Roadmap for the Transition from Analogue to Digital Terrestrial Television in Guyana

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List of Acronyms

16-QAM 16-state Quadrature Amplitude Modulation
64-QAM 64-state Quadrature Amplitude Modulation
AAC Advanced Audio Coding
API Application Programming Interface
ASO Analogue switch-off: In this document, it refers to the complete switch off of the Analogue TV system.
ATSC Advanced Television Systems Committee
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: In this document, it refers to the beginning of Digital TV transmissions
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 2_{nd} generation
Emed Median minimum field strength
Emin Minimum field strength
EPG Electronic Programme Guide
ERP Effective Radiated Power
FCFS First come, first served
FFT Fast Fourier Transform
FTA Free-To-Air
GNBA Guyana National Broadcasting Authority
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 – Telecommunications 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
NFMU National Frequency Management Unit

NRT National roadmap Team
NSP National Spectrum Plan
OPN Open Network Provisioning
PMO Project Management Office
PPP Public Private Partnership
PSB Public Service Broadcasting
QPSK Quadrature Phase Shift Keying
RR Radio Regulations
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 Radiocommunications Conference 2007
WRC-12 World Radiocommunications Conference 2012
WRC-15 World Radiocommunications Conference 2015

1   INTRODUCTION

ITU has published guidelines for the transition from analogue to digital broadcasting. These guidelines (hereinafter, ITU Guidelines) provide assistance to ITU Member States to smoothly migrate from analogue to digital broadcasting. In a further effort to help switch over to digital broadcasting, ITU has selected countries to help draft a national roadmap for the digital switch-over (DSO) process. Guyana is one of the beneficiary countries for further assistance.

The ITU expert, Andres Navarro, developed the roadmap jointly with the National Roadmap Team (NRT). The NRT is coordinated by Valmikki Singh, Managing Director of the National Frequency Management Unit (NFMU), under the guidance of Dr. Roger Luncheon, Head of the Presidential Secretariat (HPS). The NRT consists of representatives from the following organizations:
- National Frequency Management Unit
- Guyana National Broadcasting Authority
- Guyana Revenue Agency (GRA)
- Ministry of Tourism, Industry and Commerce (MINTIC)
- Guyana National Bureau of Standards
- Consumers' Association

The process of roadmap development was carried on during two visits. The first visit was focused on the regulation part and had one short meeting with broadcasters, as well as an informative meeting with general public.

During the second visit to Guyana, some specific issues were discussed. One of the main objectives of the visit was to discuss and define the dates for ASO date and DSO and to discuss with broadcasters the deployment scenarios for DTT.

During the visit, a meeting between the ITU expert and a representative group of broadcasters was made. During the meeting, some un-awareness about the Digital TV technology was perceived. This situation lead to recommend the modification of the communication process, in order to begin with at least a web page as soon as possible, in order to increment the awareness and interest in the process by the different stakeholders.

Also, the initially proposed dates for DSO and ASO was validated with broadcasters and confirmed. The DSO date was established for 2016 and the ASO date for the end of 2020. However, depending of the legal procedure required for the licensing process, the proposed dates will require revisions. At the time to write this report there are two possible scenarios: the first one where only the issuing of regulations defining the licensing procedure for DTTB system and the definition of the multiplex operator is needed, and means an expedite process. The second scenario requires an amendment to Broadcast Act and uncertainty about the length of the process. In the second scenario it could not be possible to determine the DSO date for 2016.

The Guyana TV market is mainly a terrestrial TV market with three public national channels (National Communications Network, Television Guyana Inc. and the Guyana Learning Channel),. In addition to analogue terrestrial TV, digital satellite TV services are offered by DirecTV. Furthermore, there are three Conditional Access Operator in the MMDS band (E-Networks Inc. , Quark Communications Inc and Ali's Broadcasting Company Inc.) and some cable operators in the Georgetown area and main cities (Atlantic Cable Network, IRAMCO (Guyana) Ltd, Bartica Communications Network, E3 Communications (Guyana) Inc. and Infinity Telecommunications Inc.).

For Guyana, DTTB could be the means to provide a public television service to all Guyanese people, guaranteeing quality TV services that are modern, free, open, participatory, interactive, accessible and promoting citizenship. DTTB should become in this way one of the main communication tools for the reduction of the digital divide, the fight against exclusion of information, and access of the population to the benefits of the information society.

In order to realize this vision, Guyana government has to decide on a number of important principles, including:
- To seek a Switch off date near to other South American countries. That is, some date near 2020.
- Replacement of at least the current analogue TV coverage by digital.
- Providing a simulcasting period before analogue TV will be switched off.
- Separation of network operations from programme production and to study the possible scenario of having a common DTTB multiplex and network operator.
- To analyze the possibility of financing a considerable part of the transition costs such as:
  - the digital TV network investments;
  - simulcasting costs;

  o set top box (STB) subsidies;

  o ASO communication costs.

The ITU assistance to Guyana, at this point, consisted of two activities:
1. Preparation and first ITU expert mission to collect information.
2. Drafting of the roadmap report.
3. Second visit and Roadmap

The Guyana National Broadcasting Authority (GNBA) must be involved in the transition process and will be responsible for issuing Digital Broadcasting Licenses in the near future. The GNBA is chaired by former Human Services Minister, attorney-at-law Ms. Bibi Shadick. The members of GNBA are Margo Boyce, Gerry Gouveia, Norman Mc Lean, Charles Ramson (Jr), Dindyal Permaul, Sherwood Lowe and Valmikki Singh (Managing Director, NFMU an ex-officio member of the Board). It will be supported by the NFMU, but there is a need of a coordinated work to develop the new licensing process for DTTB transition and to take key decisions for a successful DTTB transition process.

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 shows the roadmap for broadcasters. Section 5 gives considerations regarding the top ten key topics and choices. Annexes 1 and 2, show the current legislation in Broadcasting and Telecommunications.

2 CURRENT BROADCASTING SITUATION IN GUYANA

The Co-operative Republic of Guyana, commonly known as Guyana and previously known as British Guiana, is the only nation state of the Commonwealth of Nations on the mainland of South America. Bordered to the east by Suriname, to the south and southwest by Brazil and to the west by Venezuela, it is the third-smallest country on the mainland of South America. It is one of four non-Spanish-speaking territories on the continent, along with the countries of Brazil (Portuguese), Suriname (Dutch) and the French overseas region of French Guiana (French). While English is the official language of Guyana, Guyanese Creole (an English-based creole with African and/or East Indian syntax) is widely spoken[1].

The population is approximately 751,223 people (information from 2002 census). Population is mainly located in the urban centers like the capital Georgetown and the east border in cities like New Amsterdam. Other main cities are Bartica, Linden and Parika.

Guyana is organized in regions with some small towns in the south of the country, which is mainly rain forest and jungle areas. In Figure 1 , administrative regions are shown and in Figure 2 main populated areas and topography is shown.

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[1] http://gina.gov.gy/wp/?page_id=5738

Most of the TV channels are located in the capital Georgetown. With the current legal framework most of the broadcasters serve only specific towns, however, at least three TV stations broadcast their signals in more than one Towns via different frequencies. These are the Guyana Learning Channel, the National Communications Network Inc. and Television Guyana Inc. Two national channels have coverage in the Coastal / most populated areas of the country; the National Communications Network Inc. and the Guyana Learning Channel.

During the two ITU expert visits we had discussions about current situation and two meetings with a representative group of the broadcasters. Most of the broadcasters are not aware of the DTV technology and the main business model is based on advertising. During the meeting sustained during the second visit, few broadcasters had some grade of awareness about DTTB and were preparing for the transition.

Transmitter structure is based on low power transmitters with coverage in the urban area of the town served, with structures like shown in Figure 3.
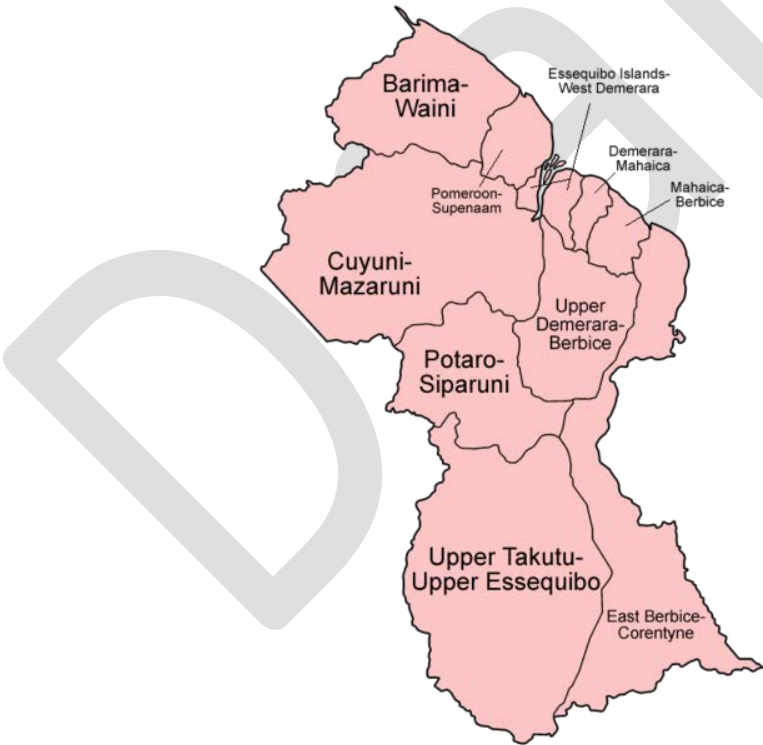
Figure 1 Guyana Regions

Figure 2 Guyana towns and topography

Figure 3 Typical TV transmitter in Georgetown

In total, in Georgetown there are 14 operating TV Stations, 12 private broadcasters and 2 public broadcasters. As shown in Table 1, in Georgetown, most VHF channels are in use and an important number are in use in UHF. Four channels are used for studio to transmitter / transmitter links, which must be moved in order to release spectrum for DSO. In other towns, the number of existing analog TV channels is very low, as can be seen in the same Table 1.

Broadcast Area	Channels used
Georgetown	2,6,7,9,11,13,14,16,18,21,25(link),27,29,35(link), 38, 40(link), 42, 46, 50(link) and Cable "O"
New Amsterdam	3,8, 10, 12, 15
Corentyne	10, 16, 19, 21, 24
Essequibo	8, 10, 25
Linden	8, 10, 13
Bartica	3, 5
Mabaruma, Ituni, Mahdia, Aishalton, Annai – 3	
Lethem, Karasabai - 5	
Port Kaituma, Kwakwani – 10	

2.1 MARKET STRUCTURE

TV market structure in Guyana is based mainly in terrestrial TV (free to air) with 14 commercial channels in Georgetown and two national channels with coverage in populated areas. As shown in Table 1, In addition to the two national channels, there are commercial channels in New Amsterdam (3 channels) and Corentyne (2 channels, this includes a relay from new Amsterdam).

In Georgetown area, two Conditional Access operators use the MMDS band. There are five small cable operators (areas include Bartica, Linden, Corentyne, Georgetown). Some local broadcasters have their content distributed by cable TV operators. There is one registered DTTH Satellite operator (Stabroek TV Inc.) facilitating DirectTV. The market is fairly small with subscribers in in Georgetown and other parts of Guyana.

In Table 2, a list of ten administrative regions and population is shown. (With the exception of the National Channels,. Two national channels have coverage in most of the populated areas of the country; channel NCN and Guyana Learning Channel. Learning Channel has the largest coverage of the country. In Table 3, a list of broadcasters and their respective channel is shown; most of these channels are operating in Georgetown.

No.	Region	Area (km²)	Pop. (2002)	Pop. per km²
1	Barima-Waini	20,339	24,275	1.2
2	Pomeroon-Supenaam	6,195	49,253	8.0
3	Essequibo Islands-West Demerara	2,232	103,061	46.2
4	Demerara-Mahaica	1,843	310,320	168.4
5	Mahaica-Berbice	3,755	52,428	14.0
6	East Berbice-Corentyne	36,234	123,695	3.4
7	Cuyuni-Mazaruni	47,213	17,597	0.3
8	Potaro-Siparuni	20,051	10,095	0.5
9	Upper Takutu-Upper Essequibo	57,750	19,387	1.3
10	Upper Demerara-Berbice	19,387	41,112	2.1
	Guyana	**214,999**	**751,223**	**3.5**

Table 3 List of TV Channels in Guyana.

Broadcaster	Main Broadcasting Channel
Guyana TV	
Channel 2 Television Station/GWTV/2 Inc.	2

Tarzie's Transmission Service	5
CNS Inc.	6
WRHM Inc.	7
Pinnacle Communications Inc.	8
Dave's Television Channel 8 Inc.	8
Blackman and Sons Inc.	9
Little Rock Television Station Inc.	10
National Communications Inc.	11
Rambarran Broadcasting Systems Inc.	13
Multi Technology Vision Inc.	14
HGPTV-Omar Farouk Inc.	16
National Television Network Inc.	18
Countryside Broadcasting Inc.	19
STVS Channel 4/21 Inc.	21
Television Guyana Inc.	Cable 'O'
GUYANA LEARNING CHANNEL	29
WRHM Inc.	38
21st Century Communications Ltd.	42
SKAR Communications Inc.	46

2.2 REGULATORY FRAMEWORK

The Telecommunications Act No.27 of 1990, known as Telecommunications Act 1990 is the current telecommunications regulatory framework. An amendment Bill is currently in Guyana National Assembly, the Telecommunications Bill 2012

The Broadcasting Act 2011 (Act No. 17 of 2011), which created the Guyana National Broadcasting Authority (GNBA), was assented to in September 2011 and commenced in August 2012. The Governing Board of the Guyana National Broadcasting Authority was appointed and commenced work in September 2012. The Guyana National Broadcasting Authority (GNBA) is still being established; the governing Board has commenced processing applications for Broadcasters. The Managing Director of the **National Frequency Management Unit** (NFMU), is an ex-officio member on this Board. Most broadcasters are in the process of renewing licenses with the new framework.

The National Frequency Management Unit (NFMU) was established in December 1990 as a Public Corporation by way of Order No.79 of 1990, made under The Public Corporations Act 1988 (No. 21 of 1988).

In the current framework, the process to issue a broadcast license from the Guyana National Broadcasting Authority is required along with permission from the National Frequency Management Unit for the use of the Radio Spectrum (this permission is granted under and in accordance with the Post and Telegraph Act Cap. 47:01), in cases where the transmission is done via wireless means.

GNBA comprises seven members; it is chaired by former Human Services Minister, attorney-at-law Ms. Bibi Shadick. The others are Presidential nominees Margo Boyce, Gerald Gouveia, Major General Rtd. Norman Mc Lean, Charles Ramson (Jr) and Dindyal Permaul and Opposition nominee Sherwood Lowe.

Table 4 Summary of regulatory issues related with DTTB

Type of Right	Regulatory body	Ministry	White Paper/Law	Notes
Spectrum	National Frequency Management unit (NFMU)	Office of the President	**Order No.79 of 1990** **Post and Telegraph Act Cap.47:01**	Under the Telecommunications Bill 2012, the NFMU would be closed with the responsibilities for Spectrum Management being administered by the 'Telecommunications Agency' and governed by the new/amended law . Any transition from the NFMU to the new agency should not affect the roadmap team
Broadcast	Guyana National Broadcasting Authority (GNBA)	Office of the President	Broadcasting Act of 2011	It will be necessary to revise this Act as part of the DTTB migration process
Operating	GNBA		Broadcasting Act of 2011	
Site Sharing	None			
Building Permits	None? City Council / Local Authorities (Guyana Civil Aviation Authority for Towers)			

2.3   DIGITAL SWITCHOVER OBJECTIVE

The main objectives of the Guyana switchover are considered in Table 5.

Table 5 Digital Switchover objectives for Guyana

No.	Objective	2014-2018	>2018
1	Smooth Transition from Analogue to Digital	Beginning of the Digital transition around 2016	
2	End of Analogue Transmission		2020 is an estimated for the ASO
3	New Entrant/Services	Services like HD and Interactive TV are being considered	
4	Coverage	Coverage improvements with respect to Analogue TV is expected	
5	Picture Quality	Probably SD at the beginning of the DSO	HD or UHD is a possible scenario for some broadcasters
6	Compensation for Viewer		Minimize migration costs
7	Broadcasters	Not defined yet	Probably HD or 3dTV
8	Digital Dividend	Allocation of Digital Dividend	

Objective 1

The Digital switchover will take in phases, beginning with less populated areas, like New Amsterdam. In Table 5 we suggest an implementation schedule.

Table 6 Digital switchover transition scenario proposed for Guyana

Year	Cities/Regions
2016	New Amsterdam, One or two channels in Georgetown
2016	Corentyne
2017?	Essequibo
2017?	Linden
2017	Georgetown

Objective 2

End of analogue transmission is being considered by 2020. However, no formal date has been established by the Government of Guyana as yet . The date of 2020 was part of the discussion

during the visit, considering the planned dates in South America. New events reported in Topcomm news[2], report that Paraguay have shifted the analog switch off until 2023. This new scenario has to be considered by Guyana, but the relevant dates to be considered are Brasil (2018) and Venezuela (2020). Suriname is an important player for this purpose, but we cannot find information about the switch off date.

Objective 3

New entrant and new services are being considered. Specifically, after the ITU expert visit, the implementation of new services as a consequence of DTV implementation is being considered. The possibility of new entrants is remote in Georgetown, because currently there are 17 private broadcasters in Guyana, and a small market, not very attractive for new entrants in the DTV business. A most probably scenario will be the offering of new services by the existing broadcasters. However, with the new Broadcasting Act, several applications for TV broadcasting have been submitted for consideration.

Objective 4

Actual coverage in Guyana is limited to main urban centres like Georgetown and New Amsterdam and surrounding areas. Basically, because the use of low power analog transmitters, with the exception of the public national channels. The implementation of DTTB transmitters will allow a better coverage and the opportunity to have services in more than one city by a broadcaster.

Objective 5

Picture quality is an important issue to discuss in Guyana. For some broadcasters focused on sports, specifically Cricket and horse races could be important to offer HD or UHD services. This is an important issue in the discussion about DTV standard and network structure considerations.

Objective 6

According to Guyana conditions, it is important to consider some scenarios to minimize the final cost of the receivers to the final user. This can be achieved using tax reductions or exemptions or even direct subsidies to the users. These scenarios will be discussed by the NRT and proposal can go to the Government of Guyana /parliament for consideration.

Objective 7

At the moment of the visit, Guyanese broadcasters were not aware of the transition to Digital TV and do not manifest knowledge about the Digital technology and its advantages. After the visit, most of the broadcasters were interested in the new technology and will be exploring the new business models associated with DTTB. During the second visit, the situation was not quite different, but most broadcasters were very interested in the Digital system.

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[2] http://www.topcomm.biz/home/index.php/component/content/article/12-topcomm-noticias/destacadas/4404-paraguay-pais-sera-el-ultimo-en-apagar-la-tv-analogica.html

Guyana has taken the decision of the allocation of digital dividend and NFMU is finalizing the spectrum plan for this band e. There are interests in use of this spectrum in the near future for IMT.

3   NATIONAL ROADMAP

3.1   Roadmap concept

After having determined the objectives of the roadmap as described in Section 2, this section will describe the roadmap itself. This section starts with an introduction on the concept of a roadmap, followed by the description of the construction of the roadmap in Section 3.2. In Section 3.4, the selected functional building blocks of the Guyana roadmap are shown and each of the phases of the Guyana roadmap are described.

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, as shown in Figure 4.

By	Phases of the Roadmap		
Regulator	Policy and Regulation	1.DTTB/MTV Policy development 3. Licensing Policy & Regulation	4. License Administration
	ASO	2.ASO Planning	

Operators	Market Business & Development	1.Preparation	2.Plannning	3.Implementation
	DTTB/MTV Networks			4.AnalogueSwitch Off
	Timeline			
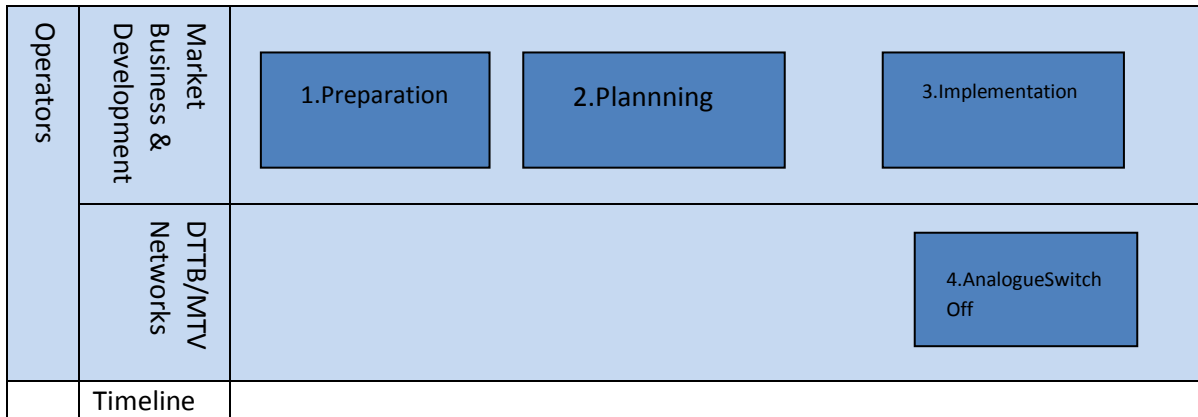
Figure 4 Phases of the Roadmap, according to ITU guidelines.

The ITU Guidelines for transition to digital television describe a method for developing a roadmap for transition to digital television. This methodology will be followed in the development of the national roadmaps. The basis is a functional framework consisting of five layers (see Figure 5).

Functional Layers
- A. Policy and Regulation
- B. Analogue Switch off (ASO)
- C. Market and Business development
- D. DTTB&MTV networks
- E. Roadmap Development

Functional Building Blocks
- In each layer 3 to 13 functional buildng blocks have been identified

Key Topics&Choices
- Each functional building block is described in the corresponding chapters of part 2 to 6, including
  - Key topics and Choices
  - Implementation Guidelines

Information and Implementation Guidelines
- Each functional building block is described in the corresponding chapters of part 2 to 6, including
  - Key topics and Choices
  - Implementation Guidelines

Figure 5 Functional layers and Building blocks

Each layer consists of a number of functional building blocks covering all functionalities relevant to the transition to digital television.

Development stages

Figure 5 shows the stages in the development of a roadmap. These stages will be described in the following paragraphs.
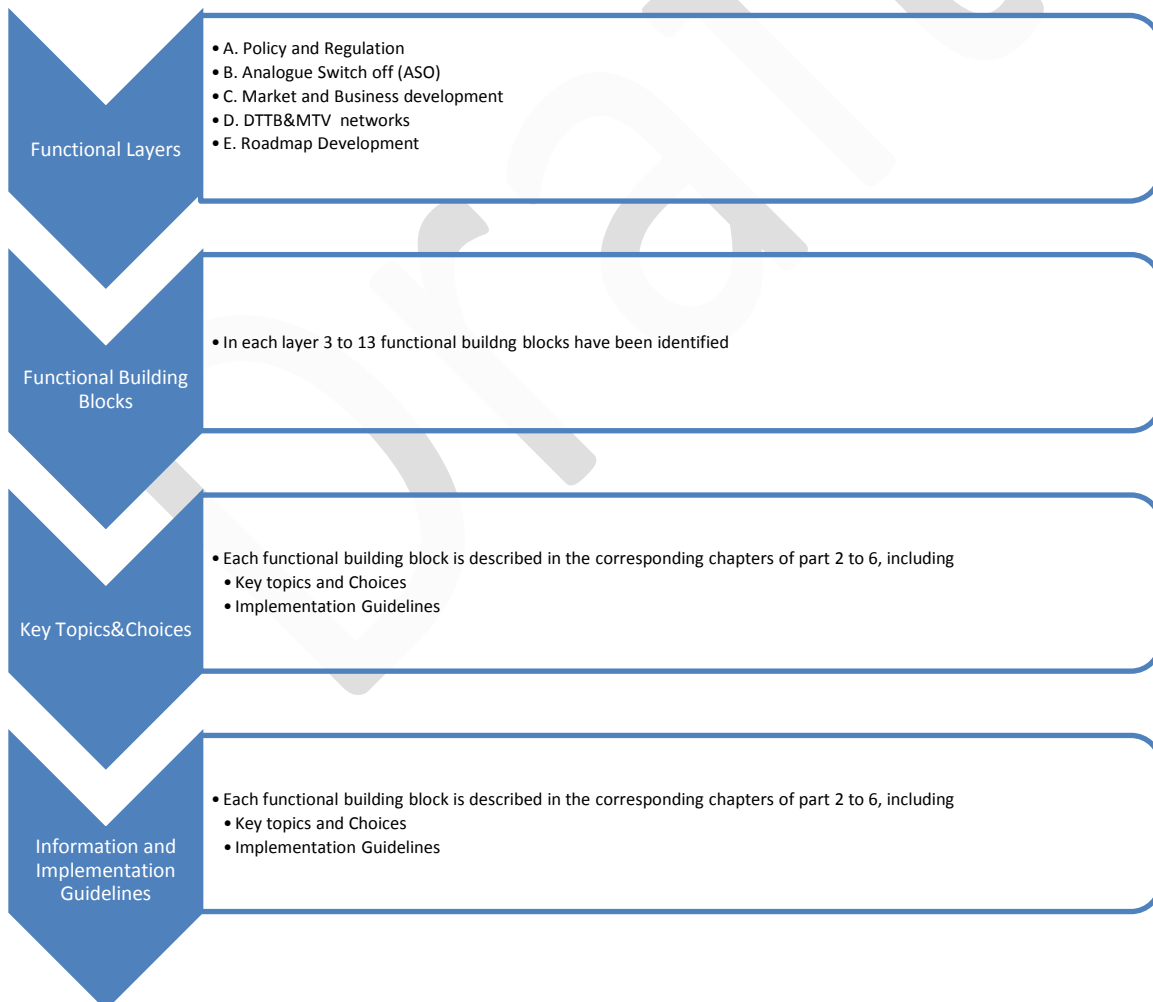
1. Consideration of functional layers and selection of functional building blocks.

