditional access system (which is likely to be embedded to keep costs down).

d. Business planning (functional building block 3.4): the NRT will also have to resume responsibility for an economically viable service offering. Hence the NRT will have to assess the future cash flows of the common multiplex/network operator and what type of financing is required.

2. DTTB network layer:

a. Technology and standard application (functional building block 4.1) to radiation characteristics (functional building block 4.5): all these five technical functional building blocks have to be included as to determine what the required DTTB network will look like. This includes aspects as the design of the key network elements (i.e. the head-end/multiplex centre, the distribution links and the transmitter sites), the various system parameters (i.e. transmission mode, guard interval, etc.), and the applied frequencies per site (i.e. ERP, antenna height and diagram).

b. Network interfacing (functional building block 4.6), transmission equipment availability (functional building block 4.8) and network roll-out planning (functional building block 4.9): all these three functional building blocks have to be include as the NRT will have to directly manage the planning of the network roll-out.

Figure 3.6 shows the functional building blocks to be included in each phase of the Ethiopia roadmap. Please note that the yellow shaded blocks are described in the chapters of the ITU Guidelines with corresponding numbering. The grey shaded blocks are not described in the ITU Guidelines. These blocks represent activities that are not specific to the introduction of digital terrestrial television services.

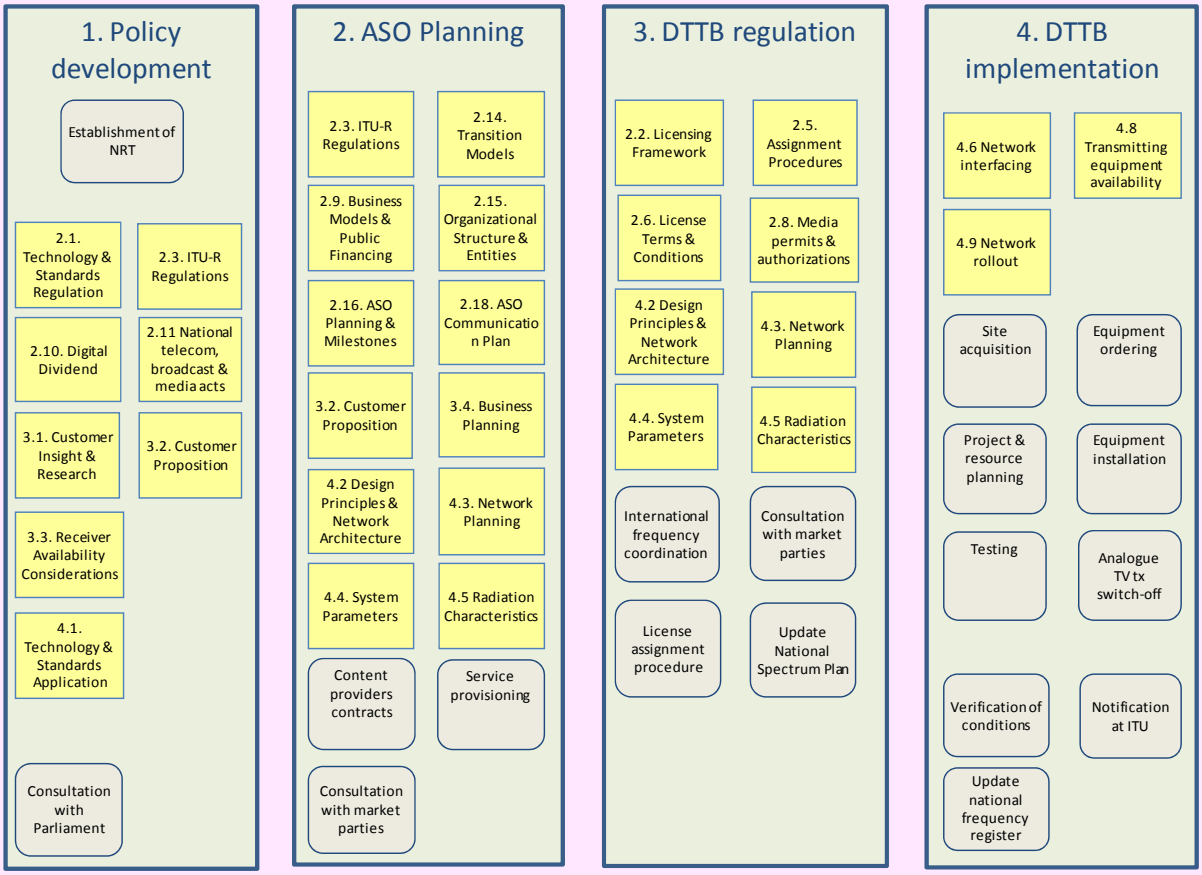
3.4.2 Phase 1 DTTB policy development

The DTTB policy development phase of the roadmap is aimed at getting the DTTB policy objectives agreed at a political level. Political consensus and commitment lies at the heart of any successful ASO project. Politicians will have to commit to the ASO objectives, deadlines and the necessary budget and endorse the establishment of a NRT with a clear mandate to plan and execute the ASO process.

Inputs

The inputs for this phase are international agreements, such as agreements made in the Common Market for Eastern and Southern Africa (COMESA), the GE06 Agreement, existing regulatory framework (see Table 2.1) and existing policy objectives (see Table 2.2). The policy objectives as included in Table 2.2 act as a starting point as these objectives still have to be further completed (for example the exact ASO dates and the minimum number of PSB channels and their coverage) and endorsed in Parliament.

Figure 3.6: Functional building blocks for each of the four phases of the Ethiopia roadmap



Source: Adapted from ITU Guidelines

Outputs

The key output of the DTTB policy development phase is a politically endorsed DTTB policy document to be published to the general public (in the 'Official Gazette'). Such a DTTB policy document typically includes the following items:

- Policy justification. This includes the benefits and necessities of introducing DTTB services in Ethiopia (including the allocation of the digital dividend).
- The legal framework. This entails the legal basis (and any necessary changes) for the DTTB service introduction and the ASO.
- Technical framework. Detailing the available spectrum for the DTTB services and the current spectrum in use by existing broadcasters.
- Starting and ending date of ASO process. These dates have to be exact as to inform the general public and the industry accurately.
- ASO model. This could be either a form of simulcasting (to include duocasting) or no simulcasting as well as the simulcast/duocast period and the phasing of these periods, completed with a justification for these policy choices.
- DTTB services. Detailing which existing PSB channels and additional content/services will be distributed on the DTTB platform and at which locations these service will be made available.
- DTTB standards. Standards (for example the transmission and compression standard) that will be mandatory and the justification.

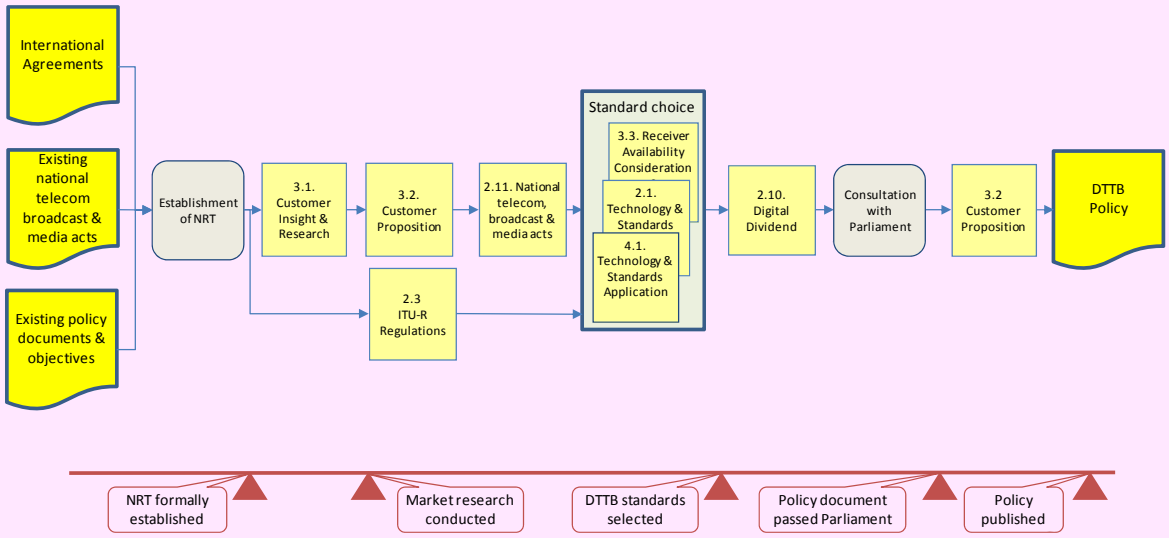
- Financial means and funds. Including the intention to include selected ASO costs in the government budgets and the way it is going to be funded.
- (Any) DTTB compensation schemes. This entails a summary of which groups (e.g. viewers and existing broadcasters) will be financially compensated (if at all) and of what this help will consist.
- Communication and plan of action. Outline of how viewers (and other stakeholders) will be informed about the ASO process and plan of action with major regulatory and operational milestones (e.g. the establishment date of the NRT, the date of when the Broadcast Act will be changed/updated, the decision on the allocation of the digital dividend, etc.).

For an example DTTB policy document please refer to "Strategy for Switchover from Analogue to Digital Broadcasting of Radio and Television Programs in the Republic of Serbia" as published in the Official Gazette of the Republic of Serbia, No. 55/05, 71/05 – correction 101/07, the Government of the Republic of Serbia on July 2nd 2009[6].

Roadmap

The roadmap of the DTTB policy development phase and the associated functional building blocks is shown in Figure 3.7. The decisions taken, partly taken and not yet taken on the key topics and choices regarding phase 1 of the roadmap and the activities required to prepare the decisions that are still pending, are indicated in Annex 1.

Figure 3.7: DTTB policy developments phase of the roadmap



Source: Adapted from ITU Guidelines

As can be derived from Figure 3.7, the following steps (i.e. functional building blocks and non-DTTB specific activities) are included in the first phase of the roadmap:

1. Establishing the NRT. The NRT will have to be formally established by government in order to deliver the DTTB policy document. It should have a clear mandate to do so. After having this

[6] Document can be download from www.itu.int/ITU-D/tech/OLD_TND_WEBSITE/digital-broadcasting_OLD/Bulgaria_Assistance_Transition/Serbia/Serbia_Web.pdf, and www.irex.rs/attachments/130_Strategy%20for%20Switchover%20from%20Analogue%20to%20Digital%20Broadcasting.pdf

document formally approved, its mandate can be extended to prepare, plan and execute the ASO planning. In this phase of the roadmap this NRT can have a limited membership. At the second phase of the roadmap (i.e. ASO planning) the NRT membership can be extended to include all stakeholders in the DTTB value chain (and structured in line with the implementation guidelines of functional building block 2.15).

2. Conducting market research of the current television and future DTTB market in Ethiopia. This step includes the functional building blocks 3.1 and 3.2. At this phase of the roadmap this market research serves the purpose of providing support/justification for the DTTB policy. Hence it will focus on the following elements:

    a. *Current* television market in Ethiopia. A profound and *agreed* understanding of the current television market provides a sound basis for any policy document. This part of the research will include the following:

        i. Current market players (to include broadcasters, content creators, network operators, service providers, etc.). Figure 2.1 provides a good starting point;

        ii. Television viewing 'demographics'. This entails the common market parameters like number of television sets deployed, the number of television households , the number of viewing hours (per channels), the number of subscriptions, etc.;

        iii. Current reception situation and conditions. This entails having insight in what the different viewing groups (to include individual viewers, household size, group viewing, hotels, multi-dwelling units, etc.) look like, their numbers and under what conditions current analogue television is received (e.g. the antenna installation and type of television sets). This part should also include the reception from other platforms (i.e. Arabsat and DSTV);

        iv. Current analogue service coverage. Given the current reception conditions, it should be clarified where and what service can be received. This might entail an analogue service planning exercise (similar to the DTTB service planning as described in the ITU Guidelines). This part should also take into account the different regional broadcasts and the different channel bouquets the various viewers might receive;

        v. Television market logistics and supplies. The current logistic chain for television sets will be important for the distribution of DTTB receivers. An understanding of its structure, volume (e.g. how many outlets where?) and operations will be necessary;

        vi. Television licence fees and other income. Currently the PSB system in Ethiopia is financed by two main sources; the television licence fee and advertising income. An insight into the volumes and the way they are collected and distributed over the PSB system will be important for developing a financing proposal for DTTB;

    b. *DTTB* market in Ethiopia. The DTTB policy document should illustrate that there is a need for DTTB and this part of the market research should provide an insight in what the viewers and industry players expect, including:

        i. Content. To include the number and the type of programmes/channels and other service to be broadcasted (for example: the EPG, subtitling, theme channels, etc.);

        ii. Willingness to pay or ability to pay for digital terrestrial services, including the set-top-box (STB) (and any necessary antenna);

        iii. Supplies. Ethiopian manufacturers and distributors might show an interest in supplying DTTB receivers;

        iv. Content creators. Ethiopian content creators might be interested in providing dedicated content for the DTTB platform.

3. Determining the current available spectrum for DTTB. A clear and shared understanding of the available spectrum will enable the NRT to develop a well-motivated DTTB policy document. It should be noted that the GE06 digital plan entries for Ethiopia have been modified. Currently the digital plan contains 435 digital UHF assignments, 1 to 5 per site. On the basis of these newly acquired assignments, the available spectrum for digital terrestrial television services should be clarified and shared in the NRT taking into account:
    a. Spectrum already assigned (not necessarily in use yet) for analogue and/or digital television services (as indicated/to be incorporated in the National Spectrum Plan and Register).
    b. Neighbouring spectrum usage. Some spectrum may not be readily available in Ethiopia as the same spectrum is in use in neighbouring countries (especially near the borders)[7]. Coordinating this spectrum is in the interest of all involved countries and may require bilateral/multilateral coordination.
    c. Spectrum required for future digital radio services (as indicated/to be incorporated in the National Spectrum Plan and Register).
    d. Spectrum requirements for non-broadcasting services, for example spectrum for LTE/IMT services[8] (as indicated/to be incorporated in the National Spectrum Plan and Register).
4. Checking compliancy with current legislation and identifying required changes. A first assessment should be carried out of what parts of the current legislation will be impacted by the introduction of DTTB services. Table 2.1 in this report and Table 2.11.1 in the ITU Guidelines provide a good starting point for this assessment. At this first phase of the roadmap, the assessment is focused on identified the areas that might be impacted, how required changes can be achieved (e.g. legal and parliamentary procedures) and what time this will take. This assessment will then provide input for the plan of action (as part of the DTTB policy document). During the third phase of the roadmap (i.e. determining the DTTB regulations) as specific DTTB regulations are defined (e.g. the licensing framework and procedures), a further detailed assessment of necessary changes will be conducted.
5. Selecting the transmission standard. As Figure 3.7 shows, the procedure for deciding the transmission standard is an iterative process between the functional building blocks 4.1 Technology standards application (i.e. addressing the technical performance), 2.1 Technology standards regulation (i.e. considering regulatory aspects) and 3.3 Receiver availability considerations (i.e. dealing with functionality, price and delivery of receivers). Selecting the transmission standard is however not only a technical and regulatory evaluation, given the specific situation in Ethiopia. It should also explicitly include the following elements (next to the considerations provided in the ITU Guidelines):
    a. Independent and warranted supplies. Dependency on one single supplier should be avoided. Any DTTB system (head-end and receivers) will incur many changes (e.g. frequency changes, software updates, additional functionality, etc.) during its life span (i.e. 5-15 years) and suppliers should support this. One should be in the position to change providers. Changing suppliers is not uncommon in this industry;
    b. Affordable and sufficient supplies of DTTB receivers. Given the public financial resources available and the ability to pay under Ethiopian viewers, receivers (including set-top-boxes and IDTVs) should be made available at the lowest price levels. Not only in the short term but also in the long run pricing should be considered. In Ethiopia the DTTB adoption speed

[7] In the GE06 plan it is indicated that some DTTB assignments on channel 29 and 30 require coordination with regard to protection of analogue TV services in Somalia. This requirement lapses on 17 June 2015.

[8] LTE is an application of the International Mobile Telecommunications (IMT) as meant in ITU Radio Regulations RR 5317A.

might take a long(er) time and hence the product roadmap of the receiver suppliers should be taken into account. Suppliers should also be committed to provide sufficient quantities in a flexible manner (e.g. according to a rolling forecast). This might need special attention in case a conditional access system (CAS) is stipulated. Even more if specific Ethiopian language requirements are demanded (e.g. for the EPG and the user interface of the receiver).

6. Deciding the digital dividend. At this phase it should be decided whether digital dividend will become available for other services then broadcasting services (including DTTB and MTV), as this might be an important element for justifying the introduction of DTTB in Ethiopia. For example, the introduction of new mobile services might fit in the economic development agenda of Ethiopia.
7. Consultation with Parliament. In this step a draft DTTB policy document is offered to Parliament to approve. This might include many consultation sessions, extensive lobbying and several revisions and sufficient time should be planned for this. It should be noted that in this set-up of the roadmap, the DTTB policy document should leave room for the NRT to further detail the customer proposition, frequency plan (including the service planning process) and ASO plan (including the organizational structure, budget and planning).
8. Determining the first customer proposition and communication to the general public. As a result of the DTTB policy document being passed by Parliament, a first outline of the customer proposition is available. This proposition will be at high level and in terms of the policy document. After any simplification/adjustments, the passed DTTB policy document can then be published in the Official Gazette.

3.4.3 Phase 2 ASO planning

The second phase of the Ethiopia roadmap is aimed at providing a detailed insight in the roles and responsibilities of the various involved parties, the process of transitioning from analogue to digital terrestrial television broadcasting, the milestone planning and the communication/support process. The ASO planning phase also services the purpose of getting support from various involved market parties and Parliament.

Inputs

The key input for this phase is the (passed) DTTB policy document. As Figure 3.5 suggests, it might be that the second phase of the roadmap can be initiated before the DTTB policy document has passed Parliament. This will depend for some part on the assessment of any likely changes in Parliament and the provided mandate to the NRT when it was established. This might entail some later changes in the resulting documents of this ASO planning phase.

Outputs

The main outputs for the ASO planning phase are an initial frequency plan (based on an initial DTTB service planning) and the ASO plan. In general terms, an initial frequency plan describes how the available spectrum will be utilized in a deployed network and which service (including the number of channels and reception mode) will be provided in what areas and with what quality levels (including picture quality and coverage probability). In more specific terms, the frequency plan details all the decisions and trade-offs as included in the functional building blocks 4.2 to 4.5.

The ASO plan describes in detail the transition process from analogue to digital and will include at least:

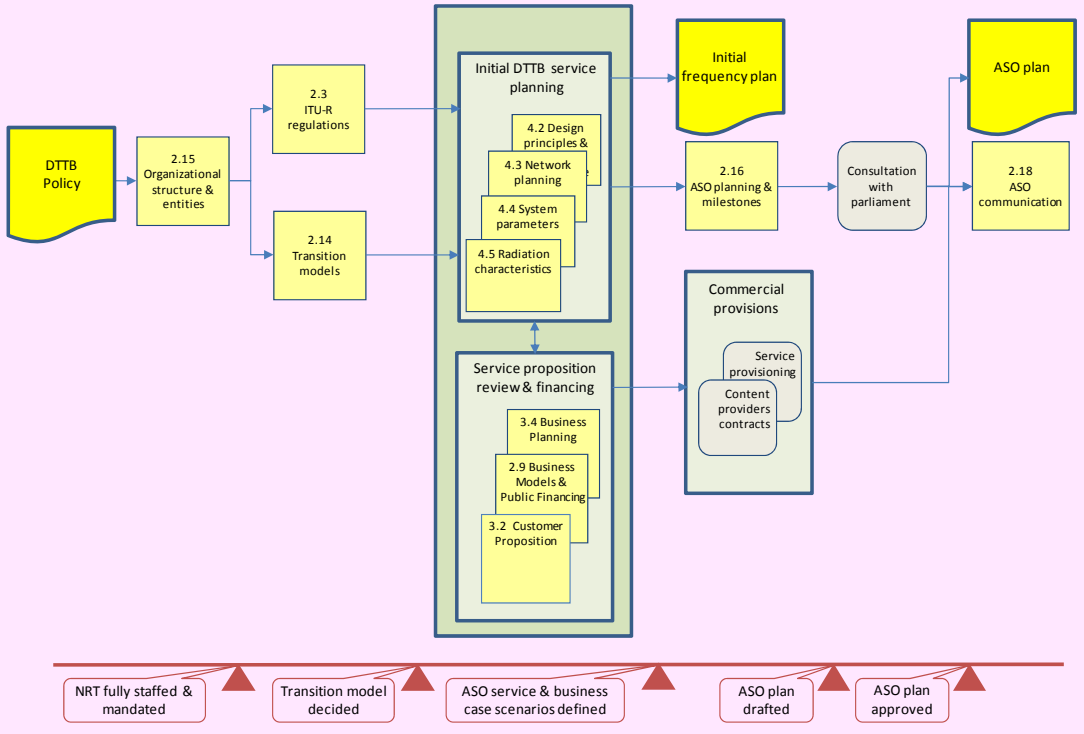
- The applied ASO model (see functional building block 2.14). The applied model might be different from area to area. For example, the non-served areas in Ethiopia might have a different model to the served areas;
- The customer proposition (see functional building block 3.2). Including the details about which channels and additional services can be received and under what conditions (i.e. the reception conditions) in what areas;

- The ASO planning (see functional building block 2.16). This planning describes when what customer proposition will be made available and how this proposition will be provided. As indicated in the ITU Guidelines this planning comprises several works streams or result paths, including (see also Section 4.6):
  - communications (further detailed in functional building block 2.18 ASO communication);
  - STB delivery;
  - network plan and rollout (includes DTTB service delivery details);
  - consumer and market monitoring;
  - regulation and licensing (further detailed in phase 3 of the roadmap);
  - financial and installation support;
  - etc.
- The business planning and public financing (see functional building block 3.4 and 2.9). A business case should detail what the ASO process will cost (under various scenarios) and what financial resources should be made available (including for example a raise of the television licence fee). The initial frequency plan will provide the basis for a first estimate of the network costs. Please note that, as Table 2.15.2 in the ITU Guidelines illustrates, the network costs are just one item of the overall budget. Especially the (financial) support provided to affected viewers will be an important decision to be made.

Roadmap

The roadmap of the ASO planning phase and the associated functional building blocks is shown in Figure 3.8. The decisions taken, partly taken and not yet taken on the key topics and choices regarding phase 2 of the roadmap and the activities required to prepare the decisions that are still pending, are indicated in Annex 2.

Figure 3.8: ASO planning phase of the roadmap



Source: Adapted from ITU Guidelines

As can be observed from Figure 3.8, the following steps (i.e. functional building blocks and non-DTTB specific activities) are included in the second phase of the roadmap:

1. Establishing the organizational structure and participating entities (see functional building block 2.15). Dependent on the exact mandate of the NRT in first phase of the roadmap, this might include an additional (political) mandate. The participating parties and their responsibilities in the ASO planning process might be political sensitive and needs a further approval. In this step also the reporting structure and escalation procedures should be clarified so that the NRT can efficiently operate and manage the ASO process.

2. Determining the current available spectrum and model for ASO (see functional building blocks 2.14 and 2.3). In the first phase an initial understanding of the available spectrum, according to the GE06 plan entries, was established. In this phase of the roadmap, given the available spectrum it should be assessed what various ASO models are possible and if any changes in the GE06 plan entries should be needed. As indicated in the ITU Guidelines, the GE06 plan changes are possible but may require considerable time to accomplish. However these administrative procedures may not need to be on the critical path of the ASO planning. This assessment together with the implementation guidelines in the ITU Guidelines (see Section 2.14.4) on the ASO model decision, an ASO model can be selected (which may vary for served and non-served areas).

3. Balancing DTTB service planning, customer proposition and financing. This step entails an iterative process where three elements (i.e. service proposition, network planning and business case) are balanced against each other as illustrated in Figure 3.1.1 in the ITU Guidelines. Although in the ITU Guidelines this process is explained for a commercial DTTB service provider, the process is in essence no different for the NRT. As Figure 3.8 illustrates, this iterative process consists of two parts:

   a. Initial DTTB service planning (which in turn is an iterative process of four functional building blocks 4.2 – 4.5);

   b. Service proposition review and financing (which is also in turn an iterative process of three functional building blocks 2.9, 3.2. and 3.4).

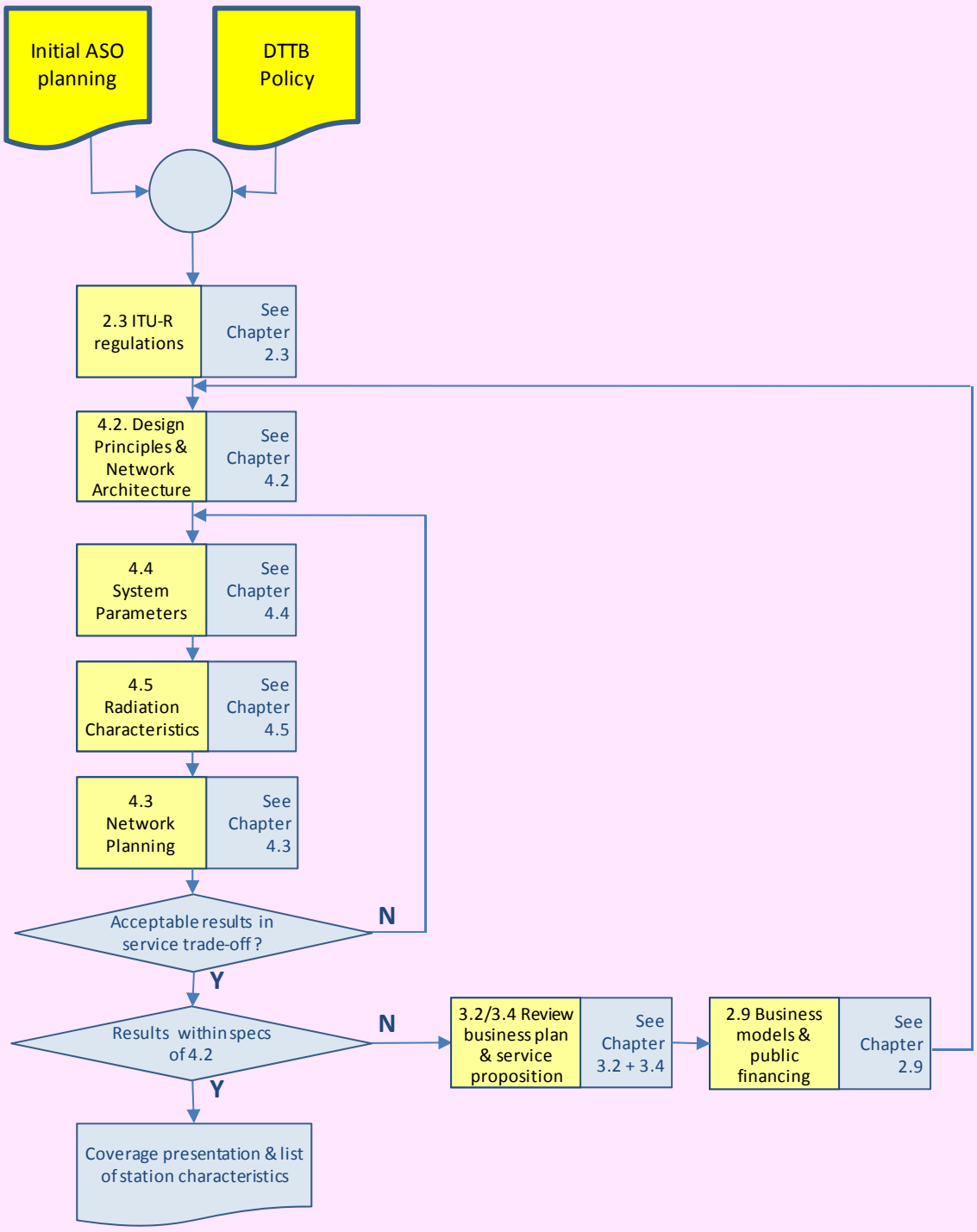
   Figure 3.9 provides a flow chart of the two feedback loops that are incorporated in the balancing of these three elements.

4. Drafting ASO planning and milestones (see functional building block 2.16). The abovementioned balancing of three elements will result in one optimum scenario to be selected by the NRT. Based on this scenario the initial ASO planning can be drafted. As mentioned before, in case the ASO plan requires political approval, it is advisable to draft a planning based on one or two additional scenarios, perhaps not in all its details.

5. Consultation with Parliament. In this step a draft ASO plan is offered to Parliament to approve (with several options). Again this might include many consultation sessions, extensive lobbying and several revisions and sufficient time should be planned for this.

