

RWANDA UTILITIES REGULATORY AGENCY



MANAGING THE CHANGE FROM ANALOGUE TO TERRESTRIAL DIGITAL BROADCAST IN RWANDA

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LIST OF ABBREVIATIONS AND ACRONYMS

AM	Amplitude Modulation
BTH	Broadcasting to Hand
CA	Conditional Access
CD	Compact Disc
CLF	Converged Licensing Framework
CMUX	Commercial Multiplex Operator
CSP	Content Service Provider
CTI	Confederation of Trade and Industries
DAB	Digital Audio Broadcasting
DSTV	Digital Satellite Television
DTT	Digital Terrestrial Television
DTV	Digital Television
DVB	Digital Video Broadcasting
DVB-H	Digital Video Broadcasting Handheld
DVB-S	Digital Video Broadcasting Satellite
DVB-T	Digital Video Broadcasting Terrestrial
EPG	Electronic Programme Guide
FM	Frequency Modulation
HDTV	High Definition Television
ITU	International Telecommunication Union
MF	Medium Frequency
MHz	Megahertz
MICS	Ministry of Information, Culture and Sports
MID	Ministry of Infrastructure Development
MITM	Ministry of Industries, Trade and Marketing
MUX	Multiplex
MNO	Mobile Network Operator
NFL	Network Facilities Licence
NICT	National Information and Communications Technologies Policy
NTSC	National Television Systems Committee

PAL	Phase Alternation Line
PMUX	Public Multiplex
PSB	Public Services Broadcaster
PVR	Personal Video Recorder
RRC	Regional Radio-communication Conference
SIMULCAST	Simultaneous Broadcasting
SDTV	Standard Definition Television
SMS	Subscriber Management System
STL	Studio to Transmitter Link
T-DAB	Terrestrial Digital Audio Broadcasting
T-DMB	Terrestrial Digital Multimedia Broadcasting
TV	Television
UHF	Ultra High Frequency
UK	United Kingdom
USA	United States of America
UTC	Universal Time Co-ordinated
VCR	Video Cassette Recorder
VHF	Very High Frequency

EXECUTIVE SUMMARY

1. DIGITAL AND ANALOG BROADCASTING

Analogue broadcasting uses analogue signals throughout its broadcasting chain. Therefore, for each programme being broadcast it has to be assigned a frequency channel and it is the responsibility of the broadcaster to distribute signals to be transmitted to all transmission sites, and to operate and manage transmitters in all areas the programme has to cover. It was primarily offering ONLY broadcasting service. Hence, for TV Rwanda to broadcast three programmes it needs three separate frequency channels and operates and man transmitters all over the country.

Digital Broadcasting on the other hand uses digital signals in its broadcasting chain. The different signals to be transmitted are combined with identifiers so that several programmes can use the same frequency channel as is the case for mobile telephone today. The combined signals can be distributed to transmission sites together as a bundle to the receiver. Therefore, a single frequency channel that carried one programme can now carry up to eight programmes. Hence, the capacity of the bandwidth resource has been increased substantially through sharing. The sharing however calls for a different way of managing the broadcasting chain. There is need for an entity to combine the different programmes to be referred to as MUX Operator and the network facilities are being shared hence its management and operation is an issue to be addressed. Broadcasters will share bandwidth, network facilities, distribution of signals and related operational costs.

2. ADDITIONAL SERVICES POSSIBLE IN DIGITAL BROADCASTING

In digital broadcasting scenario it is possible to combine broadcasting with a whole range of other services. These include phone services, internet access and thus e-mail, movies and music services on demand, pay-tv services, module TV,

and all kinds of data services. Therefore, digital broadcasting enables integrating broadcasting services with multimedia and data services while allowing mobile reception for TV and radio programmes.

3. IMPLICATION OF SWITCHOVER

Switch over from analogue to digital broadcast in Rwanda will require replacement of 11 analogue television transmitters which mainly operates from power ranging from 500 – 2KWatts. Subsequently 8 analogue STLs equipments will as well need to be replaced. 7 editing television studios will need to be upgraded while 2 analogue studios will completely need replacement. The existing analogue television receivers will need to be upgraded by incorporating equipment named Set Top Boxes, This equipment convert digital signal to analogue. Switch over implies much more than a technical migration, considering the role of TV and radio in modern societies, that the impact will not only be economic but also social and political. Switch over affects all segments in the broadcast value chain namely content production, transmissions and reception.