Depending on the national situation, taking into account the actual status of transition to digital television and the scope of interest of the National Roadmap Team, the relevant functional layers and functional buildings blocks should be selected.

2. Consideration of key topics and choices

The selected functional building blocks and the information received regarding key topics and choices related to the functional building blocks will be summarized in a checklist guided by available information. Key topics and choices were addressed during the first visit in discussions between the NRT and the experts.

In considering the key topics and choices of the relevant functional building blocks, it should be determined if the issues are:
- partly decided;
- not considered or decided yet;
- in need of revision;
- decided already.

In discussing key topics and choices that are partly decided or not decided yet, it may be possible to make some decisions based on the available information, the overall national strategy, or as a consequence of other choices. However, it should be noted that for those principle decisions further work may be needed. These further activities should be listed. For most of the key topics and choices the NRT will have to carry out investigations before a decision can be made. In these cases, the necessary activities for the NRT should be identified. For Guyana case, it is necessary to empower the NRT members and give to NRT enough capabilities to take the necessary decisions.

3. Construction of a national roadmap

The results of the discussions of the first visit will be analysed and a draft roadmap will be prepared for those parts that are in scope of interest.

The steps needed to construct the national roadmap are shown in Figure 6.
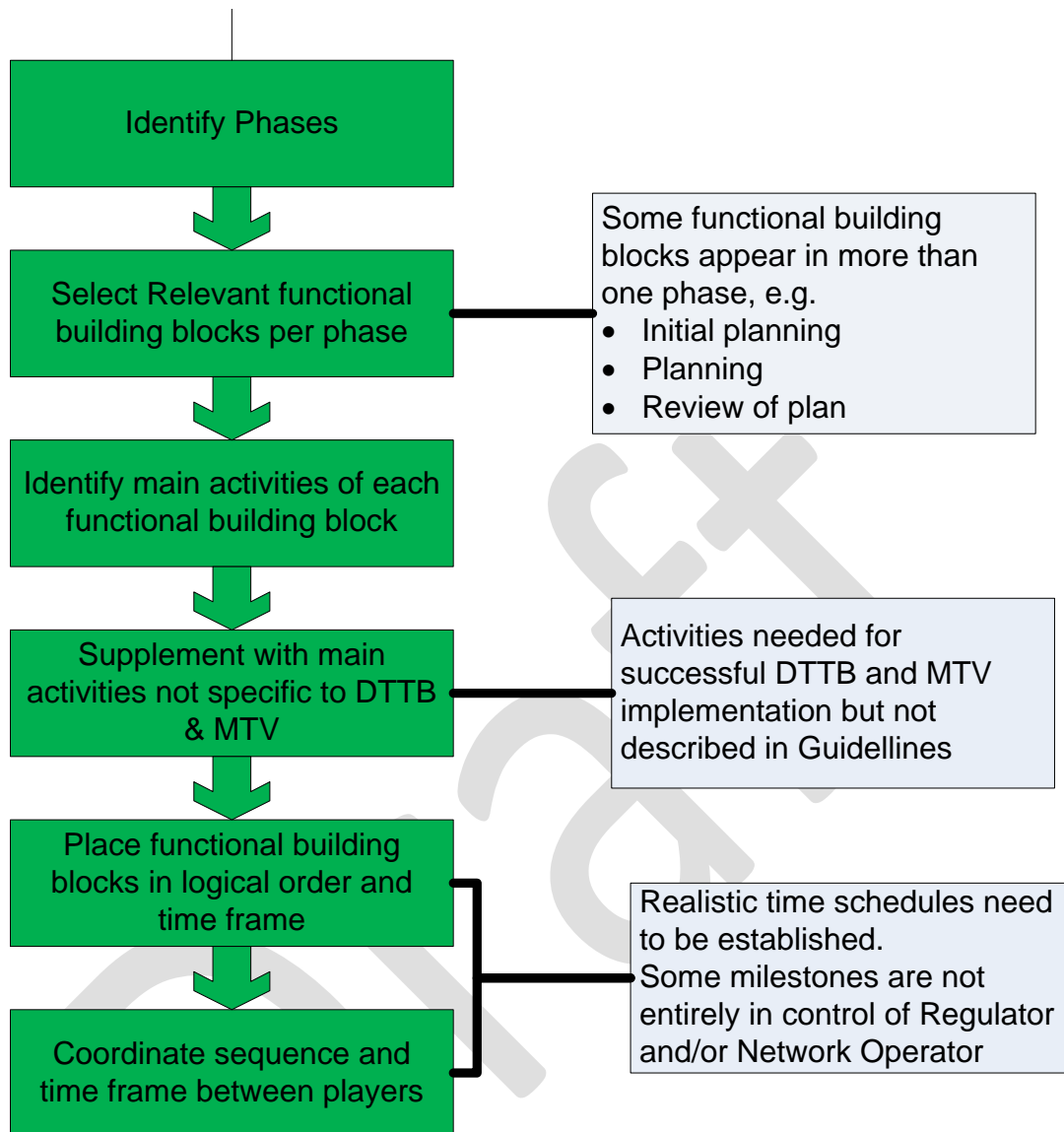
Figure 6 Roadmap construction steps

In constructing the roadmap the following steps should be taken:

1. Identify the roadmap phase in which the national process of transition to digital television currently takes place and the phases that still need to be carried out.
2. Place the relevant functional building blocks in the phases that still need to be carried out. It should be noted that certain functional building blocks may appear in more than one phase.
3. Identify the decisions already taken and activities that need to be carried out in order to be able to take the still pending decisions.
4. Note activities that are needed for successful implementation that are not specific to DTTB and MTV implementation and not described in the ITU Guidelines for transition to digital television.
5. Place the functional building blocks, together with the listed activities, in logical order and a time schedule to complete the process.

3.2 DESCRIPTION OF THE CONSTRUCTION OF THE ROADMAP FOR GUYANA

Part 6 of the ITU Guidelines for transition to digital television 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 Guyana roadmap. In Figure 3, the functional blocks relevant to the process are shown.
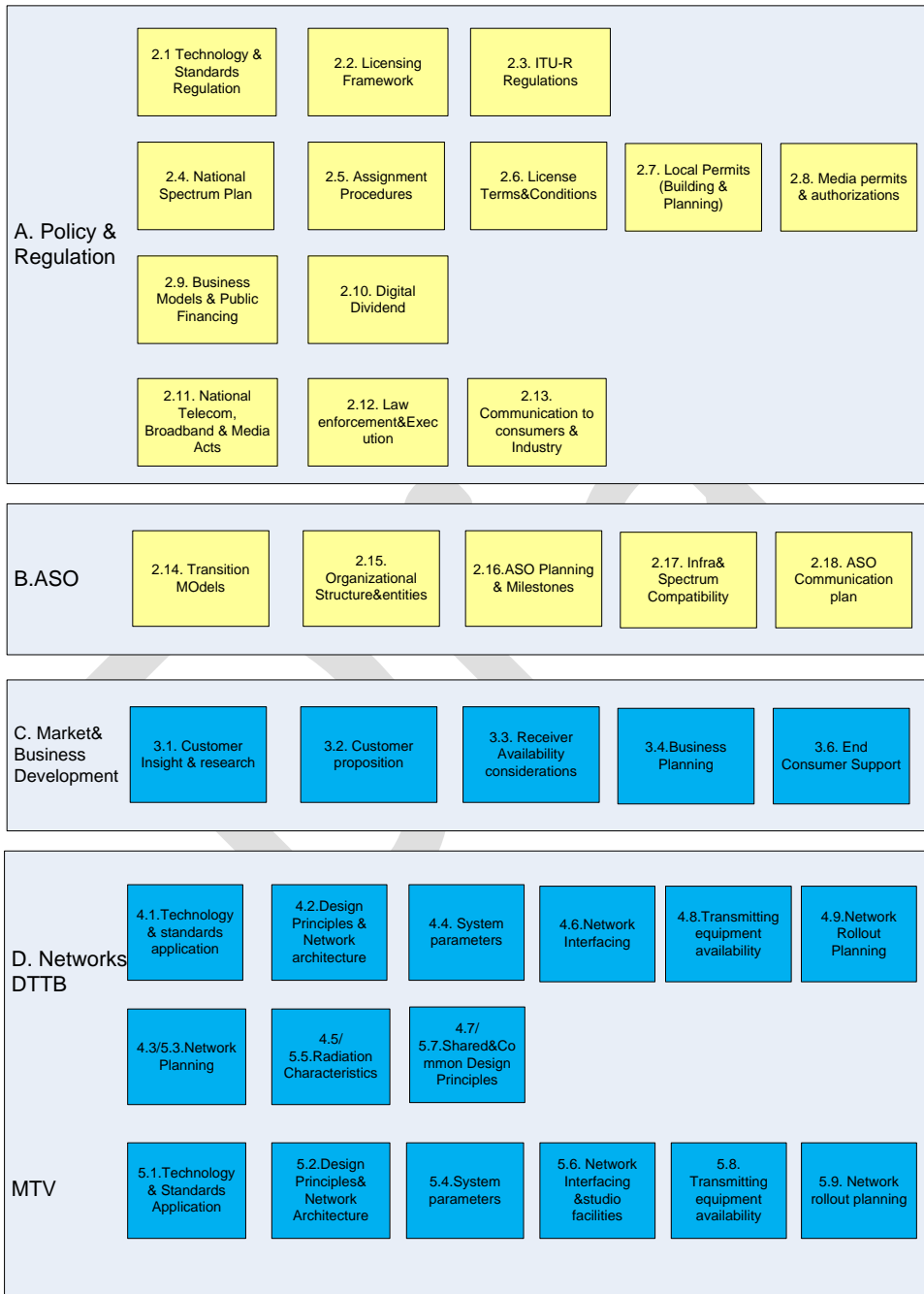

Figure 7 Functional building blocks of the ITU Guidelines

3.2.1   Input data

International agreements and existing relevant legislation and policy documents are the basis for establishing the DTTB/MTV policy. During the ITU expert visit, some documents regarding trade agreement were requested and revised by the NRT members.

A revision of the current state of TV sets are being carried out by the NRT, in order to determine if there are (and how many) digital TV receiver in the Guyana market. This survey will be an important input to the DTTB standard decision process.

Guyana is in the transition process to a new Broadcast regulation and, at the moment of the expert visit, the broadcasters were in the process of renewing (or updating) their licenses with this Broadcast Act of 2011. In Annex 2, a copy of the Broadcast Act is included.

3.2.2   Establishment of a national committee

Normally the first step is to set up a national digital broadcasting committee. DTTB and MTV introduction is a complex process, involving many players and many interrelations between the players. Good communication between all players (government and market parties) is essential.
Therefore a DTTB introduction committee, in which all players are represented, would be advisable.

In practice these kinds of committees could have different forms and mandates, ranging from informal set-ups to official government led commissions or independent organizations taking final decisions. The NRT in Guyana depends formally on the Head of the President Secretariat/Office of the President.

For the Guyana case, a National Roadmap Team formed basically with government members was established and is working towards the DTTB introduction. At least up to some point in the process, the NRT can do the work, but it will be necessary to incorporate members of the broadcasters and consumers (a consumer rep is already on the NRT). This expanded NRT could be the National Digital Broadcasting committee. During the implementation phase, the composition of the committee can probably change and include experts on implementation.

It is important to include in the DTTB Committee (or expanded NRT) representatives of the consumers and senior engineers from broadcasters, as well as skilled engineers and people from national engineering programs (mainly electrical engineering or Telecommunications engineering) from main universities (In this case at least from University of Guyana). Depending on the experience levels and skills of the NRT members, a training program or a set of workshops about DTTB technologies, services and spectrum regulation could be useful for supporting the decisions.

3.2.3   National Telecom, broadcast and media acts

Taking into account the advice of the national committee, existing relevant documents and acts will be reviewed by carrying out the activities related to functional block 2.11 National Telecom, broadcast and media acts (see Table 7).

2.11 Proposing changes in national telecom, broadcast and media acts
1. Make inventory of current Legislation
2. Map inventory on DTTB/MTV introductions and compare with 'best practices'
3. Identify gaps and draft proposals for additional and/or changes in Legislation (based on 'best practices')
4. Determine planning for changes in the law and determine 'must haves' for launching DTTB/ASO and MTV

In Table 8, some key aspects of the guidelines and tasks required for the roadmap are shown, as well as the results of the discussion with NRT members and some initial decisions taken or suggested actions for the Guyana Roadmap. During the second visit, some issues regarding the licensing framework were discussed and some decisions depend on the type of modifications required in the licensing procedure. With the current broadcast Acts could be possible to issue some specific regulations for DTV licensing without amend the Act. This issue should be analyzed by the legal people, because is critical for the timeline proposed in this document.

Table 8 Decisions of the NRT on key points of the functional Blocks

Functional Blocks	**NRT Key Decisions**
2.1 Technology and standards regulation	The following issues were discussed: a) presentation format: SDTV in the initial deployment, but will be discussed with broadcasters b) TV standard: Not decided yet c) compression standard: Not decided yet d) application programme interface: Not decided
2.2 Licensing framework	Action regarding: a) spectrum rights. b) broadcast rights. c) operating rights will be started immediately and rules framed depending on requirements. d) along with rights, obligations will be defined. Framing of rules and legislative support will be started as soon as possible and completed around the end of 2015. **It is important to determine if only regulations is required or an amendment of the broadcast Act. In such case the timeframe will be different.** However if legislative support is required then setting the time frame will be difficult as parliament has to amend the broadcasting acts.
2.3 ITU-R Regulation, and 2.4 National spectrum plan	Work out frequency plan for DTTB/MTV. It will be ready by the end of 2014. However, this date depends also on the duration of the coordination with neighbor countries.
2.5 Assignment procedure	Assignment procedure is not defined yet in the DTTB framework. This decision will be taken after the decision of the standard. Legal revision about this procedure is required.
2.6 Licensing terms and Condition	Define licensing terms and conditions and seek legislative support if required. The estimated date is by the end of 2015.
2.7 Local permits	To facilitate sharing and fair pricing of infrastructure – rules regarding: a) reduction of horizontal pollution, and

	b) safety from health hazards, EMC, dangerous goods etc., Currently, this is responsibility of local authorities and will not affect the regulatory conditions and development of DTTB in Guyana. However, the DTTB transition could be a good argument to discuss some regulation related.
2.8 Media permits and Authorization	Regarding: a) eligibility condition of applicant; b) granting of broadcast rights whether at program level or multiplex level; c) content obligation; d) applicability of Conditional Access These items will be included in the regulation and expected to be completed around the end of 2014 or beginning of 2015, but in such case after the decision of the standard.
2.9 Business model and public financing	Regarding how to: a) finance DSO/ASO of public service broadcaster; b) finance STB/digital receivers; c) finance simulcast mode; it was decided to discuss about requesting government to reduce import tax/duty, relief on customs duty for importation of transmitter equipment, STBs/IDTVs etc.
2.10 Digital dividend	Guyana has already allocated the Digital Dividend in the National Frequency Allocation Chart
2.11 National telecom/broadcast and media act	All actions in 2.1 to 2.10 should conform to the Guyana Broadcast Authority, Broadcasting Act and National Frequency Management Unit. National Broadcasting Act of 2011 will be revised and possibly the Telecommunications Act of 2011 also be revised. DTTB inputs will be given to the committee conformed to review these acts. At this point, it is difficult to propose a firm deadline for these activities.
2.12 Enforcement and Execution	Proposal to have engineering and administrative set up to execute these functions will be included in the broadcasting act and expected to be completed by 2014/2015 but since it is an act and the National Assembly has to consider it, it is very difficult to propose a firm date at this stage.
2.13 Communication to end customer and industry	This function will be entrusted to ASO commission to be set up. It is not clear yet if ASO commission will be the same NRT.
2.14 Transition model	The discussed DSO strategy considers the conversion from lowest population centres, specifically New Amsterdam, upwards and switching off simulcast operation after viewers are supplied with STBs/IDTVs in the coverage area of that centre, and the ASO could be carried out in a phased manner. The UHF frequency for the simulcast mode has been earmarked. In Georgetown it will be possible to begin the transition with two or three frequencies, which allows migrating around 6 analogue channels. The ASO commission must be set up. Funds will be provided to the commission for provisions of STB etc. The operation is expected to be spread over a period 2016 – 2020.
2.15 Organizational structures and entities	The ASO commission is not defined yet.
2.16 ASO planning and Milestones	When to start? Activity should start at the end of 2015? ASO approach and simulcast mode? It would be simulcast mode. Contact Centre Management to help customer: ASO commission to be entrusted with this work.
2.17 Infrastructure and spectrum compatibility	To be sorted out during planning stage; multiplex sharing conditions to be taken care of through regulation as well as infrastructure compatibility.
2.18 Consumer insight and Research	To be dealt with by the commercial wing of the respective broadcaster.
3.1 Consumer's insight and research, and 3.2: Market research methods	To be dealt with by the existing commercial wing of the broadcaster
3.3 Receiver availability	Once the standard is chosen, the ASO commission will look into this aspect. The ASO commission should be given sufficient funds for providing at least some STB and communication campaigns.

3.4 Business planning	The public sector broadcaster will use free to air mode and advertisement will be the main source of revenue. For commercial stations, it would be advantageous, plus pay TV model. Conditional access (CA) would be required by them. The ASO committee will be given inputs regarding DTTB for framing rules regarding CA. DTH is not a relevant business in Guyana.
3.5 End customer support	The ASO commission will be entrusted to take care of this issue.
4.1 to 4.5: Technology and standards application; Design principles; Network planning; System parameters; Radiation characteristics	DTV Standard to be decided. SDTV for the time being, CA system, single multiplex to start with, designing system and network as per DSO strategy, other system parameters like STB specification and type approval, after the standard decision and experience with experimental set up in Georgetown.
4.6 Network interfacing	To be decided after standard selection.
4.7 Shared infrastructure	A single multiplex to start with and a second one some months later. To be decided at the time of execution of project. MTV is being considered, but no decision has been made. A very probable scenario could be not to deploy MTV.
4.8 Transmitting equipment Availability	This is part of the considerations to be analysed for the DTV standard selection. Some pilot tests have been considered in Georgetown.
4.9 Network roll out Planning	Pilot project execution and testing will give experience in optimising parameters to get best results and roll out planning would be realistic and efficient.
5.1 Technology and standards application for MTV	No decision has been taken about MTV.
5.2 to 5.9	Will be in line with ITU Guidelines. Parameters etc. will be decided later. Based on the decisions of ITU expert visit to Guyana, a draft roadmap for transition from analogue to digital TV broadcasting has been prepared.

3.3   SELECTED FUNCTIONAL BUILDING BLOCKS FOR THE ROADMAP FOR THE REGULATOR

Of the five functional layers described in the ITU Guidelines and shown in Figure 5, layer E is "Roadmap Development" and hence is covered in this document. The other functional layers contain in total 38 functional building blocks, as shown in Figure 7. Out of the 38 functional building blocks, for the Guyana case, only 18 were selected.

The Roadmap covers:

- DSO Objectives (until 2016)
- Activities managed by the NRT
- ASO objectives (Up to 2020)
- Draft schedule for DSO and ASO

Figure 8 shows the selected functional building blocks as a lighter color (yellow or blue) with a dashed frame.
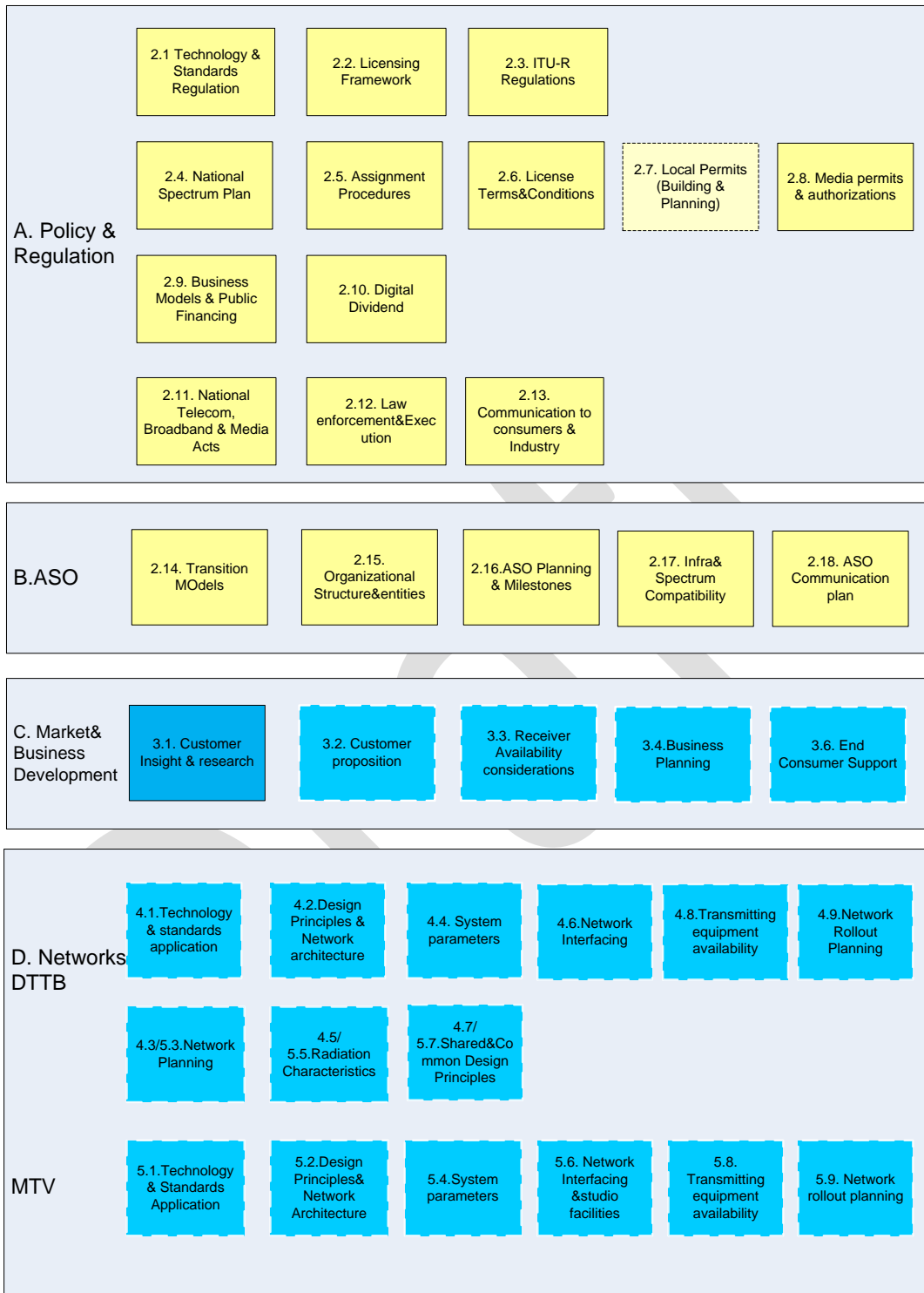
Figure 8 Selected functional building blocks in Guyana Roadmap

Reasons for not including the dashed blocks are discussed in Table 7. In Figure 9, the relation between phases, according to ITU Guidelines, and proposed timeline for Guyana roadmap is shown. In Figure 10, the related functional blocks with each phase are shown.