6. Finalization of ASO plan and detailing the ASO communication plan (see functional building block 2.18). After having the ASO plan approved by Parliament, the ASO plan can be finalized for the selected scenario. This ASO plan will act as the working document for the NRT which will be continuously revised and updated. It will also include the ASO planning on the basis of which the ASO implementation can commence. As discussed previously, one work stream or result path of the ASO planning includes the ASO communication. Following the guidance provided in the ITU Guidelines (functional building block 2.18) a detailed strategy for informing/supporting the viewers and industry parties can be developed (included for each communication target group a planning for the various messages).

Figure 3.9: Flowchart of planning iterations (chapter and part number refer to the ITU Guidelines)



Source: Adapted from the ITU Guidelines

In Figure 3.9, the first iteration is the so-called service trade-off. In this trade-off transmission costs (given by the number of transmitters and the radiation characteristics), service quality (given by the multiplex capacity) and coverage quality (given by the coverage area depending on receiving installation and location probability) are balanced. The optimum solution should be found within the limits given by the decisions taken in the functional building blocks 4.1 (Technology and standards application) and 4.2 (Design principles and network architecture).

The second iteration is further balancing of the service trade-off optimum against the financial possibilities. If no satisfactory solutions can be found in the service trade-off, the service proposition and business plan may need to be reviewed, resulting in a possible review of functional building blocks 4.1 (Technology and standards application) and 4.2 (Design principles and network architecture).

3.4.4 Phase 3 DTTB regulation

The objective of this third phase of the Ethiopia roadmap is to have the required DTTB licences defined and the associated licensing procedure and planning published. In this way, clarity is provided to interested market parties to operate on the Ethiopia DTTB market. It also services the purpose of ensuring uninterrupted broadcasts, free of any interference from any other spectrum users.

Inputs

The input data for this phase are the DTB Policy document resulting from the first Phase of the Roadmap and the ASO Plan resulting from the second Phase. As indicated in Figure 3.4 in this report, the third Phase may start in parallel to the execution of Phase 1 and 2. For example, the NRT could start working on the activities in this Phase before the DTTB Policy document and ASO Plan have passed Parliament. Such an approach might entail some later changes/revisions of the resulting documents.

Outputs

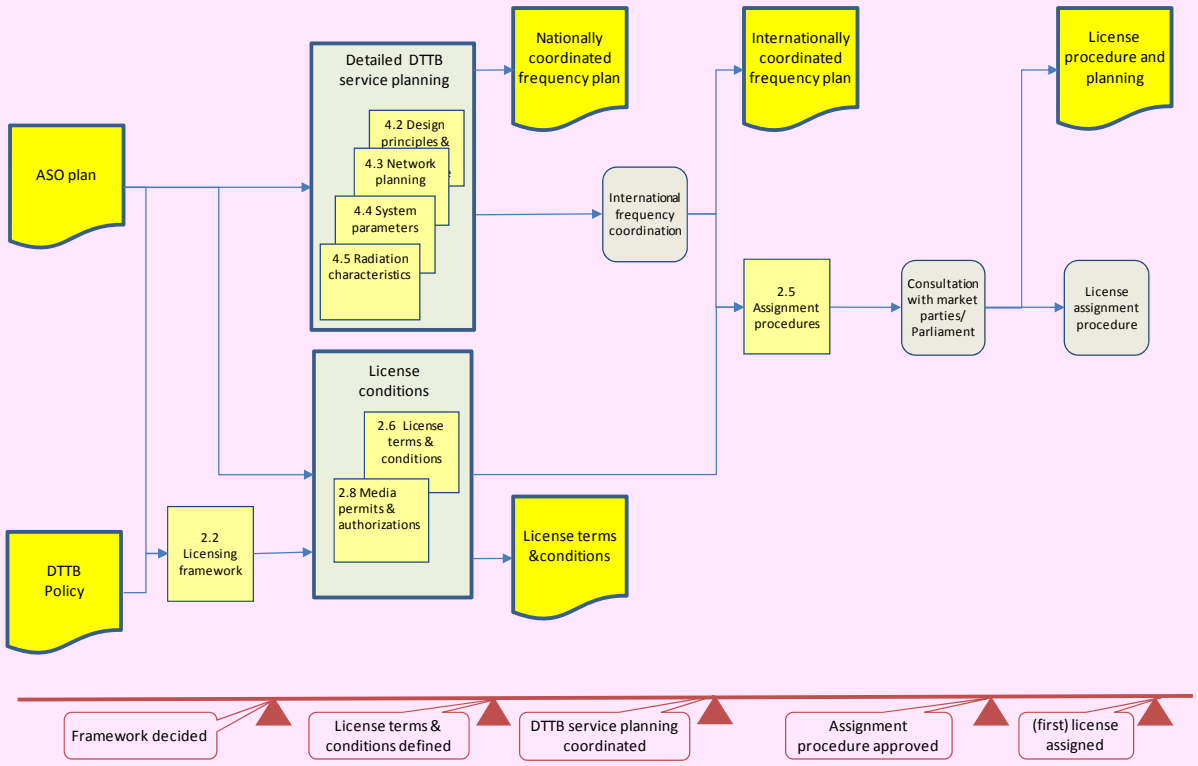
This third phase has the following output documents, of which the latter two might be published in the Official Gazette, including:

- A nationally coordinated frequency plan defining which DTTB frequencies will be used when in which geographical areas. This plan will have to be in line with the National Spectrum Plan or reversely made part of this National Spectrum Plan (please refer to functional building block 2.4 of the ITU Guidelines).
- An internationally coordinated frequency plan. As indicated before the GE06 plan for Ethiopia might need changes. However these administrative procedures may not be part of the critical path of the ASO planning.
- The DTTB licence conditions and terms. Depending on the selected licensing model (either model A or B, please refer to the functional block 2.2 of the Guidelines for more details) this might entail different licences (differentiating broadcast and spectrum rights) for the various value chain entities (e.g. the multiplex operator and the various service providers).
- A document describing the licence procedure and planning. For an example document please refer to the ITU Guidelines, footnote 97 on page 50.

Roadmap

The roadmap of the DTTB regulation phase and the associated functional building blocks is shown in Figure 3.10. The decisions taken, partly taken and not yet taken on the key topic and choices regarding phase 3 of the roadmap and the activities required to prepare the decisions that are still pending, are indicated in Annex 3.

Figure 3.10: DTTB regulation phase of the roadmap



Source: Adapted from the ITU Guidelines

As can be observed from Figure 3.9, the following steps (i.e. functional building blocks and non-DTTB specific activities) are included in the third phase of the roadmap:

1. Detailing DTTB service planning (see functional building blocks 4.2 – 4.5). After having agreed the ASO plan (including the initial DTTB service planning) a detailed service planning can be drafted. This detailed planning is different from the initial planning as on the basis of this planning network equipment should be ordered (including head-end, distribution and transmitter equipment). It will consider the specific site locations (no fictive locations) and its characteristics (what antenna and transmitter space is available), the available distribution possibilities, the ASO Plan (in which order will sites have to be put into operations). It will have to provide the details for the communication plan so that viewers know exactly what services they will receive where and what they have to do (e.g. instructions for retuning their exiting rooftop antenna or acquiring a new one).Please note that the detailed planning is a working document too. On the basis of this planning the network roll-out planning will be further detailed. During the roll-out changes will take place and the detailed planning will have to be updated and consequently the ordering of equipment (a rolling forecast system is also advised here).

2. Coordinating the required spectrum with national and international users. Based on the detailed planning, stipulating the exact spectrum use, the DTTB frequencies can be coordinated with other spectrum users. Coordination should take place at a national and international level. At a national level this is carried out by matching the detailed DTTB spectrum plan with the National Spectrum Plan. For example, this might entail changing frequencies in the detailed planning and/or migrating exiting national spectrum users. For the process of international coordination of the detailed planning we refer here to the GE06 agreement. As mentioned before the GE06 plan entries for Ethiopia might need revision.

3. Determining the licensing framework (see the functional building blocks 2.2). In this Phase the first key decision to be made is the applicable licensing model (model A and B). Apart from the underlying factors for selecting different licensing frameworks and the implementation guidelines as mentioned in the Guidelines (see respectively page 28-29 and 31-32), the following aspects for Ethiopia should be considered as well:
    a. DTTB licences already assigned (i.e. the Bridgetech licence) and the possibilities to change this licence if deemed necessary;
    b. the possibilities to establish an independent Multiplex operator quickly (model B), given the situation that ETV already operates a significant part of the required network infrastructure;
    c. the limited financial possibilities for rolling out a DTTB network (and all its associated costs as included in the ASO Plan) without the support of other industry parties. Moreover, from an economic point of view the market possibilities to bear the cost of rolling out and operating several independent DTTB networks.
4. Licence conditions and procedures (see functional building blocks 2.6, 2.8 and 2.5). Only after having a clear decision on the licensing model, the licence conditions and procedures can be defined. Clearly the licence conditions will vary under two different models. In case of model B, the spectrum licences will be assigned to an independent national multiplex operator and the broadcast rights to the various DTTB service providers. In contrast, in model A the spectrum rights can be assigned to the DTTB service provider as well. Consequently the licensing procedure will change too as the number and type of licences will be different.
5. Consultation with market parties and Parliament. Before actually deciding the licensing regime (to include licensing framework, conditions and procedures), the NRT can organize a market consultation to check the validity and market support for its plans. Given the limited number of directly involved market parties on the Ethiopian television market (see also Figure 2.1) this might be organized in a closed set-up with invited parties only. After market consultation, the NRT can support its proposal to Parliament with the feedback acquired in this consultation. Finally, before the licensing regime can be officially published the regime should be endorsed by Parliament. Sufficient time should be incorporated in the ASO planning for this endorsement.

3.4.5 Phase 4 DTTB implementation

The aim of the DTTB implementation phase is to have the DTTB network deployed and all sites in operation and switched-off in accordance with the ASO Plan (including the planning and the budget) and approved by the Ethiopian Broadcast Authority (EBA) (as national spectrum manager) and ITU (as international spectrum manager). In this implementation phase the (inter)nationally coordinated frequency plan is translated into a network rollout or implementation planning. As mentioned in the second ASO phase, the ASO planning comprises a network plan and roll-out work stream or result path. The network implementation planning feeds into this work stream.

It should be noted that this implementation phase only covers the steps to be taken for the DTTB network roll-out. The other work streams or result paths in the ASO planning will need further detailing too and all result paths will have to be kept coordinated with the progress of the network implementation planning.

Inputs

The input data for this phase are the licence procedure and planning (including the licence terms and conditions which also provide the timing of frequency (de)activation) and the (Inter)national coordinated frequency plan from phase 3.

Outputs

The output of phase 4 is a set of documents describing:

- DTTB implementation plan. Other than the actual DTTB network rollout planning, this plan also includes the project management structure and resources (including tasks, responsibilities, escalation procedures), detailed and broken down project budget and operational and financial progress reporting.
- Detailed coverage presentations. As the network roll-out progresses the coverage predictions become definitive (i.e. when the sites have been equipped and no further changes can occur). These detailed coverage predictions or presentations will feed into the work stream communication of the ASO plan. Please refer to Section 5.3 of the ITU Guidelines for more details service availability check and tools. As discussed in the first visit, coverage presentations can also be distributed in printed format. In this case, network changes should be kept to a minimum and sufficient time should be taken into account for distribution;
- Notifications to EBA that stations have been installed. The EBA as national spectrum manager should be notified of stations that are ready to be taken into operation. In the ASO planning, a timely reporting of these notifications to EBA should be carried out early so that this activity will not be an obstacle in the critical path;
- Approval by EBA of the stations. After having checked the transmitter station the EBA can provide an official approval. The EBA will check if the installation is in compliance with the assigned spectrum rights (in the assigned DTTB frequency licence). As Table 2.2 shows, local planning permissions are provided in close collaboration with the local councils. Hence these station approvals should be coordinated with local councils. For more details on the items on the check list please refer to Section 2.7.2. of the ITU Guidelines;
- Notifications to EBA that analogue TV has been switched off. For the purpose of updating its National Spectrum Register the EBA also has to be notified when the analogue transmitter (sites) are taken out of operation.

Roadmap

The roadmap of the DTTB implementation phase and the associated functional building blocks are shown in Figure 3.11. The figure also shows the relationship with the other work streams or result paths, which should be coordinated with the planning and implementation of the DTTB network roll-out (see the grey blocks in the top half of the figure). The decisions taken, partly taken and not yet taken on the key topics and choices regarding phase 4 of the roadmap and the activities required to prepare the decisions that are still pending, are indicated in Annex 4.

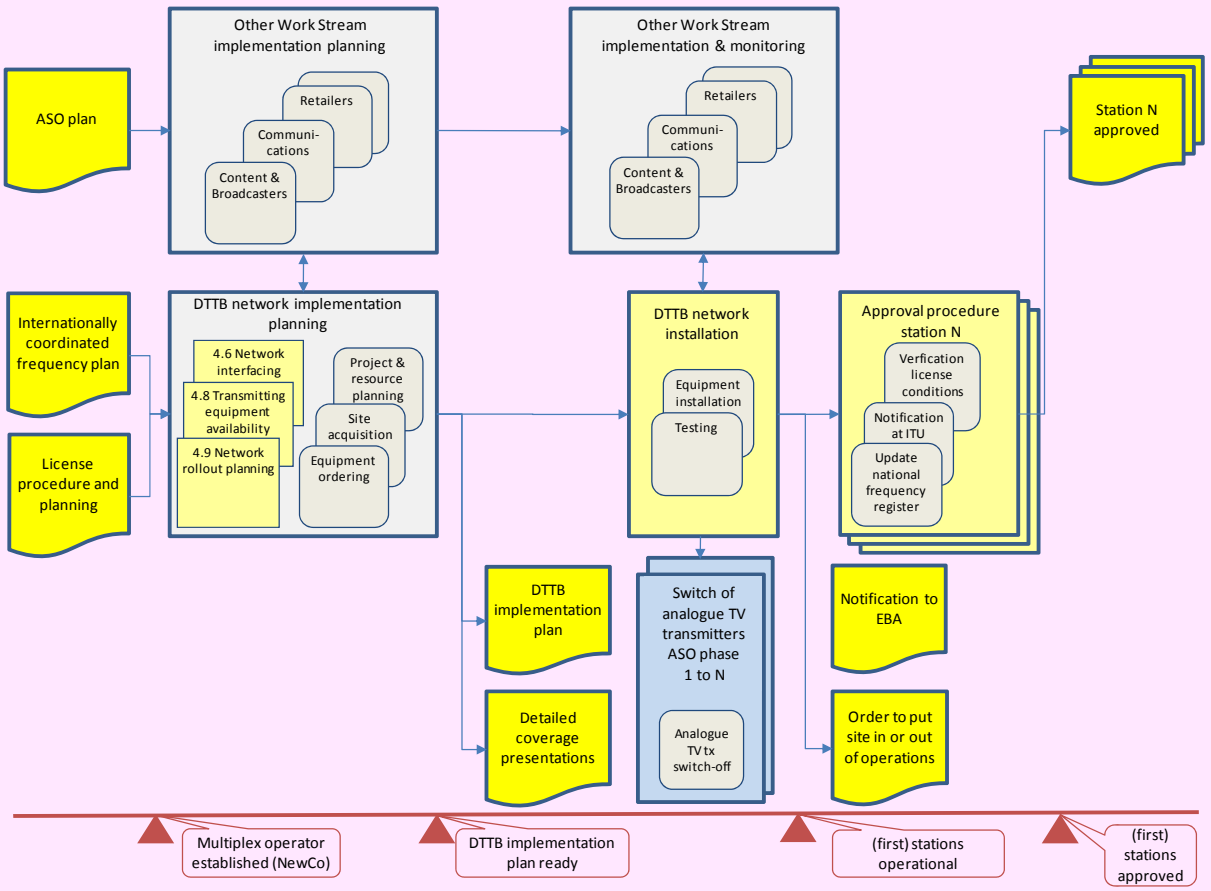
As Figure 3.11 shows, the following steps (i.e. functional building blocks and non-DTTB specific activities) are included in the fourth phase of the roadmap:

1. Developing and executing the DTTB network implementation planning (see functional building blocks 4.6, 4.8 and 4.9). Developing the network implementation planning entails a large amount of work and the functional building blocks of the ITU Guidelines cover an important part of this work but not all. The ITU Guidelines blocks cover the design and implementation of the network infrastructure ranging from the head-end(s), distribution network, transmitter sites, monitoring system and all interfaces of this infrastructure. For developing and executing a DTTB network implementation planning other critical activities will have to be incorporated in the planning, including:
    a. *Project management.* This includes the project structure and resources, budget management and reporting and progress reporting (not only to the project team members but also to the NRT).
    b. *Site acquisition.* Although an important part of the transmitter sites are already in operation, new sites will have to be acquired for completing the network. This might entail long

preparations (e.g. meeting/negotiations with local councils, land owners, public hearings, etc.) and procedures. Experience has shown that in many cases this is a critical path activity and sufficient time should be given to it.

c. *Equipment ordering.* Network equipment ordering is not an off-the-shelve ordering process. Manufacturers tend not to keep transmitters in stock. Production times are lengthy (i.e. 3-6 months and beyond). Also the testing and acceptance procedures take several stages (for example, in-factory testing, on-site testing and end-to-end testing). In addition, in Ethiopia the network equipment ordering might be closely related to the receiver ordering process.

Figure 3.11: DTTB implementation phase of the roadmap



Source: Adapted from the ITU Guidelines

2. DTTB network equipment installation. An important part of the installation process is managing the available resources. Especially when the ASO plan stipulates an approach with large phases (i.e. with many transmitter sites to be switched on and off simultaneously), the installation capacity should be well managed. In case the installation process is outsourced to the manufacturer, this capacity planning will be part of the equipment ordering process.

3. Approving stations. As indicated in this section, before any station can be operated, it should be approved by the EBA and notified at the ITU. When a station should come into operation it should be notified by EBA to ITU-BR. In case of a different transmission standard other than DVB-T it

should be notified in accordance to Article 5.1.3 of GE06 using form GB1[9]. When any difficulty arises with the notification, the Ethiopian administration is welcome to contact ITU Radiocommunication Bureau (BR)[10].

After approval, the EBA will update its National Spectrum Register accordingly.

4. Switching off stations. As the DTTB network implementation planning is part of the ASO Plan (and its associated planning), analogue transmitters will be switched off too. It is important that this will not only be reported to the EBA (as they can update their National Spectrum Register) but also to the NRT. These reports will feed into the work stream consumer and market monitoring, too, where this information will be used to monitor the progress of the ASO process and improve the logistics and communications.

4. Considerations on the top-ten most critical key topics and choices

In this section the top-ten most critical key topics and choices will be discussed in more detail. The order of these topics does not express their level of priority or importance. This priority is determined by the ASO planning and whether the topic is on the critical path of the ASO planning.

Table 4.1: Top-ten most critical key topics and choices in Ethiopia

No.	Key choices/decisions to be taken	(Part of) Block
1	Transmission standard	2.1, 4.1
2	Conditional access	2.1, 4.1
3	Model A or B	2.2
4	Required and available budget	2.9, 2.15, 3.1, 3.4
5	ASO model	2.14
6	ASO organization	2.15
7	ASO communication plan	2.18
8	Customer proposition	3.2, 3.1
9	Network architecture	4.2
10	Reception mode	4.2

Please note that some of the top-ten most critical key topics and choices do not necessarily correspond to the complete scope as addressed in the functional building blocks of the ITU Guidelines. For example, the transmission standard is part of the functional building block 2.1 Technology and standards regulation. This functional block also addressed standard setting for other system elements. In drafting and executing the Ethiopia roadmap all relevant choices and decisions will have to be considered.

4.1 Transmission standard

As said in the previous section, selecting the transmission standard is not only a technical and regulatory evaluation but should also explicitly include the specific aspects of independent/warranted supplies and affordable and sufficient supplies of DTTB receivers in Ethiopia.

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[9] See the Broadcasting Services Guide on the submission of notices, which can be found at: www.itu.int/ITU-R/terrestrial/docs/notice-forms/ge06/BS_Guide.pdf.

[10] email: brbcd@itu.int.

Following the ITU Guidelines the stipulating of a transmission standard involves regulatory and technical considerations (functional building blocks 2.1 and 4.1). Hence this section is structured accordingly.

Together with the abovementioned additional considerations, the provided regulatory and technical considerations should be included in an evaluation matrix where the appropriate importance/weights can be assigned to them in the NRT.

Regulatory considerations

The ITU Guidelines provide an implementation guideline for regulating the transmission standard for DTTB services. Please note that the guideline text below has been abbreviated and adapted for Ethiopia. Following this guideline the following observations can be made:

- Stipulate the transmission standard for new DTTB services because safeguarding the public interest (Universal Service) will be required *and* there is only a small down side risk of setting the wrong DTTB transmission standard:

  a. Setting a single standard will provide clarity in the Ethiopia market and will reduce consumer confusion as like in most other African countries, Ethiopia still has to implement the ASO. For a successful ASO, consumer choice should be limited and the ASO process itself manageable. Especially for the Ethiopia market, this could apply as the communication means are limited (limited Internet access and use). As the NRT has decided to narrow down the choice of the various options for the transmission standard, the single standard could be either DTMB or DVB-T2 standard. Please note that there are two versions of the DTMB standard (single carrier system and a multi-carrier system) and the risk of consumer confusion should be checked (as parallel and uncontrolled import of receivers will take place).

  b. Stipulating either DTMB or DVB-T2 standard is in line with the GE06 Agreement. Different standards are possible under the GE06 Agreement, including the Chinese DTMB standard. Both standards are in line with the applied spectrum envelope of the GE06 (see also Annex 5, subsection 2, Technical characteristics below).

  c. Setting the DVB-T2 standard will provide a future resilient standard as this standard is a so-called second generation standard. From a technical perspective, this second generation standard outperforms any first generation standard, including the DTMB standard (for more details see second part of this section). The only drawback of this standard seems to be the relatively high STB price (compared for example to DVB-T STBs which retail around EUR 10 retail, with MPEG2 and without CAS). Currently, in the UK DVB-T2 STBs retail for EUR 50 and prices are expected to drop further (considering the steep price decline the DVB-T2 STBs went through). The risk of setting the wrong standard seems to be limited.

  d. As indicated in section 2.3 Digital switch-over objectives, the launching of the first DTTB services is planned to be in 2012. At that time, especially if it is at the end of 2012, DVB-T2 prices will be lower. However, DTMB STBs seem to be cheaper. Currently DTMB STB wholesale prices are around USD 20 at a minimum order quantity of 2000 pieces (ex-factory)[11]. This would imply retail prices around the USD 40 mark. It is difficult to assess whether DVB-T2 prices will be close to the price of first generation STBs (including DTMB). In the end this will depend on the volumes in the end-consumer markets.

  e. In the Ethiopia market there are no other DTTB market players (let alone having a significant market share) that operate a DTTB service yet. Consequently this is not an element to take into consideration when selecting the transmission standard. The fact that there is already one DTTB licence assigned to Bridgetech, which stipulates the DVB-T standard, seems not to

[11] See for example http://factory.dhgate.com/set-top-box/hd-dtmb-set-top-box-p48394710.html.

be of great importance as this service operator has not commenced operations yet and is willing to wait for a decision from the regulator.

- In markets where more than one DTTB multiplex operator will be operational, the risk of having a fragmented local market is less likely and from this point of view setting a transmission standard might be necessary.

  For Ethiopia this could be the case, even if Ethiopia opts for licensing model B (one independent national multiplex operator) Bridgetech would still have to deploy its own network. Setting a single standard (either DTMB or DVB-T2) would be advisable in such circumstances.

Technical considerations

Annex 5 gives a summary of technical information on the DTMB and DVB-T2 transmission standards obtained from ITU and other sources. A comparison of the technical features of DVB-T2 and DTMB is shown in the Table 4.2.

Table 4.2: Comparison of technical features of DTMB and DVB-T2

Feature	DTMB	DVB-T2
Multiplex capacity	***	*****
Robustness	***	*****
Power economy	***	*****
SFN use	**	*****
Reception at high speed	***	*****

Note: The number of asterisks represents the relative advantage.
More detailed information is given in Annex 5.

DTMB and also DVB-T (on which the GE06 Agreement is based with regard to DTTB) are classified as a first generation DTTB standard, while DVB-T2 is a second generation DTTB standard. All first and second generation standards are flexible in their application. By choosing the appropriate system variant, the payload (net bit rate of the multiplex) and the C/N value (determining the power of the transmitter for a given coverage area) can be varied. As indicated in Section 4.3.1 of the ITU Guidelines, in applying a DTTB standard a balance has to be found between transmitter power, multiplex capacity and coverage area. This applies to DTMB and DVB-T2; however the ranges with DVB-T2 are much larger.

With a given transmitter power and a given coverage area, the multiplex capacity of a DVB-T2 transmission is much larger than with DTMB or DVB-T. In the examples given in Section 4.9.2 the multiplex capacity under these conditions is 24.3 Mbit/s with DTMB and 40.2 Mbit/s with DVB-T2.

Alternatively, with a given transmitter power and a given net bit rate of the multiplex, the coverage area of DVB-T2 transmission is much larger. Instead of a larger coverage area, the higher efficiency of DVB-T2 can be used in reducing the power of the transmitter, while keeping the coverage area the same. Practical examples of are given in Section 4.10.

Improved SFN use of DVB-T2 is possible because of the larger guard intervals that can be achieved with FTT sizes of 16k and 32k. Improved reception at high speed with DVB-T2 is obtained by means of time interleaving and in addition the possibility to use the 2k FFT size.

Planning criteria for DTMB are given in Draft Revision of Recommendation ITU-R BT.1368. In ITU, work is in progress on a new Recommendation regarding planning criteria for second generation DTTB standards and no planning criteria are available yet in ITU. However, a detailed description of the technical features

of the DVB-T2 standard and information on frequency and network planning is given in EBU Tech 3348 Frequency and Network Planning Aspects of DVB-T2, Geneva May 2011[12].

The choice of the transmission standard, being either DTMB or DVB-T2 has a major impact on the network architecture and network planning (see sections 4.9 and 4.10) and therefore on the cost of the network and the coverage that can be achieved.

4.2 Conditional access

It is not common for the regulator to stipulate a standard for the conditional access system (CAS) (see ITU Guidelines, section 2.1.2). The underlying reason for this neutral regulatory stance is that in most countries pay-tv operations on a DTTB platform are offered by one single service provider (either operating one or more multiplexes), mostly a commercial market party. The risk of consumer confusion and market fragmentation is limited as subscribers to the DTTB pay service can only go to one provider.

However, it was expressed that ETV has the ambition to offer a pay-tv service on the DTTB platform, next to its free-to-air services. Given the fact that Bridgetech is going to launch a pay-tv service as well, the risk of market confusion and market fragmentation does arise.

It should be noted that an additional reason for having conditional access (CA) at the public service broadcaster (PSB) platform was identified. The CA could be used to collect television licensing fees as a source for financing the ASO. The CA would provide the regulator with the means to switch-off PSB services of non-paying viewers and hence make the collection of the television licence fees far more effective (see also Section 4.7).

Public service broadcasters offering pay-tv service on a DTTB platform is rarely seen, especially in the framework of an ASO. Spectrum/capacity availability and strictly defined Broadcast Acts (and hence the associated funding of the PSB activities) limit the possibilities of public service broadcasters to do so (in most Western/European countries).

Whether the CAS standard should be stipulated depends therefore on the decision of ETV to offer a pay-tv service (or to have it has a means to collect television licence fees). The following considerations could be taken into account when planning to introduce pay-tv services:

- The business case for offering a pay-tv service should be clarified. The additional revenues that can be generated, next to the free-to-offering and the Bridgetech offering should be quantified and compared to the additional costs of having DTTB receivers with embedded CAS (the option of having a CAM is excluded for its high additional costs). In the case of financial compensation for viewers (e.g. set-top-box vouchers) the pay-tv decision will directly impact the required ASO budget.
- The intended date of launching these pay-tv services. A service launch beyond the ASO planning (i.e. beyond 2015, see also Section 2.3 of this report) might open up the possibility to wait and see what the Bridgetech service uptake will look like. In the case of a successful service take-up, a 'standard' might already be adopted in the market and CAS standard regulation might not be necessary (ETV can adopt the Bridgetech applied CAS).
- Compliancy with the existing regulatory framework. Especially the Ethiopian RTV and Broadcast Act (see Table 2.2) should be checked whether such a pay-tv offering might constitute conflicts with this legislation. Given the fact that Bridgetech has already been assigned a licence, this might also give rise to anti-competition claims. As included in the first phase of the roadmap, these considerations are also included in functional building block 2.11.

[12] See http://tech.ebu.ch/docs/tech/tech3348.pdf.