4. THE NEED TO ESTABLISH A MUX OPERATOR

Digital broadcasting needs establishment of a MUX Operator to facilitate the sharing of a frequency resource among different broadcasters and services. The MUX Operator is to facilitate sharing by providing the platform to achieve this referred to as MUX that will multiplex the different programmes for distribution and transmission. It is recommended that the MUX Operator also be the operator of the network facilities to reduce complexity and costs in the broadcasting delivery chain.

5. THE NUMBER OF MUX OPERATOR COUNTRYWIDE

There is no business case for having several MUX Operators in Rwanda at present considering the number of broadcasters at present and the size of the country. Similarly, there is no business case for having different MUX Operators in different provinces, districts and communities. Therefore, it is being recommended that the national operators provide the MUX services in provinces, districts and communities.

At the initial stage of digital broadcasting operation there should only be two MUX Operators one for public broadcasting services and one commercial MUX Operator. The public MUX Operator be allowed to carry programmes from commercial broadcasters to foster some degree of competition. Having more than two operators will make the digital rollout to be expensive to broadcasters hence undermining the benefits of sharing in terms of operation costs. The number of operators can increase with expansion of the broadcasting industry.

The MUX Operators be encouraged to rollout as quickly as possible and to participate in advertising migration to digital broadcasting.

The Public MUX Operator is to be funded by government and should spearhead the digital migration process in Rwanda by ensuring that the transmission of its programmes go digital in most parts of Rwanda sooner than later.

Broadcasters and Mobile Telephone Network Operators should not be given priority for licensing as MUX Operators since it can lead to conflict of interest and can introduce uncompetitive tendencies in the communication sector.

6. KEY PLAYERS IN THE BROADCASTING CHAIN

The following key players have been identified: The regulator who represents the government although the government has a place in its own right, the MUX Operator, the broadcasters or content service providers, and the consumer. All of them have a role to play to ensure smooth migration to digital broadcasting. The relationship between these players has to be understood and respected and each part has to meet its roles and obligations.

7. PUBLIC BROADCASTING

Public broadcasting offering has to continue in digital broadcasting scenario as a base for informed unbiased source for socially but not necessary commercial information. It should be a reference source for promoting cultural heritage, social values and in preserving the identity of Rwandan society, its people and history. It should have a strong production base in Rwanda for locally produced material not only for its own consumption but that shall draw interest of other broadcasters. It should continue to be funded by the government, but it need be encouraged to find means of reducing its burden to the government. Under public broadcasting there is expected to be three entities: Rwanda Television, Radio Rwanda and the Public MUX Operator.

It is recommended that an entity be established to coordinate and oversee the operation of these three public entities that shall be dealing with broadcasting funded by the government.

8. TECHNOLOGY

The choice of digital broadcasting technology to be adopted in Rwanda shall need to be that which shall maximize the frequency channel programmes and services carrying capacity of a MUX. At present OFDM, 64 QUAM and MPEG4 is part of the specification of digital broadcasting system. The technology to be adopted should be that used widely worldwide to ensure availability of a variety of end-user equipment and spares at affordable costs.

Interoperability is an important aspect for consideration when the regulator is approving technology to be used so that consumers need to have only one end-user equipment to have access to several services on offer to customers.

Currently the adopted standard by RRC-06, are DVB-T for Television and T-DAB for sound broadcasting.

9. POLICY, LICENSING AND LEGISLATION ISSUES

The laws guiding broadcasting in Rwanda in its present form and hence the policies, regulations and licenses cannot handle the dynamics involving the possible offerings under digital broadcasting and the manner that it is done. Digital broadcasting calls for a MUX Operator and there is convergence of broadcasting with multimedia, data and telephone services and it facilitates sharing of resources among broadcasters and with other content service providers. Broadcasting to mobile devices is also a reality. Hence, the appropriate licenses are needed. There is need therefore to have four primary licenses: Multiplex Operator, Infrastructure (Network) Service Provider, Content Service Provider (broadcaster), and Application Service Provider. This call for applicable laws and policies to be amended to accommodate digital broadcasting and the same applies for license regulations.