Table 9 Functional building blocks not included in Guyana Roadmap

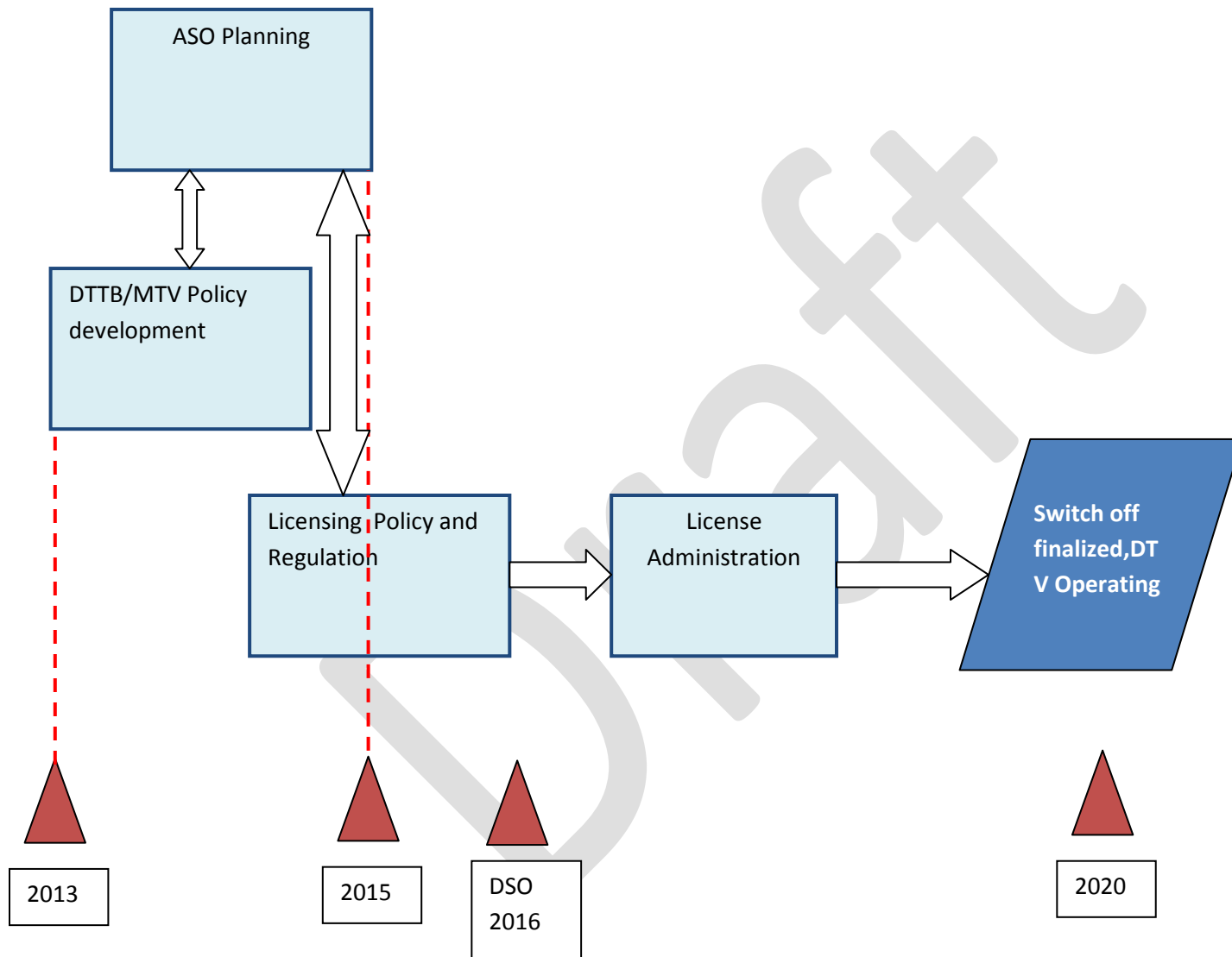| Not Included functional Building Block		Reason
Number	**Title**	
2.7	Local Permits	This issue is the responsibility of local authorities and is not considered an important issue in the DTV deployment.
3.2	Customer Proposition	Some case studies will be provided.
3.3.	Receiver Availability considerations	This item as part of the roadmap of the operator is not useful at this stage. Will be important in the discussion of the DTV standard in Guyana.
3.4.	Business Planning	Because no standard is defined and new regulatory issues must be revised, it is very difficult at this stage to make some business planning. Local broadcasters could analyze new business models associated with DTV, in order to participate actively in the discussion about the standard.
3.6	End Customer Support	The activities related with customer support will be deployed in the ASO phase. These activities will be considered as part of the transition process and communication plan.
4.1	Technology & Standards application	No digital standard has been selected in Guyana. The first task to be executed during the roadmap is the standard selection. Guyana government and NRT will revise different conditions like Free Trade agreements which could include issues related with technology provisioning; TV sets availability in the homes with its characteristics, in order to define the standard. The availability and costs of receivers will be an issue in the process.
4.2	Design Principles and Network Architecture	
4.3/5.3	Network Planning	
4.4	System Parameters	
4.5/5.5	Radiation Characteristics	
4.6	Network Interfacing	
4.7/5.7	Shared and Common Design Principles	
4.8.	Transmitting equipment availability	This verification is part of the considerations that Guyana NRT must consider in the process of DTV standard selection.
4.9	Network Rollout planning	Will be considered after the standard decision
5.1	Technology & Standards Application	Guyana has not decided if will deploy MTV. As have been discussed during the first expert visit and according to Guyana geographical conditions, probably MTV will not be deployed.
5.2	Design Principles & Network Architecture	
5.4	System Parameters	
5.6	Network Interfacing and Studio Facilities	
5.8	Transmitting Equipment availability	
5.9	Network Rollout Planning	

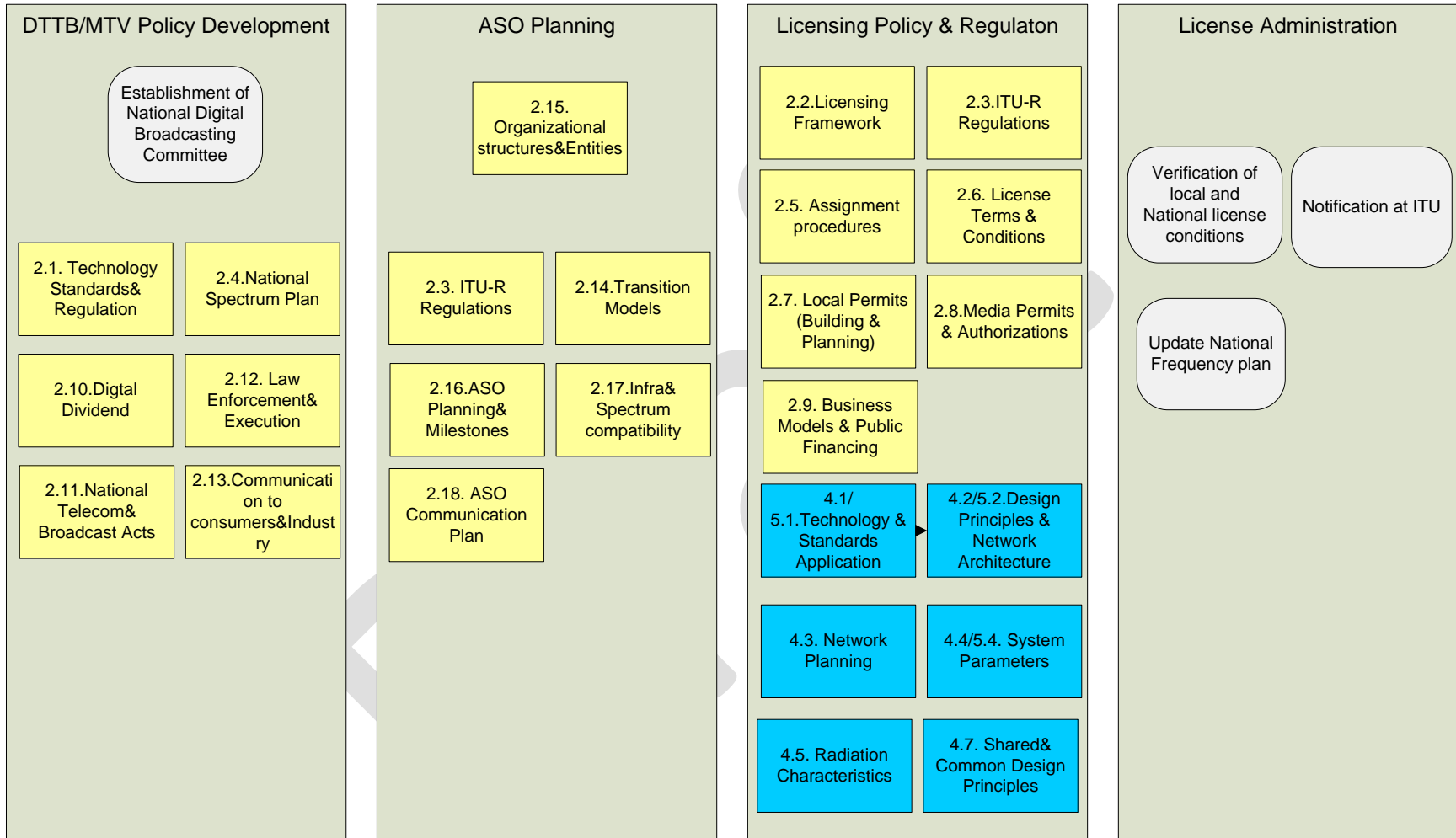**Figure 9 Interrelation between the four phases of the Guyana roadmap**

Figure 10 Functional blocks related to each of the four phases of the regulator's roadmap for transition to DTTB and implementation of MTV

DTTB/MTV Policy Development

- Establishment of National Digital Broadcasting Committee
- 2.1. Technology Standards& Regulation
- 2.4.National Spectrum Plan
- 2.10.Digtal Dividend
- 2.12. Law Enforcement& Execution
- 2.11.National Telecom& Broadcast Acts
- 2.13.Communication to consumers&Industry

ASO Planning

- 2.15. Organizational structures&Entities
- 2.3. ITU-R Regulations
- 2.14.Transition Models
- 2.16.ASO Planning& Milestones
- 2.17.Infra& Spectrum compatibility
- 2.18. ASO Communication Plan

Licensing Policy & Regulaton

- 2.2.Licensing Framework
- 2.3.ITU-R Regulations
- 2.5. Assignment procedures
- 2.6. License Terms & Conditions
- 2.7. Local Permits (Building & Planning)
- 2.8.Media Permits & Authorizations
- 2.9. Business Models & Public Financing
- 4.1/ 5.1.Technology & Standards Application
- 4.2/5.2.Design Principles & Network Architecture
- 4.3. Network Planning
- 4.4/5.4. System Parameters
- 4.5. Radiation Characteristics
- 4.7. Shared& Common Design Principles

License Administration

- Verification of local and National license conditions
- Notification at ITU
- Update National Frequency plan

3.4 PHASE 1: DTTB AND MTV POLICY DEPLOYMENT

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.
Policy Makers and Legislators will have to commit to the ASO objectives, deadlines, necessary budget and endorse the establishment of the NRT with a clear mandate to plan and execute the ASO process.

Inputs

The inputs for this phase are international agreements, such as agreements with Brazil or the United States, existing regulatory framework (see Table 5) and policy objectives (see Table 6). It should be noted that the DSO policy objectives as included in Table 4 still have to be completed. For example, the exact ASO dates and the minimum number of television services and their coverage have to be determined.

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 Guyana. The customer benefits/competitive edge of DTTB for the key markets (e.g. terrestrial served and non-served) should be clearly outlined. The digital dividend to become available may also be part of this policy justification (hence it will be possible to introduce new mobile services).
- The legal framework. This entails the legal basis (and any necessary changes) for the DTTB service introduction and the ASO.
- Technical framework. Detailing the current spectrum in use by existing broadcasters and the available spectrum for the DTTB/MTV services..

• Starting (i.e. the introduction of the first DTTB broadcasts) and ending date of ASO process (i.e. switching of the last analogue broadcasts and lifting any restrictions on the DTTB broadcasts).
These dates have to be exact in order to accurately inform the general public and the industry.
• The principle ASO model. This could be either simulcasting or non-simulcasting (including the justification for any of the two). The suggested model for Guyana was having a simulcasting period.
• DTTB services. Describing which existing television services (including any regional services) and additional content/services will be distributed on the DTTB platform and for which districts/provinces these services will be made available.
• DTTB standards. The mandatory standards (for example the transmission, compression and application programming interface (API) standards) and justification for their use. In Guyana, No decision has been made. It is important to consider not only the DTV standard but also the video compression and the interactive services and API Standard. The introduction of Pay services has been suggested as a new business model for broadcasters and the consideration of a Conditional Access System (CAS) 'standard'.
• Funding principles. The intention to include selected ASO costs in the government budgets and the way it is going to be funded (for example by public private partnerships).

• 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.). <mark>This communication and Awareness plan MUST be initiated as soon as possible, in order to generate interest and raise the public awareness about DTV in Guyana.</mark>

Roadmap

The roadmap of the DTTB policy development phase and the associated functional building blocks is shown in Figure 11. The decisions taken, partly taken and not yet taken on the key topic and choices regarding phase 1 of the roadmap and the activities required to prepare the decisions that are still pending, are indicated below.

In Figure 11, a separate block for the standard decision was made. In this block, sections 2.1, 3.1 and 4.1 of the ITU Guidelines were included. For these blocks, the following considerations should be discussed by the NRT and stakeholders.

1. Selection of standard will consider the trade agreements existing with different countries, as well as a market research indicating the installed base of TV sets with less than three years which can probably have ATSC receivers.
2. Because the channelization in Guyana is 6MHz, the receiver availability is a very important point for standards different to ATSC. The cases of countries like Colombia and Panama for DVB-T/T2 will be considered as well as experience of Costa Rica with ISDB-Tb.
3. As Guyana is part of the Caricom Community from the political point of view, some discussion was taken about the revision of Caricom countries decisions. However, from the geographical point of view, Guyana is a South American country and decisions from such countries like Brazil or Venezuela have more relevancies for the DTTB standard decision.

As can be derived from Figure 11, the following steps (i.e. functional building blocks and non-DTTB specific activities) are included in the first phase of the roadmap:

1. Mandating the NRT. Although the NRT has been formally established, its mandate should be checked. In order to deliver the aforementioned DTTB policy document it should have at least a clear mandate to do so. After this policy document has acquired political approval, the NRT mandate can be extended to prepare, plan and execute the roadmap. 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 Guyana. This step includes the functional building blocks 3.1 and 3.2. At this phase of the roadmap, market research serves the purpose of providing support/justification for the DTTB policy. The available market data will have to cover the following elements:
a. *Current* television market in Guyana. 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 (if any), network operators, service providers etc.) and their television services.

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. Size and growth of the total television advertising market in Guyana. Also the impact of the ASO and DTTB introduction on this advertising market should be assessed;

iv. 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 (cable and satellite);

v. Current analogue service coverage. Given the current reception conditions, it should be clarified where and which 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 local broadcasts and the different channel bouquets the various viewers might receive;

vi. 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 and their location), and operations will be necessary. At this point, the Guyana Revenue Agency is revising how many TV sets with less than three years are in the local market. This is important because many TV sets comes from the United Stated and probably have the ATSC receiver;

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

i. Content. The number and the type of programmes/channels and other services to be broadcast (for example the electronic programme guide (EPG), subtitling, theme channels). Also the willingness to pay for the STB and the television services is an important aspect to include. Knowing this willingness can help to determine any necessary financial support for viewers.

ii. Supplies. Manufacturers and local retailers might show an interest in provisioning DTTB receivers.

iii. Content creators. Content creators (i.e. in most cases the current broadcasters) might be interested in provided dedicated content for the DTTB platform.

3. Determining the *current available* spectrum for DTTB (functional building blocks 2.3 and 2.4). A clear and shared understanding of the available spectrum will enable the NRT to develop a well motivated DTTB policy document. The available spectrum for digital terrestrial television services should be clarified, 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. Spectrum may not be readily available in Guyana as the same spectrum is in use in neighboring countries (especially near the borders). 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 HSPA/LTE services (as indicated/to be incorporated in the National Spectrum Plan and Register).

4. Checking compliance with current legislation and identifying required changes (functional building block 2.11). A first assessment should be carried out of the parts of the current legislation that will be impacted by the introduction of DTTB services. 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 areas that might be impacted, how required changes can be achieved (e.g. legal and parliamentary procedures), and the 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), specific DTTB regulations are defined (e.g. the licensing framework and procedures), and a further detailed assessment of necessary changes may be necessary.

5. Selecting system standards. The procedure for deciding standards 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). For Guyana this iterative process will focus on setting the DTTB standard. Furthermore the NRT will also consider:

    a. Long term supplies of DTTB receivers. Given the public financial resources available and the ability of viewers to pay, receivers 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 (perhaps after subsidies are cut). In Guyana the DTTB adoption speed might take a shorter time and hence the strategic 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 the case where a conditional access system is stipulated.

    b. **Independent and warranted supplies**. 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. It should be possible to change providers. Changing suppliers is not uncommon in this industry.

6. Deciding the digital dividend (functional building block 2.11). At this phase, it should be decided what digital dividend will become available also for other services than broadcasting services. The digital dividend might be an important element for justifying the introduction of DTTB in Guyana. The introduction of new mobile services might fit in the economic development agenda of Guyana. Guyana supports the allocation of Digital Dividend for mobile services and has updated its Allocation Chart.

7. Determining the first customer proposition. As a result of the DTTB policy document a first outline of the customer proposition can be drafted. This proposition will be at high level and in terms of the policy document.

8. Consultation at a political level. In this step a draft DTTB policy document is offered to politicians to approve. This might include many consultation sessions, extensive lobbying and several revisions. Sufficient time should be planned for these activities. It should be noted that in this setup 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). After any simplification/adjustments, the approved DTTB policy document (including the customer proposition) can then be published in the Official Gazette as a first communication to the general public and television industry.
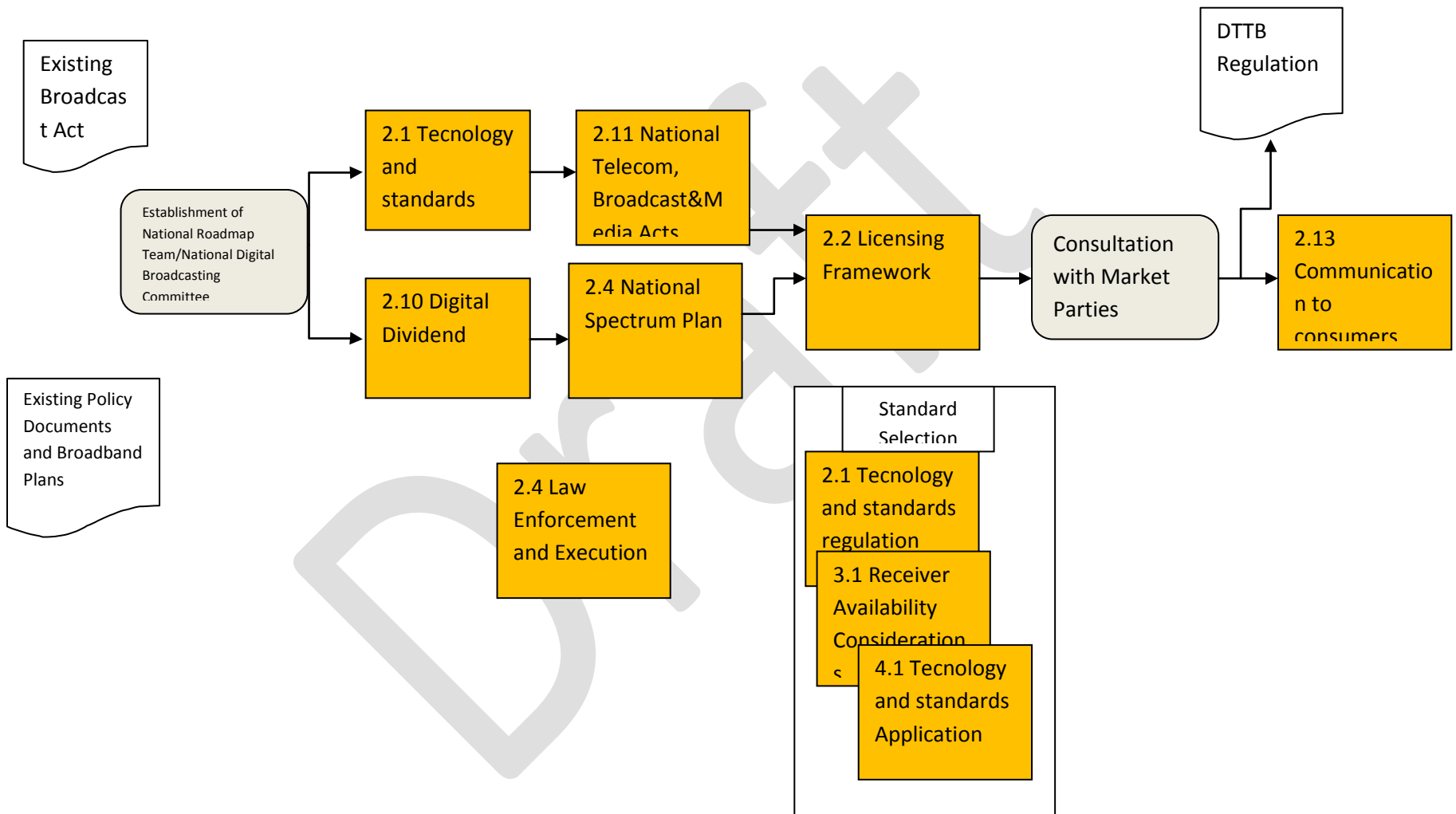
Figure 11 Phase 1 of the roadmap; DTTB/MTV policy development

3.5 PHASE 2: ANALOGUE SWITCHOFF PLANNING

At this point, in Guyana no ASO commission has been defined. In the near future, Guyana should take the decision about the conformation of the ASO commission. In Figure 12, the ITU guidelines blocks involved in the analogue switch off planning are shown.
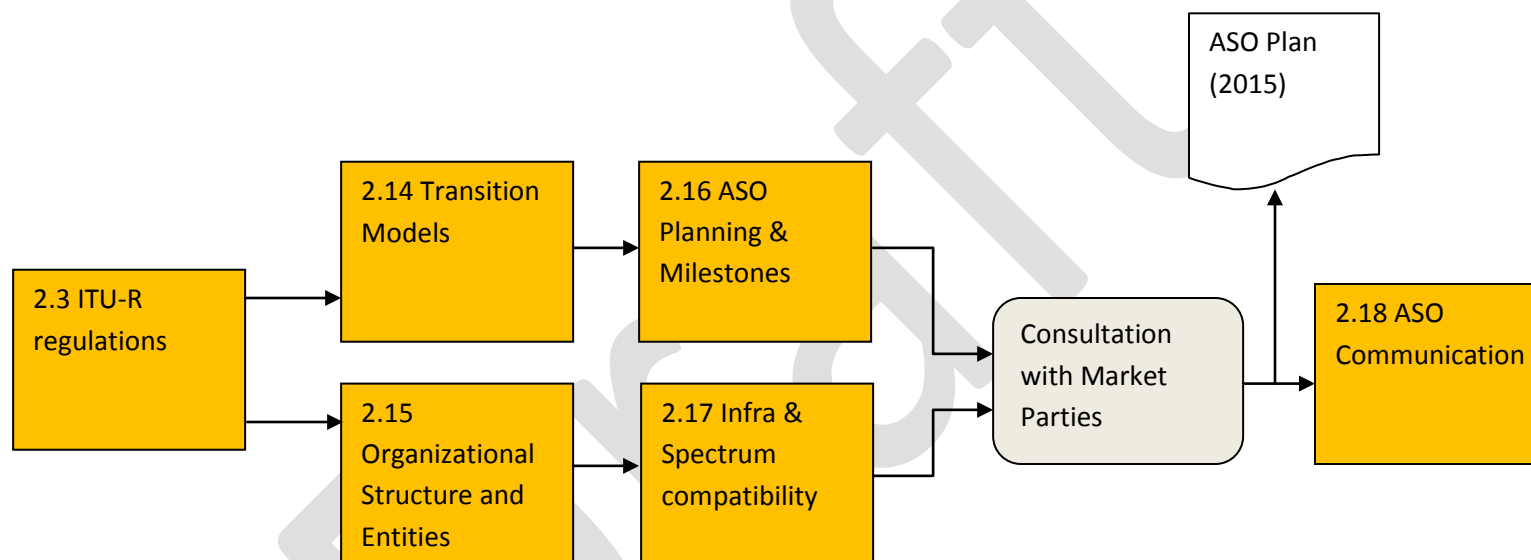

Figure 12 Phase 2 building blocks involved

3.5.1 Input data

The key input for this phase is the (approved) DTTB policy document. As Figure 9 in this report suggests, it might be that the second phase of the roadmap can be initiated before the DTTB policy document has acquired political approval. This will depend for some part on the assessment of any likely changes and the provided mandate to the NRT. Such an early start might entail some later changes in the resulting documents of this ASO planning phase.

3.5.2 Establishment of organizational structures and entities

The first step is to perform the activities relating to functional block 2.15 (Organizational structures and entities) as indicated in Table 10.

Table 10 Activities related to the establishment of organizational structures and entities

2.15 Establishment of organizational structures and entities
1. **Establish overall coordination needs**
2. **Form or extend special purpose vehicle, establish clear mandate**
3. **Establish budget and communication means (air-time, website, etc)**

These activities are followed by the actual ASO planning through the activities related to functional blocks:

• 2.3 ITU-R regulations, as far as appropriate to ASO (see Table 9);
• 2.14 Transition models (see Table 10);
• 2.16 ASO planning and milestones (see Table 11);
• 2.17 Infrastructure and spectrum compatibility (see Table 12).

Table 11 Main activities related to checking of ITU-R regulations 3 Checki

2.3 Checking ITU regulations
1. Determine applicability and implications CITEL recommendations like CCP.II-RADIO/doc. 3157/12, CCP.II-RADIO/doc. 3097/12 and CCP.II-RADIO/doc. 3092/12**on (a) the planned** *national* **DTTB and MTV services and (b) ASO (possibly indicated in the National Spectrum Plan) and (c) the** *operational* **DTTB/MTV, DAB and Analogue TV services.**
2. Determine necessary changes to *planned* **licensing procedures, terms and conditions for DTTB and MTV services and ASO plans**
3. Determine necessary changes to *assigned* **frequency (and possibly content) licences for operational DTTB, MTV, DAB and Analogue TV services.**
4. Determine necessary changes/exemptions to the GE06 Plan
5. Possibly determine necessary budget for compensations and network retuning activities

Table 12 Main activities related to defining transition models

2.14 Defining transition models
1. Check existing Legislation and policies for Public (and commercial) television service (e.g. FTA) and coverage stipulations (e.g. nationwide coverage)
2. Check ITU-R Regulations and any existing/formulated receiver regulations for impact on ASO

3. 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
4. Analyse and assess complexity and size of network modifications and receiver transitions
5. Involve and discuss ASO with Content Aggregators (esp. Public Broadcaster) and consumer Associations
6. Decide transition model (simulcast period and ASO phasing)

Table 13 Main activities related to setting up ASO planning and milestones

2.16 Setting up ASO planning and milestones
1. Draft comprehensive ASO planning (milestones and activities) and assign tasks and responsibilities (including core project management team)
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)

Table 14 Main activities related to identifying infra and spectrum compatibility

2.17 Identifying infrastructure and spectrum compatibility
1. Check Legislation, ITU-R Regulations, National Spectrum Plan and establish service priorities and acceptable interferences levels
2. Assess available antenna space and sites and site/antenna sharing possibilities/options
3. Calculate inference levels, service coverage and check EMC compatibility
4. Develop site transition scenarios (including temporary installations and sites)
5. Assess costs, time lines and service impact

The second phase of the Guyana 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 politicians.