- The need for additional pay content, the willingness to pay and the associated production costs (to include in the above mentioned business case clarification). Ideally on the basis of market research such a need for additional pay content should be identified (see also the functional building block 3.2 in the first phase of the roadmap).
- In the case of having pay-tv services of ETV and Bridgetech, billing costs can be lowered by sharing not only the CAS but also the Subscriber Management System (SMS) between the two pay-tv service providers.

Following the decision of ETV to offer a pay-tv service and provided that this service will be launched either before the Bridgetech offer or closely after (within the period of the ASO planning), it is advisable to stipulate a standard for the CAS. The following considerations could be taken into account when selecting the CAS:

- Make an inventory of the production numbers (i.e. the number of clients and deployed smartcards) of the various set-top-box suppliers for both transmission standards (DTMB and DVB-T2). Economies of scale apply here too: set-top-box production lines with a large number of single embedded CAS boxes will be cheaper.
- Check smartcard prices and their delivery volumes/schedules. Smartcard prices can vary significantly between suppliers and also the way they can be ordered (the possibilities of rolling forecasts and minimum committed order size).
- Assess the risk of hacking. Please keep in mind that efforts to hack a smartcard are directly related to value of the pay-tv package. In addition, smartcards are often only temporarily hacked and rarely cards have to be recalled. Verify the CAS supplier's track record and the way they have organized recovery procedures (including the costs and who will have to bear what cost in case cards have to be recalled).

4.3 Licensing framework model A or B

The ITU Guidelines includes several considerations for selecting either model A or B. Please note that the guideline text below has been adapted for Ethiopia. Following this guideline the following observations can be made:

1. *Spectrum management objectives*: In order to increase spectrum efficiency the regulator would like to avoid content duplication. In both models this can be accomplished:
    a. in (a variant of) model A the spectrum rights are awarded in combination with an obligation to provide a defined bouquet of channels, for example as proposed in the bid book or stipulated by the EBA;
    b. in (a variant of) model B the spectrum rights are award to an independent multiplex operator (functional bandwidth manager) and the EBA grants capacity to individual content aggregators or broadcasters in a transparent and non-discriminatory way.
2. *Competition rules and objectives*: the regulator would like to see the introduction of a new competing platform next to a dominant (e.g. satellite or cable) platform. The applicability of this consideration in Ethiopia seems limited as the combined viewing audience of Arabsat and IDTV is approximately 1 million (which under a conservative estimate does not represent a market share of more than 5 per cent). However both models can facilitate the establishment of a strong DTTB platform:
    a. in model A: the spectrum rights are assigned to a service provider with enough capacity to provide a competitive offering, by aggregating several multiplexes (next to having capacity reserved for PSB), or;

   b. in model B: when assigning the broadcast rights (i.e. capacity slots) to the individual service providers or content creators, it stipulates free-to-air broadcasts and/or a single CAS. In addition, the Regulator should stipulate a common and shared EPG.

3. *Market structure and environmental objectives*: in order to avoid duplication of infrastructure. Again, in both models this can be achieved:

   a. in model B: by assigning only one licence for the frequency and operating rights, the regulator ensures that only one network will be rolled-out (variant of model B);

   b. in model A: the operating rights are put into operation by laying down site and, possibly, antenna sharing obligations. Such an arrangement only 'loosely' avoids infrastructure duplication. In addition the regulator can stipulate that Bridgetech and ETV roll-out a common infrastructure and even share multiplex capacity.

4. *Media rules and objectives*: the Regulator would like to see the analogue television services continued onto the digital platform(s)". Assuring this objective can be facilitated in both models:

   a. in model A: assigning multiplex capacity (spectrum rights) for the existing PSB services by priority to ETV;

   b. in model B: reserving capacity on the available multiplex capacity for the existing PSB services and assigning the associated broadcast rights to ETV.

As the above considerations show, all regulatory objectives can be achieved in both models. However it can be said that the degree of 'grip' on the content varies between the models. In model B the control is greater and most direct for the regulator as it can control the platform itself as well as the access to the platform. However, it should be realized that changing content might be lengthy as a new assignment procedure (for assigning the broadcast rights) have to be conducted. In model A the content control is largest for the (regional) broadcasters as they will manage their own DTTB network and control the access to this platform (only if they hold the frequency rights).

Both models have to be mapped on the current legal framework and market structure (i.e. the current roles and assets of the various players in the value chain, most notably the ETV) and the way it can fit (or the required effort to change the legal framework) has to be assessed.

In addition to the above considerations and evaluation, an important aspect will be the possibility of sharing network costs with other commercial players. For example, in Kenya the government works together in Public Private Partnership (PPP) in rolling out one common DTTB infrastructure (model B). In model A network costs can also be shared (see above considerations) which will dependent on the willingness to cooperate for the current and future DTTB licence holders (i.e. Bridgetech and any other future commercial service providers).

It should be noted that infrastructure sharing can also take place between the national and regional public service broadcasters. Especially in case of licensing model B the current infrastructure of the regional broadcasters can be shared with the national infrastructure (ETV). Such sharing can optimize the DTTB common network infrastructure to ensure that the current analogue national and regional coverage will be matched (or further extended). Moreover, it could result in even better or improved DTTB coverage. For example the Addis TV site in the centre of Addis Ababa, working together in an SFN with the Mount Furi station (ETV), could improve in-door coverage in Addis Ababa.

The NRT should draft an evaluation matrix where the appropriate importance/weights can be assigned to all abovementioned considerations.

4.4 Required and available budget

As mentioned in the second ASO planning phase of the roadmap, the ASO phase will have to deliver a business case detailing the costs and the financial resources. In this section considerations on both costs and 'revenue' side are included.

Cost consideration

The ITU Guidelines provide in Table 2.15.2 an overview of the relative impact on the size of the ASO organization and costs, depending on what responsibilities the NRT takes on board. Below an adjusted table is provided including considerations for the situation in Ethiopia.

Table 4.3: ASO activities and budget impact for ASO process in Ethiopia

No.	ASO Activity	ASO organization function	Considerations for Ethiopian situation	Relative cost/ budget indication
1	Migrating viewers to digital	Logistic function for administrating and handing-out vouchers Logistic function for aerial retuning and installation Contact centre (and/or community centres) function for (technical) assistance Consumer communication function Media and Public Affairs function	Depends on the actual/final coverage of the DTTB network. Assuming the 80 per cent coverage target (as mentioned in Table 2.3) this could entail a considerable operation. Financial impact can be limited if financial compensations is minimized (see brackets in next column): 1. Only existing analogue terrestrial viewers are financially compensated (and not the analogue extensions); 2. Selection of cheap(est) set-top-boxes; 3. Partly financial compensation (not the whole purchase costs) or loan system (please note this will include interest/finance charge for the Government). The willingness to pay or the ability to pay should be known; 4. Roll-out indoor coverage network, as to avoid roof-top antenna purchase costs.	++(++)
2	Transmitter network migration efforts	Network planning function	Depends on the actual/final coverage of the DTTB network. Given the situation that a large extent of the infrastructure is already purchased and installed, additional costs will arise from extra multiplexes and/or sites (for example to provide indoor coverage or to facilitate more services). Especially adding sites can entail significant costs (see brackets in next column).	+(++)
3	Re-farming of spectrum efforts and compensations	Network planning function	According to current information provided (but should be checked, see remarks in Phase 1, functional building block 2.3), there are no existing spectrum users to be migrated or licences to be revoked (although the assigned rights of Bridgetech should be checked).	0
4	Simulcast period for PSB services	Broadcast network roll-out monitoring function	Depends on the decision of having a simulcast period. But even in the case of simulcasting, the costs will be limited as 1. The number of simulcast sites are limited (current estimate is 28 sites); 2. The simulcast period is limited to a maximum of 3 years for the whole country and in the case of a phased ASO the simulcast period can be reduced for the later phases.	+

No.	ASO Activity	ASO organization function	Considerations for Ethiopian situation	Relative cost/ budget indication
5	Managing the ASO process	Broadcast network roll-out monitoring function Market monitoring and research function Consumer communication function Industry communication functions	Assuming all functions (see left column) will be included in the NRT responsibilities and NRT members will be mainly Government entities managing efforts and costs might be relatively low. Given the low penetration rate of Internet access and use in Ethiopia, communication costs might be relatively high (e.g. printed materials and more radio broadcasts). The use of community centres should be considered. This could be both effective as economically feasible.	+
6	Setting mandatory certification and labelling	Industry liaisons function	These costs could be minimized by: 1. Stipulating a widely accepted and proven transmission standard; 2. Not stipulating a CAS standard; 3. Implementing a voucher system for a single standard receiver (i.e. set-top-box).	+
7	Cost for resolving any DTTB interference	Logistic function for handing-out connectors Contact centre function	Interference issues are unlikely to occur in Ethiopia, given; 1. The absence of widespread cable networks and home installations; 2. Limited or no other spectrum use in the DTTB assigned bands (to be checked though).	0

From Table 4.3, it can be concluded that the main cost element for the ASO process in Ethiopia is likely to be the costs for migrating viewers to digital and then when financial compensation will be provided. Secondly, depending on the minimal costumer proposition to be offered (e.g. 15 or more channels in combination with indoor reception), the network costs could increase significantly.

Budget considerations

An inventory should be made of the possible sources for financing the abovementioned ASO costs. The ITU Guidelines provides guidance on source for funding (see page 73). Table 4.4 provides some first considerations on the various sources.

Table 4.4: Funding source for the ASO in Ethiopia

No.	Source	Considerations for Ethiopian situation
1	General taxes	When financing the ASO from general taxes the following should be taken into account: 1. Given the 80 per cent target coverage (please note this geographical not population coverage) as indicated in the DSO objectives, a substantial part of the population will pay towards the ASO but will not directly benefit from DTTB. This may constitute a political barrier; 2. This is a form of indirect financing of activities (not through a purpose specific tax levy); the ASO costs and benefits have to be balanced against other national priorities (e.g. building schools or roads). This political process might be long and the ASO Plan should take this into account when deciding to include this source in its financial planning.

No.	Source	Considerations for Ethiopian situation
2	TV licence fees	Raising the TV licence fee can be an option to finance the ASO process. The following should be considered: 1. The current administrative procedures for collecting the licence fees should be tested on adequacy for doing so and for keeping a tight control (especially when the increase will substantial). Having CA could be an effective option to collect the television licence fees; 2. The current basis for collecting the fees is television set ownership. This will not cover viewers that are currently not served, but will be served by the DTTB network. This basis may need revision (and could be STB).
3	Industry levies	The number of licensed spectrum users which are not Government owned is very limited in Ethiopia (mainly some commercial FM operators with income from advertising). Hence the basis for additional industry levies seems to be limited. Industry levies beyond commercial spectrum users (for example, special levies for equipment suppliers) will be problematic for (inter)national competition rules and policies. Moreover this may work adversely as equipment prices will go up.
4	Spectrum auctions of tenders	As can be learned from the Guidelines spectrum auctions and tenders procedure with substantial upfront payments are rarely seen for DTTB licences. In addition one commercial DTTB licence has already be assigned, without substantial payment (Bridgetech). As the digital migration process will result is a digital dividend and if Ethiopia would decide to allocate this dividend to IMT services, the spectrum licences for these new services could be auctioned off. This might be an important source for funding the ASO process. However, it should be noted that these revenues (i.e. the auction proceeds) might come before the ASO costs and hence the Government might have to advance the ASO costs (implying a loan).
5	International organizations (ITU/NGO/World bank, etc.)	Seems limited but no practical information available.
6	Public Private Partnerships	As indicated in the Guidelines, different forms of PPPs can be applied: 1. A commercial party rolls-out the network/service and the PSB is carried in the bouquet. In return for its investment efforts the commercial party is allowed to use the remaining multiplex capacity of the PSB multiplex, does not have to pay any content rights for the PSB content and gets access to EPG data (a form of model A); 2. A Public Broadcaster rolls-out the network/services with multiple multiplexes and a conditional access platform allowing pay-tv services to be billed. The Public Broadcaster rents out the remaining capacity to any commercial broadcaster interested in DTTB distribution (a form of model B); 3. The Public Broadcaster and a commercial network operator jointly finance the DTTB network, providing a free-to-air and pay-tv DTTB services. Remaining capacity will be rented out to any other commercial broadcasters (a form of model B). As can be derived from the Table 2.1, foreign ownership rules are applicable in Ethiopia. A PPP financing structure may require revision of these rules (as to make it interesting enough for foreign parties to participate). The ASO planning should facilitate time for any such change.

From Table 4.4, it can be concluded that financing the ASO will take a considerable effort, for any of the abovementioned funding sources, to generate substantial money. This should be carefully balanced against the ASO cost items (and the possibilities to minimize them).

4.5 ASO model

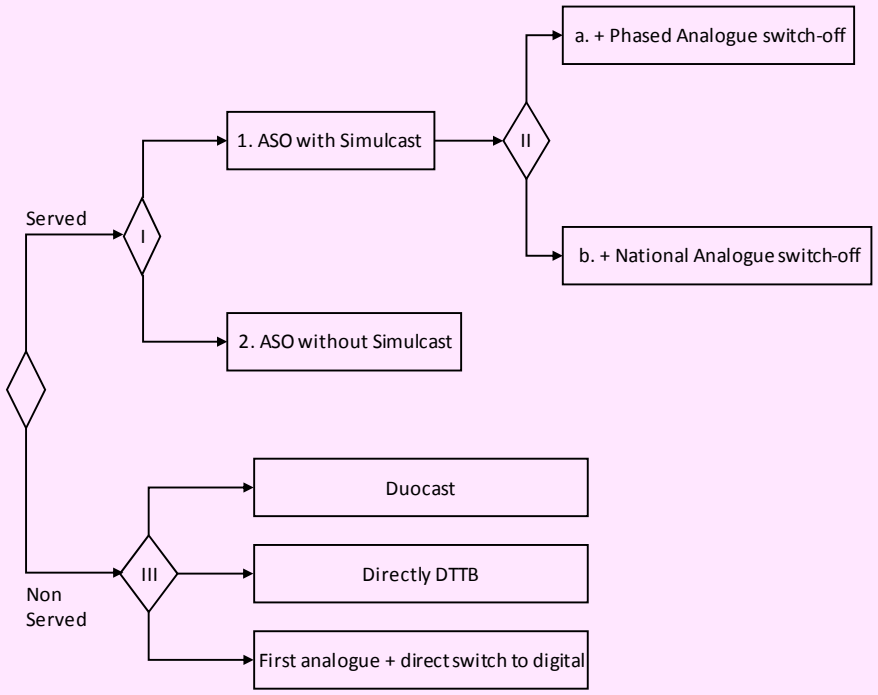
The following options have been identified in the following two situations:

1. in the currently non-served analogue TV areas: first analogue broadcasts followed by a direct switch to digital broadcasts or duocasts (i.e. alternating analogue and digital broadcasts in a limited period, for example a day) or directly start with the DTTB service;
2. in the served analogue TV areas: simulcast.

For all options a phased approach can be applied with a DTTB network already nationwide deployed (i.e. 80 per cent geographic coverage without clarity yet on the reception quality). As the nationwide DTTB network is currently being installed the option of staging the rollout of the DTTB network is excluded (this was an identified option in the ITU Guidelines). This might change if network extensions are necessary to provide a better reception quality (e.g. for indoor coverage).

When including the above situation in Figure 2.14.4 of the ITU Guidelines the figure for Ethiopia will look as indicated in Figure 4.1.

Figure 4.1: ASO models in Ethiopia



Source: Adapted from ITU Guidelines

Following the ITU Guidelines (see also chapter 2.14.4) the following considerations can be provided for the situation in Ethiopia:

1. Decision I (served areas):
   a. Simulcast is applied when the government stipulates a simulcast period. This is likely when the (political) risks of failure are assessed as high. This might be the case in Ethiopia as the analogue terrestrial television platform is of high importance for the PSB services. Both Arabsat and DSTV only provide a part of all the PSB content and they represent a low market share.
   b. Even in the case where the government does not explicitly stipulate a simulcast period, the risk of losing viewers might be high in Ethiopia as communication means are limited and

might be slow for taking counter measures. As previously discussed the cost for simulcast could be limited.

2. Decision II (served areas):
    a. Simulcast with a phased switch-off is applied when the number of analogue terrestrial television viewers is relatively high and the ASO operation is large. Both seem to be applicable for Ethiopia. The terrestrial platform is the key platform for PSB. In addition, Ethiopia is a large country were rural areas are difficult to reach and supplying these areas with information and receiver equipment are likely to entail considerable effort.
3. Decision III (non-served areas):
    a. Offering duocasting in non-served areas will need an extra planning and communication effort because:
        i. viewers need to retune their receiver installation more than once (e.g. from analogue Band III to Band IV/V and from analogue to digital) in a relatively short time span;
        ii. viewers need to have the rotating programming schedule explained and this schedule might not only give rise to public discussion but also within the PSB system;
        iii. the advantage of having an additional duocasting phase needs to be explained (in addition the advantages of a full DTTB offer later). This might be difficult as the added value seems to be limited (e.g. no extra channels or services like the EPG will be offered);
        iv. Duocasting will impose on viewers a change of the antenna input from the analogue television set to the set-top-box (assuming the number of IDTVs will be limited).
    b. In contrast, directly switching to digital will entail a much simpler message as the benefits of DTTB will become directly evident and only one change has to be explained.
    c. Introducing first analogue broadcasts and switching directly to digital services at a later date. This option arises if the existing analogue network coverage is first extended with additional sites with single (A/D switchable) transmitters (not considering the back-up transmitter). If no extra transmitter is installed at those additional sites simulcast is not possible. This option needs careful consideration because:
        i. it requires an explanation why other analogue viewers will be offered a simulcast period and the not later analogue viewers (in the current non-served areas, and this might be politically sensitive);
        ii. the additional analogue viewers that will be added to the existing analogue viewers (i.e. 20.3 million viewers representing approximately 25 per cent of the households[13]) might be substantial given the 80 per cent geographical coverage target. Hence the considerations under decision (I) are likely to apply here too.

4.6 ASO organization

A key element for the ASO organization, is that the NRT will coordinate and facilitate cooperation throughout the value chain. With reference to the value chain as presented in Section 1.2 and 2.15.1 of the ITU Guidelines, Table 4.5 provides considerations on the functions and entities to participate in the ASO organization (i.e. the NRT in the most extended form).

[13] Assuming that the total population of Ethiopia is approximately 82 million, see www.csa.gov.et.

Table 4.5: Considerations on the ASO organization in Ethiopia

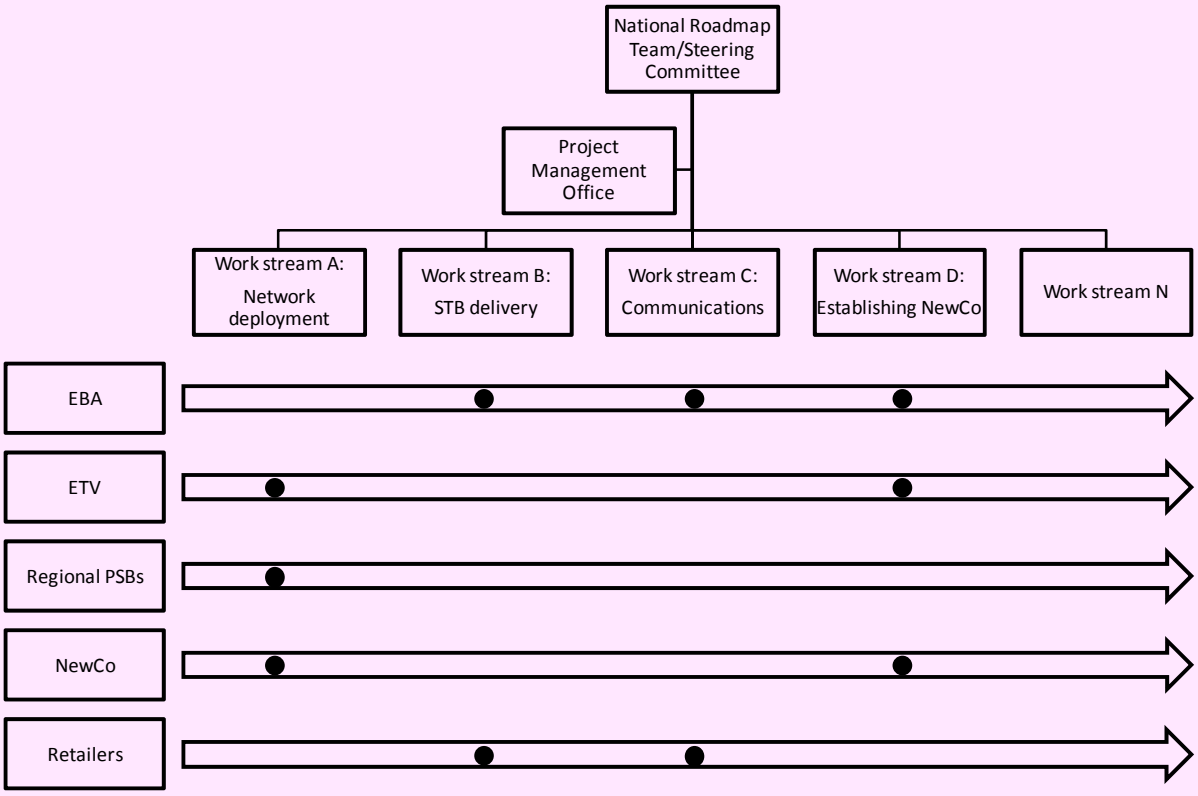
No.	Entity	Tasks	Considerations for Ethiopia
1	Government	Government needs to take political decisions, setting a firm ASO timetable.	The NRT team should include a 'liaison officer' to quickly check and monitor political issues and considerations. Staged approach, in which first a DTTB policy document is agreed (see Section 3) and later ASO Plan.
2	Government	Government needs to decide and political agree the ASO model and later Plan.	The NRT team should include a 'liaison officer' to quickly check and monitor political issues and considerations. Staged approach, in which first a DTTB policy document is agreed (see Section 3) and later ASO Plan.
3	Regulator(s)	The regulator(s) should manage and execute any additional frequency coordination efforts to free-up (temporarily) spectrum (very often with neighbouring countries).	Likely to be a task of the NRT. Especially considering the remarks in Section 3 on the need for clarifying the GE06 plan entries.
4	Regulator(s)	The regulator(s) need to assign the required DTTB media and frequency licences (to the PSB and commercial parties, either a service provider or individual broadcasters).	Evidently a task of the NRT.
5	Regulator(s)	The regulator(s) might need to take away any obstacles in the acquisition of building permits (in case new sites or temporarily transmitter sites have to be erected quickly) or any other permits.	Likely to be a task of the NRT. As concluded in Section 2 of this report, in the current situation there is already an established relationship in coordinating these building permits with local councils (when issuing broadcast licences).
6	Content creators	Be informed about the ASO timetable and the impact on the production chain.	Commercial/third party content creators unlikely to participate in the NRT. The main content creator in Ethiopia is the PSB (including the regional broadcasters). The PSB will participate in the role of broadcaster (content aggregator).
7	Content creators	Come to agreement about the content rights for PSB services (or any other service transitioned from the analogue platform) on the DTTB platform.	See consideration above.
8	Content Aggregators (Broadcasters)	Broadcasters need to ensure that viewers are informed (by incorporating ASO items in their programming).	Evidently a task of the NRT and the PSB is very likely to participate. No commercial broadcasters with production/studio facilities on Ethiopian soil. It could be considered to involve Arabsat, although not as a NRT member.
9	Content Aggregators (Broadcasters)	Broadcasters need to ensure the continuation of receiving their television services by delivering their television feeds to the DTTB head-end.	Evidently a task of the NRT and the PSB is very likely to participate. No commercial broadcasters with production/studio facilities on Ethiopian soil. In case of a coordinated roll-out with Bridgetech, it could be considered to involve Bridgetech as NRT member (see also consideration below).

No.	Entity	Tasks	Considerations for Ethiopia
10	(other) Multiplex operators/Service providers	Make sure that the marketing around analogue switch-off does not favour the terrestrial platform but instead informs viewers about opportunities for television reception across all platforms. In case of a DTTB service provider already in operations, this provider should also cooperate in the coordination of the additional DTTB network(s) roll-out.	Arabsat could provide an alternative platform and hence they could contribute to the NRT (see also the consideration above). Although Bridgetech is not in operations yet, in ether model (A or B) a coordinated roll-out will contribute significantly to the success of the ASO process. It could be considered to involve Bridgetech as NRT member.
11	Content distributor	Network operators need to detail the network planning and the associated roll-out planning.	In both models (A or B), representatives of the network operator function (ether the broadcasters with their own network or the common multiplex and network operator) are evidently need in the NRT.
12	Content distributor	Network operators need to carry out the DTTB network roll-out.	In both models (A or B), representatives of the network operator function (ether the broadcasters with their own network or the common multiplex and network operator) are evidently need in the NRT.
13	Device creators	Manufacturers need to supply sufficient quantities of DTTB receivers in regions.	This will include the retail chain as well. STB Manufactures are not likely to participate in the NRT, but a good 'liaison officer' will be needed. Representatives of logistic chain providers (shops, post offices) are likely to be included in the NRT.
14	Device creators	In case of pay-tv, CAS suppliers need to supply smartcards.	Not likely to be included in the NRT.
15	Device creators	Manufactures may be required certify compliancy with any set standard (see section 2.1) and to provide proper or specific labelling.	This will require a trusted organization to do so. Given the limited means for communications this should ideally be an organization already know to the Ethiopian public. Such an organization is likely to participate in the NRT.
16	Viewers	Help setting acceptable timetables, understanding local issues and formulated adequate messages/tools.	Representatives of the various viewer groups are likely to be included in the NRT. This needs special considerations given the many cultural backgrounds and languages spoken in Ethiopia.

Apart from the considerations included in Table 4.5, one of the other key success factors for the ASO process is strong leadership. The starting point for this is providing the NRT with a clear mandate, sufficient budget and staffing it with the right people (i.e. not only the right qualifications and skills but also with the authority to represent).

In Figure 4.2, an example organizational structure is provided for the ASO Committee or NRT. The scope of the organization is mainly driven by the government's scope of assumed responsibilities. For Ethiopia this scope can be derived from Table 4.5.

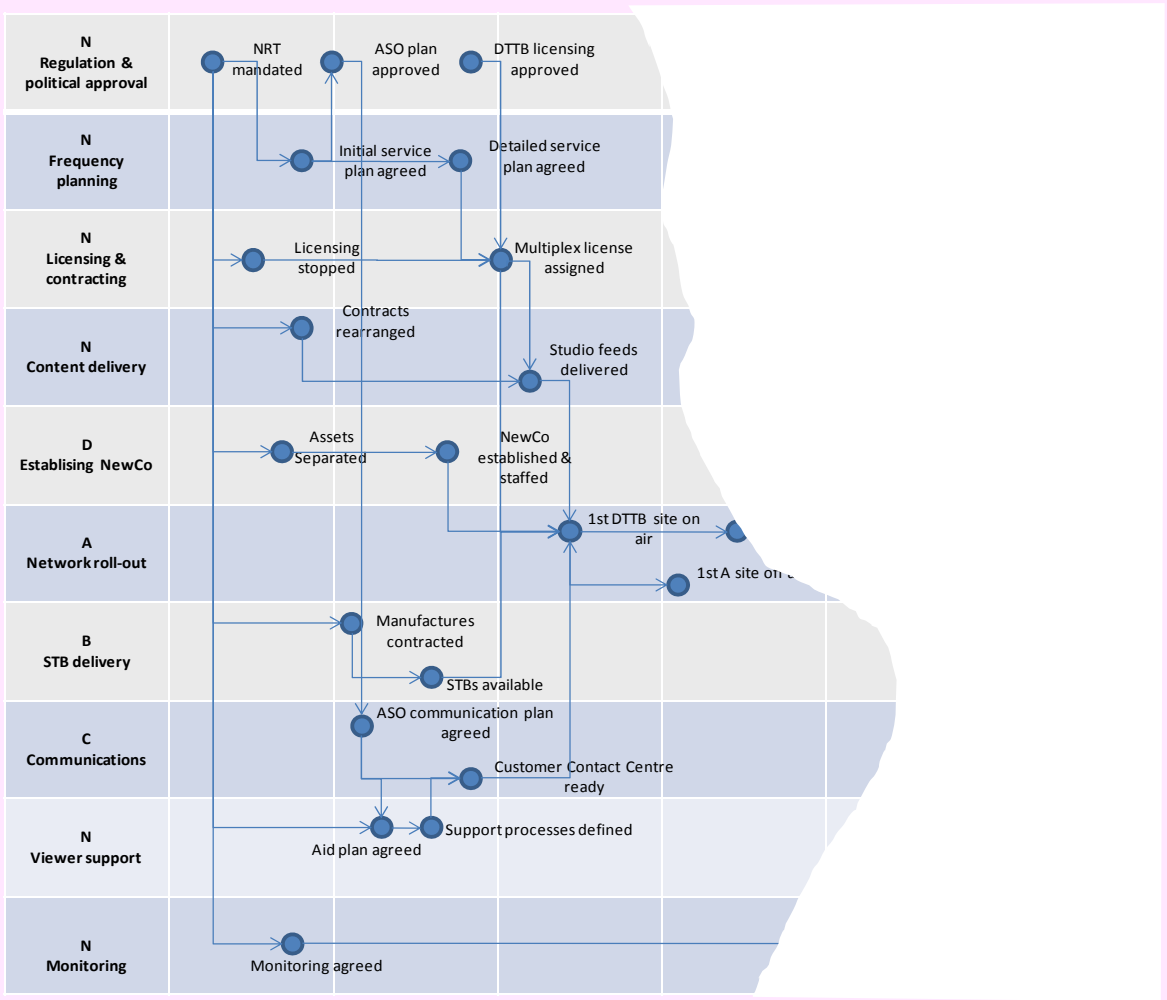
Figure 4.2: An example ASO organizational model



Source: Adapted from ITU Guidelines

Figure 4.2 also shows the several work streams or result paths. Each team, for example comprising representatives from EBA, ETV and the regional PSBs, is responsible for delivering the milestones of that work stream (for example delivering a tested and operational DTTB network). Each team will draft and execute its planning for delivering these milestones and the Project Management Office will integrate all work stream plans into an integrated ASO planning and will monitor/report progress to the NTR/Steering Committee. Figure 4.3 shows an example of integrated ASO planning (top level).