Licensing of frequency should now be made to MUX Operator based on needs of broadcasters and content service providers that are licensed or in the process of being licensed by the regulator. The regulator should avoid the landlord tenant situation in the utilization of the frequency resource. This calls for revocation of bandwidth licenses held by broadcasters once the simulcast period is over.

10. BROADCASTING TO HANDHELD (BTH)

Digital broadcasting has facilitated broadcasting to mobile and portable consumer devices that provide an opportunity for the provision of new free-to-air services, new subscription and pay-per-view services. There are various BTH technologies in use today that do not require mobile telephone operators' network to function and can bypass it completely. This leads to several business models. There are two dominant technologies in terrestrial broadcasting at present; T-DMB and DVB-H. However, the technology is still developing and its application is regional based. DVB-H is mostly promoted by mobile telephone operators. BTH is an area that presents potential for competitive

offering and/or cooperation between broadcasters/content service providers and the mobile network operators.

BTH offering through MUX Operator is being recommended rather than through telephone mobile operators in that it shall offer another platform for broadband services to foster competitive climate in the telecommunication industry in the interest of Rwandan population particularly that of the common man.

11. MIGRATION PROCESS OPTION

The option being recommended for adoption in Rwanda is that of introduction of digital broadcasting facilitated by managed market take-up strategy. This is effectively a managed and forced migration to enable achieving various goals within desired timeframes. The government shall have to subsidise the migration of public broadcaster to ensure universal access obligations of the public broadcaster.

12. Regulating IPTV

In terms of regulatory approaches to IPTV, Hong Kong, Brazil, and Taiwan, IPTV services are regulated in the same basis as pay TV services. India considers IPTV as part of its general telecommunication regime and thus separates it from pay TV. In Japan IPTV is considered as “broadcasting using telecommunication services” The Europeans Union proposes two tiered regulatory structure for audio visual media services, distinguishing linear services(where service provider decide programme schedule) and non linear services(on demand audio visual services). RURA is advised to take note of the IPTV developments worldwide and formulate the regulatory mechanism that is appropriate to RWANDA.

13. Intervention by DTT Players

The Regulator needs to guide against market players exerting pressure to ensure that public intervention and regulations reviews/settings occur in a direction which favors their own interests and not necessarily that of general public or that of digital switchover general objectives.

CHAPTER ONE: BROADCASTING LANDSCAPE OF RWANDA

1.1 Objectives of This Document

1.1.1 This document is meant to provide a basis for the migration process from analogue to digital broadcasting in Rwanda. It provides detailed information on various issues that are critical and necessary such that it needs to be understood and addressed, including recommendations to that effect to ensure that Rwanda enters digital broadcasting in a firm ground.

1.1.2 Brief explanation is provided on various broadcasting issues for the two scenarios to show the difference between the current broadcasting scenario, analogue broadcasting, and the future of broadcasting by examining necessary instrument, such as licensing and regulatory legal frame work to facilitate the digital broadcasting.

1.1.3 This document addresses issues to be observed during migration from analogue to digital broadcasting and its processes so as to avoid conflicts while optimizing the utilization of frequency resource to the betterment of the state of Rwanda and its citizens.

Broadcasting Landscape of Rwanda

1.2.1 Rwanda is a country with 26,330 sq kms, and population of 8 million by 2001 with growth rate of 2.5% and population density of 253 per sq km. Bordering countries are Burundi, Democratic Republic of Congo, Tanzania and Uganda.

1.2.2 Rwanda has one television station which is the state television station; the Rwanda Television. The operations of television started in December, 1992. Currently there are 21 licensed radio stations, 2 Pay Television stations and 1 Free to Air (FTA) Television station¹.

¹ Rwanda Utilities Regulatory Agency annual report of the year 2007 page 17

1.2.3 Rwanda stopped in October 2007 to issue licence to analogue broadcasting investors in the country to mark the beginning of an end of analogue broadcasting in the country.²

1.2.4 Telecommunications functions in Rwanda operated under the Ministry of Transport and Communications until 2001 because the Ministry had not established an independent regulatory body to oversee the telecommunications sector by then.

1.2.5 The Ministry of Transport and Communications by a bill of parliament established Multi-Sector Regulatory Body, covering the telecommunications, water, electricity, gas and transport sectors known as Rwanda Utilities Regulatory Agency (RURA) in the year 2001.