3.5.3   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. During the first ITU expert mission, some discussions have taken place about the frequencies available for DTTB migration in a simulcast scenario. For developing the ASO plan, the functional building blocks included in this second phase of the roadmap will help the NRT in the development of their 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 frequencies 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. To start with, the non-served areas in Guyana will have a different model to the served areas (analogue TV): the non-served areas will have no simulcasting. For the served areas it has been discussed during the first ITU expert mission to have a simulcast period, but no decision is made. In this phase a further decision is needed on the simulcast model (phasing and duration) for the served areas.
- The customer proposition (see functional building block 3.2). Including the details about the services that can be received, under which conditions (i.e. the reception conditions – rooftop/indoor reception) and where;
- The ASO planning (see functional building block 2.16). This planning describes when the customer proposition will be made available and how this proposition will be provided. As indicated in the ITU Guidelines this planning comprises several work streams or result paths, including:
  - regulation and political approval;
  - frequency plan;
  - licensing (further detailed in phase 3 of the roadmap)
  - content production and delivery;
  - interactive service delivery;
  - network roll-out (includes service delivery details);
  - STB (set top box and other receivers) delivery;
  - communications (further detailed in functional building block 2.18 ASO communication);
  - financial and installation support;
  - consumer and market monitoring;
- 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, as indicated in the first meeting, public private partnerships). 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. The (financial) support provided to affected viewers will be an important decision to make.

3.5.4   Roadmap

The roadmap of the ASO planning phase and the associated functional building blocks is shown in Figure 13.
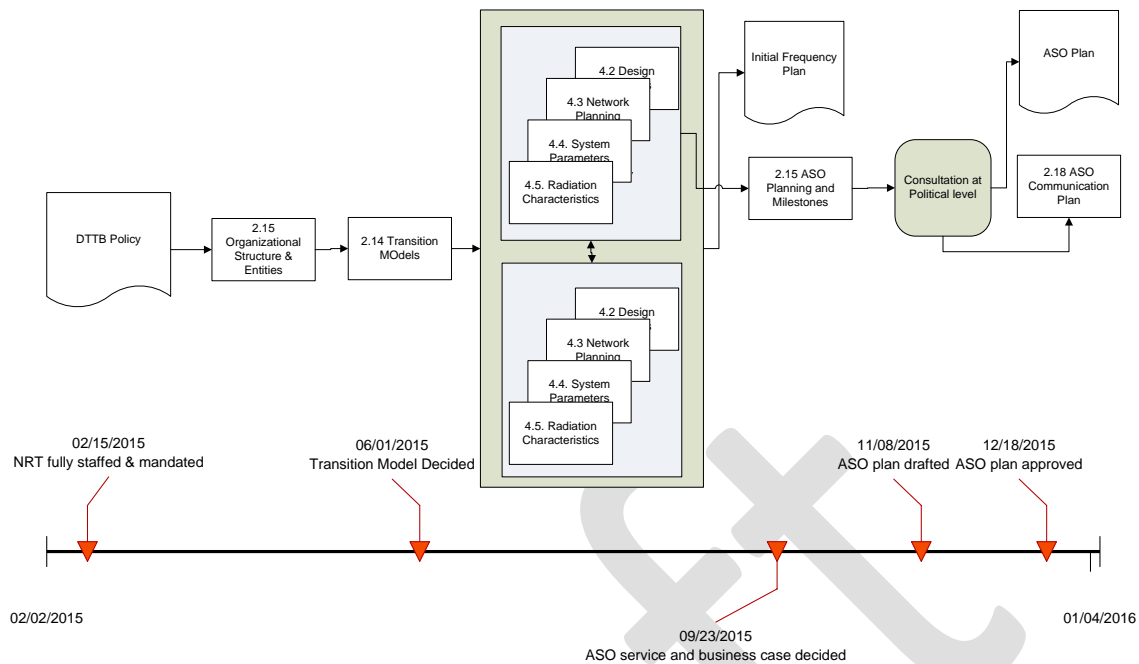
Figure 13 ASO planning phase of the roadmap

As can be observed from the above figure, 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 politically sensitive and needs further approval. In this step the reporting structure and escalation procedures should also be clarified so that the NRT can efficiently operate and manage the ASO process.

2. Determining an initial transition model (see functional building block 2.14). In the first phase of the roadmap a first understanding of the available spectrum was established. In this phase of the roadmap, the NRT should assess what ASO models are possible and if any changes of DSO objectives are needed. This assessment together with the implementation guidelines in the ITU Guidelines (see Subsection 2.14.4) on the ASO model decision, an ASO model can be selected (which will vary for served and non-served areas). More details related to the ASO model for Guyana could be developed during a second visit.

3. Balancing DTTB service planning, customer proposition and financing (functional building blocks 4.2 to 4.5, 3.2, 2.9 and 3.4). This step entails and 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 13 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 are also in turn an iterative process of three functional building blocks 2.9, 3.2. and 3.4);

4. Due to a lack of available spectrum this step may result in a revision of the initially selected transition model;Drafting ASO planning and milestones (see functional building block 2.16).The above mentioned 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 (re)drafted. As mentioned before, in the case where 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 at political level. In this step a draft ASO plan is set out for political endorsement (possibly with several ASO model options). Again this might include many consultation sessions, extensive lobbying and several revisions. Sufficient time should be planned for these activities.

6. Finalization of ASO plan and detailing the ASO communication plan (see functional building block 2.18). After having the ASO plan approved, 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).

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 which depends in its turn 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 a 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).

3.6 PHASE 3: LICENSING POLICY AND REGULATION

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

3.6.1 Inputs

The input data for this phase are the DTTB policy document resulting from the first phase of the roadmap and the ASO Plan resulting from the second phase. As indicated in Figure 9 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 been endorsed. Such an approach might entail some later changes/revisions of the resulting documents.

3.6.2   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 previously this may require bilateral/multilateral coordination. However, these administrative procedures may not have to be part of the critical path of the ASO planning;

• The DTTB license conditions and terms:

– *The spectrum licenses*. The spectrum licenses will have to be assigned according to the decisions taken by the Guyana government. As the ITU guide mentions in section 2.2.1, spectrum license could be assigned to a common multiplex/network operator (the new broadcast transmission operator) or to the broadcasters. To ensure spectrum efficiency and compatibility the spectrum license will have to specify detailed frequency use. As no decision has been taken in Guyana, the NRT will consider the licensing framework suggested in ITU Guidelines as follows:

A licensing framework for *any* television services comprises the assignment of three sets of rights (and obligations). These three types of rights apply to analogue and digital television services. However the distribution of those rights over the various market players might be different for digital platforms. The following types of rights can be distinguished:

Spectrum rights: the right to have access and use a defined part of the radio spectrum in a designated geographical area for a specified time period, which may include obligations such as:
  a. The obligation to provide television services within a certain time frame (roll-out obligations);
  b. The obligation to provide a defined portfolio of television services;
  c. Service level obligations, including aspects like broadcast standards, geographical/population coverage, service/network availability, allocated bandwidth/multiplexes per service, etc.;

Broadcast rights: the right or permission to broadcast television content on a defined broadcast DTTB/MTV platform in a designated geographical area and for a specified time period, very often both at a *programme level* (for specific programmes or services – often referred to as media/broadcast permit or authorization) and a *platform level* (i.e. for a bouquet of channels and services – often referred to as a broadcast license). These rights may also have associated obligations such as:
  a. The obligation to provide a defined portfolio of television services (including 'must carry' and 'price cap' rules);
  b. The obligation to provide Public Service Broadcasting (PSB) services (such as a certain level of local news coverage, arts, religious programming, maximum limits on the number of repeats and to be viewed freely);

c. Service level obligations, including aspects like broadcast standards, geographical/population coverage, service/network availability, allocated bandwidth/multiplexes per service;

Operating rights: the right to erect and operate a broadcasting infrastructure in a defined geographical area, for a specified time period, including aspects such as horizon pollution, environmental and health hazards. These rights can be accompanied by:
a. Site sharing obligations: network operators or infrastructure holders (e.g. tower companies) have to provide antenna space (under certain conditions;
b. Antenna sharing obligations: network operators have to provide access to broadcast antennas (provided this is technically possible).

By having a model that includes the concept of the multiplex operator in the value chain, two basic licensing models can be distinguished for DTTB and MTV services:
1. *Model A*: the spectrum rights are assigned to the multiplex operator *and* this entity can decide the allocation of the available capacity to the various services. In this model the frequency license holder is allowed to use the defined spectrum *and* can decide the loading of the multiplex(es), e.g. which broadcasters can get access to the platform. The function of multiplex operator and service provider can be aggregated into one entity/organization. In turn, this organization can outsource the technical operations to a specialized content distributor (i.e. a broadcast network operator). In this model, it can still be required for the individual broadcaster or service provider to get a general broadcast authorization (e.g. by a media authority) for broadcasting television content (very often not defined for a specific platform). This model was applied in countries like the Netherlands (for DTTB and MTV), Belgium (for DTTB and MTV) and the UK (for DTTB and MTV);
2. *Model B*: the spectrum rights are assigned to the content distributor and this entity *cannot* decide the allocation of the available capacity. In this model the frequency license holder is *only* allowed to use the defined spectrum. The regulator decides the loading of the multiplexes by assigning broadcast licenses/rights for the DTTB/MTV platform to individual broadcasters and/or service providers (bundling the various broadcast channels into one or several packages, in a separate assignment procedure (very often a public tender/beauty parade). In this model the regulator is the actual multiplex operator, or in other words the functional bandwidth manager. In this model the service provider can be a separate entity from the content distributor (i.e. broadcast network operator). This model was applied in countries like Germany (for MTV) and Sweden (for DTTB).

According to discussion had during the Mission to Guyana, at least at the beginning of the DSO, model A was suggested for the Georgetown area. Model A will allow deploying at least three SDTV channels in one carrier, requiring a Multiplex operator. No decision is taken about the Multiplex operator, but during the starting phase of DTTB, this role can be adopted by the regulator or public broadcaster.

3.6.3 Inputs

Licensing policy and regulations developed with the DTTB/MTV regulations and the ASO plan, resulting from phase 1 and phase 2 of the roadmap respectively.

3.6.4   ITU-R regulations

Functional block 2.3 (ITU-R regulations), is addressed with the aim to identifying the frequency assignments or allotments that are available according to ITU-R regulations. For the Guyana case, CITEL recommendations have to be consulted.

3.6.5   Establishment of technical criteria

A series of activities takes place in order to establish the technical criteria of the DTTB /MTV stations.

The activities are described below.

3.6.5.1   Initial network planning

In some countries, some of the technical choices and part of the network planning is done by the regulator. These functions are indicated with dotted lines in the roadmap. The related activities are listed in sections 6.2 and 6.3 of the ITU Guidelines for DTTB and MTV networks, respectively.

Depending on the detail with which the regulator wants to prescribe station characteristics and coverage that should be achieved, the activities related to the functional blocks 4.1 to 4.7 and 5.1 to 5.7 regarding DTTB and MTV respectively, may involve detailed calculations with advanced planning software. This is in particular the case when a certain degree of coverage will be defined in the license. For Guyana case, initial coverage calculations would be made by the regulator (NFMU).

In functional blocks 4.3, as described in the guidelines in chapter 4.3, the results of network planning exercises are compared with the principles defined in step 4.2 (Design principles and network architecture), which in turn is based on business plan and customer proposition. In the case where the regulator is carrying out these activities, instead of business plan and customer proposition, network planning results should be compared with the objectives formulated in DTTB/MTV regulation and ASO plan.

3.6.5.2   Consultation with market parties and international frequency coordination

The activities related to functional blocks 4.1 to 4.7 and 5.1 to 5.7 result in a network plan, of which three versions will be needed:

1. The initial network plan;

2. The national coordinated network plan in which the comments from the market parties are incorporated;

3. The internationally agreed network plan in which the agreements with neighboring countries have been incorporated.

Between the first and second network plan consultation with market parties will take place. The purpose of this consultation is to inform the market parties about the network plan and to receive feedback from the market parties about the practical implementation.

Between the second and the third network plan international frequency coordination will take place. In the case where detailed network planning is carried out by the license holder or network operator, international coordination is done at a later stage at the request of the license holder or network operator.

3.6.6 Establishment of administrative license regulations

In this series of activities the administrative license regulations will be established. These activities are described below.
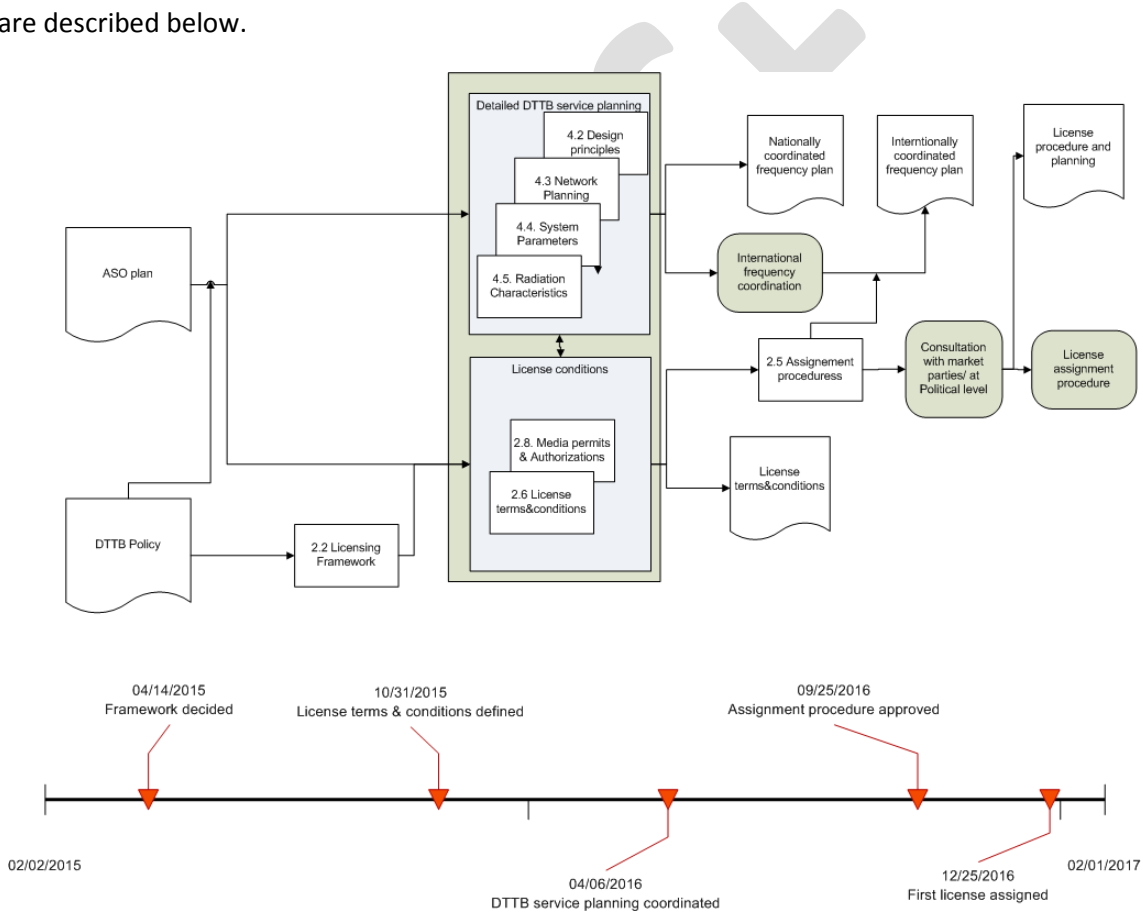

Figure 14 Licensing Policy and regulation phase of the roadmap

3.6.6.1 Licensing framework

First the licensing framework is set up by carrying out the activities related to functional block 2.2, Licensing framework (see Table 15).

Table 15 Main activities related to the setting up of a licensing framework

2.2 Setting up the licensing framework
1. Make inventory of current licensing framework and check applicability for DTTB and MTV service introductions
2. Assess and evaluate different options for licensing DTTB and MTV services
3. Assess compatibility with ASO plans and National Spectrum Plan
4. Possibly revise current licensing framework and assess impact
4. Draft planning for license assignment, framework changes and update National Spectrum Plan (and possibly Legislation)

3.6.6.2   Defining license conditions

With the results of functional block 2.2 and the information on the available assignments or allotments resulting from functional block 2.3 (ITU-R regulations), the license conditions will be defined by carrying out the activities related to functional blocks:
• 2.6 License terms and conditions (see Table 14)
• 2.7 Local permits (see Table 15)
• 2.8 Media permits and authorizations (see Table 16)

Table 16 Main activities related to formulating license terms and conditions

2.6 Formulating license terms and conditions
1. Check relevant paragraphs/ entries in Legislation/Policies, ASO plans, National Spectrum Plan,
2. Analyze market conditions and assess 'level-playing-field' requirements/provisions
3. Determine DTTB/MTV license 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)

Table 17 Main activities related to drafting policies for local permits

2.7 Drafting policies for local permits
1. Check relevant paragraphs/ entries in Legislation/policies and Licensing Framework for DTTB and MTV service introductions
2. Determine and align Building permit policies with intended DTTB/MTV license Terms and Conditions
3. Publish policies for DTTB/MTV planning and building permits (may include waivers)
4. Possibly conduct local hearings and/or expert investigations which may result in changes in permitted spectrum usage/transmitter site parameters (and delays)
5. Monitor actual transmitter site operations and check/test emitted radiation
6. Possibly update National Spectrum Plan

2.8 Drafting of media permits and authorizations
1. Check existing media Legislation, Policies and Licensing Framework
2. Check Technology and Standards Regulation (receiver regulations) and include in media permits policies
3. Determine Media permits/authorizations and procedures and align with DTTB/MTV licence Terms and Conditions and planning
4. Publish policies for media permits and authorizations (may include waivers)

3.6.6.3   Assignment procedures

After having defined the license conditions, the assignment procedures will be formulated by carrying out the activities related to functional block 2.5, Assignment procedures (see Table 19).

Table 19 Main activities related to the formulation of assignment procedures

2.5 Formulation of assignment procedures
1. Consult market (industry players and consumers) on assignment methods and license Terms and Conditions
2. Evaluate results and select assignment method and procedures
3. Draft detailed plans and planning for DTTB and MTV assignment procedures
4. Publish assignment planning and procedures and update National Spectrum Plan (and possibly Legislation)

3.6.7   Determining business models and public financing

The last functional block deals with business models and public financing. The related activities are shown in Table 20.

Table 20 Main activities related to determining business models and public financing

2.9 Determining business models and public financing
1. Check existing media Legislation, policies and Licensing Framework
2. Consult Public Broadcaster(s) on current/future analogue television, DTTB and MTV Transmissions
3. Analyze market situation and assess possible market distortions
4. Define or complete required public service offering on DTTB and MTV platform (if not defined in Legislation yet)
5. Align defined public service offering with other DTTB/MTV license terms and conditions and media permits, and their planning
6. Determine and establish budget for public broadcast service offering and/or subsidizing consumer equipment

3.7 PLANNING AND IMPLEMENTATION DTTB NETWORK

This phase can only commence when the new broadcast transmission operator has been established and preferably a supplier/partner has been contracted for the DTTB network roll-out and service introduction.

The aim of the DTTB implementation phase is to have the DTTB network deployed and all sites in operations and switched-off in accordance with the ASO plan (including the planning and the budget). 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. This 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 rollout. 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.

3.7.1 Inputs

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

3.7.2 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 definite (i.e. when the sites have been equipped and no further changes can occur). This detailed coverage predictions or presentations will feed into work stream communication of the ASO plan. Please refer to Section 5.3 of the ITU Guidelines for more details on service availability checks and tools. In addition coverage presentations may 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 NFMU that stations have been installed. NFMU as the national spectrum manager should be notified by the multiplex/network operator that stations are ready to be taken into operation. In the ASO planning a timely reporting of these notifications to the NFMU should be taken into account as to avoid that this activity will be part of the critical path.
- Notifications to NFMU that an analogue TV transmitter has been switched off by the analogue terrestrial broadcasters. For the purpose of updating its National Frequency Register, NFMU also has to be notified when the analogue transmitter (sites) are taken out of operation.
- Order to put DTTB site into operation. After checking compliancy with the ASO planning the NRT issues an order to the multiplex/network operator to bring the site into operations.

3.7.3 Roadmap

The roadmap of the planning and implementation DTTB network phase and the associated functional building blocks are shown in Figure 15. 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). In Guyana case, most decisions related with this phase have been not taken yet.
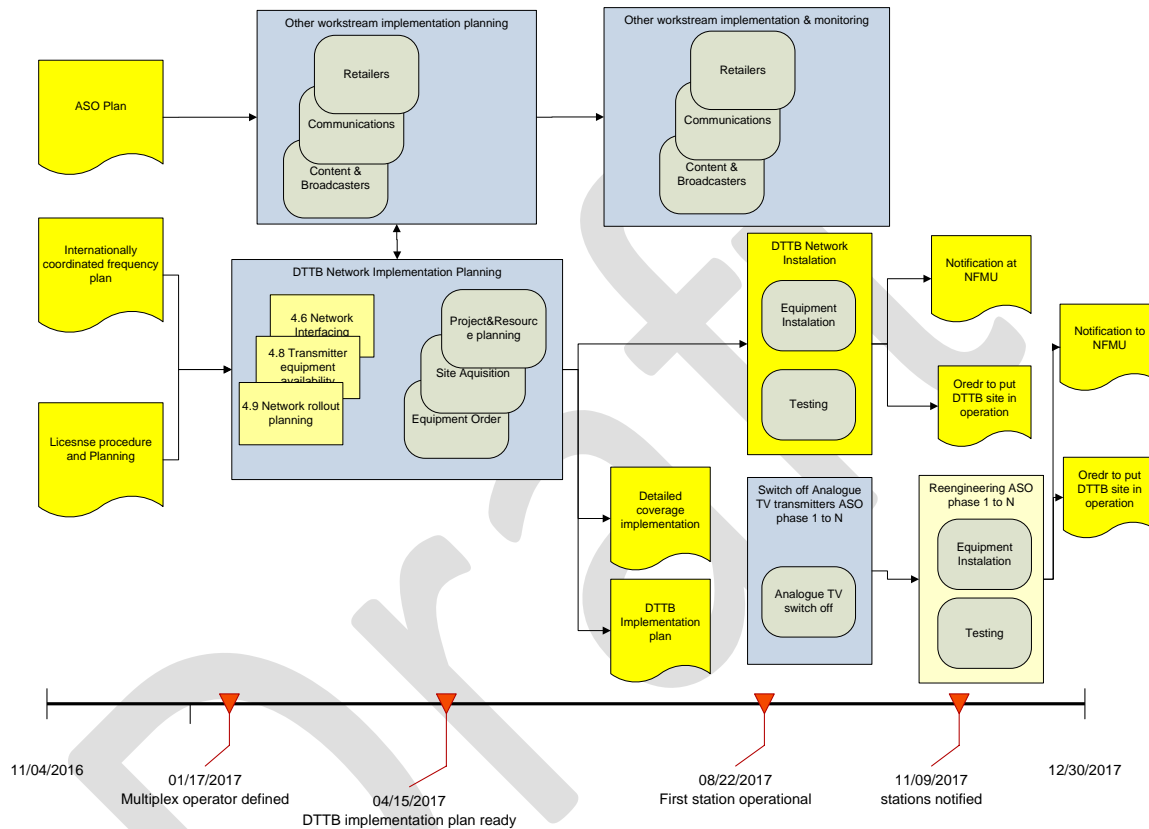

Figure 15 Phase 3 of the roadmap; Implementation

As Figure 15 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 actual 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 present, new sites may have to be acquired for completing the network. This may entail long preparations (e.g. meeting/negotiations with local councils, land owners, public hearings, etc.).

c. Equipment ordering. Network equipment ordering is not an off-the-shelf ordering process.

Manufacturers tend not to keep transmitters in stock. Production times are lengthily (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 Guyana the network equipment ordering might be closely related to the receiver ordering process, because the 6MHz channelization.

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 supplier/manufacturer, this capacity planning will be part of the equipment ordering process. It should also be considered that the new broadcast transmission operator will be just established and possibly not all people and processes will be fully in place and hence capacity might initially be limited. The selected network operator partner could help out here and speed up the network implementation.

3. Switching off stations (by the analogue television broadcasters). 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 NFMU (as they can update their National Frequency 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 logistics and communications

4. Re-engineering DTTB network sites. When analogue sites are switched off, additional spectrum for the DTTB network might become available. Also foreign spectrum usage restrictions might be lifted during the network roll-out. This could entail frequency changes to sites that are already taken into operation. Re-engineering of these sites might be necessary. Special care should be taken to avoid service interruption. For this reason more complex solutions with temporary sites, transmitter/combiners and carousel like planning methods are not uncommon in network implementation planning. The approval procedures for these re-engineered sites are no different to the approval procedure for new sites, as explained above.

3.8   LICENSE ADMINISTRATION

The objective of the license administration phase is to check compliancy with the issued license (to the new broadcast transmission operators), to update the National Frequency Register and to notify ITU of any new DTTB stations put into operation.

The same procedure also applies for changing the station characteristics (e.g. when restrictions on the digital transmissions have been lifted after switching off analogue transmitter stations) and when taking stations out of operation. In the latter situation, no approval will be issued by NFMU.

However, as indicated before, the NRT will have to approve the analogue television transmitter switch-off.

3.8.1 Inputs

The input data for this phase are the notifications of the new operators (the new broadcast transmission operator) at Broadcast Agency.

3.8.2 Outputs

The phase will have two outputs:

- Approval by NFMU of the stations. After having checked whether the transmitter station is compliant with the DTTB spectrum license terms and conditions, NFMU will provide an official approval;
- Recording of the assignment (i.e. station) in the Master International Frequency Register (MIFR). INFMU will notify ITU (i.e. Radiocommunication Bureau) of the new DTTB station taken into operation. The ITU will check the station's conformity and will, after approval, record the station/assignment in the MIFR.