Figure 4.3: An example ASO planning (top level)



Source: Authors

4.7 ASO communication plan

As indicated in the ITU Guidelines, the ASO communication plan is a strategy on how to inform the public at large and the involved market players in several successive stages. One of the main deliverables in preparing this plan is a matrix which matches:

- the different target groups with;
- the different messages (per stage).

It is important to realize that two markets exist in Ethiopia; the served and the non-served (with analogue terrestrial television) areas. Consequently, the communication messages between these two groups will differ significantly.

In the served areas, different reception situations exist. For example situations in which viewers have a rooftop antenna or viewers only have an indoor antenna (i.e. the 'rabbit ears'). Instructions for antenna re-use/re-directing for receiving the DTTB service will differ for each group. Secondly, the analogue service package differs.

From Figure 2.3 above (Section 2.1), the following situations can be derived, viewers receiving:

- only ETV1;
- ETV1, ETV2 and ORTV;
- ETV1 and ORTV
- ETV1, ORTV, Dire TV;
- etc.

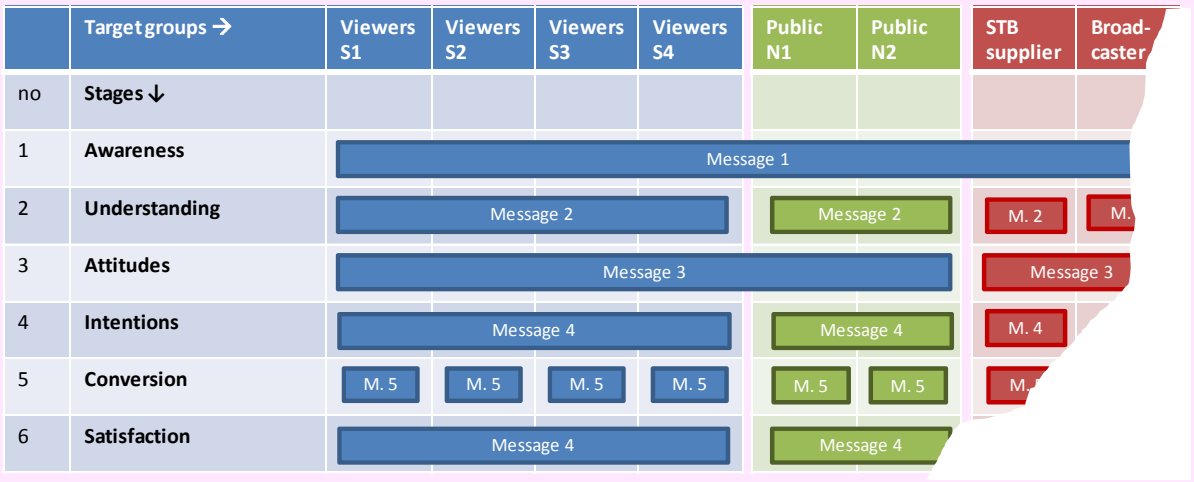
In both the served and non-served areas there are viewers who receive Arabsat and/or DSTV. All these different reception situations will imply different messages, although some messages can be common (e.g. in the awareness phase of communications). But definitely at the conversion stage, in which the viewers have to be explained in detail what he/she has to do to change to digital, the message will differ.

Next to the target group 'the public' other involved market parties have to be informed too. Depending on the responsibilities the ASO organization will take on board (for example whether or not a voucher system will be implemented), the following target groups could be included in the matrix:

- STB suppliers and retailers;
- certification and labelling institutes/organizations;
- broadcasters;
- content creators;
- landlords and public places (with television sets);
- government entities (e.g. local councils, regulatory bodies, etc.);
- voucher (or loan) supplier.

In Figure 4.4, the matching of different target groups with the different communication stages and messages is illustrated.

Figure 4.4: Example communication matrix for Ethiopia



Source: Authors

In drafting its communication strategy the NRT should also consider the role of Bridgetech. Bridgetech could help promote the DTTB platform and inform viewers about digital television and the switch-off of analogue services. Form this communication perspective, it is important that Bridgetech would then

deploy the same STBs as the PSBs (i.e. with the same transmission standard and, if applicable, the same CAS). In a coordinated deployment of commercial and public services the communication can be much simpler (no different STBs) and effective.

Also the role of Arabsat should be considered. Arabsat could play an important role in providing an alternative viewing platform for analogue television viewers when the service is terminated at the ASO date (in the respective regions if a phased ASO model is selected). Especially in the case when no simulcasting is offered providing an alternative platform might be important. As discussed in Section 4.5, this could be the case when the analogue network is first extended, followed by a direct switch to DTTB.

As part of the ASO planning and more specifically the communications work stream, the NRT should complete and detail the above illustrated matrix. Subsequent steps will include:

- Determining the communication tools per stage and target group. For example, the non-served public will rely heavily on the radio or mobile communications to be informed whilst served viewers can be easily reached with the PSB broadcasts. It should also be noted that Ethiopian community centres could play a significant role in the communication strategy as they have traditionally a close relationship with communities in the different regions.
- Mapping the communication matrix on the network roll-out planning in order to determine the exact dates for communication (especially the conversion and satisfaction/monitoring stage).

4.8 Customer proposition

Although in the ITU Guidelines (functional building block 3.2) the customer proposition is being addressed from a commercial perspective, the competitive advantage of the DTTB offering will be of equal importance to the ASO process. In any ASO process, the attractiveness of the DTTB platform will for a large part determine the success of the ASO operation and the NRT should take this aspect into account.

Before addressing the competitive advantage of DTTB it is important to recall that two markets exist in Ethiopia; the (analogue terrestrial) served and the non-served areas. Satellite television services (Arabsat and DSTV) are available throughout the country and therefore present in both markets. The competitive landscape for DTTB differs between the two areas because:

1. In the served areas, analogue terrestrial viewers will compare switching costs between satellite and DTTB (next to comparing the channel line-up). This is comparing the purchasing costs for a DTTB STB and antenna (including any subsidies/vouchers) to the satellite STB and dish. Please note that for analogue terrestrial viewers with Arabsat this trade off will be different (they may decide not to switch to DTTB).
2. In non-served areas, people will have to decide whether DTTB offers enough value (i.e. content/services) given the purchasing costs of the DTTB STB and antenna. Given that Arabsat has been present in the market for many years (15+), the people without any analogue terrestrial service and having enough purchasing power will probably have switched to satellite already. Consequently, the market that DTTB will address in the non-served areas will be the lower income households/viewers. If this is the case a low DTTB STB price will be crucial for the uptake of the DTTB service in these non-served areas. Therefore it is important to check this assumption by examining the uptake curve of Arabsat over the years. A stable number of Arabsat viewers which hasn't increased significantly the last few years (together with an unchanged service bouquet and STB/dish costs) could be a clear indicator of Arabsat's market saturation in Ethiopia.

Served areas

The ITU Guidelines (see Section 3.2.1) identifies six competitive advantage categories. Applying these categories on the served areas in Ethiopian results in the following considerations:

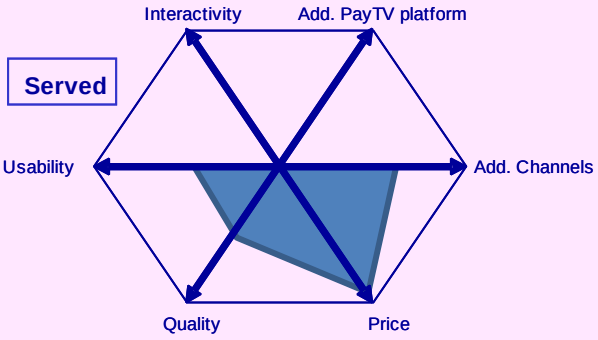
1. *Interactivity/enhanced television services*: The DTTB platform could offer interactive service as a competitive edge. However without any return path, these interactive services are limited to

services like the electronic programme guide (EPG), additional programme information and enhanced teletext. Recent market developments show that (mass produced) receivers are available with return path capabilities, such as integrated IPTV/DTTB set-top-boxes. But given that these are relatively expensive, this seems not to be an option for the majority of people in Ethiopia.

2. *Additional Pay-TV platform/conditional access and billing facilities*: DTTB platforms can easily be equipped with conditional access and billing facilities, this could provide service providers with a platform to launch pay-tv services, such as tiered television packages, pay-per-view offerings and pre-paid facilities. This consideration applies to Bridgetech's offering and not directly to the PSB offering. This may change in the case where ETV decides to offer a pay-tv service next to its FTA service (see also Section 4.2 in this report). It should be noted that even in the case of a combined pay-tv/FTA offering between Bridgetech and ETV the possibilities of offering tiered television packages are limited on a DTTB platform, let alone the content production and network cost consequences.
3. *Addition channels/multi-channel offering*: In Ethiopia the analogue terrestrial television platform is the main platform offering television services, however with a limited set of channels (i.e. 2-4 channels). The introduction of a multi-channel DTTB offering could be a key demand driver. It should be noted however that in Ethiopia DSTV and Arabsat offer a multi-channel offer (pay-tv satellite) and the DTTB platform is faced with limited capacity. One advantage that the DTTB platform has over satellite is that ETV and the regional PSBs have football content that is not present on Arabsat. However, it should be assessed whether these football rights are enough to make a difference when considering the full bouquets between the different service providers/platforms.
4. *Lower costs (one-off and recurring)*: The DTTB platform in Ethiopia has the advantage of having lower receiver costs as compared to satellite. As discussed in this report STB retail prices are in the range of EUR 20/30 (DTMB) to 50 (DVB-T2). Satellite receivers/dishes are currently retailed at around EUR 125/150 in Ethiopia. These one-off costs form a major barrier for consumers to adopt digital television. It should be noted however, as the DTTB launch is part of an ASO process (a government led operation), a low STB price (including subsidies/vouchers) is really a prerequisite rather than a competitive edge in Ethiopia.
5. *Picture and reception quality*: The introduction of DTTB could entail for (a proportion of) Ethiopian viewers a significantly better reception and/or picture quality. Most terrestrial viewers have an indoor reception installation (the so called 'rabbit ears') in a rooftop designed network. Hence due to multipath propagation viewers will have distorted reception and picture quality. This does not apply to viewers with rooftop antennas. However the number of rooftop antennas is limited in Ethiopia. Consequently, the competitive edge of picture and reception quality should be evaluated and communicated with care.
6. *Usability/Portability*: DTTB services are wireless and can be received on compact receivers. Hence DTTB services have the competitive advantage of portability, especially when the receiver comes with a small antenna or an integrated antenna. In Ethiopia DTTB in a robust modus can deliver more coverage and in more places of the home. This is only under the provision that marketing this competitive edge is accompanied by accurate coverage predictions and coverage is defined for areas with a higher level of reception probability. It should also be noted that the current analogue terrestrial broadcasts are in the VHF band and the digital broadcasts will be in the UHF band with more propagation losses (see also Section 4.10). Depending on the reception mode (i.e. the network design) digital reception might be different (not in all places of the home, but if sufficient signal strength picture quality will be good) compared to the analogue reception.

From the above considerations the following competitive profile of the DTTB platform in served areas can be drawn:

Figure 4.5: DTTB platform's competitive profile in served areas in Ethiopia



Source: Adapted from ITU Guidelines

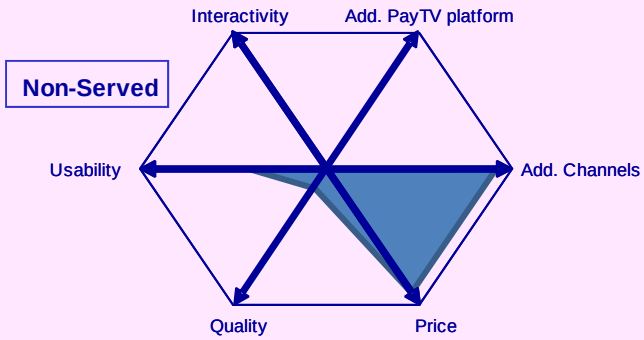
Non-served areas

Applying the six categories on the non-served areas results in the following assessment (only the differences are discussed below):

1. *Addition channels/multi-channel offering*: The introduction of a multi-channel DTTB offering could be the key demand driver. For people in the non-served areas this argument seems stronger as the added value of DTTB is larger compared to served viewers and hence the difference with the larger satellite offering is smaller. Consequently the DTTB's competitive edge is stronger in this market.
2. *Lower costs (one-off and recurring)*: People without analogue terrestrial service and having enough purchasing power will probably have already switched to satellite. Provided that the DTTB offering is in the range of the purchasing power of those with lower income levels, many will switch to DTTB just because it becomes affordable. Price could work as a minimum price hurdle for people to surpass.
3. *Picture and reception quality*: For people in the non-served areas there is no reference point (other than satellite for just a small group of people with enough purchasing power). Consequently this competitive edge cannot be effectively used in a marketing strategy.

From the above considerations the competitive profile of the DTTB platform in non-served areas can be drawn in Figure 4.6.

Figure 4.6: DTTB platform's competitive profile in non-served areas in Ethiopia



Source: Adapted from ITU Guidelines

4.9 Network architecture

The network architecture and in particular the definition of the regional areas has a significant impact on:

- transmission costs (number and capacity of links, number and capacity of head ends and number of transmitters per site);
- multiplex capacity (number of services in the multiplex);
- SFN size, in case of SFNs, transmitters broadcasting different content at any moment in time, cannot be part of the same SFN.

The different options should therefore be listed and evaluated in order to find solutions that best fit within the service proposition and business plan. The solutions will be different for the DTMB or DVB-T2 transmission standard (see also Annex 5).

In the considerations in this section the following system variants of the DTMB and DVB-T2 standard will be taken into account:

- DTMB, 64QAM 2/3, providing a net bit rate of 24.3 Mbit/s;
- DVB-T2, 256QAM 2/3, providing a net bit rate of 40.3 Mbit/s.

With each of the above mentioned DTTB standard applications, the C/N value (carrier-to-noise ratio) is similar (about 18 dB in a Ricean channel). With a given transmitter, the noise limited coverage area is the same in both cases.

A regional coverage area is characterized by regional services as part of the multiplex of all transmitters in the regional coverage area. For feeding the regional transmitters with the national and regional services, three basic network lay-outs can be considered:

1. **One main head-end only.** All national and regional services are transported to the main head-end and from there distributed to all transmitter sites.
2. **Regional head-end in each region.** National services and regional services are multiplexed at regional head-ends and distributed to the transmitter sites that are part of the regional coverage area.
3. **Combination of 1 and 2.** Some regional services are multiplexed at the main head-end and together with the national services distributed to all transmitter sites. Other regional services are coded and (re)multiplexed with national services at regional head-ends.

Section 4.9.1 describes the basic network with one main head-end and Section 4.9.2 describes the basic network regional head-ends. The main aspects of both network configurations are summarized in Section 4.9.3.

4.9.1 One main head-end

Figure 4.7 shows an example of a basic network lay-out with one main head-end. Regional area A represents a regional coverage area with one transmitter site and regional area B represents a regional coverage area with more than one transmitter site.

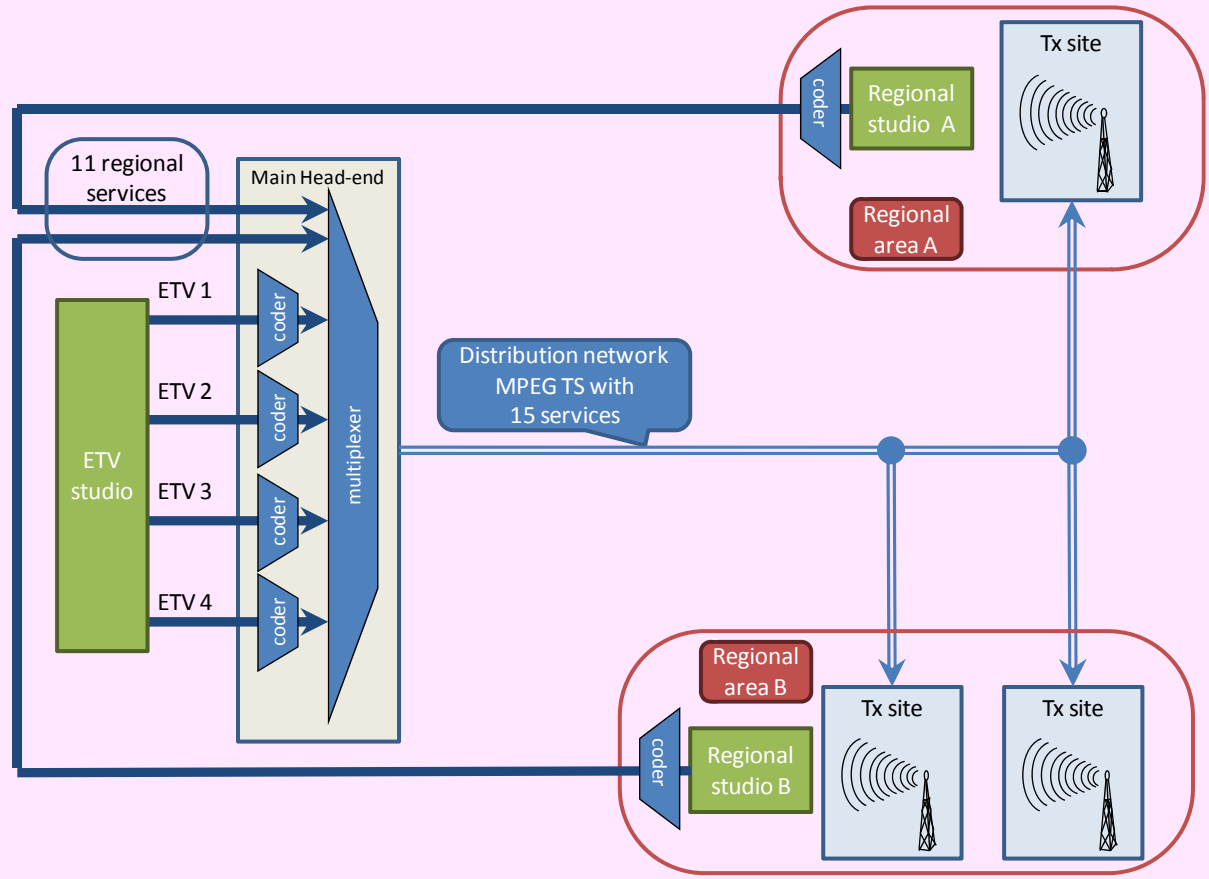
In Figure 4.7 the signals of the national public services (ETV1, ETV2, ETV3 and ETV4) are coded in the main head-end. All eleven regional services are transported to the main head-end. Compression (in MPEG2 in case of DTMB and in MPEG4 in case of DVB-T2) in the regional studios saves capacity in the transmission links. However, if high capacity links with serial digital interfaces (SDI) are available compression of regional services can also take place in the Main Head-end.

At the main head-end in total fifteen services are multiplexed into one MPEG transport stream, which is distributed to all transmitter sites by means of:

- telecommunication satellite;

- optic fibre with additional microwave links from the points of presence of the optic fibre to the transmitter sites;
- DVB-S satellite used for distribution of the transport stream of the DTTB network.

Figure 4.7: Example of network lay-out with one main head-end only



Source: Authors

An initial indication of the multiplex composition is shown in Table 4.6.

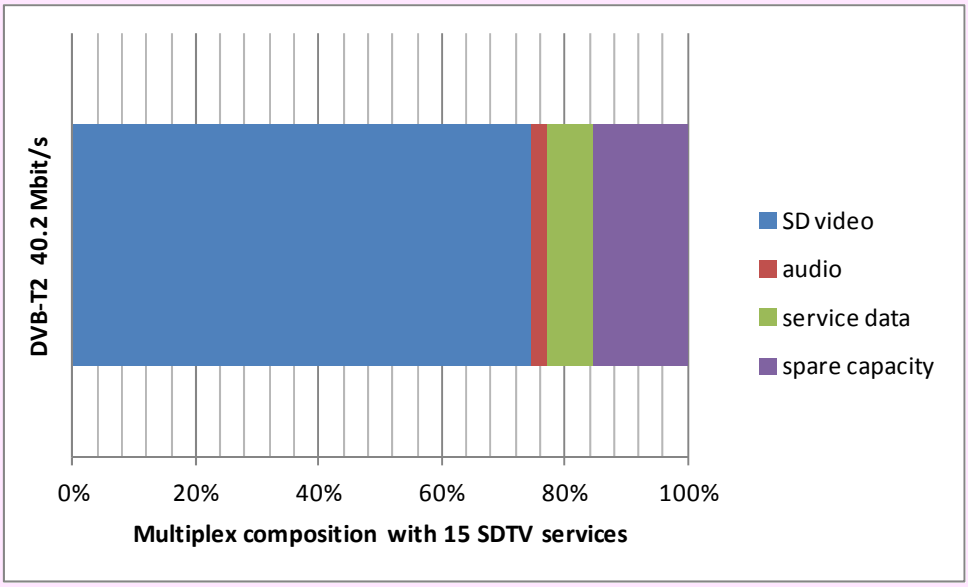
Table 4.6: Initial multiplex composition example

SDTV	DTMB payload 24.3 Mbit/s		DVB-T2 payload 40.2 Mbit/s	
	Estimated bit rate per service (Mbit/s)	Estimated bit rate with 15 services (Mbit/s)	Estimated bit rate per service (Mbit/s)	Estimated bit rate with 15 services (Mbit/s)
Video bit rate	4	60	2	30
Audio bit rate	0.096	1.44	0,064	0.96
Service data bit rate	0.2	3	0.2	3
Total requirement	4.296	64.44	2.264	33.96
Spare capacity		–40.14		6.24

From Table 4.6 it can be seen that with one main head-end the DTMB multiplex capacity is insufficient (available 24.3 Mbit/s; needed 64.44 Mbit/s). Even if the bit rate per service is halved, the multiplex capacity is not sufficient.

With DVB-T2 there is a spare capacity of 6.24 Mbit/s (available 40.2 Mbit/s; needed 33.96 Mbit/s), which leaves room for future extension (see Figure 4.8).

Figure 4.8: Example DVB-T2 multiplex compositions with 15 SDTV services



Source: Authors

If the video bit is slightly reduced from 2 to 1.96 Mbit/s, three additional services will be possible. With statistical multiplexing it would be possible to transmit more additional services. However, statistical multiplexing is only possible if all coders are in the same location. Consequently statistical multiplexing is not possible if regional services are coded in regional studios.

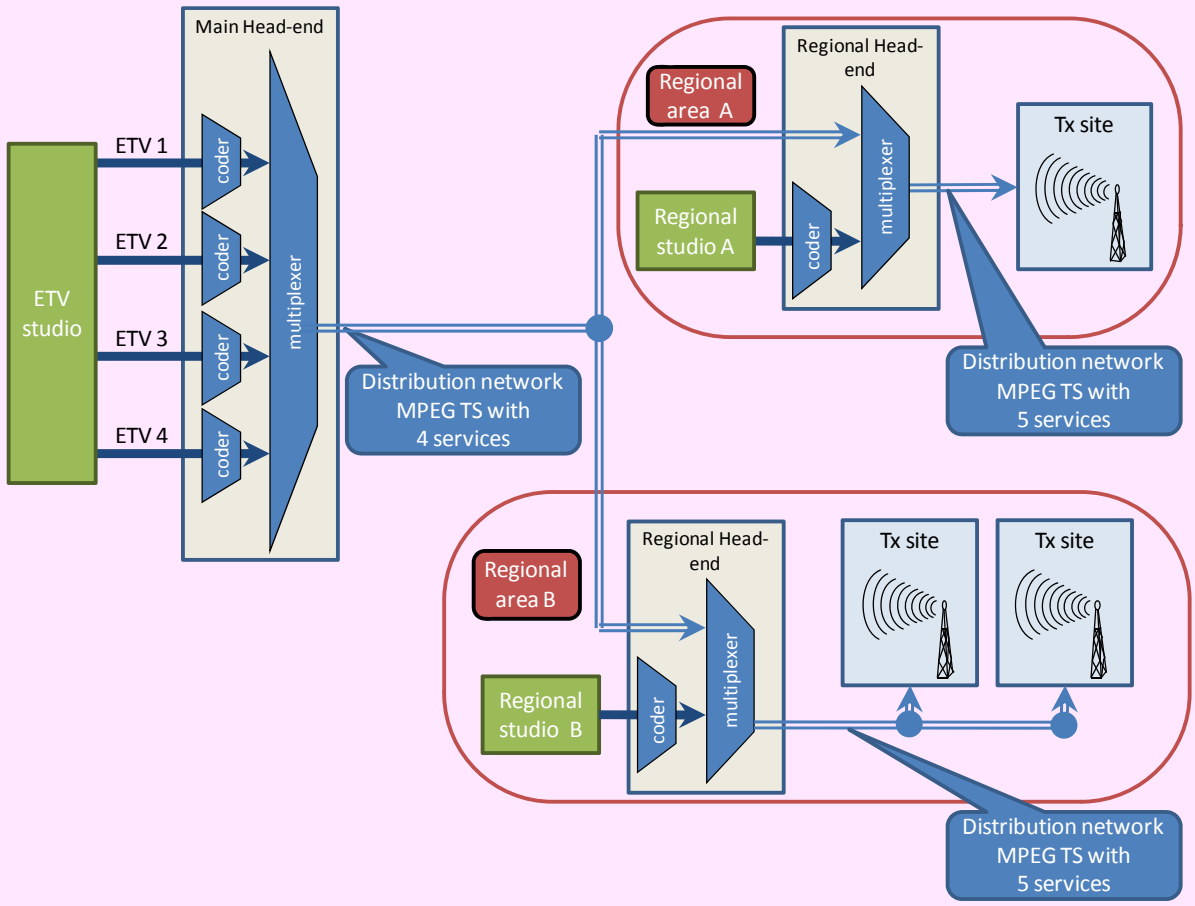
4.9.2 Regional head-ends

Figure 4.9 shows an example of basic network with regional head-ends. Regional area A represents a regional coverage area with one transmitter site and regional area B represents a regional coverage area with more than one transmitter site.

In Figure 4.9 the signals of the national public services (ETV1, ETV2, ETV3 and ETV4) coded in the main head-end. From the main head-end one MPEG transport stream is distributed to the regional head-ends by means of:

- telecommunication satellite;
- optic fibre with additional microwave links from the points of presence of the optic fibre to the transmitter sites;
- DVB-S satellite used for distribution of the Transport Stream of the DTTB multiplex;
- DVB-S satellite (Arabsat package), as currently applied for analogue TV distribution.

Figure 4.9: Example of network lay out with regional head-ends



Source: Authors

In the latter case the four ETV services are MPEG2 compressed. For DVB-T2, the MPEG2 encoded signals need to be re-coded to MPEG4 at the regional head-ends. Cascading of encoding processes could decrease picture quality. The service information contained in the DVB-S multiplex may not be appropriate for the DTTB network and may need to be re-inserted at the regional head-ends. It should also be noted that the Arabsat DBV-S service content of ETV is not always identical to the terrestrial content (e.g. football). With this way of distribution none of the transmitters in the DTTB network will be fed with the exclusive terrestrial content.