1.2.6 The minister of State for Energy and Communications stated recently (November 2007) that Rwanda has already “Four digital channels ready to be rented out to investors interested in starting digital broadcast television stations in the country”. It was pointed out also that Rwandans owning analog TV sets and willing to pay for the services will be able to view digital programmes, with the help of the imported 100 digital-to-analog set-top converter boxes. This shows clearly the seriousness with which the Rwandan government takes the issue of migration to digital³.

1.2.7 The move towards digital broadcasting can assist Rwanda to re-dress the rural urban divide where the average teledensity is 0.5 and ratio rural: big-cities is 1:100 because the digital broadcasting can accommodate wide ranging added value services integrating broadcasting, multimedia services and telephony. This is in line with the “Integrated ICT-led Socio-

² Referenced from http://www.rwandagateway.org/article.php3?id_article=7372 as downloaded from the internet on 03.01.2008

³ Referenced from http://www.rwandagateway.org/article.php3?id_article=7372 as downloaded from the internet on 03.01.2008

Economic Development Policy and Plan for Rwanda: 2001 - 2005” to make Rwanda a cyber country.

1.2.8 Rwanda has recently erected a mast at Karisimbi Summit, in what is known as the Kirisimbi project, which has improved coverage of Rwanda Television in the North and Western regions and reliability of local Frequency Modulation (FM) stations in the region. This project started in 1985 with the construction of a 40m mast that was brought down by volcano. The Kirisimbi Project is seen as the corner stone pilot project for Digital Video Broadcast Terrestrial (DVB-T) in Rwanda. It is believed in Rwanda that through this project Rwanda could be the first country in Africa apart from Mauritius to use Digital Video Broadcast Terrestrial⁴.

1.2.9 Telecommunications in Rwanda is governed by the Law N° 44/2001 of 30/11/2001 enacted by the Transitional National Assembly and Mministerial order n° 9/DC/04 of 07/06/2004 on conditions to be incorporated into telecommunications and radio communications licenses.

⁴ Referenced from http://www.mininfra.gov.rw/news.php?subaction=showfull&id=1170085174&archive=&start_from=&ucat=5& as downloaded from the internet on 03.01.2008

CHAPTER TWO: INTRODUCTION

- 2.1 The ITU Member States, which Rwanda is a member, at its Session 2001 and 2002 agreed to start planning of terrestrial digital broadcast for the combined planning area covering the European Broadcast Area, the African Broadcasting area, and the countries outside the African Broadcasting area which are parties to the Regional Broadcasting Agreement Geneva 1989 planning process were completed by July 2006.
- 2.2 Digital broadcasting which is in various stages of development and implementation throughout the world (see annex 2) has the capacity to allow substantial expansion of broadcasting services in Rwanda, bring greater choice to free-to-air and subscription or pay per view broadcasting services.
- 2.3 The new digital technologies have brought about significant changes in the broadcasting landscape. The changed broadcasting environment that has introduced new opportunities and challenges needs to be addressed by new policies, laws, regulations, rules and procedures.
- 2.4 Rwanda recognizes the problem of frequency resource scarcity to be alleviated by migration to digital broadcasting.
- 2.5 The switchover from analogue to digital broadcasting is a complex process that's social and economic implications go well beyond the pure technical migration. Replacing analogue broadcasting with a digital system presents huge advantages in terms of more efficient spectrum usage and increased transmission possibilities; these will lead to new services, wider consumer choice and enhanced competition.
- 2.6 This document addresses issues to be observed during migration from analogue to digital broadcasting and its processes so as to avoid conflicts

while optimizing the utilization of frequency resource to the betterment of the state of Rwanda and its citizens.

2.7 The analogue to digital broadcasting switchover affects all segments in the broadcasting value-chain, namely: content production, transmission and reception. Considering the role of television and radio in contemporary societies, the impact is therefore not only technical but also economic, social and political hence needs to be handled carefully.

2.8 Switchover can thus complex that can be a protracted process unless handled systematically since it involves many variables and affecting all social groups - consumers, industry and public authorities and present and future broadcasters.