3.8.3 Roadmap

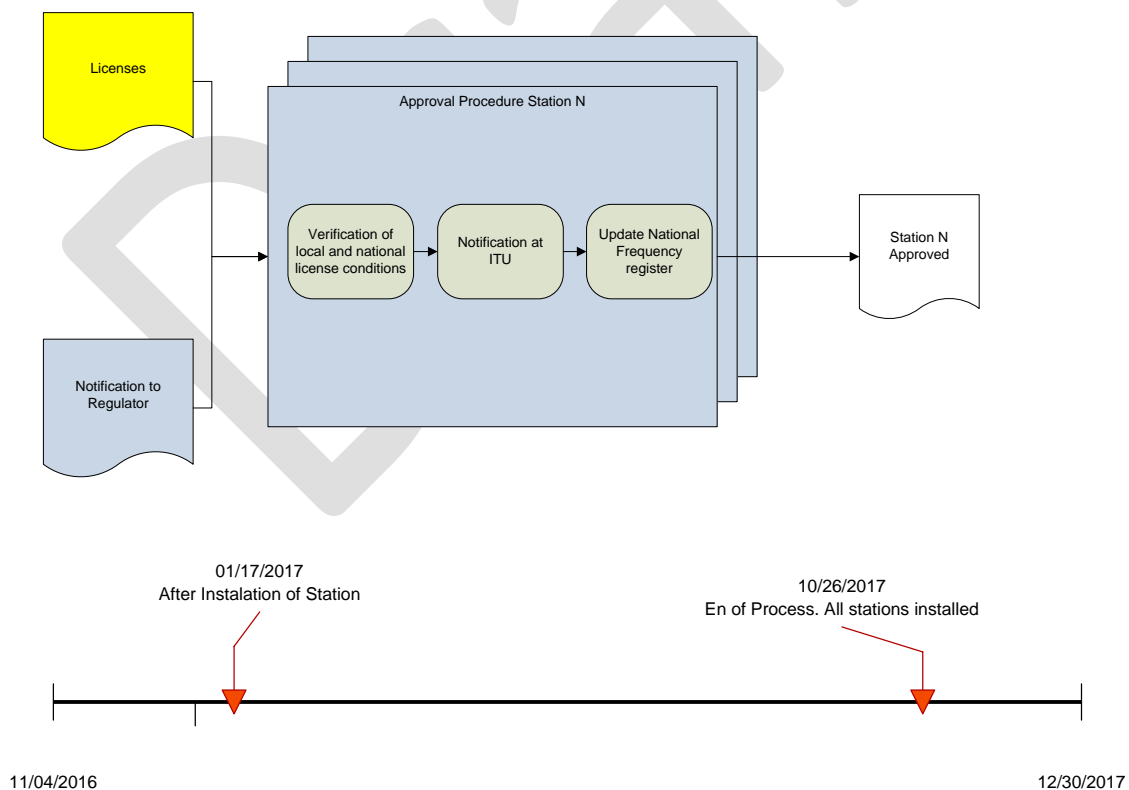The roadmap of the license administration phase and the associated activities is shown in Figure 16.

Figure 16 Phase 4 of the roadmap; license administration

3.8.4 Verification of license conditions

After licenses have been granted and the operator has informed the regulator that a station is in operation, the regulator should verify if the station operates in accordance with the license conditions, including:
• Station characteristics;
• Roll-out obligations;
• Media permits;
• Local permits.

3.8.5 Notification to ITU

Subsequently the station will be notified to ITU, taking into account that ITU-BR will register the provisions given.

3.8.6 Update of national frequency register

The license administration phase ends with the formal approval of the licensed stations and an update of the national frequency register, with the operational characteristics of the station.

3.9 Roadmap for the operator

Chapter 6.2 provides background information and guidelines on key topics and choices regarding the preparation of a roadmap for transition to DTTB by a network operator. The chapter consists of three sections:
6.2.1 Construction of a roadmap;
6.2.2 Generic roadmap for transition to DTTB by a network operator;
6.2.3 Implementation guidelines.

At this point of the evolution of the Guyana roadmap is necessary to decide the DTTB standard, before develop this part of the roadmap, because of the differences and particularities of the different standards available.

As a general comment, the Guyana broadcasters must consider the new business development opportunities the DTTB provides, as High definition, better coverage and image quality, and interactive TV.

4 Roadmap for transition to DTT by broadcasters.

The chapter of the ITU guidelines dealing with market development provides an overview of the key business issues and choices Digital Terrestrial Television Broadcasting (DTTB) Service Providers/Broadcast network operators face when planning the commercial launch of these services. It includes a set of business activities and tools for defining the DTTB/MTV service proposition and associated business case and plan, taking into account identified demand drivers, service barriers, financial feasibility and more specifically receiver availability and customer support issues.

This part of the document is not only intended for *commercial* market parties seeking an acceptable return on their investments, such as DTTB Service Providers and Broadcast network operators. Also Regulators should acquire an understanding of the key business issues and choices at hand so as to define realistic DTTB policies and license conditions. In these guidelines for Guyana, specific activities from the ITU guidelines will be developed.

Commercial parties will seek a DTTB Service Proposition which fulfills a consumer demand, generating sufficient revenues (either advertising of subscription based). In contrast, Public Service Broadcasters (PSB) normally fulfills objectives of public interest in the field of information and culture. That is why they are interested in viewing ratings, high population coverage and mainly prefer unencrypted broadcasting. Market and business development works differently as they have to fulfill primarily these 'information and culture' objectives. However, PSBs can also have advertising-based income and some of the topics addressed in this section might also be relevant for PSBs.

As discussed previously, in Guyana exists two public broadcasters (NCN and Learning Channel) and over 15 commercial broadcasters, concentrated mainly in the Georgetown area, with two commercial broadcasters in New Amsterdam.

In the next part of the document we will revise the blocks related with Market and business development for Guyana, as shown in Figure 1.
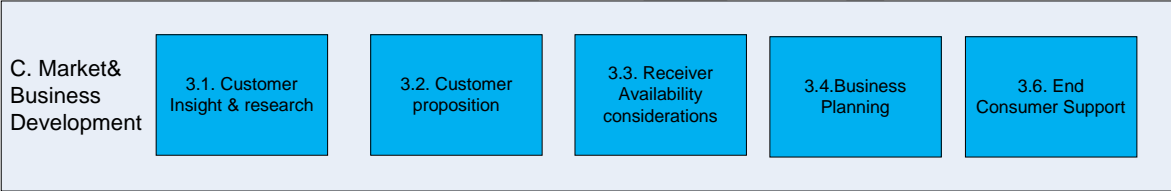
C. Market& Business Development	3.1. Customer Insight & research	3.2. Customer proposition	3.3. Receiver Availability considerations	3.4.Business Planning	3.6. End Consumer Support

Figure 17 Blocks related with DTTB deployment, according to ITU guidelines

4.1 Customer Insight & Research

Launching a commercial 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 market. Service Providers and Network Operators will carry out some form of market research to identify these demand drivers, competitive advantages and service uptake projections.

This section is structured as follows:
1. Overview of the DTTB and MTV markets: market definition, key service and market characteristics;
2. Market research methods: basic market research approaches and embedding market research in the DTTB/MTV business planning process;
3. Implementation guidelines.

4.1.1   Overview of the DTTB market, key service and market characteristics

As mentioned before, Guyana market is highly fragmented and the main market is the city of Georgetown. DTTB services deliver the linear broadcasts onto a *stationary* or *portable* device with, in most cases, no return channel, including Set-Top-Boxes (STB), digital recorders/personal video recorders (e.g. PVRs) or Integrated Digital Television sets (IDTV). Currently, there are a mature market of STB, PVR and iDTV for the different DTV standards.

New technologies for DTTB are available, like UHDTV, or 3DTV for viewing in households or public places. The main target for these new technologies is sports or movies.

In the next table, some specific aspects of the DTTB market are shown.

Market Element	DTTB
Viewing Time	• Prime time: between 19:00 and 23:00 hours • Average viewing duration: >1hr
Target Groups	• Households • Leisure sites (sports clubs, etc.) • Public places (bars, stations, banks)
Receivers and Service Life Cycle	Long (4 years or more) Service provider switching low (5 – 10%)
Window of Opportunity	ASO
Type of Service Offering	Stand alone multi-channel offering
Revenue model	• Advertising based • Subscription based
Competing Platforms	• Satellite multichannel (like DirecTV) • Cable multi-channel • IPTV • Internet, VoD (YouTube,Netflix, Cuevana)
Market Maturity	• Mature • Established value chain • Elaborate Channel Offering • Interactive services available

4.1.2   Market Research Methods

Market research and the resulting customer insights are used for the following key elements:

1. Service Proposition: determining the demand drivers (i.e. customer needs) for the various customer target groups will help determining the willingness-to-pay and which attributes of the Service Proposition have to be included;
2. Business Case: determining the relative value of the included Service Proposition attributes (as compared to the attributes of the competing Service Propositions) will help assessing the DTTB/MTV market share and up-take curve;
3. Network Planning: determining the customer target groups (e.g. where they are located, when and under what conditions they would like to receive the television content) will

help planning the initial DTTB and MTV network (type of required network and roll-out order)

For carrying out market research, elaborate literature and specialized firms can be found. The different market research methodologies are not individually addressed in ITU guidelines. However, a general three-step approach will be presented for:
Step 1. Determining the Service Proposition attributes and willingness-to-pay;
Step 2. Estimating the DTTB/MTV market share;
Step 3. Selecting the DTTB/MTV uptake-curve.

For each step, several research methodologies are suggested. The methodologies can be combined and are not necessary limited to one single step but can also cover all steps in one single market research effort

Step 1. Determining the Service Proposition attributes and willingness-to-pay

For any service launch the Service provider has to determine which service attributes to include in its Service Proposition. These attributes can be categorized as:
1. 'Must haves'/bare minimum: these attributes are necessary for the service to be accepted by the end-consumers/viewers, regardless of price;
2. 'Competitive advantage' or 'unique selling point': these attributes will set aside the DTTB/MTV service from other Service Propositions in the (future) market and preferably they are unique, that is to say that competitors cannot copy these attributes in the near future.

In the table below some examples are provided for DTTB services. The attributes included in the table do not necessarily apply to all DTTB markets and are dependent on the specific customer demands and competitive landscape. For a more elaborate overview of Service Proposition attributes see the next section of this document.

'Must haves'	Competitive advantage
• Number of channels above threshold level (dependent on the competing television offerings)	Exclusive content (for example Cricket rights) or local/regional content[8]
Top-10 most viewed channels	Portability
'Must-carry' channels	Receiver price/one off price
• Pre-paid facilities	

Step 2 Estimating the DTTB/MTV market share

At this stage the DTTB service provider will have to consider the consumer's alternatives. Hence the provider will need to know the competition's current and possibly future offerings. By lining up the available (and future) service offerings and evaluating the value of the included attributes, the potential market share can be estimated. The market research results from Step 1, forms the input for this step.

For estimating the DTTB/MTV market share the following research methodologies are available:

1. *Conjoint or Rank Order & Acceptance (ROA) analysis*: Conjoint analysis requires research participants to make a series of trade-offs, for example by presenting them a series of cards with possible DTTB/MTV service propositions (including the competition's attributes) and asking the participants to rank them in order of preference. The mathematical analysis of these trade-offs will reveal the relative importance of the various attributes. To improve the predictive ability of this analysis, research participants should be grouped into similar target groups or client segments. Further improvement can be obtained by applying a Rank Order & Acceptance analysis, in this method the participants are also asked to indicate which card propositions are not acceptable. In this way, information is also collected on 'must have' attributes. The figure below illustrates a simplified example of a series of cards.

Card 1		Card 2	
1.	A single television package	1.	A-la-cart selection of channels
2.	Of 20 channels	2.	Of 10 channels
3.	No Video-on-demand	3.	Video-on-Demand
4.	Information Channels	4.	Information channels
5.	Simultaneous viewing and recording	5.	Simultaneous viewing and recording
6.	Internet and email on screen	6.	Internet and email on screen
7.	Price: US$50 per month	7.	Price: US$25 per month
Card 3		**Card 4**	
1.	A single television package	8.	A-la-cart selection of channels
2.	Of 50 channels	9.	Of 10 channels
3.	Video-on-demand	10.	Video-on-Demand
4.	Information channels	11.	No Information channels
5.	Simultaneous viewing and recording	12.	No Simultaneous viewing and recording
6.	No Internet and email on screen	13.	Internet and email on screen
7.	Price: US$12 per month	14.	Price: US$45 per month

Figure 18 Example of cards for market study. (taken from ITU guidelines)

2. *Market breakdown and market comparables*: in this approach the potential market for DTTB service is broken down into smaller market segments and for each market segment the potential market share should be estimated. An expert panel could assess the relative strength of DTTB service attributes, as compared to the competition's service attributes, in each segment. Subsequently all the estimations are summed to a grand market total. Such a bottom-up approach could be further improved by checking the grand total with market comparables for the total market (see above). A common model to segment the market is Roger's diffusion of innovation or Product Life Cycle model with the categories of adopters: innovators, early adopters, early majority, late majority, and laggards.

Step 3. Selecting the DTTB uptake curve

In the previous step, the results show an estimate of the potential DTTB/MTV market share. This is the market share at market saturation level. But little information is known about how quickly this potential market share can be obtained and neither is the curve known at this stage.

Assessing the uptake curve is important because DTTB service is capital intensive, requiring relatively large up-front investments. Most uptake curves, especially for innovative products and services, are based on Roger's Product Life Cycle model. When plotted over a length of time the adoption of an innovation follows an S curve. Extensive academic literature can be found on estimating this S curve. It is important to consider that DTTB is deployed in many countries, and some experiences exist.

A pragmatic approach is in essence based on market comparables. What services are similar to the planned DTTB service and what adoption curve can be observed? In the case where good market comparisons are lacking, the remaining uncertainties (speed of adoption and exact curve) can be incorporated in the business case sensitivity analysis.

For Guyana case, the selection of the DTTB standard will help to identify different experiences and adoption timeline in near countries. Most countries in Latin America are in the adoption process, so sharing experiences will be useful for Guyana Broadcasters. Assistance to workshops and seminars about DTTB adoption is useful to broadcasters in this stage of the process.

4.1.3   Implementation guidelines

The following guidance can be provided for customer insight and research:

1. Carry out profound market research, especially in the case where the required funding is largely to be provided by third parties (e.g. banks or private equity funds). In any business case for DTTB services the key value driver is the penetration level of the service.
   External financers will seek evidence for the presented penetration levels. Strategic investors might adopt a different stance (e.g. they might also consider the synergies with their current business lines);
2. Consider market research as part of the business planning process and for planning DTTB services this process will be a highly iterative process. Service Proposition design, Network Planning and Business Case development are strongly interrelated and need to be set-up in a flexible way so that changes can be executed easily;
3. Include competition in any market research. In the long run, competition will be present (even when markets are limited by the number of issued spectrum licenses). Also consider regulatory limitations for example:

   a. Limitations to provide receiver subsidies;
   b. Limitation to freely assemble the channel line up (e.g. due to 'must-carry' obligations);
   c. Limitation to strike exclusive content deals (e.g. in Europe the European Commission issued a list of sport and national events not to be included in pay-tv packages; in Colombia, some football events are free to air and others are available on pay-tv).

4.2 Customer Proposition

In the previous section an outline of the applied market research methods were provided for determining the DTTB Service Proposition attributes. This section focuses on determining the competitive advantage and what the related service attributes could look like, based on previous DTTB service launches around the world.

This section is structured as follows:

1. DTTB competitive advantage and related Service Proposition attributes;
2. Implementation guidelines.

4.2.1.1 DTTB competitive advantage and related Service Proposition attributes

From a commercial perspective, the competitive advantage of a DTTB offering is solely dependent on the competitive landscape of the television market. Hence DTTB launches differ from country to country and are marketed in different ways, emphasizing different competitive advantages.

However, from observations of the various DTTB launches, mainly in Europe, six competitive advantage categories (or marketed reasons for DTTB launch) can be identified:

1. Interactivity/enhanced television services: in markets with only analogue television platforms, DTTB could offer interactive service as a competitive edge (however for a limited duration as all platforms will migrate to digital in the long run). Without any return path, these interactive services are limited to services like the Electronic Program Guide (EPG), additional program information and enhanced teletext. Recent market developments show that (mass produced) receivers come available with return path capabilities, such integrated IPTV/DTTB set-top-boxes. Also television set producers, like Samsung, LG and Sony, launch Internet enabled television sets for browsing and accessing Internet content on the television screen with a normal remote control. This development sometimes comes under the phrase Hybrid Broadband Broadcast (HBB);

2. Additional Pay-TV platform/conditional access and billing facilities: as DTTB platforms can easily be equipped with conditional access and billing facilities, it could provide Service Providers a platform to launch pay-tv services, such as tiered television packages, pay-per view offerings and **pre-paid facilities**. Pay-tv services are often launched on the basis of a multi-channel offering and hence this competitive edge comes very often in combination with a 'additional channels' augment;

3. Addition channels/multi-channel offering: in markets with the analogue terrestrial television platform being the main platform and offering only a limited set of channels (e.g. 2-5 channels), the introduction of a multi-channel DTTB offering could be a key demand driver. It should be noted however that in most countries a multi-channel (paytv) satellite offer is available too and the DTTB platform is faced with limited capacity. A long(er) lasting competitive advantage should really be added to the DTTB platform;

4. Lower costs (one-off and recurring): A DTTB platform could have the advantage of having lower network costs and receiver costs. For example, if the competing platform is digital

satellite, the receiver costs are approximately US$ 180 (ex-factory, including receiver dish and installation). A DTTB receiver costs around US$30 (ex factory, including antenna and excluding installation). Especially these one-off costs could form a major barrier for consumers to adopt digital television. However, following a low cost strategy should be carefully considered as the competitor could have 'deeper pockets';

5. Picture and reception quality: the introduction of DTTB could entail for viewers a significantly better reception and/or picture quality. A DTTB offer in Guyana should include HDTV channels. As addressed in section 4.4 of the ITU guidelines, trade-offs have to be considered between picture quality and reception quality (i.e. robustness of the signal). Notably, the publication of the DVB-T2 standard and the near future version 2 of ATSC standard could entail a significant improvement for facilitating HDTV, 3D-TV and UHDTV channels;

6. Usability/Portability: DTTB services are wireless and can be received on very compact receivers. Hence DTTB services have the competitive advantage of portability, especially when the receiver comes with a small antenna or an integrated antenna. The latter even allows mobile reception as shown in the German market with the launch of mobile phones with integrated DVB-T receivers. None of the regular competing television platforms can offer such functionality. Whether portability forms a demand driver, depends on the local market and should be investigated (like all the other above mentioned categories).

4.3   Receiver Availability considerations

Today many different DTTB and MTV receiver types are commercially available. Also more and more integrated devices, supporting different transmission standards and platforms, are becoming available due to further chipset integration. For example it is not uncommon for MTV receivers to support DVB-T, DVB-H and T-DMB or set-top-boxes having IPTV and DTTB receiver capabilities.

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. At all times 'nice to have' requirements should be avoided as these will come with a price and may negatively affect the business case.

4.3.1   DTTB functional receiver requirements and availability

DTTB Receivers can be divided in the following categories:

1. A STB (Set Top Box) is a receiver which is a separate unit (external) from the TV Set (Display);
2. An iDTV (integrated Digital Television Set) is a receiver which is integrated into the TV Set/Display;
3. A PVR (Personal Video Recorder or digital video recorder) is a separate unit (external) from the TV set (Display) with capabilities to store and playback broadcast services/programs;

4. Other receivers, such as a PC Cards (e.g. PCI), Personal Media Players (PMPs or MP4 players), navigation devices or USB/Firewire external receivers, these products together with the PC can be treated as an iDTV excluding the CA requirements.

4.4   Business Planning

Any DTTB and MTV business planning process will result in a plan for launching or introducing DTTB and MTV services in a defined market, including a set of business goals, the way they can be achieved and the required (financial) means. This DTTB/MTV launch plan is very often a business plan in the case of external funding.

In the DTTB/MTV business planning process three key deliverables or milestones can be identified:

1. Agreement on the *business model* between the involved parties in the value chain. Basically this entails what each involved party will deliver and what the source of income (and the associated costs) will be;
2. Finalized *business case* for each (set of) Service Proposition(s), detailing the associated revenue streams and costs. A business case is very often a spreadsheet model including the profit and loss statement, cash flow statement and balance sheet. In most cases, this spreadsheet model is also used to carry out a financial scenario and sensitivity analysis;
3. Agreement on a final *business plan* between the business plan investors (and possibly management). For a business plan there is no standard format, but normally such a plan includes:
   a. Mission, strategy and objectives statement;
   b. Market and competition analysis;
   c. Service Proposition definitions and market projections
   d. Service Proposition delivery, means and organizational set-up;
   e. Management structure and team;
   f. Financial projections, analysis and funding.

This section will focus on the first two steps for the introduction of DTTB services. This section is structured as follows:
   1. Business models for DTTB services;
   2. Business models for MTV services:
   3. Example business cases;
   4. Implementation guidelines

4.4.1.1   Business models for DTTB services

Considering the DTTB business model the key question for DTTB Service Providers is really whether to launch a multi-channel offering on the basis of a free-to-air (i.e. a business model on the basis of advertising income) or a pay-tv model (i.e. a business model on the basis of subscriptions).

In countries with the analogue terrestrial platform as the main delivery platform (i.e. delivering one to four/five television channels) and with a limited pay-tv offering in the market (i.e. a low penetration level), as is the case in Guyana, the preferred position might be a free-to-air (FTA)

offering. However, whether a FTA or a pay-tv offering can be success depends on various factors, including:

1. For FTA models:
    a. Additional viewers or viewing hours. Any FTA proposition will have to add additional viewers (or viewing hours) not previously addressed by existing platforms. In most cases, in such a FTA model the network transmission costs of the DTTB network have to be financed by the (commercial) Broadcasters on the platform. Adding viewers or viewing hours is not necessarily restricted to unserved viewers (e.g. because the channels are not broadcast on widely distributed networks), but can also be driven by additional (viewing) value for the end consumers. In France for example, new viewers were attracted by offering a multi-channel HDTV offering;
    b. Absolute volume of the advertising market and market share for television advertising. Some markets may have limited advertising budgets, which may not cover the additional cost of setting up and running a DTTB services. Please note that also the advertising budget distribution should be considered. In some markets the advertising spend might be proportionally larger than for other media (e.g. such as radio or newspapers). As advertisers are known to be conservative, changing these spend patterns might be a lengthy process;
2. For pay-tv models:
    a. Other existing pay-tv offerings in the market and their bouquet composition. Existing pay-tv Service Providers might address only the top segment of the market with relatively expensive packages (very often based on exclusive sport rights). There might be room in the market for offering lower-tier packages without exclusive/expensive content. In addition, existing Service Providers might provide a (perceived) bad service, providing a driver for viewers to switch to an alternative television offering;
    b. Existing free-to-air offerings. The potential market share for pay-tv service might be limited by the existence of widely adopted free-to-air offerings (e.g. satellite channels);
    c. Existing television content contracts in the market. Especially exclusive content deals might limit the possibility of creating attractive pay-tv packages. Conversely, the absence of exclusive contracts might create an opportunity;
    d. Willingness to pay for television content. The willingness to pay is very often historically and culturally determined. Pay-tv Service Providers should carefully investigate paying patterns for television services. Many examples exist of viewers refusing to pay for content (e.g. for live sport coverage).