In each regional head-end the four national services and the regional encoded service (in MPEG2 in the case of DTMB and in MPEG4 in the case of DVB-T2) are (re)multiplexed into a regional transport stream and distributed to the transmitter sites belonging to the region.

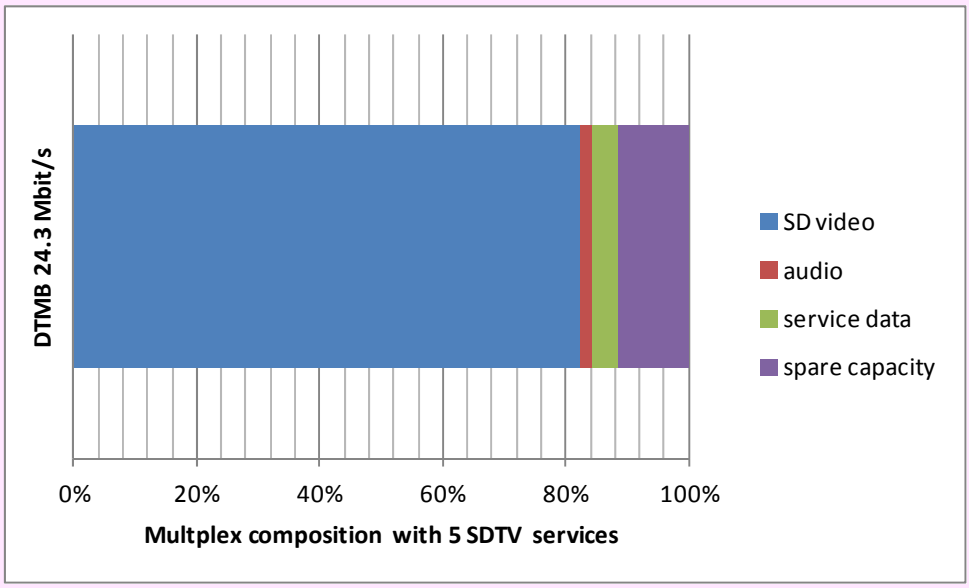
An initial indication of the regional multiplex composition of four national services and one regional service is shown in Table 4.7.

Table 4.7: Initial regional multiplex composition example

SDTV	DTMB payload 24.3 Mbit/s		DVB-T2 payload 40.2 Mbit/s	
	Estimated bit rate per service (Mbit/s)	Estimated bit rate with 5 services (Mbit/s)	Estimated bit rate per service (Mbit/s)	Estimated bit rate with 5 services (Mbit/s)
Video bit rate	4	20	2	10
Audio bit rate	0.096	0.48	0,064	0.32
Service data bit rate	0.2	1	0.2	1
Total requirement	4.296	21.48	2.264	11.32
Spare capacity		2.82		28.88

From Table 4.7 it can be seen that in the regional head-end the DTMB multiplex capacity leaves a spare capacity of 2.82 Mbit/s (see Figure 4.10). In some regions there is a requirement to broadcast more than one regional service. To accommodate six services the video bit rate per service needs to be reduced from 4 to 3.75 Mbit/s.

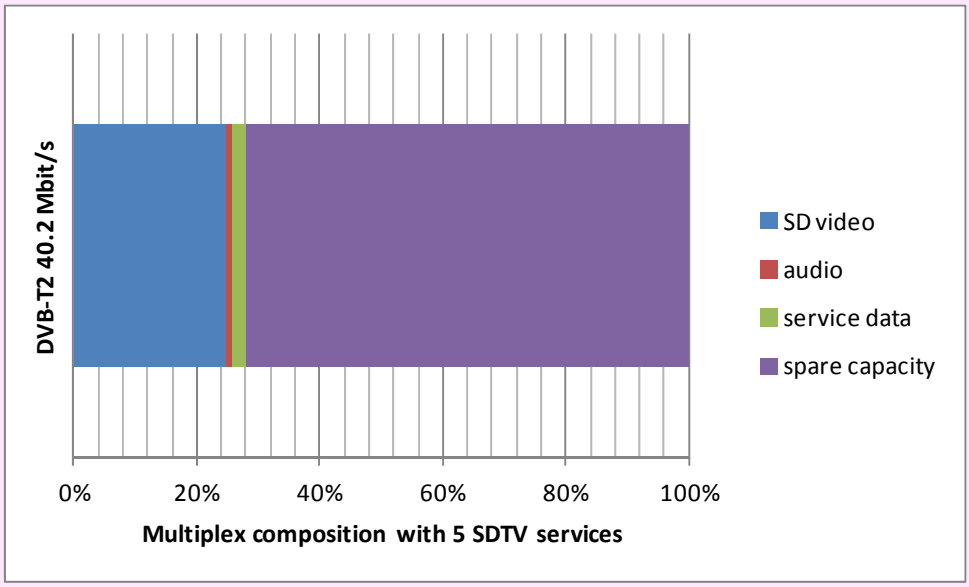
Figure 4.10: Example DTMB multiplex composition with five SDTV services



Source: Authors

With DVB-T2 there is a spare capacity of 28.88 Mbit/s, which leaves considerable room for future extension (see Figure 4.11). It could be considered to use a more robust system variant, with a net bit rate comparable to the DTMB payload. The related C/N value will be much lower thus giving a larger coverage area.

Figure 4.11: Example of DVB-T2 multiplex composition with five SDTV services



Source: Authors

4.9.3 Summary

Table 4.8 shows the impact of the network lay-out described in Section 4.9.1 (one main head-end) and 4.9.2 (regional head-ends).

Table 4.8: Impact of network lay-out on network planning

Network element	Only Main Head-end	Regional Head-end in each region
1. Head-ends	1 head-end with: • Input for 15 services (4 national and 11 regional); • Output for 1 MPEG transport stream (TS) with DVB-T2 256QAM2/3 (40.2 Mbit/s); • DTMB does not provide sufficient capacity.	11 head ends with each: • Input for 5 or 6 services (4 national and 5 or 6 regional); • Output for 1 MPEG TS with: – DVB-T2 256QAM2/3 (40.3 Mbit/s); – DTMB 64QAM 2/3 (24.3 Mbit/s); – A more robust DVB-T2 system variant providing larger coverage.
2. Long distance studio to head-end links	11 links, from each regional studios to Main Head-end, depending on link capacity and costs: • In MEPG2 with coder in regional studio; • Uncompressed (SDI interface) and coder in Main Head-end.	ETV signals can be distributed by DVB-S (Arabsat package)) and re-multiplexed at Regional Head-ends – With DVB-T2/MPEG4 the MPEG2 compressed DVB-S services need to be re-coded to MPEG4 with probably loss of quality. – None of the transmitters in the DTTB network will be fed with the exclusive terrestrial content that is not contained in the Arabsat package (e.g. football). Alternatively national services are transported in MPEG TS to the regional head-ends using communication satellite, DVB-S with DTTB TS or optic fibre complemented with microwave links.

Network element	Only Main Head-end	Regional Head-end in each region
3. Distribution links (head-end to transmitter sites)	Distribution of 1 MPEG TS (see 1) to all transmitter sites using communication satellite, DVB-S with DTTB TS, or optic fibre complemented with microwave links.	Distribution of 1 MPEG TS (see 1) to the transmitter sites in the region using communication satellite, DVB-S with DTTB TS, microwave links or optic fibre complemented with microwave links.
4. Statistical multiplexing	Not possible if regional services are coded in regional studios. If all coders are in Main Head-end, statistical multiplexing is possible and advised.	Not possible if national services are coded in the national studio. If all coders are in Regional Head-end, statistical multiplexing is in principle possible and advised.

From the above comparison the following observations can be made:

1. One main head-end,
   a. Only the DVB-T2 standard provides sufficient capacity to broadcast 15 services with one transmitter per site.
   b. Spare capacity is available for three additional services.
   c. Regional services need to be transported to the main head-end.
2. Regional head-ends,
   a. Both the DTMB and DVB-T2 standard provide sufficient capacity to broadcast five or six services with one transmitter per site.
   b. With DVB-T2 considerable spare capacity is available for additional services, alternatively a more robust system variant can be chosen, providing a larger coverage area.
   c. National services could be distributed to regional head-end using the Arabsat DVB-S package, however with DVB-T2 the signals need to be re-coded to MPEG4, likely resulting in loss of quality. Also exclusive terrestrial content, not contained in the Arabsat package (e.g. football) cannot be distributed.

4.10 Reception mode

This section describes the choice of reception mode for DTTB, followed by coverage considerations in which the consequences of the choice is indicated with regard to required effective radiated power and coverage.

4.10.1 Fixed and portable reception

Minimum field strength

In planning DTTB, four reception modes can be distinguished; the reception modes are defined in the GE06 Agreement:

1. Fixed reception (FX), also called rooftop reception, with a fixed mounted antenna on top of the roof.
2. Portable outdoor reception (PO), with a simple transportable antenna in an outdoor location (the TV set connected to antenna is not necessarily transportable).
3. Portable indoor reception (PI), with a simple transportable antenna in an indoor location (the TV set connected to antenna is not necessarily transportable).
4. Mobile reception (MO) at high speed (also called vehicular reception) with a simple antenna mounted on the vehicle, improved reception can be achieved with diversity reception.

Mobile reception is not of main interest in Ethiopia and will therefore not be considered further.

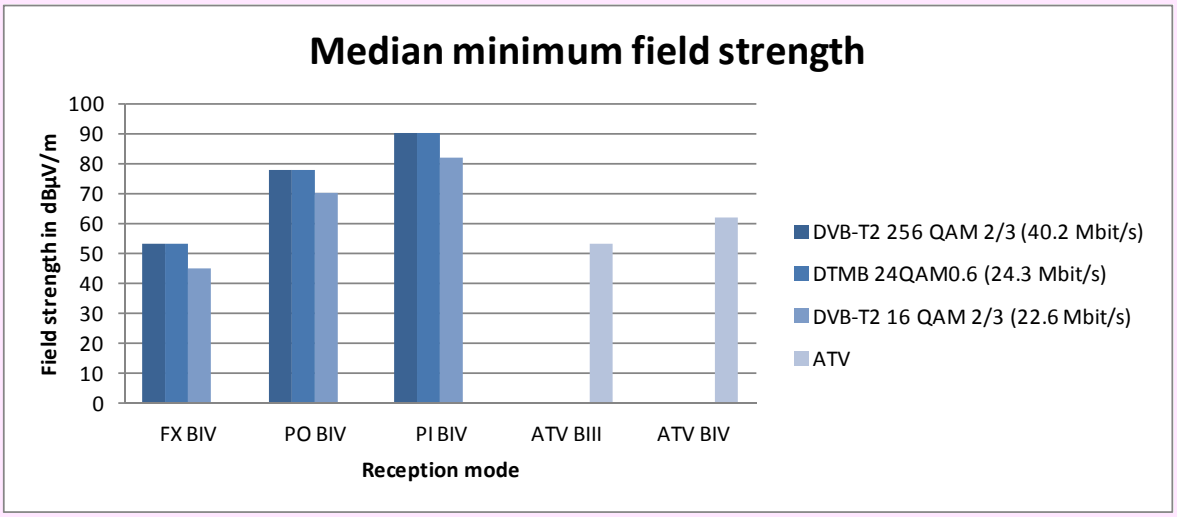
With regard to reception of digital television it should be reminded that, contrary to analogue television, there is no smooth degradation from good to poor picture quality when the field strength is decreasing. This is the reason that digital television is planned for a high location probability (fixed and portable reception normally 95 per cent), whereas analogue TV is planned for 50 per cent.

Portable reception requires much higher field strength values than fixed reception due to the lower receiving height and the lower receiving antenna gain. Portable indoor reception requires higher field strength than portable outdoor because of the building entry loss.

Figure 4.12 shows the median minimum field strength (E_{med}) in Band IV to receive DTTB services with probability of 95 per cent. The E_{med} values are shown for fixed (FX), portable outdoor (PO) and portable indoor (PI) reception using the DVB-T2 and DTMB system variants considered above in Section 4.9.

For comparison also the minimum field strength for analogue TV with a probability of 50 per cent in Band III and Band IV with fixed reception[14] is shown in Figure 4.12.

Figure 4.12: Median minimum field strength of DTTB in Band IV and analogue TV in Band III and IV



Source: GE06 Agreement, Chapter 3 to Annex 2; Rec. ITU-R BT.417

The minimum field strength requirements have an impact on:

1. Radiation characteristics and network topology.

   The higher the minimum field strength, the more power is needed. The power requirements may exceed the power allowed by the frequency plan or may not be practically feasible. In such cases power distribution by means of an SFN may be chosen.

2. Multiplex capacity.

   With a given transmission standard, a high net data rate of the multiplex results in relative high minimum field strength values. A low net data rate of the multiplex offers the advantage of relative low minimum field strength values. For portable reception lower net data rates may be chosen in order to reduce the required power.

[14] The minimum field strength in the absence of interference other than noise taken from Recommendation ITU-R BT.417.

3. Extent of coverage area.

   With a given transmission standard, given radiation characteristics and system variant, the coverage area for fixed reception is much larger than for portable reception.

A balance has to be found between on the one hand the efforts viewers have to undertake to achieve satisfactory reception (e.g. installing a rooftop antenna) and on the other hand costs of the network and service quality.

The key objective in the ASO process is reducing the risk of service interruption. Hence, the coverage area of a digital TV service should be at least the same as the coverage of the analogue service it replaces.

The receiving conditions of analogue and digital television should therefore be specified in order to be able to predict coverage. Important elements of the receiving conditions are:

- noise figure of the receiver or set-top-box;
- receiving antenna height;
- receiving antenna gain;
- indoor or outdoor reception;
- reception probability.

Analogue TV reception

Analogue television is planned for fixed reception with a reception probability of 50 per cent. However, in practice, analogue TV viewing takes place under conditions well below the recommended minimum field strength values in ITU[15]. Portable reception of analogue TV is not defined in ITU and is likely to be dissatisfactory because of lack of field strength and multipath propagation resulting in noisy pictures with several strong ghost images or even loss of synchronization.

It has to be decided on which basis analogue TV coverage has to be accessed, e.g. based on:

1. Experience and practical knowledge of coverage areas.
2. Calculations with either the recommended ITU minimum field strength values, or the values indicated by ITU as reception limits[16].

It should be noted that the larger the analogue coverage areas are determined, the higher the effective radiated power (ERP) of digital transmitters should be in order to match the analogue coverage.

DTTB reception

The specified reception mode should in principle reflect the actual practical receiving conditions. In Ethiopia television reception often takes place at indoor locations with simple antennas. Indoor and outdoor DTTB reception is very well possible, provided that the field strength exceeds the required minimum value.

Portable outdoor reception is a balanced compromise for the type of receiving installation normally used in the situation in Ethiopia, because:

- it represents reception with a simple antenna;

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[15] See Recommendation ITU-R BT.417-5 Minimum field strengths for which protection may be sought in planning an analogue terrestrial television service.

[16] See Annex 1 of Recommendation ITU-R BT.417-5. In this annex it is noted that the public begin to lose interest in installing television reception equipment when the field strength falls much below the indicated levels in this annex.

- it is a well-defined receiving condition; portable indoor reception would require the establishment of building entry loss data (mean value and standard deviation) in the situation in Ethiopia;
- portable outdoor reception represents also portable indoor reception but with lower reception probability. When reception takes place indoor, an optimal location for the antenna should be sought. Indoor reception is easier relative close to the transmitter, at higher floors and when building penetration losses are minimal.

Fixed reception (rooftop) is normally the basis for the coverage obligation of public broadcasters.

4.10.2 Comparison of analogue TV and DTTB coverage

General considerations

The ERP of a UHF DTTB station with a coverage that matches the analogue TV coverage depends on:

- the basis for defining analogue coverage (recommended minimum field strength or limit of reception);
- the frequency band in which the analogue transmissions takes place (VHF or UHF);
- the DTTB system variant (standard, carrier modulation and code rate);
- the reception mode (FX, PO or PI).

Table 4.9 shows the ERP of a UHF DTTB station needed to match analogue coverage based on the recommended minimum field strength in UHF. In Table 4.9 the ERP of the DTTB station has been calculated with fixed reception and the DVB-T2 and DTMB system variants considered in Section 4.9.

The ERP of the DTTB station is expressed as mean power, whereas the ERP of the analogue TV station is expressed as in peak envelope power.

Table 4.9: ERP of digital TV transmitting stations to replace an analogue coverage area

DTTB variant	DTTB ERP in dBW	DTTB ERP in kW
DVB-T2 256QAM 2/3	Analogue ERP (dBW) – 9 dB	Analogue ERP (kW) x 1/8
DTMB 64QAM 0.6	Analogue ERP (dBW) – 9 dB	Analogue ERP (kW) x 1/8
DVB-T2 16QAM 2/3	Analogue ERP (dBW) – 17 dB	Analogue ERP (kW) x 1/50

The ERP of a DTTB station with other reception modes and different analogue TV coverage situations can be calculated with the following formulas:

1) In dBW $ERP_D = ERP_{DFX} + C_{RM} + C_B + C_A$

2) In kW $ERP_D = ERP_{DFX} \times C_{RM} \times C_B \times C_A$

Where,

ERP_D is the ERP of the DTTB station in dBW (formula 1) or kW (formula 2);

ERP_{DFX} is the ERP of the DTTB station with fixed reception to match UHF analogue coverage based on the recommended minimum field strength, as given in Table 4.9;

C_{RM} is the correction for the digital reception mode as given in Table 4.10;

C_B is the correction for the analogue TV frequency band as given in Table 4.10;

C_A is the correction for the analogue TV coverage basis as given in Table 4.10.

Table 4.10: Digital ERP corrections

Correction		Formula 1	Formula 2
C_{RM}	Digital reception mode FX	0 dB	1
	Digital reception mode PO	25.3 dB	340
	Digital reception mode PI	37.3 dB	5340
C_B	Analogue TV band III	12 dB	16
	Analogue TV band IV/V	0 dB	1
C_A	Analogue coverage; Recommend minimum field strength	0 dB	1
	Analogue coverage; Limit of reception	10 dB	10

The correction factors of Table 4.10 are based on the following assumptions:

C_{RM} The indicated values are the differences between the median minimum field strength values given in GE06[17] of respectively fixed and portable outdoor reception and fixed and portable indoor reception. The correction factors take into account:

a. Ricean transmission channel with fixed reception and a Rayleigh transmission channel with portable reception[18].

b. The receiving antenna gain and feeder loss, height loss, building entry loss, signal variation at outdoor and indoor locations as specified in GE06[19].

C_B The correction factor is the combination of:

a. The difference of the analogue minimum field strength values in Band III and IV, in the absence of interference from other television transmissions and man-made noise, according to Recommendation ITU-R BT.417.

b. The difference in propagation in Band III and Band IV taken from the propagation curves of Recommendation ITU-R P.1546. The propagation difference depends on the effective antenna height and the distance from the transmitter. The correction given in Table 4.10 is an initial indication.

C_A The correction factor is the difference between the analogue minimum field strength values referred to in correction factor $C_{B,}$ item a, and the field strength values from Recommendation ITU-R BT.417, Annex 1.

Figure 4.13 shows an example of the coverage area an analogue TV transmitter of 10 kW with an effective antenna height of 75 m in VHF and the DTTB UHF transmission parameters to match the analogue coverage. Also the DTTB portable outdoor coverage is indicated. The coverage areas have been calculated with the ITU propagation curves[20].

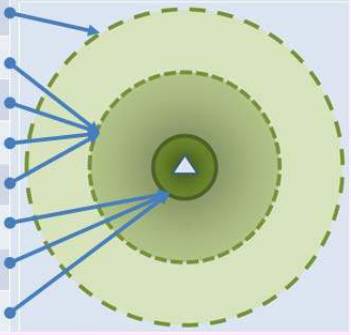
[17] See Geneva 2006 Agreement, Chapter 3 to Annex 2, Appendix 3.2.

[18] Ricean and Rayleigh channel are defined in the footnotes in Annex 5 of this report.

[19] See Geneva 2006 Agreement, Chapter 3 to Annex 2.

[20] See Recommendation ITU-R P.1546 or Chapter 2 of Annex 2 of the GE06 Agreement.

Figure 4.13: Example of coverage and EPR in various situations

Transmission	Payload	Reception mode	Coverage radius	ERP at 75 m	Coverage area (ITU propagation curves)
B/PAL	-	Fixed-limit of reception	≈55 km	10 kW	
	-	Fixed-recommended Emin	≈35 km	10 kW	
DVB-T2 256QAM 2/3	40 Mbit/s	Fixed	≈35 km	20 kW	
DTMB 64QAM 0.6	24Mbit/s	Fixed	≈35 km	20 kW	
DVB-T2 16QAM 2/3	22 Mbit/s	Fixed	≈35 km	3.2 kW	
DVB-T2 256QAM 2/3	40 Mbit/s	Portable outdoor	≈11 km	20 kW	
DTMB 64QAM 0.6	24 Mbit/s	Portable outdoor	≈11 km	20 kW	
DVB-T2 16QAM 2/3	22 Mbit/s	Portable outdoor	≈11 km	3.2 kW	

Source: GE06 Agreement, Chapter 2 of Annex 2

The minimum field strength and ERP values indicated in this section are an initial estimation. Coverage assessments, making use of a terrain and clutter data base, the actual assigned frequencies and interference from other broadcasting transmissions should indicate if coverage is acceptable in practical cases.

Coverage situations in Ethiopia

In Ethiopia three coverage situations will occur:

1. **Areas served by ETV in VHF**

   These areas are covered by VHF analogue TV. The estimated ERP of the analogue TV stations ranges from about 1 to 25 kW. At 28 sites new UHF TV transmitters have been installed. These transmitters have an ERP of 25 kW analogue peak envelope power or 10 kW ERP digital mean power.

2. **Currently non-served areas by ETV**

   At 26 new sites UHF TV transmitters will soon be in operation to extend analogue TV coverage. These transmitters have an ERP of 25 kW analogue peak envelope power or 10 kW ERP digital mean power. The service will start as analogue TV and will be switched to digital TV in accordance with the ASO planning or may directly start with digital.

3. **Areas served by regional broadcaster**

   These areas are covered by VHF or UHF transmitters. The estimated ERP in VHF is 10 kW and the estimated ERP in UHF ranges from 20 to 30 kW. Digital replacement is subject of further study by the NRT.

The DTTB ERP requirements in order to match analogue coverage in the three situations, calculated by formula 2, are indicated in Table 4.11.

Table 4.11: Required DTTB ERP in different coverage situations in Ethiopia

Situation	DTTB ERP requirements; DVB-T2 256QAM2/3 or DTMB 64QAM0.6	
	Matching ATV recommend Emin	Matching ATV limit of reception
1. Areas served by ETV in VHF	• ATV ERP 1 kW (VHF): 2 kW • ATV ERP 25 kW (VHF): 50 kW	• ATV ERP 1 kW (VHF): 20 kW • ATV ERP 25 kW (VHF): 500 kW
2. Currently non-served areas by ETV	• ATV ERP 25 kW (UHF): 3 kW	• ATV ERP 25 kW (UHF): 30 kW
3. Areas served by regional broadcasters	• ATV ERP 10 kW (VHF): 20 kW • ATV ERP 30 kW (UHF): 4 kW	• ATV ERP 10 kW (VHF): 200 kW • ATV ERP 30 kW (UHF): 40 kW

From Table 4.11 it can be concluded with regard to fixed (rooftop) reception that:

1. **Areas served by ETV in VHF**

   The UHF transmitters, switched to digital (estimated ERP 10 kW) have more than sufficient power to match analogue VHF coverage with analogue transmitter ERP up to 5 kW. To match the coverage of analogue transmitters of higher ERP, it needs to be investigated if the actual loss of coverage is acceptable. In case of the analogue TV ERP of 25 kW, a factor 5 in power (7 dB) is lacking (see also the example of the Mount Furi station described below). Lack of coverage could be resolved by a combination of measures such as:

   a. Improved receiving installations (higher reception height, higher receiving antenna gain, antenna amplifiers).

   b. Doubling the ERP by changing the passive back-up configuration of the transmitters to an active back-up configuration.

   c. A more robust system variant.

   Matching analogue coverage based on the limit of reception will be very difficult to achieve in practice. For pragmatic reasons it is therefore advised to determine analogue coverage on the basis on the recommended minimum field strength.

2. **Currently non-served areas by ETV**

   In this situation analogue coverage will be provided in early 2012 by UHF transmitters with an ERP of 25 kW. After analogue switch-off the same transmitter will provide digital coverage with an ERP of 10 kW. The ERP of the DTTB transmitter is more than sufficient to match the analogue coverage. The digital coverage will be larger than the analogue coverage, but not so large to match the analogue coverage based on the limit of reception.

3. **Areas served by regional broadcasters**

   To match the coverage of VHF regional transmitters by a UHF DTTB transmitter, the digital ERP should be at least 20 kW. If a lower digital ERP would be applied the measures indicated in the first scenario above (areas served by ETV in VHF) could be used to improve the digital coverage. To match the coverage of UHF regional transmitters the digital ERP should be at least 4 kW. Also in this situation matching analogue coverage based on the limit of reception will be very difficult to achieve in practice.

Example of the Mount Furi transmitting station

Coverage predications[21] of the Mount Furi TV station near Addis Ababa have been calculated using a terrain databank with geographical data (100 by 100 m) and clutter data (1000 by 1000 m).

At the Mount Furi station, VHF B-PAL transmitters are in operation on channel 5 and 7. Also a UHF transmitter on channel 42 has been installed that can transmit analogue TV with an ERP of 25 kW or DTTB with an ERP of 10 kW.

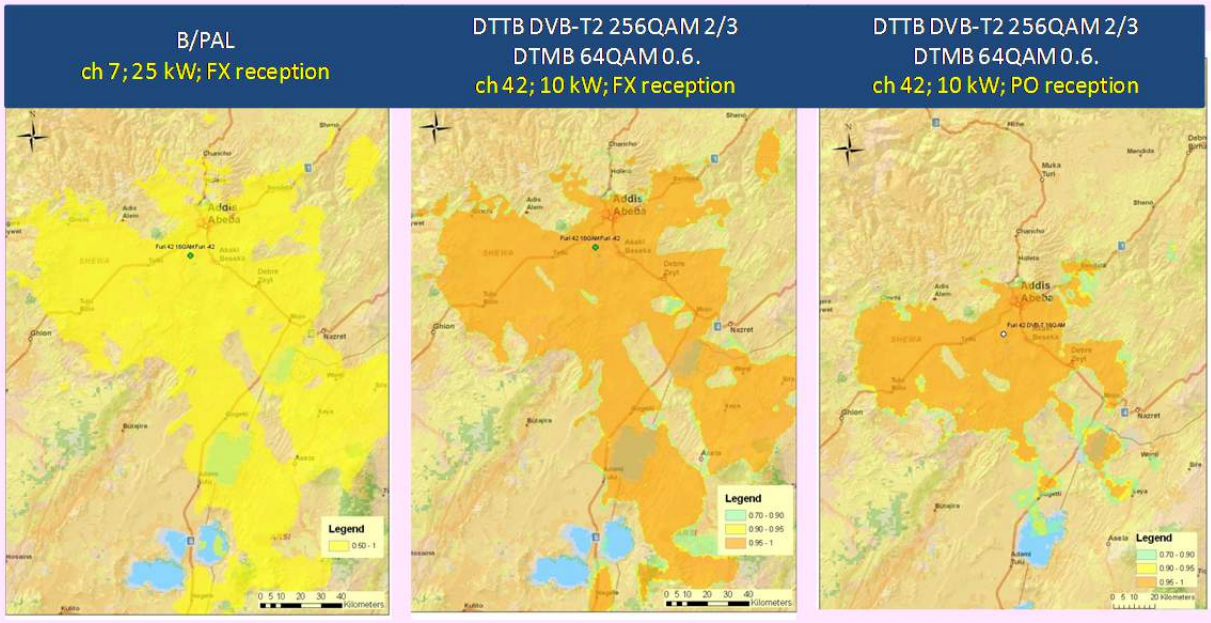
The table below shows the calculated area coverage of the B-PAL and DTTB transmissions using DVB-T2 256QAM 2/3 or DTMB 64QAM 0.6.

Table 4.12: Overview of results of coverage calculations of the Mount Furi station

Transmission standard	Channel	ERP	Antenna height	Reception mode	Calculated area coverage km^2
B-PAL	7	25 kW	40 m	Fixed (rooftop); 10 m	20969
DTTB DVB-T2 256QAM 2/3 DTMB 64QAM 0.6	42	10 kW	60 m	Fixed (rooftop); 10 m	16345
DTTB DVB-T2 256QAM 2/3 DTMB 64QAM 0.6	42	10 kW	60 m	Portable outdoor; 1.5 m	6370

The coverage plots in Figure 4.14 show noise-limited coverage, without taking into account interference from analogue or digital television stations.