CHAPTER THREE: THE ANALOGUE BROADCASTING CHAIN

3.1 Transmission chain from studio to transmitter station

- 3.1.1 The current system of broadcasting in Rwanda is predominantly analogue especially the free-to-air services. Cable television services in Rwanda have not been introduced, which leaves terrestrial and satellite to be the only mode of broadcast.
- 3.1.2 Satellite broadcast subscription service has slowly but steadily been growing in the region. There are only two registered operators in Rwanda who broadcast by subscription via satellite. Satellite broadcast use digital platform even though at the receiving end the signal has to be converted to analogue for receivers to be able to display the signal. The growth of satellite broadcasting by subscription is far less because of the high initial costs and the monthly subscription fees being very high hindering its growth. The initial subscription fee is \$150, while the monthly fees range from \$ 35 to \$80
- 3.1.3 Satellite broadcasting as an extension of terrestrial broadcasting free-to-air services that is common particularly from foreign broadcasting stations or major broadcasters that are accessed by urban dwellers to expand choice and in remote sites to have access to TV broadcasting.
- 3.1.4 Radio broadcasting is by far the most accessed service than television. This is primarily because radio broadcasting services covers almost the whole country of Rwanda (95%) while television covers 80%. However, a relative cost of receivers is yet another significant factor⁵.
- 3.1.5 The regulatory broadcasting policies in operation today were conceived during analogue broadcasting era based on analog value chain shown in fig. 1, hence cannot address issues and challenges that digital broadcasting presents.

⁵ The signal coverage statistics were obtained from the chief engineer of the National Rwanda television after doing demographic listeners profile survey in year 2006

3.1.6 In analogue broadcasting scenario one programme occupies one radio frequency or channel. The programme cycle begins from the studio where production of the programme takes place. The licensed broadcaster is responsible for the entire process from production to

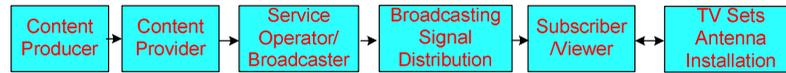


Fig. 1: The analogue broadcasting value chain

transmission and delivery of signal to the consumer by free-to-air mode of transmission as illustrated in fig. 2.

3.1.7 In analogue broadcasting, each broadcaster must distribute signals for transmission to every transmission site and must own and operate transmitters in all areas that are to be covered. Hence, ten broadcasters will need ten transmitters for the ten programmes to cover a given locality each using a separate frequency channel.

3.1.8 The Broadcaster owns studio and transmission facilities including Studio Transmitter Link (STL), and is assigned frequency to facilitate signal transmission and broadcasting.

3.1.9 The production process from the studio to the consumer receivers is in an analogue format. Broadcasters can be licensed to provide content, broadcasting and other value added services to the consumers.

3.1.10 In most of the stations, researchers, producers and commissioning editors use a wide range of analogue and digital equipment to initiate the programme cycle in broadcasting studio.

3.1.11 Most post production is done in digital format. However the transmission of programme from studio to the receivers is basically an analogue process.

3.2 Shortcomings of Analogue Broadcast

3.2.1 The sound broadcasting frequencies used by broadcasters at present are Very High Frequency (VHF) and Frequency Modulation (FM) and Medium Frequency and Amplitude Modulation (MF/AM) that use analogue transmission technology. This technology has its own technical limitations as follows:-

- (i) Inefficient use of radio spectrum;
- (ii) Unreliable system performance under mobile reception conditions;
- (iii) Susceptibility to interference; and
- (iv) Inefficient system of editing broadcasting content.

3.2.2 Each broadcaster has to own, man and operate the entire broadcasting value chain shown in fig. 1. Each programme needs allocation of a frequency channel and requires transmitters at various sites determined by desired coverage area.

3.2.3 Cause duplication of efforts by broadcasters, in infrastructure and operation costs so as to cover a given area.

3.2.4 Takes long time for any new comer to broadcasting business to cover large area because of the need to deploy infrastructure.