In the figure below a common business model for FTA DTTB is depicted. In this model, the multiplex operation (i.e. the assignment of the available capacity to the different broadcasters) is carried out by a separate entity from the broadcaster. In the model this functionality is part of the network operator's activities (see also section 2.2.1 of ITU guidelines on the value chain and the extra function of the multiplex operator). It should be noted that the function of service provisioning is not included in the figure. Strictly speaking, this function does exist and comprises of platform promotion and providing information on the DTTB service and service activation. Such an entity is very often funded by the broadcasters and network operator. However, there is no service flow through this entity and it is left out for clarity' sake.
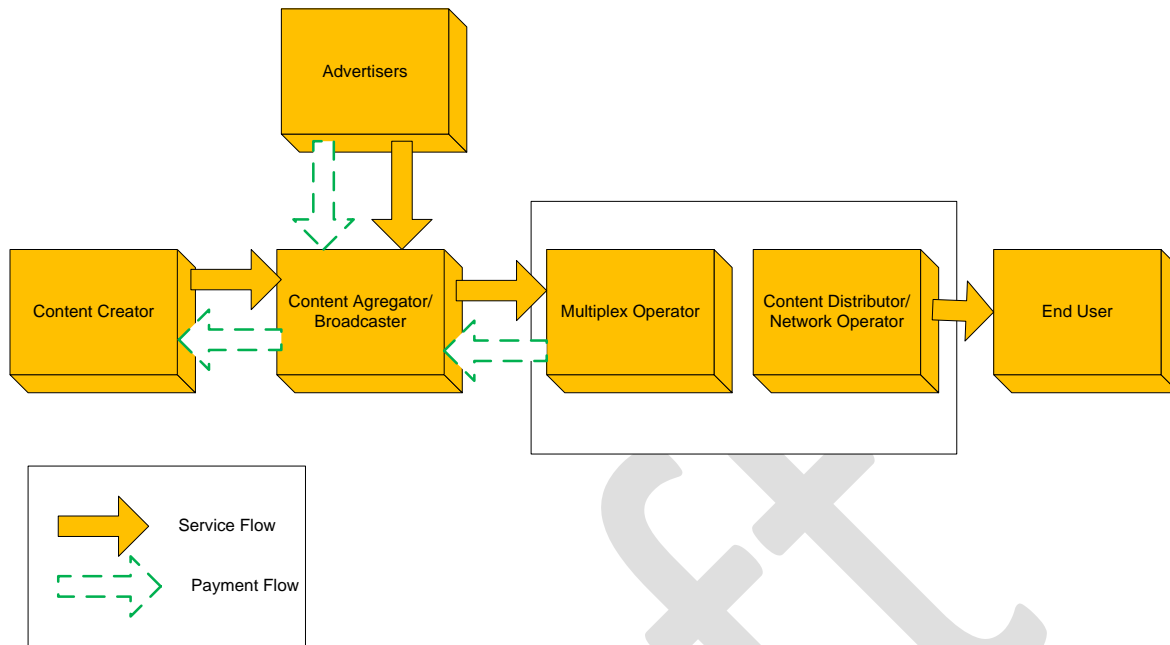
Figure 19 Value chain for DTTB (taken from ITU guidelines)

4.4.1.2 Implementation guidelines

The following guidance on business planning can be provided:

1. Study and understand the implications of the regulatory framework before any business model negotiations are started. The possible DTTB business models are largely determined by the regulatory framework (see section 2.2of these document) and the assignment procedure (see section 3.6.6.3);
2. Consider and evaluate the provided factors for adopting a FTA business model. Although for DTTB services the FTA model seems to be the 'default' model, in some markets the FTA model might not work;
3. Reserve enough time for business model negotiations (or prepare in advance). Given the available regulatory room for negotiations, business model negotiations can be very lengthy.
4. Settle the content rights before launching any service. Also in a FTA model (subscription based) interactive services (like interactive overlays or push VOD) content rights should be carefully settled. It may be that content/rights owners might claim a share of these additional revenues. The same applies to having additional advertising space on the EPG. The commercial broadcasters on the DTTB platform may stop this or claim a revenue share.
5. Not only calculate your own business case (depending on your value chain position), but check whether the additional DTTB costs in the whole value chain can be covered by additional income. In the most favorable situation, where all involved parties can deliver their services against very low or null marginal costs, the DTTB network investments remains the major investment hurdle

4.5   Selection of DTTB transmission standard

Guyana has not decided yet its DTTB standard and this decision should be made during 2014. IN order to illustrate about the available standards, a brief description of the standards will be done. Worldwide, four DTTB standards are in use:

Table XXI Transmission standards overview

Standard	Modulation	Description in Report ITU-R BT.2140-6(2013)	Recommendation ITU-R BT.1306-6	Applicable standards
ATSC Single carrier	8-VSB	Brief: part 1 section 2.6.2.1 Detailed: part 2, section 1.5	System A; annex 1 table 1a	A/52,A/53, A/65, A/153
DTMB (also referred to as ChinaDTV)	Multi carrier OFDM	Brief: part 1, section 2.6.2.2 Detailed: part 2, section 1.9	System D; annex 1 table 1d	GB 20600-2006
DVB-T/T2	Multi carrier OFDM	Brief: part 1, section 2.6.2.4 Detailed: part 2, section 1.6	System B; annex 1 table 1b	EN 300 744 (T) EN 302 755 (T2)
ISDB-T	Multi carrier Segmented OFDM	Brief: part 1, section 2.6.2.5 Detailed: part 2, section 1.8	System C; annex 1 table 1c	ARIB STD-B31 ABNT NBR 15601

A new European standard, DVB-T2, has been specified since 2010. DVB-T2 will give efficiencies of 30% to 50% in its use of spectrum compared to DVB-T and also a better performance with Single Frequency Networks (SFN). Is used in Colombia and probably in Suriname.

The ATSC group is also working in a second version of the standard and there are some draft documents available.

Selection guidelines for ATSC (systems A), DVB-T (system B) and ISDB-T (system C) are described in Recommendation ITU-R BT.1306-6. The guideline for initial selection from this Recommendation has been reproduced in Table II.

Table XXII Guideline for the initial selection

Requirements		Suitable systems
Maximum data rate in a Gaussian channel for a given *C/N* threshold	Required	A or D
	Not required	A, B, C or D
Maximum ruggedness against multipath interference[1]	Required	B, C or D
	Not required	A, B, C or D
Single frequency networks (SFNs)	Required	B, C or D
	Not required	A, B, C or D
Mobile reception[1, 2]	Required	B, C or D
	Not required	A, B, C or D
Simultaneous transmission of different quality levels (hierarchical transmission)	Of primary importance	C
	Required	B or C
	Not required	A, B, C or D
Independent decoding of data sub-blocks (for example, to facilitate sound broadcasting)	Required	C
	Not required	A, B, C or D
Maximum coverage from central transmitter at a given power in a Gaussian environment[3]	Required	A or D
	Not required	A, B, C or D
Maximum ruggedness against impulse interference[4]	Required	A, C or D
	Not required	A, B, C or D

Notes relating to Table II:

[1] Tradable against bandwidth efficiency and other system parameters.

[2] It may not be possible to provide HDTV reception in this mode.

[3] For all systems in situations with coverage holes, gap filler transmitters will be required.

[4] Systems B and C in 8K mode are applied for this comparison.

4.6 Design principles & network architecture

This section provides some background information and guidelines on key topics and choices regarding design principles & network architecture of DTTB networks. The section consists of seven sub-sections:

- Trade-off between network roll-out speed, network costs and network quality;
- Main reception mode and defining receiving installations;
- Services for national, regional, or local coverage;
- Frequency plan and network topology;
- Head- end configuration
- Equipment reserve configurations;
- Type of distribution network.

Development of a broadcast infrastructure with new technologies is a challenging but complex matter. It is essential that technical staff understands not only the main principles regarding network architecture and network planning, but also the impact of technical choices on the

business plan and regulations. In addition to the documents referred to in these guidelines, training sessions and seminars will help in educating staff. In case of limited human resources, external experts may be contracted to assist staff, to perform a number of tasks or to advise the management.

A DTTB network consists basically of one or more head ends, a distribution network and transmitter sites. Block diagrams of a typical DTTB network are shown in Figure 2, Figure 3 and Figure 4. In Figure 2, the analogue TV is introduced in the digital system using a Codec and later inserted in the multiplexer, in order to be distributed using different technologies like cable, satellite and DTTB. In Figure 3, the Electronic Program Guide (EPG) is included in the system.
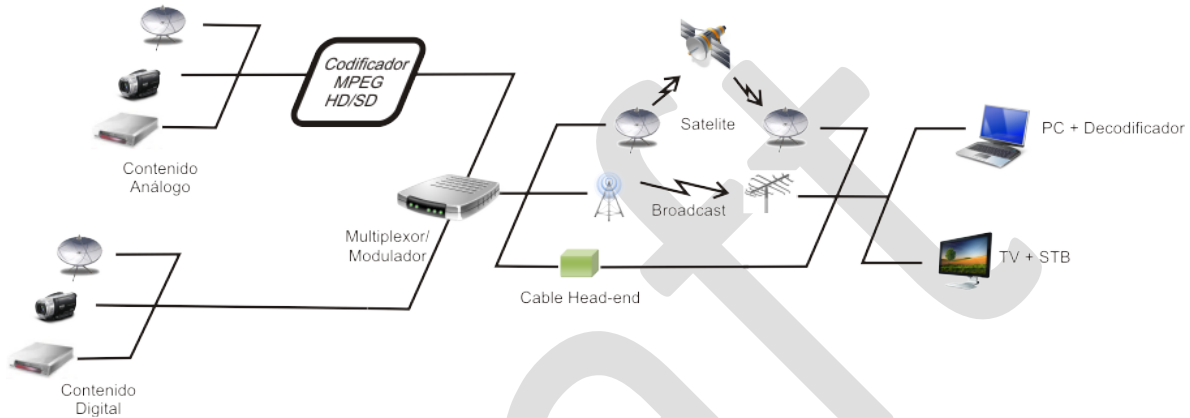
Figure 20 Diagram of a DTTB network with analogue content and different distribution networks.
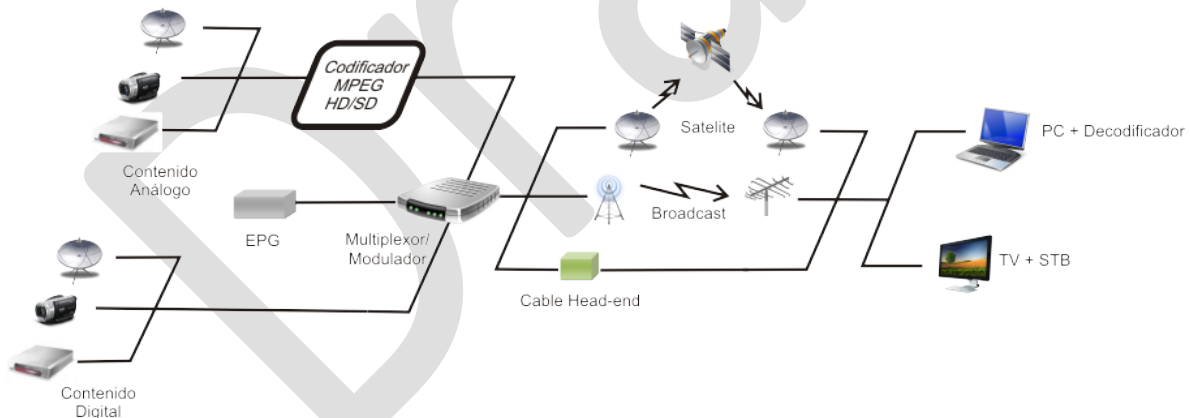
Figure 21 Diagram of a DTTB network with analogue content and EPG
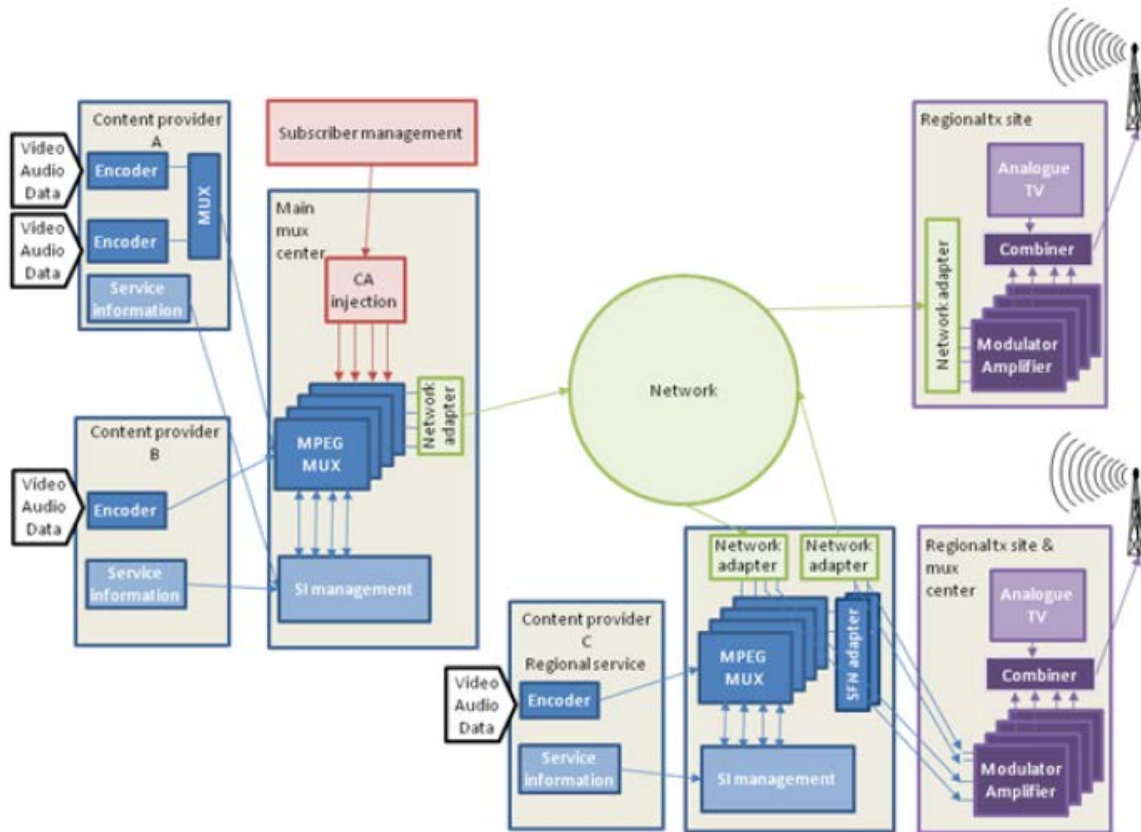
Figure 22 Typical DTTB network layout (taken form ITU guidelines)

4.6.1   Trade-off between network roll-out speed, network costs and network quality

Roll-out speed, networks costs and network quality (expressed in coverage probability, signal availability and number of multiplexes) are interrelated and an optimal balance should be chosen. Many factors could be relevant in the trade-off between roll-out speed, costs and network quality depending on local circumstances.

The balance in this trade-off could be different for various roll-out phases and various areas (e.g. main population centers and rural areas).

4.6.2   Main reception mode and defining receiving installations

Receiving installations consist of a receiver (set top box or integrated digital TV set), antenna cable and antenna. The receiver should be equipped to receive the current transmission standard, compression system and (if needed) conditional access system.

The reception mode for Guyana system will be fixed reception using. Some decision should be taken about the type of fixed reception (indoor or rooftop antenna) during the licensing procedure. Currently, analogue TV system is based on rooftop antenna reception and it is expected that the DTTB system will have a similar reception mode.

For planning a broadcasting service it is important to specify the percentage of locations in a small area (say 100 by 100 m) where reception is possible with a certain receiving installation. All "small areas" where the required percentage of coverage is reached from the coverage area.

When the required signal strength of analogue television is decreased below the required value, the picture is still visible but becomes gradually noisier. For that reason it is common practice to plan analogue TV services with a location probability of 50%. However a characteristic of digital television is the sharp degradation of quality when the signal to noise ratio and signal to interference ratio drop below the required values. To ensure good DTTB coverage quality, a high percentage of receiving locations should obtain satisfactory reception. A typical accepted value used is 95% coverage probability.

4.6.3   Services for national, regional, or local coverage

The wanted service area for a multiplex of services needs to be clearly defined. In general, services could be destined for national coverage, regional or local coverage. If a service contains partly national and regional or local programs, even for a short time (e.g. local news or advertising), the whole multiplex should be considered as regional or local because part of the service-package needs to be remultiplexed in order to insert the regional or local service

4.6.4   Frequency plan and network topology

Analogue TV sites are in general also used for DTTB, for reasons of economy. However, additional stations may be needed in cases where:
- The analogue TV network does not cover the complete wanted coverage area;
- Portable or mobile reception is an important requirement and:
    - because of the high required field strength and regulatory or practical power limitations power distribution, using SFNs, is applied;
    - existing sites, planned for roof top reception, are situated too far from population centers.

On the contrary, experience has shown that, for DTTB, fewer fill-in transmitters are needed than for analogue TV.

Because the main coverage area in Guyana will be Georgetown, most analogue transmitters are located in the urban area and it is expected that this situation remains the same for the DTTB system.

4.6.5   Head- end configuration

The multiplex centre consists generally of interfaces, encoders, statistical multiplexer, monitoring and control equipment and ancillary equipment. In order to achieve a flexible network, a router is installed that can connect each television signal to each encoder input.

Statistical multiplexing is widely used. In a statistical multiplexer bit rate is dynamically allocated to different services depending on the program content. Compared to a constant bit rate per service, it provides a way to increase multiplex capacity while maintaining picture quality.

Statistical multiplexers need to be co-located; regionally inserted programs can, until now, not be statistically multiplexed. For the Guyana case, we are not considering the possibility of regional programs.

4.6.6 Equipment reserve configurations

Service contracts between content distributers and service providers normally contain provisions about the availability of the service. This could be expressed for instance as a percentage of time (measured over a long period) that the service should be on air or a maximum time of interruptions.

The service availability requirements could be variable for different parts of the day or the kind of program. In order to avoid long service interruptions in the case of maintenance or equipment failure, critical parts in the transmission chain should have a certain redundancy, either passive reserve e.g. in n+1 configuration, or active reserve. Passive reserve has the advantage of unrestricted transmission capacity or radiated power in case of failure or maintenance, but is more expensive.

As with analogue TV transmissions, transmitting antennas are often split in two parts. Each part is fed by a separate cable. In case of failure or maintenance one part of the antenna can be switched off while the station is still operational, albeit with reduced radiated power.

Usually a distribution ring is made in order to feed each transmitting site from two sides. In this way it may not be necessary to have passive reserve in the link equipment.

In addition to appropriate reserve equipment, an adequate equipment monitoring system is needed to identity equipment failures and alert maintenance staff. Operational status of equipment should be visible at a central monitoring centre through a few basic indicators (e.g. on/off, failure, prealarm).

The Simple Network Management Protocol (SNMP) is a suitable remote control protocol by means of a web browser.

4.6.7 Type of distribution network

There are several ways to distribute the multiplex signals from the head-end to the transmitters. In general the MPEG TS is distributed to the transmitter sites and to regional re-multiplexing centers in the case of regional services. Alternatively the MPEG TS can be modulated at the head end and distributed to the transmitters via analogue links.

In MFNs it is even possible to use off-air reception, e.g. as back-up link. In SFNs this is not possible because the time needed for the demodulation and modulation process in the transmitter exceeds by far the longest time of the guard interval. However SFN fill-in stations are an attractive solution.

For distribution of the MPEG TS the choice is between: optical fiber, Plesiochronous Digital Hierarchy (PDH) or Synchronous Digital Hierarchy (SDH) networks, Metro Ethernet, Asynchronous Transfer Mode (ATM), Ethernet microwave links and satellite distribution. The choice depends on the local telecommunication infrastructure, operational and technical considerations and costs.

4.6.8   Network Planning and Coverage

In this section we provide some background information and guidelines on key topics and choices regarding network planning for DTTB. For specific information related with planning for specific standards, please refer to planning documents and recommendations provided by the organizations responsible for each standard (DVB or EBU for European, ATSC for American, ABNT for Brazilian) and ITU recommendations.

Network planning is an iterative process between system parameters regarding DTTB and Radiation characteristics, with the aim to achieve optimal coverage, multiplex capacity and radiation characteristics within the limits given by the license conditions and business plan.

After establishment of design principles, system parameters are defined and radiation characteristics specified, followed by network planning.

Depending on the stage of preparations for DTTB introduction and the data that are available, these functions could be done with lesser or greater accuracy. Normally more detailed assessments are made in the project planning phase than in the preparatory phase (before the license has been granted).

It is likely that several iterations need to be done before an optimal balance in the service trade-off between transmission costs, service quality and coverage quality between has been achieved. Network planning results in coverage presentations and the lists of characteristics of each station. A coverage presentation shows coverage probability (in the presence of noise and interference) in the wanted service area, the number of people or household obtaining the required coverage quality, the system variant and bit rate of the multiplex.

A large part of the network costs is related to the number of sites and investments in transmitters and antennas. It is therefore important to carefully investigate the station characteristics and optimize coverage. With network planning, coverage problems can be identified at an early stage and solutions can be sought before the network is implemented. Furthermore, network planning can be an efficient tool for consumer marketing.

The net bit rate of the multiplex and the number of services in the multiplex determine the bit rate per service and consequently picture and sound quality. Multiplex capacity depends on the compression system, the transmission standard, encoder quality and the choice of system variant (carrier modulation, code rate and guard interval). In a DTTB system, coverage is associated with the desired or required bit rate, according to the service. HDTV will require larger bit rate than SDTV and sport channels will require also larger bit rate than new channels. Typically, the trade-off between bit rate and coverage means to sacrifice coverage to obtain a higher bit rate, or use more power in the transmitter.

In some DTTB standards, the concept of Fill-in transmitters is used. Fill-in transmitters, also referred to as gapfillers, are often used for coverage of small areas with poor reception from a main transmitter, without the need of use a main transmitter and at lower cost.

The radiated power of a fill-in transmitter is low and often fill-ins have a directional antenna diagram.

Consequently a fill-in transmitter has limited interference potential to other TV coverage areas. For this reason and because the coverage area of a fill-in transmitter is in general shielded from other transmitters, frequency reuse distances can be relatively small.

For coverage estimation, many planning tools are available that can be used to obtain coverage plots and coverage probability. As important as the software tool, a good digital terrain map (DTM) is required. For initial coverage estimation, some free DTM can be used, like the USGS terrain information. For more precise coverage estimations, especially in urban areas, DTM with at least 5m resolution is recommended.

Another important factor to consider is the propagation model used for coverage estimations. ITU recommendations include some propagation models. Also, each software tool uses different propagation model, which can be used according to the DTTB standard or the type or terrain. In Figure 2 we show a coverage calculation map using a propagation model commonly used for DTTB systems and which includes diffraction effects. In Figure 3, results of a drive test process for coverage verification is shown. In order to calibrate the propagation models to specific terrain conditions (like forest or humidity in Guyana case), it is useful to make coverage verification using drive test tools, also available from many providers in the market, for the different available DTTB standards.
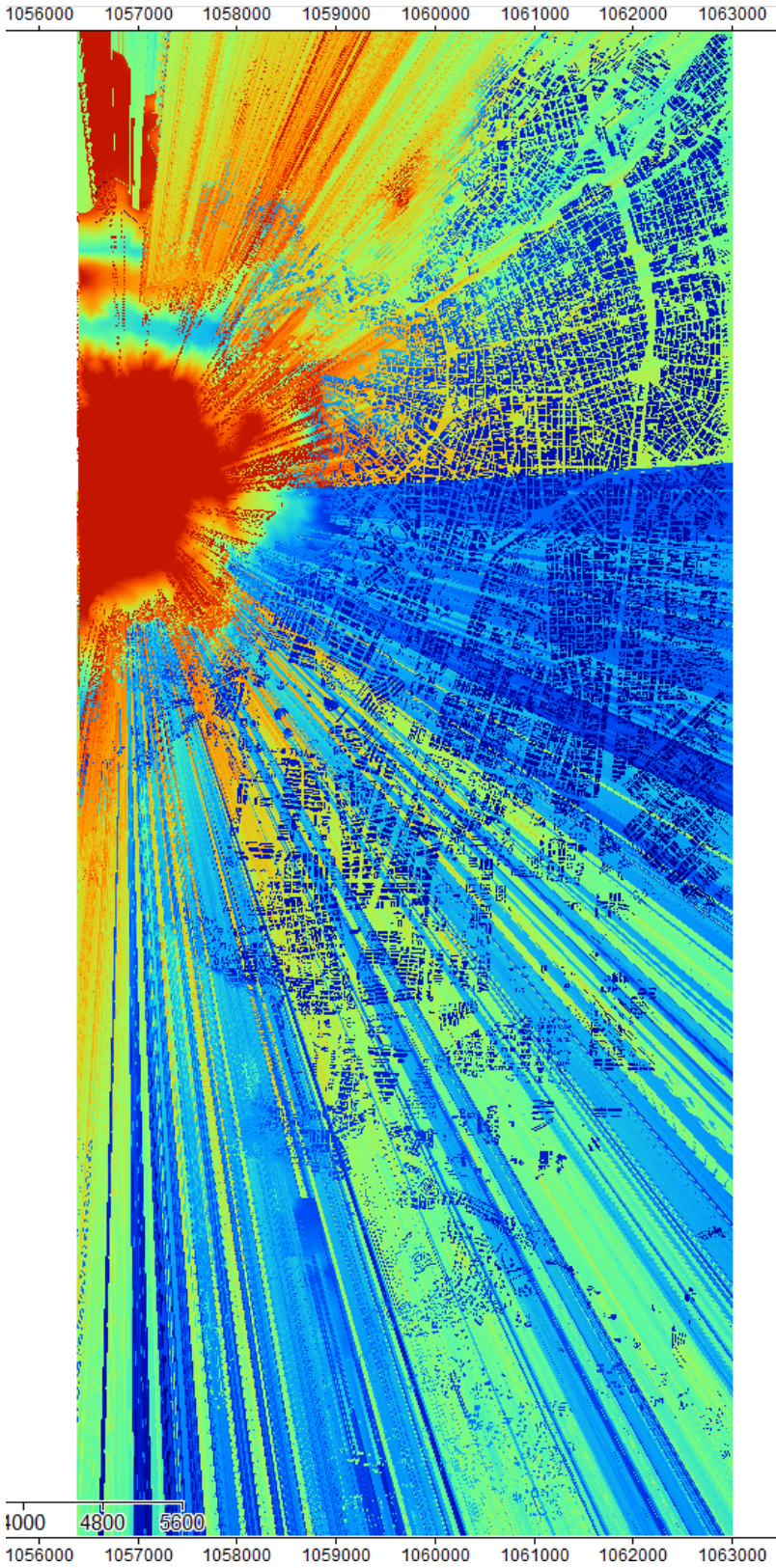
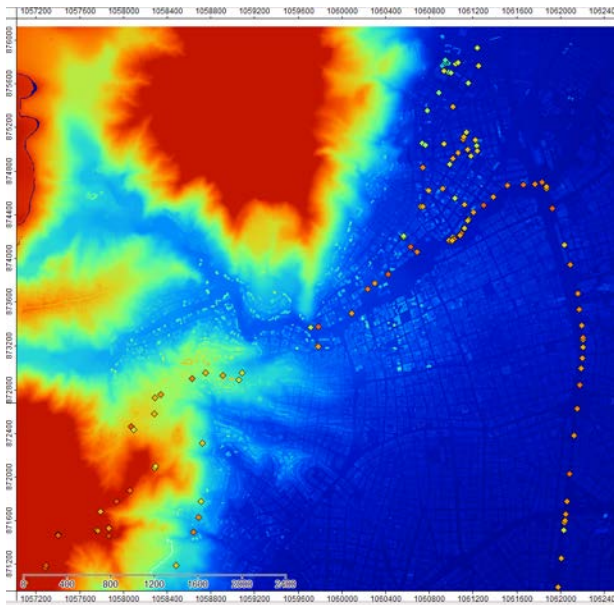Figure 23 Coverage estimation showing signal level

Figure 24 Drivetest for coverage verification in DTTB system

In Figure 4, a coverage probability map is shown. In this map, the blue/purple color shows zones with 95% coverage for indoor receivers, and in light blue, the zone with 70% coverage probability for fixed users is shown.