Figure 4.14: Coverage predictions Mount Furi station



Source: Giraplan (made available by courtesy of Progira Communications)

[21] The broadcast planning software package Giraplan, has been made available for this propose by courtesy of Progira Communications.

The coverage presentations show that coverage range is limited to about 20 to 80 km by the surrounding mountains in a wide arc. In the South-East direction propagation is less obstructed by mountains and TV reception can take place at much larger distances.

Addis Ababa and surroundings is well covered by analogue TV and DTTB (DVB-T2 256QAM 2/3 or DTMB 64QAM 0.6), even with portable reception.

The covered area is largest with B-PAL on channel 7.The DTTB coverage with fixed (rooftop) reception is somewhat smaller. It needs to be investigated how many household will have no good reception after the digital switch-over. Measures to improve coverage are given above in the description of Situation 1 (areas served by ETV in VHF).

Portable reception

With a given DTTB transmitter, the portable coverage area is considerably smaller than the coverage area with rooftop reception. In the example given in Figure 4.13 the fixed reception coverage radius is about 35 km, whereas the portable outdoor coverage range is about 11 km. In not too large towns where the transmitter is situated close to the town, the portable target may be achieved by the indicated ERPs. In the example of the Mount Furi station (Table 4.14 and Figure 4.14) the portable reception area is about 40 per cent of the fixed reception area. However, Addis Ababa and surroundings is included in the portable coverage area. Therefore in many practical situations portable reception in urban areas near transmitters may be acceptable.

If the portable reception area is not sufficient, DTTB portable reception can be improved by

- higher ERP (up to the maximum given in GE06);
- dense SFN;
- more robust system variant.

5. Recommendations

Given the information collected/provided during the two missions to Ethiopia and the analyses carried out by the experts, the NRT is recommended to carry out the following steps for a smooth transition to digital television broadcasting and the analogue services switch-off:

1. Submit the roadmap report for approval at either ministerial level and/or political level.
2. After approval, acquire a mandate to plan and manage the ASO process in accordance with the phases of the roadmap. As indicated in the roadmap report, this mandate may come in stages.
3. After being mandated, prepare and take the following decisions as the first of the roadmap as these decisions are needed to determine the scope and duration of the roadmap planning:
   - determine ASO date and the date of the first DTTB transmissions;
   - stipulate the transmission standard (DVB-T2 or DTMB) and decide whether a mandatory CAS is necessary (either in the case of ETV having pay-tv services or applying CAS for collecting television licence fees);
   - finalize the licensing model, to include (if it is decided to have an common (independent) multiplex/network operator):
     - the decision on which activities/assets to separate: this is to say the ETV radio activities as well as the network activities of the regional PSBs;
     - a model for assigning broadcast licences (and hence the bandwidth management/assigning slots), in particular for common multiplex/network operator;
     - ONP rules for the common multiplex/network operator;

- finalize and agree the DSO objectives (see Table 2.3) and determine the customer proposition (see section 4.8);
- if decided to have a network partner/supplier, determine the procedure and licence to be awarded to a network operator partner and/or supplier.

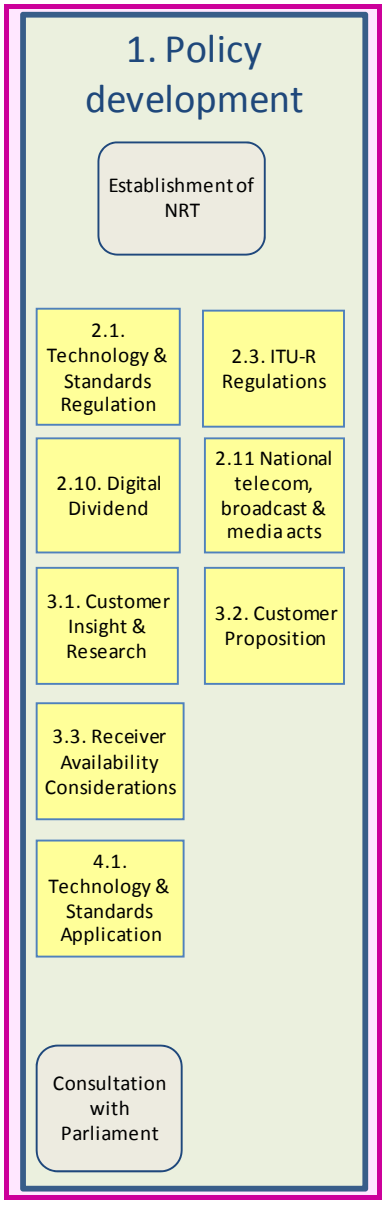
4. Form a project management office (PMO) and start drafting an initial detailed ASO planning and determine the progress reporting procedures and structures.
5. Start preparations for separating ETV (and possibly regional PSBs) network assets and establishing the common multiplex/network operator.

Apart from these steps for the NRT to take, some additional recommendations can be provided which seem to be evident for the situation in Ethiopia:

6. Have market research carried out covering the key elements as indicated in this roadmap report (see phase 1). As indicated some key research data should be collected, including data on the current analogue viewers and the ability/willingness to pay for STBs.
7. Carry out detailed frequency and service planning (see phase 2 and 3). Extensive and profound frequency planning will be required to see what is possible, especially considering the minimum requirement to cover at least the existing analogue television coverage (including the regional PSBs);
8. Reserve capacity for future MTV services. Without such a capacity reservation it will be difficult (or even impossible) to introduce these services at a later date or only against very high costs.
9. Investigate the possibilities of auctioning mobile (IMT/LTE) spectrum as an important means for financing the ASO process. This also includes the investigation of the possibilities of advancing the ASO costs as the proceeds of the auction will become available after ASO.

Annex 1: Functional building blocks related to phase 1 of the roadmap

DTTB policy development



The selected functional building blocks related to phase 1 of the roadmap are shown in Figure 3.6 and are reproduced here.

Section 3.4.2 describes phase 1 of the roadmap.

This Annex gives an overview in the form of tables of the status of each of the selected functional building blocks related to phase 1 by means of the following codes:

A. the decisions on key topics and choices that are already taken;

B. the decisions on key topics and choices that are partly taken;

C. the activities needed regarding key topics and choices that have not yet been decided;

D. the activities needed regarding key topics and choices that need revision.

For those issues that are not (fully) decided or need revision the main activities are indicated.

The selected functional building blocks are presented in the order of the number of the block. This number refers to the corresponding chapter in the ITU Guidelines, where more information and implementation guidelines can be found.

The grey blocks are not described in the ITU Guidelines and not described in the tables below. These blocks represent activities that are not specific to digital terrestrial television.

2.1 Technology and standards regulation

Brief description	In this section the key *policy* decisions are outlined on adopting or promoting DTTB/MTV technology and associated standards.
Objective	This section deals with the question whether a standard should be prescribed/promoted and for what system/network elements.

Key topics and choices		Status	Decision
2.1.1	Television presentation formats: for DTTB platforms either Standard Definition Television (SDTV) and/or High Definition Television (HDTV)?	A	No television format obligation. Although a minimum picture quality should be applied when planning the DTTB network.
2.1.2	Transmission standard: for DTTB platforms e.g. DVB-T or ATSC. Has the standard setting been decided?	C	A standard will be set and choice is limited between DVB-T2 and DTMB. For more detailed considerations see Section 4.1.
2.1.3	Compression technology: for DTTB platforms MPEG2 or MPEG4. Has the standard setting been decided?	B	Compression technology will be regulated but system not selected yet. In the case DVB-T2 is selected, the STBs will come automatically with MPEG4. In the case DTMB is selected such a decision will be required and the availability of DTMB MPEG4 STBs have to investigated. The price difference between DVB-T2 and DTMB is currently still significant. However, as the ASO process is to start in 2012 (see Section 2.), this price difference is expected to be smaller as DVB-T2 prices are expected to fall further.
2.1.4	Conditional Access (CA) system and Digital Rights Management (DRM): interoperability between deployed systems for respectively DTTB and MTV platforms. Has the standard setting been decided?	B	CA will be regulated in the case ETV will launch pay-tv services before or at the same time as Bridgetech will launch its pay-tv services. CA may also be regulated if it will be deployed for collecting television licence fees (see Section 4.4) CAS is still to be selected. For more detailed considerations see Section 4.2.
2.1.5	Application Programming Interface (API) for additional and interactive services: for DTTB platforms e.g. MHP or proprietary and for MTV platforms specific technical requirements to support integration between broadcast TV and 3G mobile TV networks. Has the standard setting been decided?	A	No API obligation.

Main activities	Observation/Advice
1. Carry out market research/surveys for identifying industry and consumer needs for standardization.	To be included in the market research as suggested in this first Phase (see Section 3.4.2).
2. Determine minimum set of receiver Standards for the DTTB and MTV market, based on the market developments.	See Section 3.4.2.
3. Assess impact on industry and end consumers.	As part of the analysis of the market research results (as indicated in Section 3.4.2).
4. Determine receiver requirements and include in frequency licence terms and conditions and/or media permits and authorizations.	See Section 3.4.2.
5. Determine communication messages, planning, standardization/testing bodies and methods (including logos and labelling).	The functionality of the selected STB (transmission standard and possibly CAS) and specs are important input for the Communication Plan (see second Phase of the Ethiopian Roadmap) and the ASO planning (e.g. the work stream 'Financial and installation support' can include the logistics of the labelling of the STB as to support the viewer).

2.3 ITU-R Regulations

Brief description	ITU-R regulations entail the Radio Regulations (RR) and in particular the table of Frequency Allocations (Region 1) and the relevant provisions of the World Radiocommunication Conference 2007 (WRC-07). As well as the Geneva Agreement 2006 (GE06) and the entries in the associated plans for the use of African Administrations.
Objective	With these regulations the ITU strives to ensure the compliancy with the international RR and the GE06 agreement as to avoid harmful interference, achieve equipment compatibility and to ensure future spectrum availability for DTTB.

Key topics and choices		Status	Decision
2.3.1	The international context of the ITU-R regulations: Are the different entries in the GE06 plan considered (allotment/assignment)?	B	The different layers still to be determined, given the available spectrum as defined in the GE06 entries. Most of the 54 ETV UHF transmitters comply with GE06. With regard to some sites the Article 4 procedure is not yet finalized. ETH has no VHF DTTB assignments; if it is decided to plan VHF DTTB transmitters, the Article 4 procedure should be followed too.
2.3.2	Applicability and implications of the GE06 plan and ITU-RR: (a) what frequencies or allotments will be assigned for what type of service (for example two allotments/multiplexes for DTTB services and one for MTV services)? (b) In what combinations these frequencies or allotments will be assigned (for example two separate allotments/multiplexes to be licensed to two different licence holders or two allotments to one single licence holder? (c) When these frequencies or allotments will be licensed or can be taken into operation? For answering these questions process steps are defined in this section.	B	All three sub-choices (a-c) still to be decided. The possibility to use band III for digital television services (especially for future MTV assignments) is not excluded. Split MTV/DTTB partly decided. • 1 frequency /site for DTTB • the 54 UHF transmitters have frequencies assigned to them • DTTB will start in 2012. Check compliance of ATV UHF transmitters in currently non-served areas in the case ATV will be introduced first and switched to DTTB at later date. If not in compliance with GE06, may wish to bring the ATV transmitters into operation on a non-protection/non-interference basis.

Main activities	Observation/Advice
1. Determine applicability and implications of the GE06 Plan on (a) the planned *national* and regional DTTB services (b) ASO process (especially considering any simulcasting areas) and (c) the *operational* analogue TV services.	As said in Section 3.4.2 of this report, a clear and shared understanding of the available spectrum will enable the NRT to develop a well-motivated DTTB Policy document. At this first Phase of the Roadmap, this understanding should be established.
2. Determine necessary changes to *planned* licensing procedures, terms and conditions for DTTB services and ASO plans.	As (preliminary) input for Phase 3.
3. Determine necessary changes to *assigned* frequency (and possibly content) licences for operational DTTB and Analogue TV services.	Especially the assigned DTTB licence to Bridgetech needs to be evaluated.
4. Determine necessary changes/exemptions to the GE06 Plan.	As discussed in Section 3.4.2 (and 3.4.3) this might be necessary for Ethiopia. However, these activities (i.e. the administrative procedures need not to be part of the critical path).
5. Possibly determine necessary budget for compensations and network retuning activities.	As indicated in Table 4.1, this was assessed as not likely to be necessary. However, this should be checked and confirmed.

2.10 Digital dividend

Brief description	The Digital Dividend is the spectrum in Band III, IV and V that is available after analogue television has been transferred to digital television.
Objective	Freeing up spectrum for more valuable services.

Key topics and choices		Status	Decision
2.10.1	Determining the size of the digital dividend: has the size been determined?	A	Channel 21 – 60 will be used for Digital Television. After ASO Band III and channel 61-69 will be earmarked for digital dividend (i.e. spectrum not to be used for DTTB services).
2.10.2	Digital Dividend options: have the allocation to the different service been determined? (broadcasting or non-broadcasting)	A	For the application of the Digital Dividend Ethiopia will follow global developments and the WRC 2012 results. This is likely to result in an additional allocation to Mobile of the channels 61-69. The application of Band III channels will be decided after ASO.

Main activities	Observation/Advice
1. Analyse current and future market developments and possibly conduct market consultation(s) in the broadcast (and telecoms) industries.	As indicated above the two key decisions have already been taken. As the size and allocation of digital dividend is part of the DTTB Policy document, supporting evidence and motivation may need still to gathered and drafted. Market research is deemed not to be necessary given the decisions already taken.
2. Assess current and future market needs for DTTB and MTV services, possibly based on formulated Legislation and Policies.	Market research is deemed not to be necessary given the decisions already taken. Although following the WRC2012 results will be required.
3. Assess available spectrum after ASO, based on ASO plans, National Spectrum Plan and ITU-R Regulations.	Important activity to be carried out. See Section 3.4.2 and functional building block 2.3 in this Annex.
4. Map spectrum needs on available spectrum and determine priorities and assign spectrum to Broadcasting.	Important activity to be carried out. See Section 3.4.2 and functional building block 2.3 in this Annex.
5. Possibly draft spectrum re-farming plans and compensation schemes (for network and receiver re-tuning activities), reserve budgets.	Unlikely to be necessary. But should be confirmed.
6. Update National Spectrum Plan and align licence Terms and Conditions for DTTB services.	A check (i.e. whether no frequencies are/will be assigned which are part of the defined digital dividend) of the Bridgetech licence will be necessary. National Spectrum Plan will need to be updated accordingly (as a regular spectrum management activity, not specific for this Roadmap).

2.11 National Telecom, Broadcast and Media Act

Brief description	This section addresses the compliancy of the intended policy decisions with the existing and relevant regulatory framework. Very often this regulatory framework comprises national Telecommunications, Broadcast and Media Acts. For Ethiopia the relevant regulatory framework is given in Table 2.2 of this report.
Objective	To be compliant with existing regulations, which might also include regulations on cross and foreign ownership and state aid.

Key topics and choices		Status	Decision
2.11.1	Checking compliancy with existing national, Telecommunications, Broadcast and Media Acts: is the formulated DTTB/MTV policy in line with the Acts?	C	Check compliancy of PSB (ETV) pay-tv offering with Broadcasting act (reason for introducing the pay-tv offering is to finance the production cost of exclusive content). In the case of Model B (and Public Private Partnership) the pricing rules have to be set. Please note there is no general competition law to assist in setting pricing rules.
2.11.2	Checking compliancy with other legislation, especially related to cross and foreign ownership and State aid: is the formulated DTTB/MTV policy in line with the Acts?	B	Foreign and cross ownership rules do exist in Ethiopia. Content production and service provisioning by foreign (controlled) entities not possible with current foreign ownership regulations. PPP for NewCo still to be decided.

Main activities	Observation/Advice
1. Make inventory of current Legislation.	The Table 2.2 could form a basis for carrying out this activity.
2. Identify gaps and draft proposals for additional and/or changes in Legislation (based on 'best practices').	As described in Section 3.4.2, this entails a first assessment. Results of this assessment will provide input for the Plan of Action (included in the DTTB Policy document). During the third Phase of the Roadmap (DTTB Regulations), the gaps and necessary changes can be further detailed.
3. Determine planning for changes in the law and determine 'must haves' for launching DTTB/ASO and MTV.	As part of the Plan of Action of the DTTB Policy document.

3.1 Customer insight and research

Brief description	Launching a commercial PSB DTTB service, will require the identification of demand drivers (i.e. customer needs), competitive advantages, service uptake projections and possibly market entry barriers in the local market(s).
Objective	The NRT will have to carry out some form of market research for identifying these demand drivers, competitive advantages and service uptake projections.

Key topics and choices		Status	Decision
3.1.1	Overview of the DTTB markets: market definition, key service and market characteristics	C	Attributes to be included are (a) recurring payments (b) one-off payment (c) number of channels and (d) the television content (e.g. theme channels). Also the current television market has to be analysed/researched (see also Section 3.4.2 for more detail). The PSB DTTB proposition is likely not to include advanced features like 'Push VoD' considering the limited ASO budget and low ability to pay under large proportions of the population.
3.1.2	Market research methods: basic market research approaches and embedding market research in the DTTB/MTV business planning process	C	Apply low cost methods to research the Ethiopian market.

Main activities	Observation/Advice
1. Determine need, timing and scope for market research.	As part of the ASO planning.
2. Draft market research plan, staff and budget market research project.	As part of the ASO Plan and planning.
3. Analyse competitive offerings, substitutes and technology developments.	As part of the market research.
4. Design and develop preliminary DTTB service propositions.	As part of the market research. The expressed ETV ambition to offer a pay-tv offering will have to be explicitly addressed in the market research. Also the associated business case should be drafted (see also sections 4.2 and 4.4).
5. Carry out market research and analyse results, translate into DTTB service propositions, if necessary carry out additional market research.	As part of the market research. The results will be used for justification or supporting evidence for the DTTB Policy document but also for the initial DTTB service planning as described in Section 3.4.3. (ASO Planning).

3.2 Customer proposition

Brief description	This section focuses on determining the PSB DTTB competitive advantage and what the related service attributes could look like.
Objective	Finding the best Customer Proposition in line with the Business Plan objectives (see initial DTTB service planning in the second Phase of the Roadmap).

Key topics and choices	Status	Decision
3.2.1 DTTB competitive advantage and related Service Proposition attributes	B	For a first assessment of the competitive edge of the PSB DTTB offering see Section 4.8 (i.e. additional channels, price and quality).

Main activities	Observation/Advice
1. Analyse earlier DTTB service launches and compare with customer research results/local market conditions.	Select those service launches focused on the same competitive edges and in similar market conditions (i.e. low ability to pay and not that many alternative offers).
2. Define DTTB service propositions and check feasibility in terms of network planning and business case.	As part of the second Phase of the Roadmap.
3. Possibly redefine DTTB service propositions and test in market again, i.e. additional market research.	Redefining of DTTB service proposition will take place; however testing such revised offerings in the market will probably take up too much time (given the DTTB start in 2012) and budget.

3.3 Receiver availability and considerations

Brief description	The consideration of the many different DTTB and MTV receiver types that are commercially available today.
Objective	For a Service Provider it is important to draft the receiver's functional requirements based on the defined Service Proposition(s). Only those requirements supporting the Service Proposition should be incorporated. These 'must have' requirements might prove to be too expensive for the business case and therefore receiver considerations might result in a revised Service Proposition.

Key topics and choices		Status	Decision
3.3.1	DTTB functional receiver requirements and availability (see receiver model)	C	For ASO budget limitations and the low ability to pay in the market, the functionality will be to provide the basic set of functions (to include, zapping, EPG, software updates and standard compliancy). Functionality will be also be driven by regulatory stipulations for the transmission standard and CAS (see Figure 3.3.1 in the ITU Guidelines). Please note that in the case of applying CAS for collecting the television licence fees all STB should have CAS.
3.3.2	MTV functional receiver requirements and availability	NA	

Main activities	Observation/Advice
1. Analyse earlier DTTB service launches for STB supplies and functionality requirements.	This market survey exercise is to address the aspects as included in the Guidelines but also the additional Ethiopia specific issues as language requirements and specific television connectors (for example RGB connectors rather than SCART).
2. Check any prescribed Technologies and Standards, Receiver regulations and analyse market research results.	As part of the DTTB Policy development process (first Phase of the Roadmap) the standard setting is mutually dependent on the receiver requirements.
3. Assess and make inventory of availability, product roadmaps and supply planning of various receiver types/attributes.	Especially the supply planning of the various STB suppliers might be a key input for the ASO planning and might impact the decision on setting receiver functionalities.
4. Check network compatibility and interoperability (radio interfaces and API/applications).	Testing of interoperability between network and STBs might be necessary (not such much for the interface but aspects like frequency/network changes and software updates).
5. Assess and detail ex-factory and retail pricing for various receivers.	This activity should also include the assessment of the suppliers' cooperation to work together with the local retail in Ethiopia.
6. Decide key receivers and their attributes, draft receiver/service roadmap.	This might be limited to one type of STB. Functionality/attributes for IDTVs could be considered to be left to the market. Although labelling and the inclusion of IDTV information in the ASO Communication plan is strongly advised.

4.1 Technology and standards application

Brief description	Technical comparison of key DTTB standards and the characteristics of associated systems.
Objective	Technical evaluation of DTTB transmission standard and choice of systems for required services.

Key topics and choices		Status	Decision
4.1.1	Technical tests to evaluate system performance	A	EBA and ETV will carry out tests to evaluate the technical performance of DTMB and DVB-T2.
4.1.2	SDTV and HDTV specifications	B	SDTV and one sound channel. Bit rate for services still to be decided. Aspect ratio 16:9. No HDTV services envisaged.
4.1.3	Selection of DTTB transmission standard	C	Choice will soon be made between DTMB and DVB-T2. Both DTMB and DVB-T2 can be applied under the GE06 provisions (see also Section 4.1 and Annex 5).

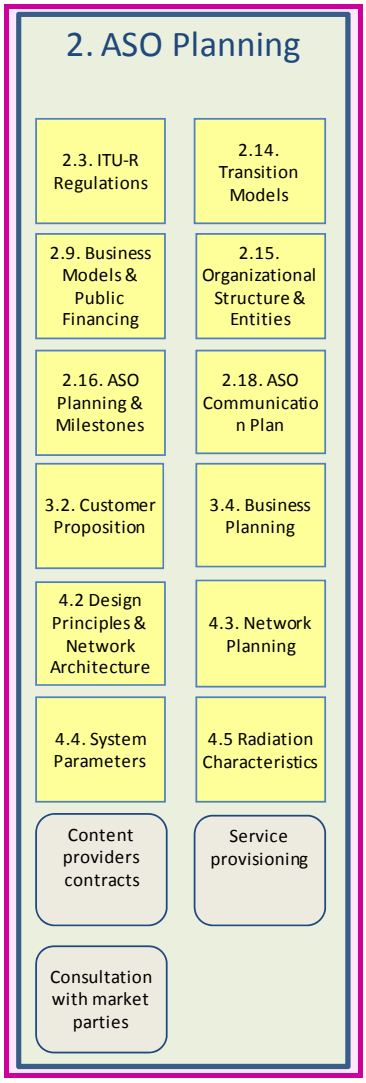
Key topics and choices	Status	Decision
4.1.4 Compression system	C	Depending on the choice of the transmission standard; either DTMB/MPEG2 or DVB-T2/MPEG4.
4.1.5 Encryption system	C	Preferably the same with all service providers.
4.1.6 Additional services	C	There are no teletext services in ETH and teletext is not a requirement for the digital platform. For Access services there are no requirements (yet). Provision for System Software Updates (SSU) is likely to be necessary.

Main activities	Observation/Advice
1. Describing tests	Test transmissions at the Mount Furi station should demonstrate: 1. Multiplex capacity of DTMB compared to DVB-T2 with system variants having the same C/N and services with same picture quality; 2. Flexibility of DVB-T2 by transmitting services with different robustness using the Physical Layer Pipeline of the DVB-T2 technology; 3. Extend of coverage of DTMB compared DVB-T2 with system variants having the same net bit rate.
2. Estimate required bit rate of SDTV services (including sound channels) The bit rate of the multiplex is trade-off between picture quality and multiplex capacity. Final estimation can only be made after Design principles and Network architecture (see functional building block 4.2 in Phase 2) and Network planning (see functional building block 4.3 in Phase 2) have been considered.	Good picture quality is a DSO objective; flat screen TVs are more sensitive to artefacts than CRTs. First estimate could be: **DTMB** • Video bit rate: ≥ 4 Mbit/s (MPEG2), depending on the kind of programme; • Audio bit rate: 96 kbit/s (MPEG1 layer 2, one mono sound channel of good quality). **DVB-T2** • Video bit rate: ≥ 2 Mbit/s (MPEG4), depending on the kind of programme; • Audio bit rate: 64 kbit/s (AAC; one mono sound channel of good quality).
3. Selection of transmission standard	DTMB and DVB-T2 have distinct characteristics (see Section 4.1 and Annex 5). The choice of the transmission standard is critical, many of the key topics and choices of other functional building block depend on it (See Section 4.9 and 4.10).
4. Evaluation of characteristics of compression systems (MPEG2 or MPEG4) The selection of is a trade-off between multiplex capacity and receiver availability and costs.	See ITU Guidelines Section 4.1.4. It is expected that by 2012 MPEG4 technology is mature and the MPEG4coding efficiency is about two times better MPEG2. Licence costs for MPEG4 technology is not needed anymore. The choice depends on the standard choice DVB-T2/MPEG4 or DTMB/MPEG2.If DTMB is chosen and DTMB receivers are available with MPEG4 at acceptable costs, MPEG4 could be considered. However DTMB/MPEG (if available) does not resolve the capacity issues described in Section 4.9.1.
5. Evaluation of conditional access (CA) systems The choice for a conditional access (CA) system is a trade-off between costs of the system and security.	CA is considered for controlling TV-licence payments; furthermore ETV is considering pay-tv services. Bridgetech will use pay-tv services and in future other service providers may also use encrypted services. In order to save costs and discomfort for viewers the same CA system should be used by all service providers (otherwise the viewer will need more expensive receivers with a Common Interface, or more than one STB).

Main activities	Observation/Advice
	See also Section 4.2.
6. Estimation of required bit rate for SI and need for SSU The only requirement at this stage is Service Information for constructing the EPG in the receiver and System Software Updates (SSU) to be able to upload new software to the receivers.	The Service Information required for the EPG may need about 0.2 Mbit/s per service. It is recommended to undertake testing of SSU beforehand to avoid risk of problems during live data transmission.

Annex 2: Functional building blocks related to phase 2 of the roadmap

ASO planning



The selected functional building blocks related to phase 2 of the Roadmap are shown in Figure 3.6 and are reproduced here.

Section 3.4.3 describes Phase 2 of the roadmap.

This Annex gives an overview in the form of tables of the status of each of the selected functional building blocks related to phase 2 by means of the following codes:

A. the decisions on key topics and choices that are already taken;

B. the decisions on key topics and choices that are partly taken;

C. the activities needed regarding key topics and choices that have not yet been decided;

D. the activities needed regarding key topics and choices that need revision.

For those issues that are not (fully) decided or need revision the main activities are indicated.

The selected functional building blocks are presented in the order of the number of the block. This number refers to the corresponding chapter in the ITU Guidelines, where more information and implementation guidelines can be found.

The grey coloured blocks are not described in the ITU Guidelines and not described in the tables below. These blocks represent activities that are not specific to digital terrestrial television.

2.3 ITU/R regulations

Brief description	ITU-R regulations entail the Radio Regulations (RR) and in particular the table of Frequency Allocations (Region 1) and the relevant provisions of the World Radiocommunication Conference 2007 (WRC-07). As well as the Geneva Agreement 2006 (GE06) and the entries in the associated plans for the use of African Administrations.
Objective	In this Phase, to determine what possible ASO model are possible given the insight of the first Phase.

Key topics and choices		Status	Decision
2.3.3	The international context of the ITU-R regulations: Are the different entries in the GE06 plan considered (allotment/assignment)?	A	As part of the ASO planning process. No spectrum incompatibilities expected given the DSO objectives.

Key topics and choices		Status	Decision
2.3.4	Applicability and implications of the GE06 plan and ITU-RR and ASO planning: what are the possible ASO models the available spectrum	A	

Main activities	Observation/Advice
1. Determine applicability and implications of the GE06 Plan on ASO process (especially considering any simulcasting areas) and the *operational* analogue TV services	As part of the ASO planning process.
2. Determine necessary changes to *planned* licensing procedures, terms and conditions for DTTB services and ASO plans	As (preliminary) input for Phase 3.
3. Determine necessary changes to *assigned* frequency (and possibly content) licences for operational DTTB and Analogue TV services	Especially the assigned DTTB licence to Bridgetech needs to be evaluated.
4. Determine necessary changes/exemptions to the GE06 Plan	As discussed in Section 3.4.2 (and 3.4.3) this might be necessary for Ethiopia. However, these activities (i.e. the administrative procedures need not to be part of the critical path.