As part of the planning process and coverage estimation, the operator needs to design the radiation characteristic of the antenna system. Because typically the antennas used for TV systems are based on arrays based on dipole or panels, it is necessary to have a tool to obtain the array pattern for different configurations. In Figure 5, the 3D pattern of the antenna array used for example is shown and in Figure 6, the panel configuration used is shown. In this case, we have used a two faces antenna system with 4 panels per face. This example was developed in the city of Cali with the transmitter intended to coverage the urban area of Cali and near towns.

Test equipment for coverage verification must be aquired to verify the by the regulator, in order to verify the license comply. This must be accompanied by an extensive training process both in planning procedures and use of planning tools by the NFMU staff.
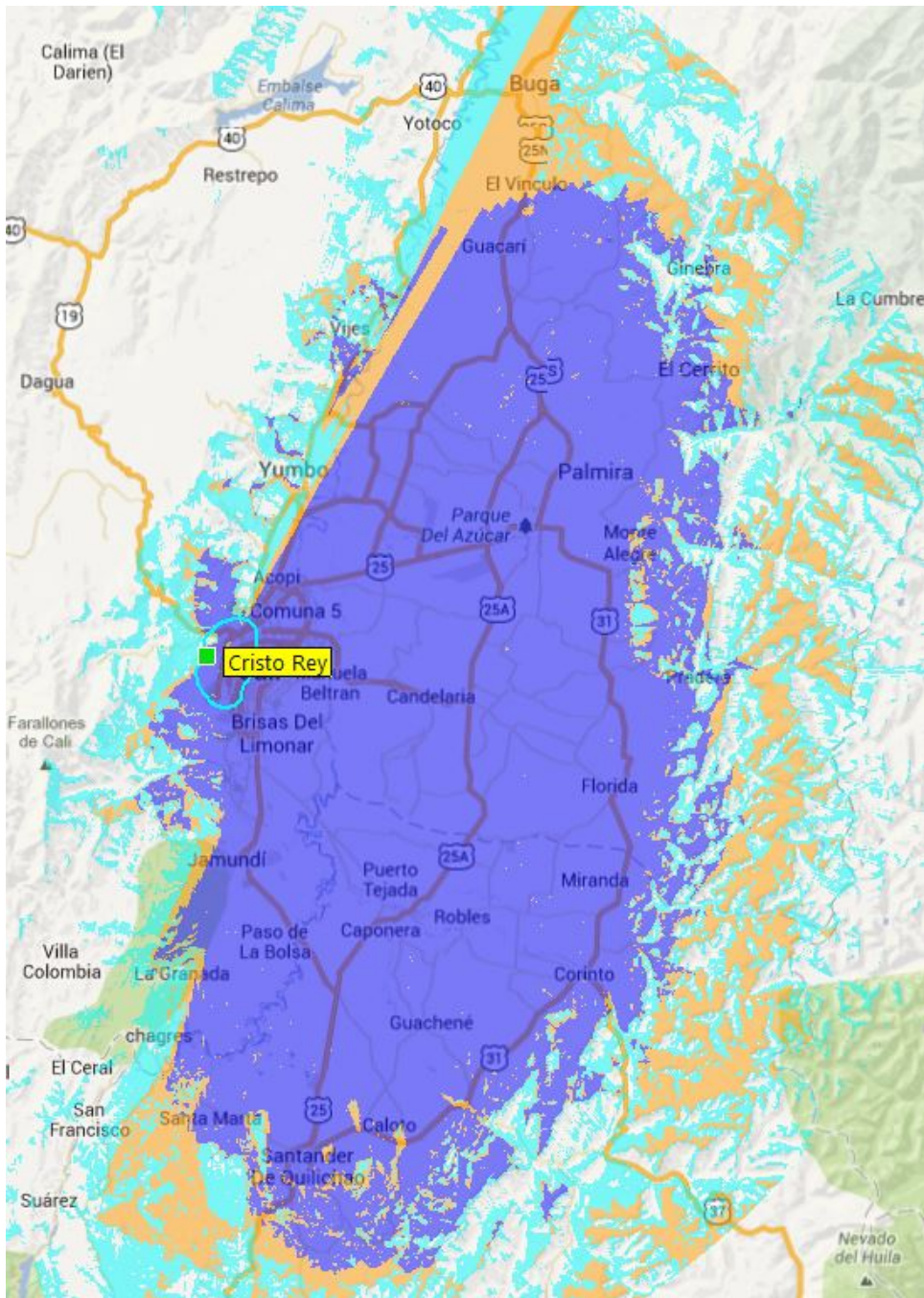
Figure 25 Coverage probability map (in spanish)

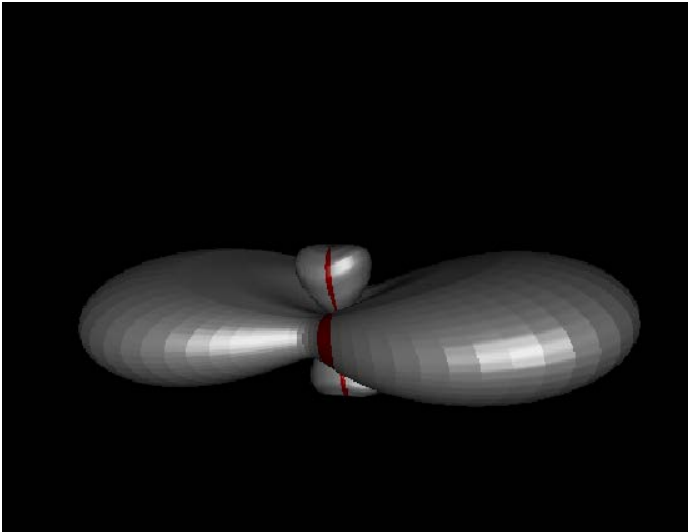| 70% Fixed coverage | |
| 70% Indoor coverage | |
| 95% Indoor coverage | |

Figure 26 3D antenna pattern for the array used for examples
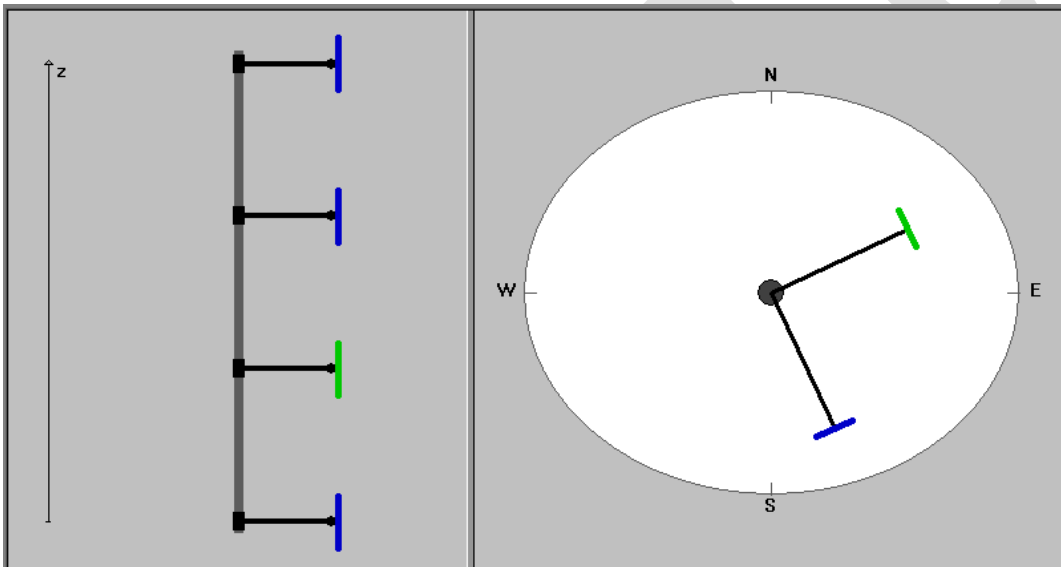

Figure 27 Array configuration for examples shown (4 panels per face, 2 faces)

4.7 Roadmap for Guyana Broadcasters

Chapter 6.2 of the ITU guidelines provides background information and guidelines on key topics and choices regarding the preparation of a roadmap for transition to DTTB by a network operator. In this section we will develop the roadmap for transition to DTTB by a network operator, oriented to Guyana broadcasters.

The section is divided as follows:

- Construction of a roadmap;
- Guyana roadmap for transition to DTTB by a network operator;
- Implementation guidelines.

4.7.1 Construction of a roadmap

The roadmap for transition to DTTB by a network operator consists of four phases:

1. Preparation

The preparatory phase starts when the Regulator is preparing the licensing policy and regulation (See phase 1, 2 and 3 of the Regulator's roadmap in section 3.4). The aim of the preparations is to apply successfully for a DTTB license. At this point, operators in Guyana should be aware of the beginning of the transition process. Part of this communication process was developed with the meeting carried out during the second visit of the ITU expert.

2. Planning

The planning phase starts at the date of issue of the license and ends with the adoption of the network implementation plan. This plan describes station characteristics and a time schedule for implementation. At this stage, it is important that Guyana broadcasters begin with some market studies and analyze different technical options as High Definition or the new technologies like UHD or 3D-TV. As part of the communication and awareness program, the government can coordinate with the broadcasters the organization of workshops with experts and to travel to TV events like NAB show or IBC.

3. Implementation

The implementation phase is the follow-up of the planning phase and ends when all DTTB transmitters are operational.

4. Analogue TV switch-off

The time schedule of the analogue switch-off phase is given by the ASO plan of the Regulator. Engineering work on DTTB sites is likely to continue after analogue switch-off.

In each phase a number of functional blocks (see Figure 7.) have to be addressed.

Guidelines regarding key topics and choices of these functional blocks are described in the corresponding sections of this document and in the ITU guidelines.

For each of the functional blocks, the main activities for carrying out the function have to be identified together with the entity that is responsible for the activities. These main activities may be supplemented by main activities that are not specific for DTTB, but are nevertheless needed for a successful transition to DTTB. Examples of such non-specific DTTB activities are:

- Service provisioning and contracting content providers;
- Project and resource planning
- Site acquisition;
- Equipment installation.

The roadmap is constructed by placing the relevant functional blocks in each phase in a logical order and in a time frame. It is important that the order of activities in each phase by the different players, including the Regulator, fits with each other. Hence for determining the order of the functional blocks, information exchange and negotiations between market parties and the Regulator is essential.

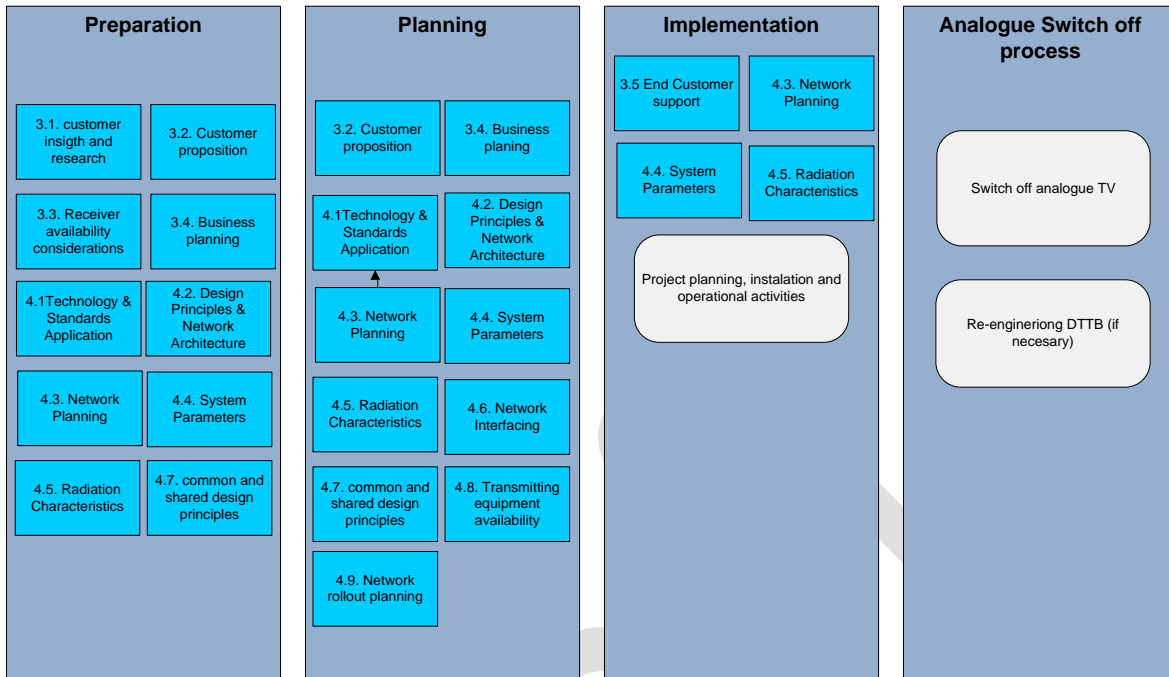A graphical illustration of the process described above is shown in Figure 28.

Figure 28 Functional blocks connected with the four phases of the network operator roadmap

It should be noted that Figure 2 represents a generic case. We have selected all the blocks for Guyana and leave the broadcasters select the blocks they prefer.

Phases 1, 2 and 3 are carried out sequentially and phase 4 is carried out partly in parallel to phase 3 with regular checks to verify if the results of these parts are still in line. The sequence of the four parts of the roadmap is illustrated in Figure 3.
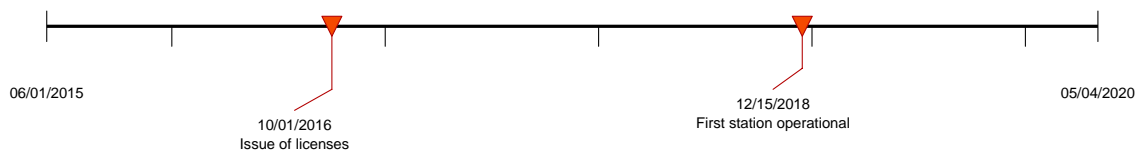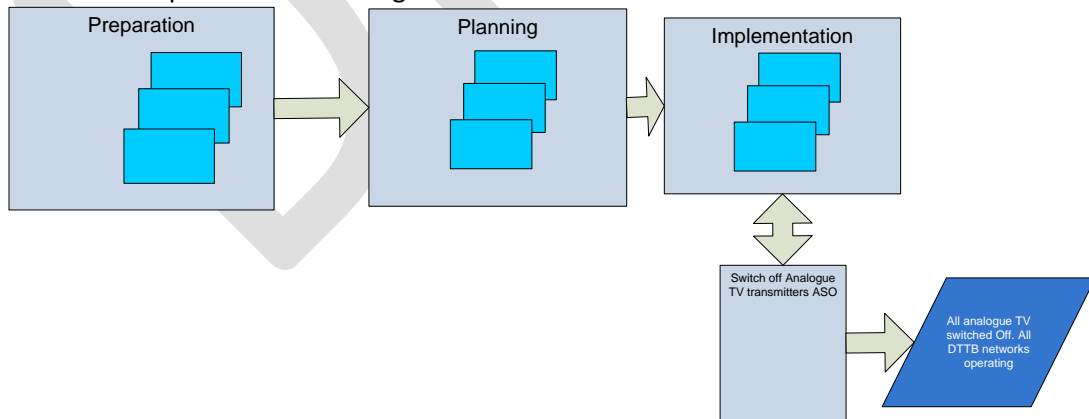
Figure 29 Interrelation between the four phases of the roadmap

The process ends when all analogue TV is switched-off and all DTTB stations are in operation without any restrictions that were necessary to protect analogue TV. However, further evolution of the network is likely to take place resulting from the introduction of new services, regulatory obligations or technology changes.

4.8   Roadmap for transition to DTTB by a network operator

In the roadmap shown in this section, the following assumptions have been made:

1. No existing DTTB services;
2. One or at most two DTTB network operators, acting as multiplex operator, service provider and content distributor;
3. Multiplexes contain also the TV services that are transmitted via analogue TV networks;
4. DTTB network operator is also responsible for the analogue TV transmissions.

When multiplex operator, service provider, content distributor and analogue TV operator are different organizations, the order of the functions will not be different. However the interfaces between the respective parts of transmission chain need to be clearly defined and service agreements should cover a smooth hand-over of responsibilities. For Guyana case, at least the multiplex operator and the TV operator are different entities; however, service provider and content distributor can be the same as TV operator. This issue has to be discussed in the process of definition of licensing rules and procedures.

The roadmap described in this section is for the case where the operator takes the technical decisions and performs the network planning, as is the case in Guyana. However, in this process, the regulator could support the broadcasters. In some countries, the Regulator has a broader role than in others. In the case where some of the technical choices e.g. standard and system choices or (part of) network planning is a responsibility of the Regulator, the roadmap is not basically different.

The network operator will still make his own assessments about service quality, coverage quality and radiation characteristics. Normally the network operator wishes to make these assessments with higher accuracy and in more detail than the Regulator.

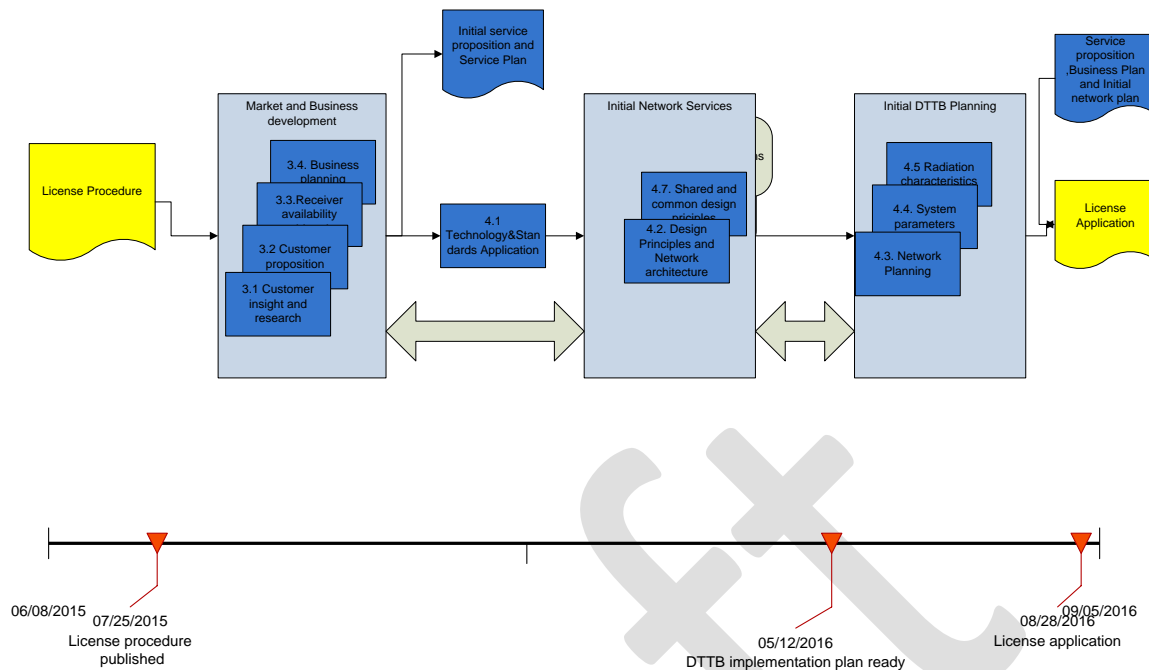The four phases of the roadmap are described below.

Figure 30 Operator's Phase 1

4.8.1.1   Input data

In the roadmap shown above, the preparatory phase starts when the license procedure has been published. This is the latest moment for the start, and it is strongly recommended to begin as soon as possible with the market research and customer proposition.

A start during first three phases of the Regulator's roadmap (see section 3) has the advantage that well informed reactions can be given to proposals from government or Regulator in consultation with market parties during:

1. DTTB/MTV policy development;
2. Analogue switch-off planning;
3. Licensing policy and regulation.

For Guyana, the recommendation is that the first phase of the operator's roadmap begins at the same time as the regulator's roadmap. Some meetings have been accomplished with broadcasters inviting them to follow the transition process.

4.8.1.2   Market and business development

In the preparatory phase, the network operator will first address market and business development by carrying out the activities related to functional blocks:

- Customer insight & research (see Table I below);
- Customer proposition (see Table II below);
- Receiver availability considerations (see Table III below);
- Business planning.

Table XXIII Activities related with market research

3.1 Investigation of customer insight and carrying out market research
1. Determine need, timing and scope for market research
2. Analyze competitive offerings, substitutes and technology developments, like UHDTV
3. Design and develop preliminary DTTB service propositions, based on HDTV for example
4. Draft market research plan, staff and budget market research project
5. Carry out market research and analyze results, translate into DTTB service Propositions.

Table XXIV Activities related with customer proposition

3.2 Defining customer proposition
1. Analyze earlier DTTB service launches in Latin America and compare with customer research results/local market conditions
2. Define DTTB service propositions and check feasibility/cost levels with key suppliers, i.e. Distributor (broadcast network operator) and Content Aggregators, Content Creators
3. Possibly redefine DTTB service propositions and test in market again, i.e. additional market research

Table XXV Activities related with receiver availability

3.3 Carrying out receiver availability considerations
1. Analyze earlier DTTB and MTV service launches, assess local substitutes and technology Developments
2. Check any prescribed Technologies & Standards, Receiver regulations and analyze market research results
3. Assess and make inventory of availability and roadmaps of various receiver types/attributes
4. Check network compatibility and interoperability (radio interfaces and API/applications)
5. Assess and detail ex-factory and retail pricing for various receivers
6. Decide key receivers and their attributes, draft receiver/service roadmap

4.8.2   Technology and standards application and initial network principles

After the initial customer proposition and business plan have been approved, the activities related to the following functional block are carried out:

4.1 Technology & standards application (see Table IV below);

4.2 Design principles & network architecture (see Table V below);

 4.7 Shared & common design principles (see Table VI below).

Table XXVI Activities related with technology and standards

4.1 Technology and standards application
1. Describing tests
2. Evaluation of SDTV and HDTV specifications (including sound channels) and estimation of required bit rate

3. Evaluation of standards characteristics, business plan and receiver Availability. Revise CITEL recommendations.
4. Evaluation of characteristics of compression systems (MPEG-4 and HVC)
5. Evaluation of conditional access systems
6. Evaluation of additional systems, like interactivity with HbbTV (including access systems if needed) and estimation of required bit rate

Table XXVII Activities related with design principles

4.2 Developing design principles and network architecture
1. Education and training of technical staff
2. Evaluation of roll-out options
3. Evaluation of type of distribution network
4. Evaluation of network topology
5. Drafting multiplex composition plan
6. Establishing frequency plan per multiplex/network
7. Drafting transmitting station lay out

Table XXVIII Activities related to deciding shared and common design principles

4.7 Deciding shared and common design principles
1. Investigate national regulations regarding site sharing
2. Determine in principle shared use of DTTB networks and which elements (sites, antennas, multiplex)
3. Determine in principle on common design and planning of DTTB networks
4. Prepare site sharing agreements, if needed

4.8.2.1   Initial DTTB service planning

In the next series of activities an initial DTTB network plan is developed, which includes several iterative steps and possibly a review of the service proposition and business plan, technology choices and network principles .

For drafting the initial network plan the activities related to the following functional blocks are carried out:

- Network planning (see Table 6.2.8 below);
- System parameters (see Table 6.2.9 below);
- Radiation characteristics (see Table 6.2.10 below);

Table XXIX Activities related to performing network planning

4.3 Performing network planning
1. Specification of station characteristics
2. Coverage analysis
3. SFN or MFN optimization, if apply according to standard selected

4. Performing interference analysis and check border coordination agreements
5. Gap-filler planning, if required
6. Proposing modifications to multiplex composition, network architecture or business plan (as far as necessary)

Table XXX Activities related to determining system parameters

4.4 Determining system parameters
1. Evaluation of FFT size or modulation, according to the standard decided
2. Evaluation of carrier modulation
3. Evaluation of code rate
4. Evaluation of guard interval, if apply according to the standard

Table XXXI Activities related to assessing radiation characteristics

4.5 Assessing radiation characteristics
1. Evaluation of transmitter power, antenna gain and polarization
2. Evaluation and optimizing antenna diagram
3. Calculation of antenna power budget

In the preparatory phase not all station characteristics are known in detail, nor is it necessary to achieve a detailed initial network plan. The purpose is:

• To verify business plan and customer proposition;

• To be able to react to proposals from government or Regulator in consultation with market parties (see phase 1, 2 and 3 of the Regulator's flowchart), in the case where the preparatory phase has been started before the license procedure has been published;

• To have sufficient information for a successful license application.

The preparatory phase ends with a set of documents describing the service proposition, business plan and an initial network plan. This should be finalized in time for the license application.
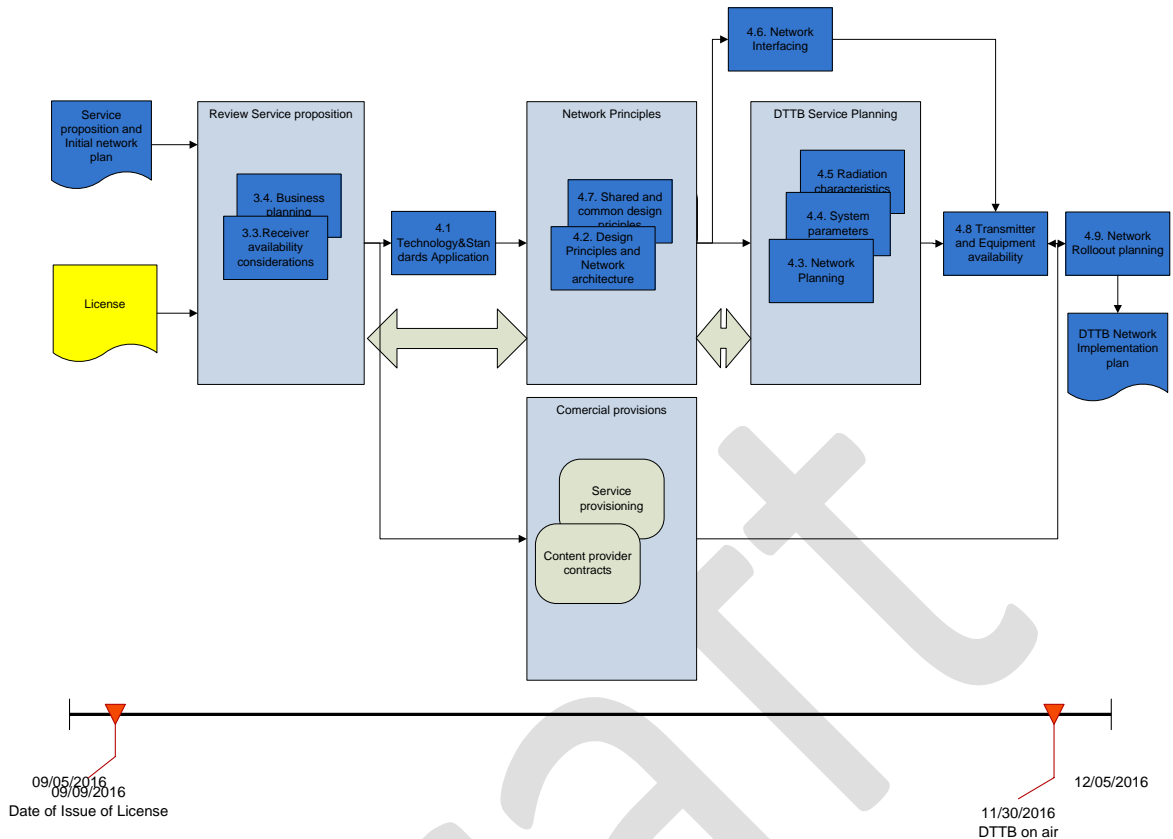
4.8.2.2   Planning

Figure 31 Phase 2 of the roadmap: Planning

4.8.2.3   Input data

The planning phase starts when the license has been issued. License conditions and the service proposition, business plan and initial network plan, resulting from phase 1, are the input data for phase 2.

4.8.2.4   Review service proposition

Depending on the license conditions, customer proposition and business plan (functional block 3.2 and 3.4 respectively) may need to be reviewed, by carrying out appropriate activities from Table II.

4.8.2.5   Commercial provisions

After review of customer proposition and business plan, the network operator will start the following commercial activities:

- Service provisioning;
- Contracting content providers.

4.8.2.6   Technology and standards application and initial network principles

In parallel with the commercial activities, the initial technical choices will be reviewed and defined in more detail by carrying out appropriate activities related to functional blocks:

- Technology & standards application (see Table IV)
- Design principles & network architecture (see Table V)
- Shared & common design principles (Table VI)

4.8.2.7   DTTB service planning

Following the review of technical choices the DTTB service planning will be reviewed and defined in more detail by carrying out the activities related to functional blocks:

- Network planning (see Table VII);
- System parameters (see Table VIII);
- Radiation characteristics (see Table IX).

As in the preparatory phase, this includes several iterative steps and possibly a review of the service proposition.

4.8.2.8   Network interfacing

In parallel to service planning, the activities related to functional block 4.6 (Network interfacing) will be carried out (see Table X below)

Table XXXII Activities related to specifying network interfaces

4.6 Specifying network interfaces
1. Drafting interface specifications between studio and multiplex head end
2. Drafting interface specifications between network monitoring system and transmitting equipment
3. Describing the radio interface

4.8.2.9   Transmitting equipment availability

When the optimum network plan has been achieved and network interfaces have been specified, transmitting equipment availability will be considered and network roll out be planned by carrying out the activities related to functional blocks:
- 4.8 Transmitting equipment availability (see Table 6.2.12 below);
- 4.9 Network roll out planning (see Table 6.2.13 below).

Table XXXIII Activities related to considering equipment availability

4.8 Considering equipment availability
1. Carrying out market research
2. Drafting transmitter specifications
3. Drafting antenna specifications
4. Drafting distribution link specifications
5. Drafting multiplex head end specification
6. Equipment testing

Table XXXIV Activities related to planning network roll out

4.9 Network roll out planning

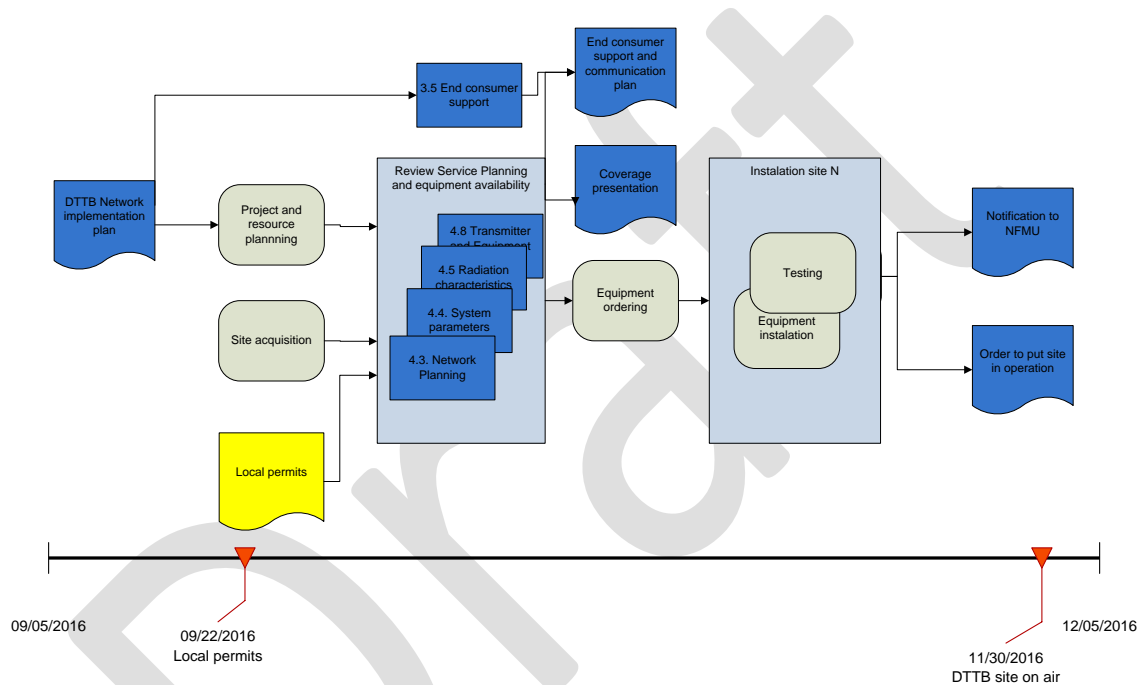|	
1. **Describing pilot tests**	
2. **Roll out planning (e.g. main cities, provincial cities, rural areas), before and after ASO**	
3. **Agreement with receiver manufacturers to deliver receivers in sufficient quantities, in time**	
4. **Coverage assessment at each stage of implementation**	
5. **Setting up communication plan and related provisions (e.g. helpdesk, website)**	

4.8.3   Implementation

Figure 32 Phase 3 of the roadmap: Implementation

4.8.3.1   Input data

The implementation phase of the DTTB network starts when the network implementation plan, resulting from phase 2 of the roadmap has been adopted. A number of DTTB stations contained in this plan probably have temporal restrictions, necessary to protect analogue TV during transition.

4.8.3.2   Project- and resource planning and site acquisition

On the basis of the DTTB network implementation plan, project and resources planning and site acquisition will start and local building and planning permits need to be acquired.

4.8.3.3   Review of service planning and transmission equipment availability

In carrying out the above mentioned activities, modifications to the network implementation plan may have to be accepted. For instance site acquisition may not be successful; or a new site may be realized at a different location than assumed in the DTTB network implementation plan. It may also happen that in the detailed project planning antenna heights or diagrams are specified differently than originally assumed. In such cases, service planning and equipment availability

needs to be reviewed by carrying out the appropriate activities relating to the following functional blocks:

4.3 Network planning (see Table XXIX);
4.4 System parameters (see Table XXX);
4.5 Radiation characteristics (see Table XXXI)
4.8 Transmitting equipment availability (see Table XXXIII)

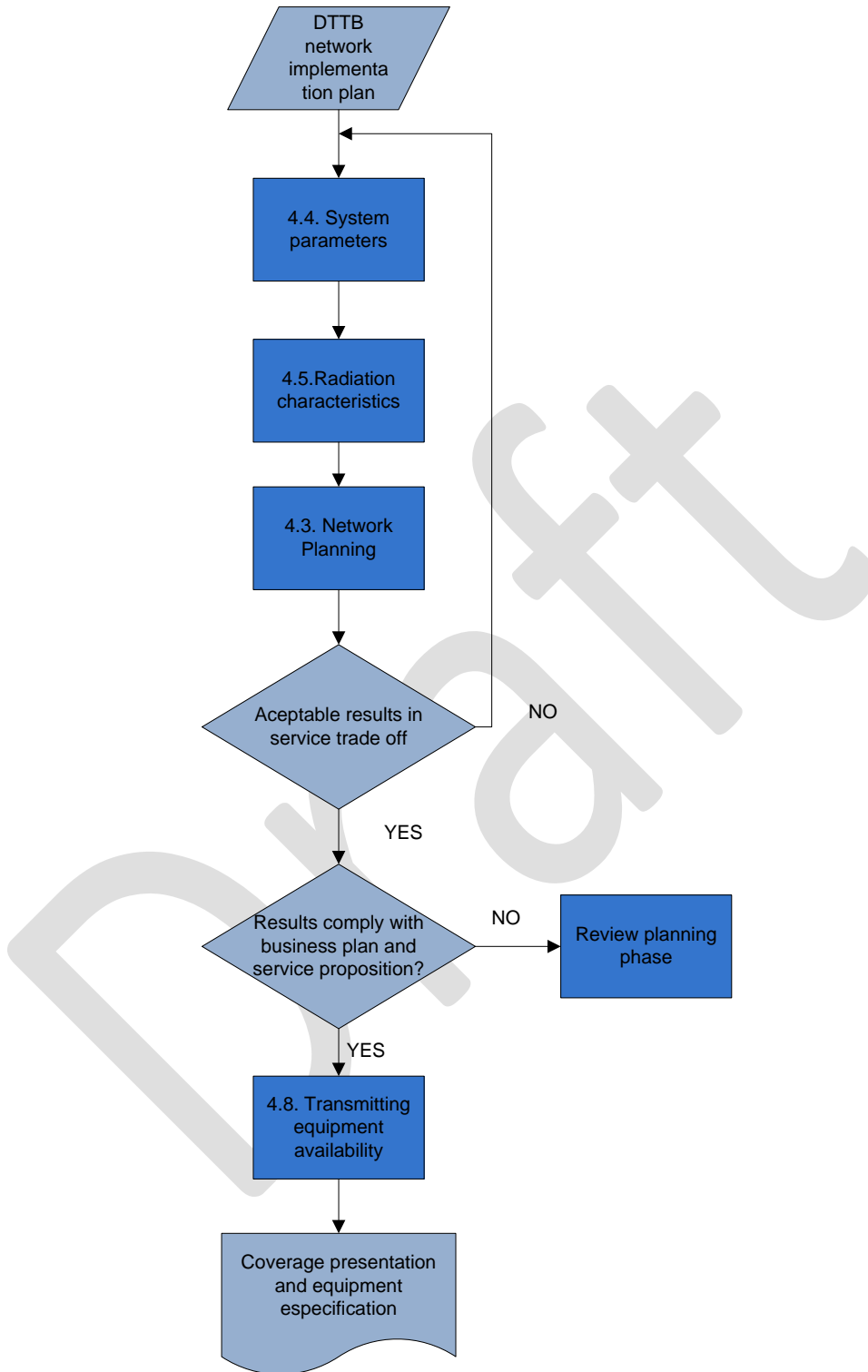This includes several iterative steps as shown in Figure 17.

Figure 33 Flow chart for defining service planning and equipment availability

If the results of the review of the service planning do not comply anymore with the customer proposition or business plan, the planning phase should be reviewed.

When the optimum set of station characteristics has been obtained, the equipment specifications will be reviewed and detailed coverage presentations will be made. The latter will be used for communication to public and content providers to show reception possibilities in the various implementation stages.

4.8.3.4 Equipment ordering

On the basis of the equipment specifications, equipment tender procedures will be initiated. After comparing several offers, suppliers will be selected and equipment ordered.

4.8.3.5 Consumer support

Before a site is brought into use, the end-consumers in the related coverage area should be informed about the new digital services and the necessary receiving equipment by addressing functional block 3.5 (End consumer support).

4.8.3.6 Installation

When the equipment has been delivered, installation of transmitting equipment starts, followed by site acceptance tests.

During the installation stage it could happen that, for unexpected reasons, stations cannot be installed as planned. In that case, the DTTB implementation plan may need to be reviewed in order to provide information on the consequences of the changes and to prepare amended coverage presentations.

The installation work should be planned in such a way that the transmitters can be put into operation at the agreed date, taking into account that some sites may be inaccessible during certain periods of the year.

When installation of a station has been completed, the Regulator will be notified that the station will be put into operation in accordance with the license terms and conditions.
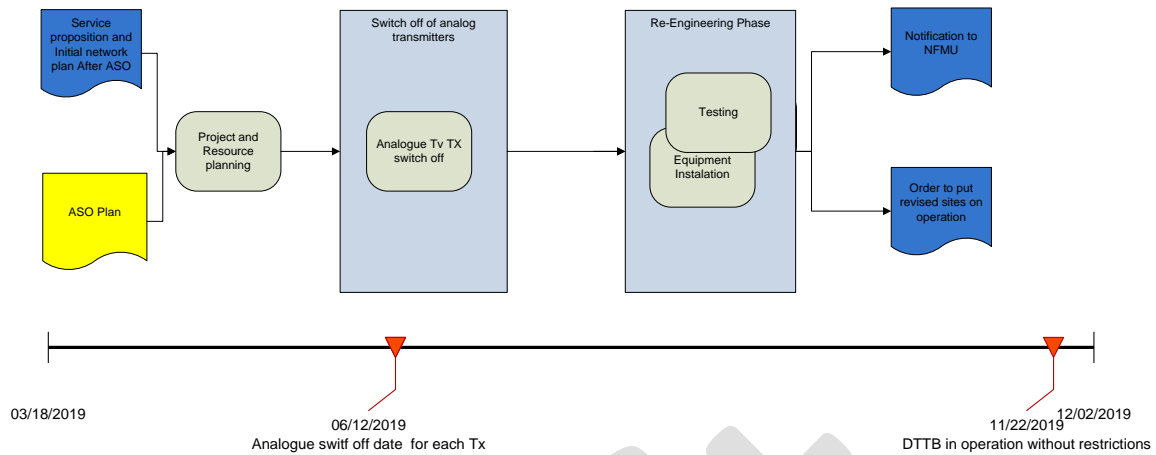
4.8.4 Analogue switch-off

Figure 34 Phase 4 of the Roadmap. ASO

4.8.4.1 Input data

The analogue switch-off phase starts during the transition period in accordance with the ASO planning and milestones documents. The DTTB station characteristics during and after simulcasting are contained in the DTTB network implementation plan resulting from phase 2 of the roadmap.

4.8.4.2 Project and resource planning and analogue switch-off

Switching-off analogue TV transmitters will be carried out in accordance with the ASO planning provided by the Regulator.

4.8.4.3 Re-engineering

After switch-off, re-engineering of the sites begins, if necesary. These activities may consist of three parts:

- Removal of superfluous analogue TV equipment;

- Modification of radiation characteristics in order to remove restrictions that were needed to protect analogue TV;

- Installation of additional DTTB transmitters that are licensed after analogue switch-off. Normally it is required to carry out these activities with minimal interruptions of the DTTB services. For the case of Guyana, it is probable that no new transmitters will be needed, except for those broadcasters which want to increase their coverage and market.

When the re-engineering work has been completed, the Regulator will be notified that the station has been modified in accordance with the license terms and condition specified for the situation after analogue switch-off.

4.8.5   Implementation guideline

Each player in the value chain should select for each of the four phases of DTTB network operator's roadmap:

- the functional building blocks that are within the operational responsibility of the organization;
- the functional building blocks that are within the operational responsibility of other players of the value chain in order determine where interfaces and service agreements are needed;
- the functional building blocks, within the responsibility of government and/or Regulator, that are inputs to a).

Furthermore, it has to be estimated to what extent key topics and choices of the selected building blocks have to be considered and the activities that have to be carried out, taking into account:

- The status of implementation of the Regulator's roadmap;
- Market situation, including already licensed DTTB transmissions and competing offers by satellite, cable or IPTV;
- Existing transmitter network infrastructure;
- Responsibilities of Regulator and license holder regarding technology choices and network planning.

A realistic time schedule for the whole process needs to be established, taking into account that a number of mile stones in the process is not or not entirely in the control of the network operator such as:

- Publication of the license procedure, describing the way licenses are assigned and may include applicable standards and site sharing regulations;
- Issue of the license, with terms and conditions prescribing, among others, service roll out obligations and permitted frequency use;
- Analogue switch-off planning and mile stones prescribing start of simulcast and analogue switch-off dates;
- Building and planning permits from local authorities for setting up new sites or changing existing sites;
- Permission of property owners to use property for setting up new sites or changing existing sites;
- Equipment delivery times;
- Installation periods, seasonal weather conditions may restrict access to some sites.

The starting point should preferably be in an early stage of implementation of the Regulator's roadmap in order to be able to react to proposals from government or Regulator in consultation with market parties. Latest moment for start is when the license procedure has been published and a license application can be submitted.

5   CONSIDERATIONS OF CRITICAL TOPICS

In this final section of the roadmap, a brief discussion of the ten most critical topics, selected by the ITU expert, will be described. The order of the topics does not reflect a level of importance.

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.

5.1   Financial resources

It is necessary to provide funding for DSO and ASO, as well as for the process of the digital standard selection. It is possible to provide some funding for the execution of pilot tests in Georgetown, in order to show to the broadcasters and community the benefits of the different DTV standards. Part of the funding can be obtained from the equipment vendors and from International cooperation.

During the DSO process it is important to provide funding for the training of NFMU personnel for gathering information and verify coverage.

For ASO implementation, it is important to provide funding to subsidize Set Top Boxes, as well as some credit to local dealers for the initial import of STBs.

ASO office has to be funded, in order to guarantee the transition process in an ordered way.

5.2   Strong leadership

Government needs to ensure strong leadership in the ASO commission and in the regulatory framework, with technically skilled people and a political leadership, in order to guarantee a smooth transition. Members of the ASO will be selected for their technical skills more than the political orientation.

A strong ASO body (commission) is absolutely essential for the Guyana process. As individual players will be too busy with their daily work, such a body would focus attention on monitoring progress and pursuing each activity to its logical conclusion. Since it would be represented by all sectors, problems related to each sector would be handled in a well-informed manner. Also the much needed communication with industry; viewers and other players could be established easily resulting in a quick and efficient ASO.

5.3   Regulatory changes

Although Guyana is in the process of upgrade the broadcasting licenses, according to new Broadcasting Act, the transition to DTTB will imply changing the licensing procedures and licensing conditions according to the standard selected and such decisions, as the operation model discussed in section 3.6., will affect the new licensing process. The general recommendation in this case is to issue short-term licences and not to issue new broadcasting licenses until the new

licensing process is defined. For this matter, a freeze date for issuing broadcasting licenses must be defined. The issues to consider in this new framework are the following:

1. Change licensing procedure.
2. Change licensing conditions.
3. Decide ownership of multiplex.
4. Frame rules for multiplex sharing.
5. Tighten law enforcement and regulation.
6. Set up wireless monitoring under the technical wing of the regulator (NFMU)

In this new scenario, the role of the NFMU will be quite important and strengthen of the technical capabilities and technological tools for this task are very important.

5.4   National frequency plan

A full DTTB national frequency plan is necessary, considering the spectrum scarcity in Georgetown area and the border conditions. As discussed during the visit, the available spectrum is in the UHF band and a coordinated transition will be necessary during the ASO to turn on new digital channels in the spectrum released as analog channels will be switched off.

5.5   Best content

The DTTB transition is an opportunity to migrate contents to new kind as High Definition (HD), especially for sports and nature. Also the possibility of interactive content should be considered.

Consider this transition as the opportunity to encourage Broadcasters/operators to have studio equipment changed to digital so that the whole chain is digital.

5.6   Technical standards based on coverage and reception quality to suit public requirements

Most of the digital TV standards have better coverage with less total power than analog TV. Such advantage must be considered during the planning process to improve the coverage and Image Quality. Some reserve in the transmitter power should be considered to increase the coverage and capacity. NRT should be provided with required technical inputs for taking appropriate decisions. Increased number of channels provides an alternative to cable TV and in FTA mode saves a few dollars of customer's money each month. This is important in the context of the low per capita income in Guyana and in the interest of viewers.

5.7   Digital dividend

Guyana has the digital dividend been allocated (As mentioned in section 3.4). The auction of the digital dividend band (70MHz) could be a source of funding for the ASO and strengthen of the technical capabilities of NFMU for this new technological development.

5.8   Revision of National Broadcasting Act, 2011

Although the National Broadcasting Act is being implemented and the process of issuing new broadcasting licenses is not completed, the migration to DTTB requires a revision of this Act, including new licensing procedures and definitions such as the existence of a Multiplex operator and the spectrum sharing between various broadcasters. This issue must be studied as soon as possible, in order to guarantee the approval of the new Broadcasting Act or its amendments by the Parliament of Guyana.

5.9   Develop suitable business plan

For the public service broadcaster, a free to air mode is considered suitable, but for the commercial broadcasters it is important to consider new business models for them. They could have a mix of FTA and CA based offerings which are expected to enhance their earnings. Subscription based earning can be further improved and should be tried. Conditional Access examples that could have success in Guyana can be sports such as Cricket in High Definition.

5.10 Staff training

Training of staff at all levels is an essential component of the project. Theoretical and practical knowledge of the new technology is required. In the initial decision of the DTTB standard, some seminars about each standard can be issued to NRT, broadcasters and Broadcasting commission people, as well as a selected group of senior engineers (like professor of Guyana University). This can be acquired through seminars, training courses, workshops, practical demos so that the skill of existing staff is upgraded and they are in a position to discharge their responsibilities. A core group of senior engineers are also required to be trained in aspects of project and network planning, frequency planning, and tests and measurements.

6   RECOMMENDATIONS

- There is a very particular situation in Guyana because as part of the new Broadcasting Act, most of the broadcasters are renewing or regularizing licenses; however the recommendation is that no more licenses for analogue TV broadcasting should be issued and notices to existing broadcasters about government plans to switch over indicating the ASO target should be sent out.

- Resources are required to be provided for DSO and ASO objectives. Since the whole process has been spread over a period of six years, mobilization of resources for each year lessens the burden.
- Viewers, retailers, broadcaster, industries, trade associations/chambers etc. are to be informed, educated about the advantages etc. in advance. Establishing proper and timely communication is essential.

- STBs, IDTVs, antenna, etc. have to be provided to viewers. Bulk procurement may provide best prices. Local retailers could be encouraged to go for development or kit (ckd/skd) assemblies to reduce cost of STB further or using duty concessions. Viewers up to a certain income level in rural areas/towns may be provided with financial support for procurement of STBs/IDTVs to reduce the financial burden.

- Grievance redress mechanism and help to customers must be provided. The fact that help will be forthcoming in case of difficulties would encourage customers to switch over. Retailers should have their technicians properly trained to respond to customer enquiries.

- Given the information collected during the ITU expert mission and the analyses carried out by the experts in this report, 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. Seek the roadmap report approval at either ministerial level and/or political level.
    2. After approval, acquire a mandate to plan and manage the ASO process in accordance to 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 step 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;
    – define a new licensing model, to include:
        - A public tender for the pay-tv/commercial service providers;
        - A model for assigning broadcast licenses (and hence the bandwidth management/assigning slots), in particular for the common multiplex/network operator, depending of the model selected;
        - Open network provisioning (ONP) rules for the common multiplex/network operator;
    – finalize and agree the DSO objectives;
    – determine the procedure and contract to be awarded to a network operator supplier.
    5. Form a project management office (PMO) and start drafting an initial detailed ASO planning and determine the progress reporting procedures and structures.

- Apart from these next steps for the NRT to take, some additional recommendations can be provided which seem to be evident for the Guyanese situation:
    1. Carry out additional market research covering the elements as indicated in this roadmap report (see phase 1). Because some market data is lacking, having additional market research available would be an advantage, and would help to manage the ASO process.
    2. Carry out detailed frequency and service planning (see phase 2 and 3). Additional frequency planning will be required to see what is possible. Coordination with Suriname, Venezuela and Brazil is absolutely critical for an efficient implementation of the Roadmap. NFMU have to deal with this issue in the shortest time.

3. Investigate the possibilities of auctioning the mobile (LTE) spectrum as an important means of 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.

- Training courses must be created by inviting experts from abroad, if required. Engineers/technicians from public service broadcasters and private broadcasters should be trained on both theoretical and practical aspects. A few core engineers may be required to train abroad ahead of activities to draft equipment specifications and for the testing and commissioning of transmitter and associated equipment.

- One full set of test and measuring equipment is to be procured and kept at Georgetown to be used elsewhere in the network as and when required.

- For frequency planning of the network, if in country expertise is not available, expert help from abroad may be sought to develop the best coverage planning with the least interference.

- Regulatory changes as suggested in action points may be incorporated. The broadcasting act has to be thoroughly reviewed. The regulator must be given monitoring, and search and seizure powers to deal with any violation of the broadcasting act.

- Content is king in television and attractive content different from the normal menu has to be created to make the platform different and unique from others to become successful.