2.9 Business models and public financing

Brief description	As part of the DTTB service planning, the associated costs and funding for the ASO process (including the PSB DTTB offer) should be established.
Objective	Financing the ASO in order to have a smooth transition from analogue to digital television broadcasting. To equip the NRT with sufficient resources to plan and manage the ASO process.

Key topics and choices		Status	Decision
2.9.1	General ASO financing models and sourcing. Has the different sources for DSO/ASO been selected and is the budget fully financed?	B	Several finance sources have been identified: (a) general tax/television licence fee (b) digital dividend/auctioning IMT licences (c) broadcast/spectrum licence fees (d) public private partnership for NewCo. A possibility to provide government loans (rather than providing subsidies) as viewer aid has been identified too. Collecting television licence fees (by means of the CAS) can then be viewed as a repayment for the supplied STB. For more considerations on this topic see Table 4.4. Currently, PSB entities financed out of general taxes (by means of budget requests). All income generated by EBA (licence fees, television licence fees) are all added directly to the Treasury. This is a point for attention as it will not be evident that these financial means will also be allocated to the ASO process. On the digital platform ETV is considering to introduce pay-tv services. A compliancy check with the current broadcast regulations will be necessary. In addition, the business case for pay-tv services should be drafted. Also it should be assessed whether pay-tv income can be used directly by ETV as a PSB.

Key topics and choices	Status	Decision
2.9.2 DTTB specific financing issues: a) Financing of digital receivers b) Financing the impact of free-to-air stipulations c) In case the PSB service is encrypted content rights can be lowered d) Financing the simulcast period e) TV licensing fee system might need revision.	A	All still to be addressed in the ASO planning phase.

Main activities	Observation/Advice
1. Consult Public Broadcaster(s) on possibilities to contribute to financing the ASO process	
2. Analyse market situation and assess possible market distortions	Due to the limited number of television service providers and their relative market share, market distortions are unlikely.
3. Define or complete required public service offering on DTTB (if not defined in Legislation yet)	Current legal framework does not quantify the required DTTB services. Here the NRT has some degree of freedom. Although the ASO plan will need approval in Parliament.
4. Align defined public service offering with other DTTB licence terms and conditions and media permits, and their planning	Special care should be given to the Bridgetech licence. Especially when a coordinated network rollout and service launch is wished for.
5. Determine and establish budget for ASO Plan	The ASO Plan should pass Parliament and hence should be well prepared and introduced in Parliament (lobby).

2.14 Transition models

Brief description	This section deals with the situation that analogue television broadcasts have to be stopped and the existing analogue services are migrated to a DTTB platform in one coordinated effort, led by the national Government (i.e. the ASO process). This section deals with what ASO model will be applied where in Ethiopia.
Objective	Existing analogue services are migrated to a DTTB platform in one coordinated effort and without service interrupts.

Key topics and choices	Status	Decision
2.14.1 ASO objectives and hurdles: What are the ASO objectives (To have a universal television service on the DTTB platform, and/or to securing the future of the terrestrial platform)	A	See DSO objectives Table 2.3 in Section 2.3 of this report.
2.14.2 ASO Transition models: Which models is envisioned a) ASO with simulcast period, with two sub-categories i) Phased approach to analogue switch-off ii) National approach to analogue switch-off b) ASO without simulcast period	B	For the two basic markets various models are still under evaluation: a) In the non-served areas: i) duocast, ii) directly start with DTTB or iii) first start with analogue and introduce directly DTTB later b) in served areas: i) simulcast ii) phased ASO .

Key topics and choices	Status	Decision
		For more considerations on the ASO model see Section 4.5.

Main activities	Observation/Advice
1. Check existing Legislation and policies for Public television service (e.g. FTA) and coverage stipulations (e.g. nationwide coverage)	Current legal framework does not explicitly states a minimum coverage percentage. This provides a degree of freedom for the NRT.
2. Carry out market research on ASO affected viewers/listeners. Identify any hidden viewers/listeners (2nd television sets, regional programming, prisons, etc.), Identify impact and risk areas	To be carried out in the previous Phase of the Roadmap (DTTB Policy). See Section 3.4.2 on the market research of the current market. The result of this market research can be used here for this activity.
3. Analyse and assess complexity and size of network modifications and receiver transitions	In the first visit it was concluded that spectrum and infrastructure incompatibilities were unlikely to occur. Also given the relative low number of analogue transmitter in operations, the complexity and size of the network modifications are assessed low.
4. Involve and discuss ASO with Content Aggregators (esp. Public Broadcaster) and consumer associations	To be included in this Phase.
5. Decide transition model (simulcast period and ASO phasing)	To be included in this Phase. For more considerations on the ASO model see Section 4.5.

2.15 Organizational structure and entities

Brief description	The ASO process is a complex and time consuming operation and a special purpose entity (e.g. Task Force, Committee or separate company) may coordinate the overall process and planning. In Ethiopia this task is assigned (not formally yet) to the NRT.
Objective	A coordinated ASO process between all involved parties and stakeholders.

Key topics and choices		Status	Decision
2.15.1	ASO success factors: are the success factors in place? (a) Cooperation and coordination across the value chain; (b) Strong leadership; (c) Effective communication strategy; (d) Sufficient financial resources for the ASO organization	C	
2.15.2	Organizational ASO structures and entities: ASO organization completed and in place?	B	The NRT to include at least the EBA, national and regional PSB, Commercial broadcasters (i.e. at least BridgeTech), multiplex/network operator (in case of model B), 'loan providers/collectors' (e.g. the post offices, MFI's), Governmental Communications Office, STB manufacturers, community centres and Consumer Protection Agency (to be established soon). For more details see Section 4.6.
2.15.3	ASO costs and support: ASO cost analysed and determined (use table in this section)	C	Detail inventory necessary as part of the process of balancing DTTB service planning, Customer Proposition and financing (see Section 3.4.3 of this report).

Main activities	Observation/Advice
1. Establish overall coordination tasks and needs	All to be included as part of this Phase. For more details see Section 3.4.3 and 4.6 of this report.
2. Form or extent special purpose vehicle, establish clear mandate	
3. Establish budget and communication means (air-time, website, etc.)	

2.16 ASO planning and milestones

Brief description	Overall ASO planning and its key milestones, managed by the National ASO committee or equivalent body.
Objective	ASO planning respecting the set dates for ASO and providing a progress monitoring tool for the National ASO Committee.

Key topics and choices	Status	Decision
2.16.1 Outlining the ASO planning: when and where to begin the process and how long the entire operation should last	B	Digital broadcasting services will start in 2012 and the last analogue transmitter will be switched off in June 2015, hence the DSO process will last at maximal 3.5 years. In the case of a phased approach, the start region is likely to be larger area of Addis Ababa.
2.16.2 Overall ASO planning set-up: including the overall programme structure and the key result paths in an ASO plan	C	
2.16.3 ASO planning phases (in a phased approach): the three stages and their key milestones	C	Phased approach is preferred. The exact phases still to be decided. Decision on ASO model in the currently non-served areas still to be decided.

Main activities	Observation/Advice
1. Draft comprehensive ASO planning (milestones and activities) and assign tasks and responsibilities (including core project management team)	All to be included as part of this phase. For more details see Section 3.4.2 and Section 4.6 of this report and the ITU Guidelines. An Example ASO reports can be found on: www.digitaluk.co.uk/__data/assets/pdf_file/0009/19791/Digital_UK_Ofcom_Q2_2007_FINAL.pdf.
2. Establish ASO project monitoring framework and reporting structure	
3. Identify ASO project risks and draft risk mitigation plans (including fall back and/or roll back scenarios)	

2.18 ASO communication plan

Brief description	This section focuses on communication to the viewers and other stakeholders in the DTTB value chain.
Objective	To help viewers prepare adequately, the whole broadcast community needs to address all viewers relying on the analogue terrestrial platform using targeted communication tools that can reach out to diverse population segments.

Key topics and choices		Status	Decision
2.18.1	Communication strategy: including communication messages (related to the communication stage) and target group(see phased model)	C	The establishment of a 'trusted brand' for labelling certified/approved receivers will be necessary.
2.18.2	Communication tools: the various communication means to reach the listed target groups	B	The main tools are likely to be (a) Government Communications Agency tools (b) Radio and Television (c) printed media (d) SMS coverage checker (e) social ETH structure (community centres and neighbours helping each other).

Main activities	Observation/Advice
1. Draft communication plan (including target audiences, timing, means, etc.)	All to be included in this phase of the roadmap. For more details see Section 3.4.3 and 4.7 of this report.
2. Continuous alignment with ASO planning	
3. Determine and establish compensation schemes and systems, include in communication plan	

3.2 Customer Proposition

Brief description	This section focuses on determining the competitive advantage and what the related service attributes could look like. In this Phase it is part of the service planning and service proposition review and financing cycle.
Objective	Finding the best Customer Proposition in line with the Business Plan objectives (i.e. ASO Plan and budget).

Key topics and choices		Status	Decision
3.2.2	DTTB competitive advantage and related Service Proposition attributes	C	Competitive advantage already established in previous Phase. Attributes still to be defined.

Main activities	Observation/Advice
1. Define DTTB service attributes and check network feasibility and cost levels	As part of the service planning, service proposition review and financing cycle as described in Section 3.4.3. See also considerations in Section 4.8 in this report and review Table 3.2.1 in the ITU Guidelines.

3.4 Business planning

Brief description	This section will focus on agreement on business case (budget) for the ASO Plan.
Objective	To have the ASO Plan adopted by Parliament.

Key topics and choices		Status	Decision
3.4.1	Business models for DTTB services: which model or combination of models is considered (may vary per multiplex)	B	Two business models are under consideration for the PSB (a) only FTA and (b) FTA + pay-tv offering.
3.4.2	What does the business case look like for the ASO Plan?	C	The Business Plan = ASO Plan budget.

Main activities	Observation/Advice
1. Assess market up-take and project revenue streams, based on customer research and proposition.	Especially the ETV pay-tv offering and its business case needs special consideration.
2. Assess and calculate associated costs for different ASO Plan.	All to be carried out as part of this Phase. For more considerations see sections 3.4.3, 4.2 and 4.4 of this report.
3. Carry out sensitivity analysis, draft business case /ASO Plan for scenarios. For example yes/no simulcast; indoor/outdoor (i.e. different quality levels) or yes/no pay-tv services.	
4. Quantify total investments and their associated risks, assess financing and public funding possibilities, consider co-operation/joint venture/vendor financing/revenue sharing.	
5. Prepare approval of ASO budget by Parliament (as part of the ASO Plan).	

4.2 Design principles and network architecture

Brief description	Implementation priorities and network architecture
Objective	Initial technical description of the main network elements in relation to service quality, coverage, costs and timing requirements, serving as input document for preparing the initial frequency plan and ASO plan.

Main topics and choices		Status	Decision
4.2.1	Trade-off between network roll-out speed, network costs and service quality	B	The roll-out of the 54 UHF transmitters is already decided. Roll-out of the additional transmitters, the head-ends and distribution network is still to be decided.
4.2.2	Main reception mode and defining receiving installations	C	DTTB reception criteria to be decided (adopted for the ETH situation) and resulting coverage to be investigated. Analogue coverage conditions to be decided.
4.2.3	Services for national, regional, or local coverage	B	Regional services in respective regions or distributed nationally, depending on costs.
4.2.4	Frequency plan and network topology	B	One transmitter (multiplex) per site. The frequencies and site locations of the 54 UHF transmitters have been determined. Need and location of additional transmitters to be decided.
4.2.5	Head-end configuration	C	

Main topics and choices	Status	Decision
4.2.6 Equipment reserve configurations	D	The 54 UHF transmitters have passive transmitter and exciter back-up. In cases where an increase of power is needed, an option is to change the passive transmitter back-up to an active back-up configuration. Reserve equipment for the head-end and distribution network and additional transmitters (if needed) is still to be decided.
4.2.7 Type of distribution network	C	

Main activities	Observation/Advice
1. Education and training of technical staff	It is essential to train technical staff in time. Education plans should be developed for each staff category.
2. Determine roll-out scheme for head-ends and distribution links	Installation of additional transmitters (if needed), head-ends and distributions links should be in conformity with ASO planning.
3. Define receiving installation for estimating coverage The definition of the receiving installation is a trade-off between transmission costs; extend of the coverage area, multiplex capacity and cost to be made by viewers (in particular in the receiving antenna).	Fixed reception (rooftop) is normally the basis for determining if the coverage obligation of Public Broadcasters has been fulfilled. In addition coverage should be estimated with the type of receiving installation that is normally used. Portable outdoor reception is a balanced compromise for the type of receiving installation normally used in the Ethiopian situation: • It represents reception with a simple antenna. • It is a well-defined receiving condition; Portable indoor reception would require the establishment building penetration data (mean value and standard deviation). • Portable outdoor reception represent also Portable indoor reception but with lower reception probability. When reception takes place indoor, an optimal location for the antenna should be sought. Indoor reception is easier relative close to the transmitter, at higher floors and when building penetration losses are minimal. Analogue reception should be matched by DTTB reception. The ERP of the 54 UHF transmitters is not sufficient to match analogue coverage based on the limit of reception For pragmatic reasons it is therefore advised to determine analogue coverage on the basis on the recommended minimum field strength. See also Section 4.10.
4. Determination of regional coverage areas A regional coverage is characterized by regional content as part of the multiplex of all transmitters in the regional area. In case of SFNs, transmitters broadcasting different content at any moment in time, should be part of different SFNs	Regional coverage areas would require a regional multiplexer. Combining regions saves costs of muliplexers, but this is offset by higher distribution costs as the content of a regional studio needs to be transported to the head-end of another region or to the main head-end if all regions are combined. Cost evaluations, taking into account the required number of multiplexers, distribution links from head-end to transmitter sites, transport links from studio to head-end and transmitters per site should be made. One main head-end, where all 4 national and 11 regional services are multiplexed is not possible if DTMB is chosen due the limited multiplex capacity. See also Section 4.9.

Main activities	Observation/Advice
5. Evaluation of network topology	Taking into account the results of main activity 4, the locations of head-ends can be determined. The sites of the 54 UHF transmitters are already decided. If the frequency range 790-862 MHz (channels 61-69) is allocated to IMT, 1 station (Kemisse, channel 63) needs to change frequency. The need for additional transmitters to match the current regional coverage areas needs to be investigated (see Section 3.3.1, observation a). Furthermore gap fillers may be needed.
6. Drafting multiplex composition plan The bit rate of the multiplex should be lower than the bit rate of the DTTB variant set at the transmitters in order to avoid overflow. Final estimation of the multiplex composition can only be made after Network planning (see functional building block 4.3) have been considered.	The initial multiplex composition for each head-end, should take into account: a. the results of main activity 4 and 5; b. the bit rate requirements established in functional building block 4.1. The use of statistical multiplexing is in principle advised, when more than two services of different kind of content are carried in the multiplex. However, implementing statistical multiplexing may impose some technical constraints – for example it would probably be necessary for the MPEG2/4 coders and the multiplexer to be physically close to each other and controlled by the same computer. Statistical multiplexing will also cause additional difficulties with downstream drop-and-insert multiplexing such as would be needed in a regional network. See also Section 4.9.
7. Evaluation of the required operational availability time of transmission equipment The operational equipment availability time is a trade-off between costs and acceptable off-air time due to failures.	ETV will have its own experience with operation of transmission equipment under the operational conditions of Ethiopia and will have specified the reserve conditions of the transmitter stations based on this experience. Moreover telecommunication regulations prescribe equipment back-up. In cases where increased transmitter power is needed it could be considered to use active back-up configurations. With regard to the head-end, it is advised to install a spare encoder in an n+1 configuration.
8. Evaluation of type of distribution network	Currently microwave relay links and DVB-S is used. In the digital network the options include: • Telecommunication satellite; • Optic fibre with additional microwave links from the points of presence of the optic fibre to the transmitter sites; • DVB-S satellite used for distribution of the DTTB Transport Stream. In network configurations, where regional head-ends are used and MPEG2 compression is applied, the DVB-S satellite service provided by Arabsat, as currently applied for analogue TV distribution may also be a possibility. However, the DBV-S service content of ETV is not always identical to the terrestrial content (football). See also Section 4.9.
9. Review of transmitting station lay out Facilities at sites should be dimensioned in such a way that the DTTB transmitting equipment, plus ancillary equipment, can be accommodated. During ASO also analogue transmitting equipment is operational.	Station lay out may need review to accommodate additional transmitters because: 1. Service requirements of other providers, either as a result of adopting licensing framework model B, or due to voluntary service agreements under licensing model A; 2. Future service requirements. The power supply facilities and electrical features of the antenna need to be checked and if necessary adapted.

4.3 Network planning

Brief description	Iterative process of achieving optimal coverage and multiplex capacity using several system parameters and varying radiation characteristics. Several network plans are likely to be made (e.g. before and after ASO, for rooftop and indoor reception, with normalized and calculated transmitting antenna characteristics, or for testing different service quality or coverage targets).
Objective	Basis for verifying service proposition and financing (see functional building blocks 2.9, 3.2 and 3.4).

Key topics and choices		Status	Decision
4.3.1	Service trade-off	C	Out of the three elements one element (radiation characteristics) has been set with regard to the 54 UHF transmitters (because the transmitters and antennas are determined). The power of additional transmitters (if needed) is still to be decided.
4.3.2	SFN or MFN	B	The Ethiopian GE06 entries are all in MFN mode. The network design principle is MFN. Small SFNs may be needed to improve indoor coverage.
4.3.3	Fill-in transmitters	C	It is expected that a number of fill-in transmitters will be needed.
4.3.4	GE06 compliance of planned stations	A	54 installed and planned UHF transmitters are in compliancy with GE06 entries.
4.3.5	Feed back to business plan and service proposition	C	See also 3.1.2.

Main activities	Observation/Advice
1. Coverage analysis Coverage presentations and a list of stations characteristics are the result of a network planning exercise and form the key tools for analysis coverage.	It is advised to prepare coverage plots using network planning software that takes into account: 1. The DVB-T2 or DTMB standard (depending on the standard choice); 2. Accurate terrain and clutter data; 3. Transmitter database of operational and planned stations (analogue and digital) including stations from neighbouring countries.
2. SFN application A Single Frequency Network is a network of synchronized transmitting stations radiating identical signals in the same RF channel	Depending on the coverage analyses and the available budget, improvement of Portable reception e.g. in main cities, can be obtained by installing additional transmitting sites in SFN mode. In SFN planning, self-interference should be avoided by choosing the appropriate guard interval and by careful planning (see ITU Guidelines Section 4.3.2).
3. Performing GE06 (annex 4, section II) conformity check The GE06 Agreement offers considerable flexibility in the application of Plan entries. Deviation from the characteristics of the Plan entry does not always require international coordination according to the Art. 4 procedure.	Most of the 54 UHF transmitters used as DTTB transmitter are in conformity with GE06. Of some, article 4 procedure is not yet finalized. Station characteristics of the additional transmitters should comply with the GE06 Agreement.

Main activities	Observation/Advice
4. Gap-filler planning Gap-fillers, also called fill-in stations, are fed off-air from a main transmitter. The transmission frequency can be different from the received frequency (MFN operation) or the same as the received frequency (SFN operation).	Detailed coverage analysis resulting from main activity 2, is likely to show areas where coverage can be improved by means of gap-fillers. In general the receiving antennas of gap-filler need line-of-sight with the main transmitter. In case of SFN operation, the power of gap-fillers is restricted, depending on the isolation between input and output signal.
5. Carrying out "service trade-off" Radiation characteristics, multiplex capacity coverage quality are interrelated.	The "service trade-off" should be carried out to find the optimum balance between multiplex capacity and coverage quality. The radiation characteristics are already set with regard to the 54 UHF transmitters. If no satisfactory solutions can be found a review is needed of costumer proposition, business case and/or design principles and network architecture.

4.4 System parameters

Brief description	Parameters related to the DTTB transmission standard
Objective	Selecting system parameter by trading-off between coverage, multiplex bit rate and radiation characteristics, serving as input in the initial network planning.

Key topics and choices	Status	Decision
4.4.1 FFT size	B	DTMB system: 4k. DVB-T2 to be decided.
4.4.2 Carrier modulation and code rate	C	
4.4.3 Guard interval	B	In MFN: lowest possible interval. The value depends on the transmission standard (DTMB or DVB-T2 and with the latter also the system variant). In case SFNs: to be decided.

Main activities	Observation/Advice
1. Evaluation of FFT size	In case of DTMB there is only one FFT size: 4k. In case of DVB-T2 the choice is between several FFT sizes. As mobile (vehicular) reception at high speed is not a requirement in Ethiopia the higher FFT sizes could be considered (16 k or 32 k), see also Annex 5.
2. Evaluation of carrier modulation and code rate Higher order modulation and higher code rates provide more multiplex capacity but at the cost of a higher C/N resulting in more restricted coverage. Lower order modulation and lower code rates provide a more robust coverage at the cost of a restricted multiplex capacity.	Initial choices are indicated in section 4.9 and 4.10. Coverage analysis, including analysis of the achieved coverage for Portable Reception and evaluating the net bit rate of the multiplex through the "service trade off" should verify the initial choices.
3. Evaluation of guard interval The choice of guard interval is a trade-off between multiplex capacity and restricted coverage due to interference from natural or artificial echoes' of the transmitted signal.	In case of MFN the lowest guard interval is sufficient. No SFNs are foreseen for the moment, however in case of SFN the length of the guard interval depends on distance between the transmitters and the transmission standard. For resolving internal network interference also other measures may be taken (see ITU Guidelines Section 4.3.2).

4.5 Radiation characteristics

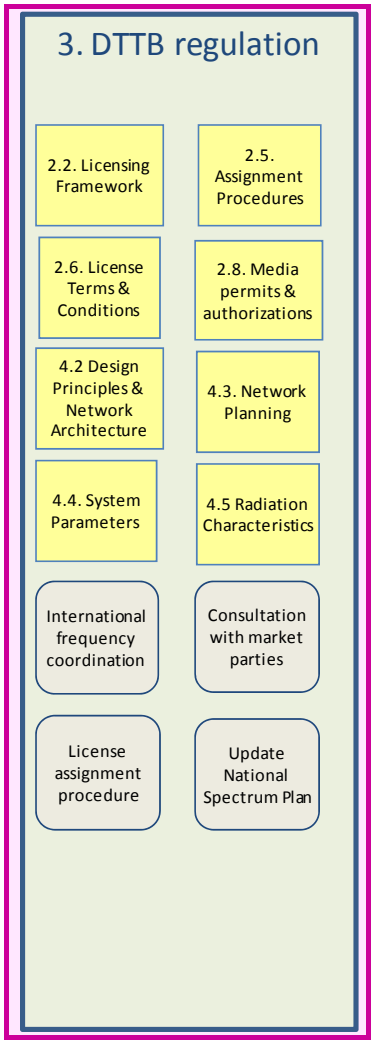
Brief description	Determination of transmitter power and transmitting antenna gain in order to achieve the required or allowed effective radiated power and configuration of the optimum antenna diagram and polarization.
Objective	Specification of transmitter power, antenna gain and antenna diagram as input for initial network planning.

Key topics and choices		Status	Decision
4.5.1	Transmitter power and transmitting antenna gain	B	At the 54 UHF sites the same transmitter power (1 kW) and antenna (4 layers) will be used. At some sites higher powers may be needed to match current analogue TV coverage in VHF. ERP of additional transmitters to be decided.
4.5.2	Polarization	A	Horizontal.
4.5.3	Use of existing antennas or need for new antennas	B	At the 54 UHF sites, new digital antennas have been installed. Antennas at the additional transmitters need to be decided.

Main activities	Observation/Advice
1. Evaluation of ERP	At some sites a higher ERP may be needed in order to match analogue TV coverage in VHF (see also Section 4.10). A possibility is doubling the ERP by changing the passive back-up configuration of the transmitters to an active back-up configuration (see also main topic 4.2.6). Initial indications of the required ERP of additional regional transmitters is given in Section 4.10.
2. Calculation of antenna power budget	In case more than one transmitter has be to fed into the same antenna (see functional building block 4.2 Design principles and network architecture), an antenna combiner is needed and the antenna power budget has to be calculated to ensure that allowed mean power and peak voltage of the antenna is not exceeded.

Annex 3: Functional building blocks related to phase 3 of the roadmap

DTTB regulation



The selected functional building blocks related to phase 3 of the roadmap are shown in Figure 3.6 and are reproduced here.

Section 3.4.4 describes phase 3 of the roadmap.

This Annex gives an overview in the form of tables of the status of each of the selected functional building blocks related to phase 3 by means of the following codes:

A. the decisions on key topics and choices that are already taken;

B. the decisions on key topics and choices that are partly taken;

C. the activities needed regarding key topics and choices that have not yet been decided;

D. the activities needed regarding key topics and choices that need revision.

For those issues that are not (fully) decided or need revision the main activities are indicated.

The selected functional building blocks are presented in the order of the number of the block. This number refers to the corresponding chapter in the ITU Guidelines, where more information and implementation guidelines can be found.

The grey coloured blocks are not described in the ITU Guidelines and not described in the tables below. These blocks represent activities that are not specific to digital terrestrial television.

2.2 Licensing framework

Brief description	For Ethiopia the licensing framework concentrates on the selection of the appropriate model; either model A or B.
Objective	The objective of the licensing framework should be to actually implement the defined policy objectives for the introduction of DTTB, including the Analogue Switch-Off (ASO).

Key topics and choices		Status	Decision
2.2.1	A licensing framework for any television services comprises the assignment of three sets of rights (a) spectrum (b) broadcast and (c) local/building rights. For DTTB and MTV services has the model been decided?	B	EBA assigns all the different rights but depending on model A/B the rights will be separated and assigned to different entities in the value chain.
2.2.2	For the extra function of the multiplex operator in the value chain, two basic licensing models can be distinguished for DTTB; model A or B. Has the basic model been decided?	D	As matter of fact model A has already been applied for licensing DTTB services (i.e. licensing of Bridgetech). Currently both models A and B are under investigation. Also combinations are considered.
2.2.3	Has the PBS services and spectrum rights been defined yet (and where) for the DTTB services?	B	The current Broadcast Act describes PSB's obligation in qualitative terms. It is expected that this will remain unchanged for the digital platform, although comprehensiveness should be checked.

Main activities	Observation/Advice
1. Make inventory of current spectrum and broadcast rights of licensed broadcasters	To be carried out on the basis of the results of the functional building blocks 2.3 in the first and second Phase of this Roadmap.
2. Make inventory of current licensing framework and check applicability for DTTB service introductions (gaps/conflicts)	To be carried out on the basis of the results of functional building block 2.11 in the first Phase.
3. Assess and evaluate different options for licensing DTTB services	All to be included as part of this Phase of the Roadmap. For more consideration see Section 4.3 of this report.
4. Assess compatibility with ASO plans and National Spectrum Plan	
5. Possibly revise current licensing framework and assess impact	
6. Draft planning for licence assignment, framework changes and update National Spectrum Plan (and possibly Legislation)	

2.3 ITU/R regulations

Brief description	ITU-R regulations entail the Radio Regulations (RR) and in particular the table of Frequency Allocations (Region 1) and the relevant provisions of the World Radiocommunication Conference 2007 (WRC-07). As well as the Geneva Agreement 2006 (GE06) and the entries in the associated plans for the use of African Administrations.
Objective	In this Phase, to perform conformity checks whilst carrying out a detailed DTTB service planning.

Key topics and choices		Status	Decision
2.3.5	The international context of the ITU-R regulations: Are the different entries in the GE06 plan considered (allotment/assignment)?	C	As part of the detailed DTTB service planning (see Section 3.4.4 of this report).
2.3.6	Applicability and implications of the GE06 plan and ITU-RR and ASO planning: what are the possible ASO models the available spectrum.	C	

Main activities	Observation/Advice
1. Determine conformity with the GE06 Plan entries	As part of the detailed DTTB service planning.
2. Determine necessary changes/exemptions to the GE06 Plan	As discussed in sections 3.4.2 and 3.4.3 this might be necessary for Ethiopia. However, these activities (i.e. the administrative procedures need not to be part of the critical path.

2.5 Assignment procedures

Brief description	Assigning spectrum/broadcast rights for DTTB services and the common instruments and procedures applied.
Objective	Assign spectrum/broadcast rights to the PSB entities and any future commercials parties in a transparent manner in line with the ASO plan.

Key topics and choices	Status	Decision
2.5.1 Basic assigned instruments and procedures: What is the preferred assignment instrument (FCFS, auction or public tender) for broadcasting?	A	For PSB the assignment instrument is FCFS (by priority). For commercial entities the instrument is public tender.
2.5.2 Assignment procedures for DTTB services: What is the selected assignment instrument (FCFS, auction or public tender) for DTTB services?	B	For PSB and NewCo (if so decided to establish NewCo) the assignment instrument is FCFS (by priority). For commercial entities the instrument is public tender.

Main activities	Observation/Advice
1. Consult market (industry players and consumers) on assignment methods and licence Terms and Conditions	All to be carried out as part of this phase. However, the number of options is already limited down to two. Drafting of the Licensing procedure and passing Parliament should be aligned with the ASO planning. Licensing procedure should be 'future proof' in the sense that after ASO additional licences might be assigned.
2. Evaluate results and select assignment method and procedures	
3. Draft detailed plans and planning for DTTB assignment procedure (for detailed steps see Appendix 2.5B)	
4. Prepare approval of assignment Procedures by Parliament	
5. Publish assignment planning and procedures and update National Spectrum Plan (and possibly Legislation)	

2.6 Licence terms and conditions

Brief description	The licence terms and conditions of the DTTB and MTV frequency or spectrum licences.
Objective	Assigning DTTB/MTV frequency rights is carried out in conjunction with assigning the other two types of rights as well. However, broadcast or operator rights could also be included in the spectrum licence (as currently the case in Ethiopia), depending on the existing regulatory and legal framework. Hence the objective is to have all rights covered, in the right balance, between the various licence types.

Key topics and choices		Status	Decision
2.6.1	Licensing and fair competition rules: Are the licence terms and conditions in line with the competition rules (transparent and non-discriminatory)?	C	
2.6.2	Frequency licence terms and conditions: have all licence terms and conditions been determined and is the list of conditions complete (see list in this section)?	C	Depends on Model A or B. Please note that one licence to Bridgetech has already been assigned.

Main activities	Observation/Advice
1. Check relevant paragraphs/ entries in Legislation/Policies, ASO Plan, National Spectrum Plan	All to be carried out as part of this phase. For details on and example licence terms and conditions check the ITU Guidelines. Depending on the licensing model selected, the frequency rights (in combination with operating rights) could be assigned separately from the broadcast rights.
2. Analyse market conditions and assess 'level-playing-field' requirements/provisions	
3. Determine DTTB Terms and Conditions and align with local Building permit policies and Media permits/authorizations and their planning	
4. Update National Spectrum Plan (and possibly ASO plans)	

2.8 Media permits and authorizations

Brief description	The right or permission to broadcast television content on a defined broadcast DTTB platform in a designated geographical area and for a specified period. In this section we focus on granting media/broadcast permits/authorizations for Non-PSB/commercial broadcasters (for public broadcasters see Section 2.2.3 in the ITU Guidelines).
Objective	In regulating access to the DTTB platform and/or to determine content composition on the DTTB and MTV platforms, the Regulator can avoid unwanted broadcasts, promote defined broadcasts or avoid duplication of content.

Key topics and choices		Status	Decision
2.8.1	Broadcast licensing framework: the different levels of granting broadcast rights, programme or platform level?	C	Depends on Model A or B and if new service providers (next to Bridgetech) will be allowed to operate on the Ethiopian market.
2.8.2	Broadcast licensing requirements: have all licence terms and conditions been determined and is the list of conditions complete (see list in this section)?	C	Some provisions can be found in the Broadcasting Act. However the Terms and conditions should still be detailed.

Main activities	Observation/Advice
1. Check existing media Legislation, DTTB Policy and Licensing Framework (model A/B)	All to be carried out as part of this Phase of the Roadmap. For more details check Section 2.8.2 in the ITU Guidelines.
2. Check Technology and Standards Regulation (receiver regulations) and include in media permits policies	
3. Determine Media permits/authorizations and procedures and review Bridgetech DTTB licence Terms and Conditions	
4. Publish policies for media permits and authorizations (may include waivers)	

4.2 Design principles and network architecture

Brief description	Implementation priorities and network architecture, based on results of Phase 2.
Objective	Detailed technical description of the main network elements in relation to service quality, coverage, costs and timing requirements serving as input document for preparing the national coordinated frequency plan and licence procedure and planning.

Main topics and choices		Status	Decision
4.2.1	Trade-off between network roll-out speed, network costs and service quality	C	The initial results obtained in Phase 2 (ASO planning) should be verified based on the initial frequency plan and ASO plan.
4.2.2	Main reception mode and defining receiving installations	C	
4.2.3	Services for national, regional, or local coverage	C	
4.2.4	Frequency plan and network topology	C	
4.2.5	Head-end configuration	C	
4.2.6	Equipment reserve configurations	C	
4.2.7	Type of distribution network	C	

The main activities are the same as described in phase 2 (ASO planning) and should be carried out in more detail based on:

- The initial frequency plan;
- ASO plan.

4.3 Network planning

Brief description	Based on results of phase 2 (ASO planning) and the review of design principles and network architecture (see functional building block 4.2 above), network planning is an iterative process to achieve optimal coverage and multiplex capacity using several system parameters and varying radiation characteristics. Several network plans are likely to be made (e.g. before and after ASO, for rooftop and indoor reception, with normalized and calculated transmitting antenna characteristics, or for testing different service quality or coverage targets).
Objective	Preparing of list of station characteristics and detailed coverage presentations.

Key topics and choices		Status	Decision
4.3.1	Service trade-off	C	The initial results obtained in phase 2 (ASO planning) should be verified based on the initial frequency plan, ASO plan and review of Network design and Network architecture (see functional building block 4.2 in Phase 3).
4.3.2	SFN or MFN	C	
4.3.3	Fill-in transmitters	C	
4.3.4	GE06 compliance of planned stations	C	
4.3.5	Feed back to business plan and service proposition	C	

The main activities are the same as described in phase 2 (ASO planning) and should be carried out in more detail based on:

- the initial frequency plan;
- ASO plan;
- review of Network design and Network architecture (see functional building block 4.2 in phase 3).

4.4 System parameters

Brief description	Based on results of phase 2 (ASO planning), review of parameters related to the DTTB transmission standard.
Objective	Selecting system parameter by trading-off between coverage, multiplex bit rate and radiation characteristics, serving as input in the detailed network planning.

Key topics and choices		Status	Decision
4.4.1	FFT size	C	The initial results obtained in phase 2 (ASO planning) should be verified based on the initial frequency plan, ASO plan and review of Network design and Network architecture (see functional building block 4.2 in Phase 3).
4.4.2	Carrier modulation and code rate	C	
4.4.3	Guard interval	C	

The main activities are the same as described in Phase 2 (ASO planning) and should be carried out in more detail based on:

- the initial frequency plan;
- ASO plan;
- review of Network design and Network architecture (see functional building block 4.2 in phase 3).

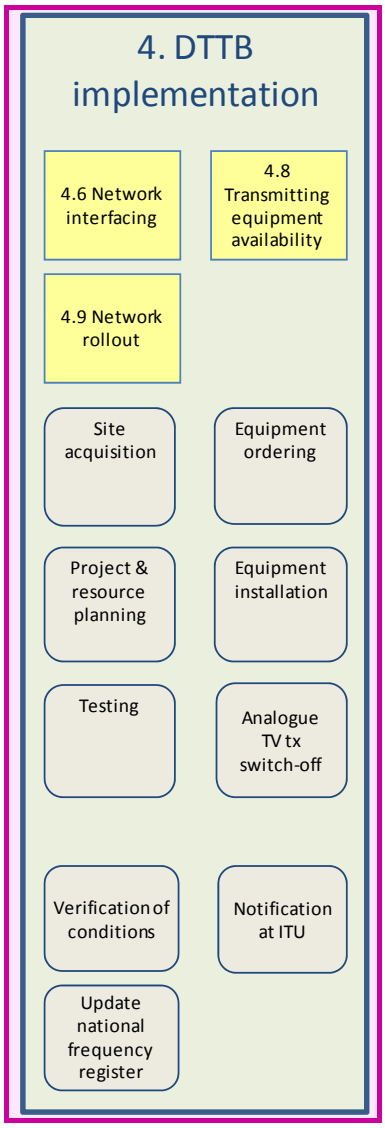
4.5 Radiation characteristics

Brief description	Based on results of Phase 2 (ASO planning), review of transmitter power and transmitting antenna gain in order to achieve the required or allowed effective radiated power and configuration of the optimum antenna diagram and polarization.
Objective	Specification of transmitter power, antenna gain and antenna diagram as input for detailed network planning.

Key topics and choices		Status	Decision
4.5.1	Transmitter power and transmitting antenna gain	C	The initial results obtained in phase 2 (ASO planning) should be verified based on the initial frequency plan, ASO plan and review of Network design and Network architecture (see functional building block 4.2 in Phase 3).
4.5.2	Polarization	C	
4.5.3	Use of existing antennas or need for new antennas	C	

Annex 4: Functional building blocks related to phase 4 of the roadmap

DTTB implementation



The selected functional building blocks related to phase 4 of the roadmap are shown in Figure 3.6 and are reproduced here.

Section 3.4.5 describes phase 4 of the roadmap.

This Annex gives an overview in the form of tables of the status of each of the selected functional building blocks related to phase 4 by means of the following codes:

A. the decisions on key topics and choices that are already taken;

B. the decisions on key topics and choices that are partly taken;

C. the activities needed regarding key topics and choices that have not yet been decided;

D. the activities needed regarding key topic and choices that need revision.

For those issues that are not (fully) decided or need revision the main activities are indicated.

The selected functional building blocks are presented in the order of the number of the block. This number refers to the corresponding chapter in the ITU Guidelines, where more information and implementation guidelines can be found.

The grey coloured blocks are not described in the ITU Guidelines and not described in the tables below. These blocks represent activities that are not specific to digital terrestrial television.

4.6 Network interfacing

Brief description	Interfaces between parts of the network, the studio and the head-end, the transmitting antenna and the receiver and transmitting equipment and the monitoring centre.
Objective	Defining interfaces with network elements in order to obtain satisfactory service delivery.

Key topics and choices		Status	Decision
4.6.1	Interfaces with head-end	C	No head-end is designed or ordered yet.
4.6.2	Interfaces between parts in the network	C	
4.6.3	Radio interface between transmitting station and receiving installation	C	There is preference for expressing the interface as probability % (not field strength) as this takes into account interference.
4.6.4	Interfaces between transmitter sites and monitoring system	B	54 UHF transmitters and antennas are ordered and partly installed and hence the monitoring interfaces are defined. For additional transmitters, the end-head(s) and distribution network the interfaces still have to be defined.

Main activities	Observation/Advice
1. Drafting interface specifications between parts of the network Parts of the network are head-end, distribution links and transmitter sites.	The specifications of the interfaces depend on the chosen transmission standard, type of distributions links and network architecture. See also Section 4.9.
2. Drafting interface specifications between network monitoring system and head end and distribution links	Operational status of head-end equipment and distribution links should be visible at the monitoring centre. The interfaces between the equipment and the monitoring centre should be in accordance with those specified for the transmitters.
3. Describing radio interface The interface between transmitting antenna and receiving installing is the radio interface. It takes into account the receiving installation as defined in functional building block 4.2 in Phase 3.	It is advised to describe the radio interface by means of reception probability. It indicates the probability of good reception in the presence of noise and interference. In order to avoid continuing discussions on coverage results, the method for assessing coverage (including the transmitter databases for different situations, e.g. during and after ASO) should be agreed in the NRT.

4.8 Transmission equipment availability

Brief description	Transmission equipment complying with the chosen transmission standard and systems and fitted to transmit all planned services.
Objective	Defining transmission equipment specification complying with network architecture and design principles and network planning.

Key topics and choices		Status	Decision
4.8.1	Market research	B	54 UHF transmitters and antennas are ordered and hence the market research has been carried out. For additional transmitters, the DTMB or DVB-T2 exciters, the head-end(s) and distribution network the research still has to be carried out.
4.8.2	Technical specifications	B	54 UHF transmitters and antennas are ordered and hence the technical specifications have been set. For additional transmitters, the DTMB or DVB-T2 exciters, the head-end(s) and distribution network the specifications still have to be set.

Main activities	Observation/Advice
1. Carrying out market research for head-ends and distribution links Head-ends and distribution links are defined in functional building block 4.2 in Phase 3	In order to get an impression of prices and ranges of characteristics it is advised to obtain technical data sheets and budgetary prices from a number of suppliers.
2. Drafting specifications of distribution links and head-ends	The specifications should include: transmission standard, compression system, CA and SMS system (if required), reserve configuration and interfaces.

4.9 Network rollout and planning

Brief description	Implementation plan taking into account coverage priorities, services priorities, ASO, equipment availability and capacity of the network operator.
Objective	To provide implementation schedule for the DTTB services within budget and time constraints.

Key topics and choices		Status	Observation/Decision
4.9.1	Test transmissions	C	
4.9.2	Implementation plan	C	For the DTMB or DVB-T2 exciters, additional sites, digital distribution network and head-end roll-out the plan has still to be drafted. This plan should be in line with any phase ASO plan.
4.9.3	Information to end consumers	C	Coverage maps can be posted in the villages (does not have to be on the Internet).

Main activities	Observation/Advice
1. Describing pilot tests and demonstrations	Before a site in brought into use it is advised to perform technical tests. After it is assured that the equipment functions perfectly, demonstrations may be arranged in particular in areas where DTTB is broadcast for the first time.
2. Roll out planning in accordance with ASO plan	The milestones of the roll-out plan are given by the ASO plan. The roll-out plan should take account of the time periods needed for delivery of equipment, installation and testing of equipment and pilot tests and demonstrations.
3. Coverage assessment at each stage of implementation	For each stage of the implementation (before and after ASO) detailed coverage maps should be produced. These maps are needed for managing switch-over and as a basis for communication to viewers.

Annex 5: Technical information on DTTB transmission standards

This Annex gives a summary of technical information on transmission standards that are considered in Ethiopia, that is: DTMB and DVB-T2. The information is obtained from ITU and other sources. First the relevant ITU-R recommendations and the work in progress on these recommendations is mentioned. In the following sections the main differences of the standards are indicated regarding technical characteristics and planning criteria.

It should be noted that in addition to the technical characteristics, the receiver (Set-top-box) price is a major criterion in the DTTB standard choice.

Information on the worldwide implementation of DTTB standards (also for non-DVB standards) can be found on www.dvb.org/about_dvb/dvb_worldwide/index.xml.

1. ITU-R Recommendations

The most important ITU-R Recommendations regarding DTTB standards are:

- Recommendation ITU-R BT.1306, Error correction, data framing, modulation and emission methods for digital terrestrial television Broadcasting[22]. A revision of this Recommendation with new information on the DTMB standard, has been submitted to Study Group 6 for consideration;
- Recommendation ITU-R BT.1877, Error-correction, data framing, modulation and emission methods for second generation of digital terrestrial television Broadcasting systems[23];
- Recommendation ITU-R BT.1368, Planning criteria for digital terrestrial television services in the VHF/UHF bands[24]. A revision of this Recommendation with new information on planning criteria related to the ISDB-T and DTMB standard has been submitted to Study Group 6 for consideration.

The Recommendations can be downloaded freely from the ITU website by using the indicated hyperlinks. For all other ITU documents mentioned in this Annex ITU TIES login and password are required.

2. Technical characteristics

Status of the work

The Draft Revision of Recommendation ITU-R BT.1306 is shown in ITU document 6/346. In Recommendation ITU-R BT.1306 the standards are represented by letters:

- System A is ATSC;
- System B is DVB-T;
- System C is ISDB-T;
- System D is DTMB.

In the Appendices 1 to 4 to Annex 1 of the Draft Revision to Recommendation ITU-R BT.1306, a bibliography of each standard is given, showing references to specifications and implementation guidelines.

[22] See www.itu.int/rec/R-REC-BT.1306-4-200909-I/en.

[23] See www.itu.int/dms_pubrec/itu-r/rec/bt/R-REC-BT.1877-0-201005-I!!PDF-E.pdf.

[24] See www.itu.int/rec/R-REC-BT.1368-8-200905-I/en.

Comparison of DTTB standards

Recommendation ITU-R BT.1306 deals with first generation DTTB standards. More advanced second generation DTTB standards are covered in Recommendation ITU-R BT.1877.

There are two types of DTTB standards: single carrier standards (ATSC and DTMB) and multi-carrier standards: (DVB-T, DVB-T2, ISDB-T and DTMB). The main distinctive features are:

- Single carrier standards provide a higher bit rate at given C/N in a Gaussian channel[25];
- Multi-carrier standards provide maximum ruggedness against multipath interference. This is important in case of reception with simple antennas; a means of reception commonly used in many countries. Furthermore multi-carrier standards allow the use of Single Frequency Networks.

The table below shows the main characteristics of the DTMB and DVB-T2 standards. In order to compare the different standards on an equal basis, where relevant the technical characteristics are shown for the 8 MHz version.

Table 5-1: Overview technical characteristics of DTMB and DVB-T2

Characteristic	DTMB	DVB-T2
Channel bandwidth	6 MHz, 7 MHz, 8 MHz	1.7 MHz, 5 MHz, 6 MHz, 7 MHz, 8 MHz, 10 MHz
Number of carriers	1 or 3780 (4k)	Nine options ranging from 853 (1k) to 27841 (32 k)
Net bit rate	4.8 to 32.5 Mbit/s	5.4 to 50.4 Mbit/s
Carrier to noise ratio in a Gaussian channel	2.5 to 22.0 dB	0.8 to 21.8 dB
Duration of guard interval	55.6 to 125 µs	7 to 532 µs

Observations regarding DTTB standards

DTMB

The DTMB specifications are described in Chinese National Standard GB 20600—2006. The standard offers:

- Three modes regarding the forward error coding with rates: 0.4, 0.6 and 0.8;
- Three guard intervals: 125 µs, 78.7 µs and 55.6 µs.
- Five types of carrier modulation: 64QAM, 32QAM, 16QAM, 4QAM and 4QAM-NR; 32QAM and 4QAM-NR only in combination with code rate 0.8;

Currently no information is available in ITU recommendations on the C/N values. In OFDM transmission systems the transmitted signal is noise like. In the considerations in this Roadmap Report it is therefore assumed that the C/N values are the same as the co-channel protection ratios given in Draft Revision of Recommendation ITU-R BT.1368 with regard to the DTMB standard.

[25] A Gaussian channel is a propagation mode when only the wanted signal with no delayed signals is present at the receiver input, but taking into account the Gaussian noise only.

The system variants and the corresponding net bit rates and the assumed C/N values for a Ricean channel[26] (rooftop reception) and Rayleigh channel[27] (portable reception) are summarised in the table below.

Table 5-2: Net bite rates and assumed C/N of the DTMB standard

Modulation	Code rate	Net bit rate (Mbit/s)			C/N (dB) Ricean channel	C/N (dB) Rayleigh channel
		GI = 125 µs	GI = 78.7 µs	GI = 55.6 µs		
4QAM-NR	0.8	4.813	5.198	5.414	4	5
4QAM	0.4	4.813	5.198	5.414	4	5
4QAM	0.6	7.219	7.797	8.122	6	8
4QAM	0.8	9.626	10.396	10.829	8	13
16QAM	0.4	9.626	10.396	10.829	10	11
16QAM	0.6	14.438	15.593	16.243	13	15
16QAM	0.8	19.251	20.791	21.658	15	19
32QAM	0.8	24.064	25.989	27.072	17	21
64QAM	0.4	14.438	15.593	16.243	16	17
64QAM	0.6	21.658	23.390	24.365	18	20
64QAM	0.8	28.877	31.187	32.486	23	29

DVB-T2

The second generation DTTB standard (DVB-T2) is described in the European standard ETSI EN 302 755. DVB-T2 offers an increased efficiency of 50 per cent in its use of spectrum compared to first generation DTTB standards. Compared to DVB-T, DVB-T2 parameters have been extended to include[28]:

- New generation forward FEC (error protection) and higher constellations (256QAM in addition to 64QAM, 16QAM and QPSK with DVB-T)) resulting in a capacity gain of 25-30 per cent, approaching the Shannon limit;
- OFDM carrier increase from 8k to 32k. In SFN, the guard interval of 1/16 instead of 1/4 resulting in an overhead gain of ~18 per cent;
- New guard interval fractions: 1/128, 19/256, 19/128;
- Scattered Pilot optimization according to the guard interval (GI), continual pilot minimization resulting in an overhead reduction of ~10 per cent;
- Bandwidth extension: e.g., for 8 MHz bandwidth, 7.77 MHz instead of 7.61 MHz (2 per cent gain);
- Extended interleaving including bit, cell, time and frequency interleaving.

[26] A Ricean channel is a propagation mode when a dominant wanted signal together with lower level delayed signals are present at the receiver input, taking into account the thermal noise.

[27] A Rayleigh channel is a propagation mode when several statistically independent signals with different delay times, none of which is dominant, are present at the receiver input, taking into account the thermal noise. Rapid and severe variations of the input signal with locations are observed, caused by multipath propagation.

[28] Information from EBU report Tech 3348.

DVB-T2 can offer:

- A higher bit rate or a more robust signal;
- A lower required power (in the absence of interference other than noise) with the same bit rate;
- Larger SFN areas (the longest guard interval is 532 µs in the 8 MHz version);
- Reception at higher speed.

In addition DVB-T2 offers Physical Layer Pipes (PLPs). PLP allows separate adjustment of the robustness of each service.

Some typical data for the DVB-T2 standard are[29]:

Typical bit rate (as used in the UK)	40 Mbit/s
Maximum bitrate (at a C/N of 20 dB)	47.8 Mbit/s
Required C/N (at 22 Mbit/s)	8.9 dB

Information on the net bit rates of the various system variants and corresponding C/N values can be found in the DVB-T2 implementation guidelines[30] (DVB Document A133).

With regard to the choice of the various system variants and taken into account that in addition to rooftop reception also portable reception is important in the Ethiopian situation, the following observations should be noted[31]:

1. DVB-T2 offers also 16k and 32k FFT, resulting in useful symbol periods of 1792 µs and 3584 µs in the 8 MHz version. These long symbol periods result in a poorer Doppler performance, due to the short inter-carrier distance in the OFDM signal. The 32k mode is therefore aimed mainly at fixed rooftop reception. Currently it seems unlikely that the 32k mode can be used to provide mobile (vehicular) reception at UHF. Even in a portable (indoor or outdoor pedestrian) receiving environment with relatively low Doppler frequencies it needs to be confirmed that the 32k mode is suitable;
2. Combined time and frequency interpolation allows for the use of transmission modes with less dense pilot patterns, and therefore a greater payload. Pilot pattern PP8 is regarded as suitable for fixed reception but not for portable and mobile reception because PP8 works not or only very limited with time interleaving.

3. Planning criteria

Status of the work

The Draft Revision of Recommendation ITU-R BT.1368 is shown in ITU document 6/352. The draft revision provides information on protection ratios regarding all standards, including protection ratios of one standard interfered by another.

Work is in progress on a new Recommendation on planning criteria, including protection ratios, for second generation of digital terrestrial television broadcasting systems in the VHF/UHF bands. Information on protection ratios of the DVB-T2 transmissions interfered with by DTTB transmissions is currently not available in the ITU working document towards the new Preliminary Draft Recommendation. However, a detailed description of the technical features of the standard and information on frequency

[29] See www.dvb.org/technology/fact_sheets/DVB-T2_Factsheet.pdf.

[30] See www.dvb.org/technology/standards/a133_DVB-T2_Imp_Guide.pdf.

[31] Information from EBU report Tech 3348.

and network planning is given in EBU Tech 3348 Frequency and Network Planning Aspects of DVB-T2, Geneva May 2011[32].

Compliance with the GE06 Agreement

The Geneva 2006 Agreement is, with regard to digital television, based on the DVB-T standard. Also new or modified plan entries should be specified with the DVB-T standard, also in case other standard will be used. Consequently, in applying the Article 4 procedure of the GE06 Agreement, the station characteristics should be specified with the DVB-T standard and the station characteristics converted to suitable DVB-T characteristics.

When an assignment is brought into operation the Ethiopian administration should notify the actual characteristics and transmission standard (DVB-T2 or DTMB) under Article 5.1.3 of the GE06 Agreement, using form GB1[33], respecting the following two conditions:

1. The peak power density in any 4 kHz of the notified assignment should not exceed the peak power density in the same 4 kHz of the corresponding Plan entry;
2. No more protection should be claimed than that afforded to the corresponding Plan entry.

DTMB

The protections ratios of DVB-T interfered with by DTMB are shown in the Draft Revision of Recommendation ITU-R BT.1368. In Annex 2, Table XX2 shows the co-channel protection ratios for DVB-T interfered with by DTMB. These values are the same as for DVB-T interfered with by DVB-T, as indicated in Annex, Table 14. Therefore the application of DTMB for GE06 plan entries will give no problems from a frequency planning point of view.

DVB-T2

DVB-T2 has been developed such that it is compatible with the provisions of the GE06 Agreement. Recommendation ITU-R BT.1877 states that the 7 and 8 MHz variants of the system are compatible with the GE06 Agreement with respect to spectrum usage[34].

No protection ratios of DVB-T interfered with by DVB-T2 are available yet in (draft) ITU-R recommendations. However, because of the noise-like radiation characteristic of OFDM systems, it is expected that DVB-T2 protection ratios (DVB-T2 versus DVB-T2) are identical to the respective C/N values. The same is expected with regard to the protection ratios DVB-T versus DVB-T2.

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[32] See http://tech.ebu.ch/docs/tech/tech3348.pdf.

[33] See the Broadcasting Services Guide on the submission of notices, which can be found at: www.itu.int/ITU-R/terrestrial/docs/notice-forms/ge06/BS_Guide.pdf.

[34] See Note 2 relating to Table 1 in the Annex of Recommendation ITU-R BT.1877.

Glossary of abbreviations

16-QAM	16-state Quadrature Amplitude Modulation
64-QAM	64-state Quadrature Amplitude Modulation
256-QAM	256-state Quadrature Amplitude Modulation
AAC	Advanced Audio Coding
API	Application Programming Interface
ASO	Analogue switch-off
ATSC	Advanced Television Systems Committee
ATV	Analogue television
BML	Broadcast Markup Language
C/N	Carrier to Noise ratio
CA	Conditional Access
CAS	Conditional Access System
dB	decibel
DRM	Digital Rights Management
DSO	Digital Switch Over
DTMB	Digital Terrestrial Multimedia Broadcast
DTTB	Digital Terrestrial Television Broadcasting
DVB	Digital Video Broadcasting
DVB-T	Digital Video Broadcasting-Terrestrial
DVB-T2	Digital Video Broadcasting – Terrestrial 2nd generation
EBA	Ethiopian Broadcasting Authority
Emed	Median minimum field strength
Emin	Minimum field strength
EPG	Electronic Programme Guide
ERP	Effective Radiated Power
ETV	Ethiopian television
FCFS	First come, first served
FFT	Fast Fourier Transform
FTA	Free-To-Air
GE06	Geneva Agreement 2006
HDTV	High Definition Television
ID	Identification
IDTV	Integrated Digital Television set
IMT	International Mobile Telecommunications
IPTV	Internet Protocol Television

ISDB-T	Integrated Services Digital Broadcasting – Terrestrial
ITU-BDT	International Telecommunication Union – Telecommunication Development Bureau
ITU-R	International Telecommunication Union – Radiocommunication Sector
LTE	Long Term Evolution, often marketed as 4G
MFN	Multi Frequency Network
MIRF	Master International Frequency Register
MPEG	Moving Picture Expert Group
MTV	Mobile Television
NA	Not applicable
NewCo	New company for common network and multiplex operations
NRT	National Roadmap Team
NSP	National Spectrum Plan
OPN	Open Network Provisioning
PAL	Phase Alternating Line; analogue colour TV system
PMO	Project Management Office
PPP	Public Private Partnership
PSB	Public Service Broadcasting
QPSK	Quadrature Phase Shift Keying
RR	Radio Regulations
SDI	Serial digital interface
SDTV	Standard Definition Television
SFN	Single Frequency Network
SMS	Short Message Service
SMS	Subscriber Management System
STB	Set-Top-Box
T-DAB	Terrestrial – Digital Audio Broadcasting
T-DMB	Terrestrial – Digital Multimedia Broadcasting
TVHH	Television households
UHF	Ultra High Frequencies (frequency range between 300 and 3000 MHz)
VHF	Very High Frequencies (frequency range between 30 and 300 MHz)
WRC-07	World Radiocommunication Conference 2007
WRC-12	World Radiocommunication Conference 2012

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