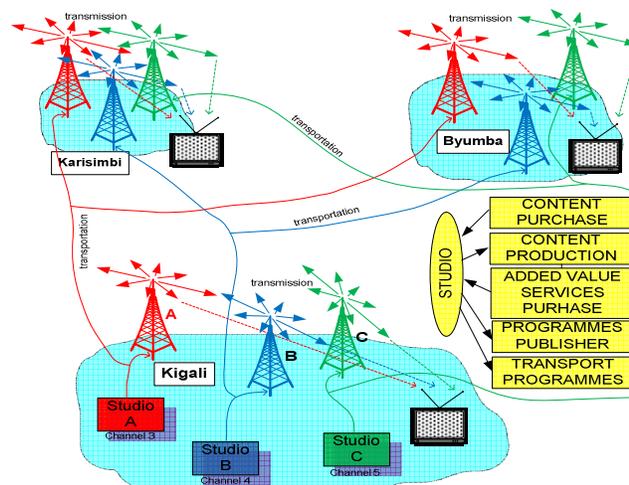


Fig. 2: The analogue broadcasting system

3.2.5 Each broadcaster must acquire competences in all parts of the broadcasting chain at a cost.

- 3.2.6 Digital transmitter allows for the establishment of single frequency networks (SFN) whereby a particular geographic area can be covered using only a single frequency. This cannot be achieved by using analogue platform
- 3.2.7 Digital transmitter use low power transmitter compare to analogue to cover the same area.
- 3.2.8 Allows much more value added services than analogue, as the signal is digital and is much better suited to support data applications
- 3.2.9 Digital transmitter allows for interactive services while analogue not.
- 3.2.10 Reduction of capital and operational transmission cost due to the fact that one transmitter can be used for a number of channels in place of one analogue transmitter for each channel. This reduction in cost should be reflected in the signal distribution fees
- 3.2.11 EPG: Ease of content selection/navigation. This feature is not possible to be done in analogue platform.
- 3.2.12 Improved quality for both video and audio

CHAPTER FOUR: DIGITAL BROADCASTING

Unlike analogue television, which is transmitted in a form of continuous wave, digital terrestrial television is transmitted in the form of bits of information. As such, digital terrestrial television is considered superior to that of analogue transmission as it provides better picture quality, better viewing experience, allows flexibility in programs, as well as maximizes the use of spectrum through sharing of a frequency channel.

4.1 Digital Broadcasting Scenario

- 4.1.1 Digital broadcasting represents a fundamental change from analogue broadcasting whereby basically one frequency carries one programme. In digital terrestrial broadcasting one radio frequency channel can accommodate a number of broadcast programmes and services.
- 4.1.2 Digital broadcasting involves the delivery of a variable number of digital bit streams not only for sound and television but also multimedia services.
- 4.1.3 These streams are combined into a single digital stream for transmission on a particular frequency channel.
- 4.1.4 The process of combining digital streams into a single channel is known as multiplexing. The central feature of digital broadcasting is multiplexing.

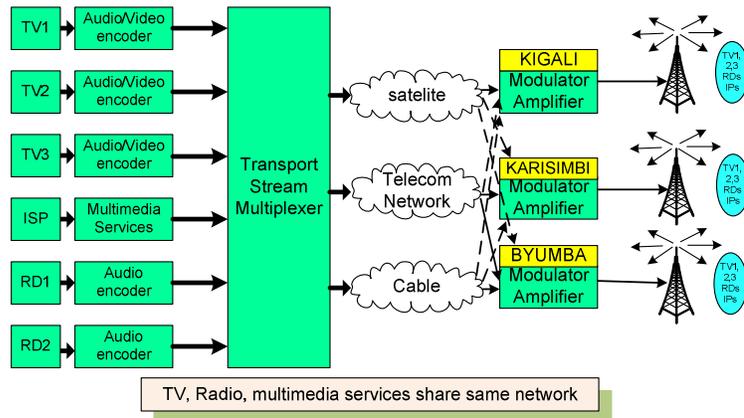


Fig. 3: The digital terrestrial broadcasting principle

4.1.5 The Digital Broadcasting concept is shown in fig. 3.

4.1.6 There are three digital television systems that have been developed so far: ISDB-T (Integrated Services Digital Broadcasting - System C) DVB-T (Terrestrial Digital Video Broadcasting - System B) and ATSC (Advanced Television Systems Committee - System A)⁶. Rwanda being part of ITU region 1 need to adopt DVB-T system as agreed at the Regional Radio Conference (RRC 2006) to replace the analogue system (GE 89) currently in use. However, the three digital terrestrial television systems are closer to compatibility than their analogue counterparts, i.e. the PAL, NTSC and SECAM used in analogue since the same compression technology is used in digital broadcasting.

4.1.7 There are three reception modes applicable to DVB-T: Portable reception for indoor/outdoor, fixed reception requiring rooftop antenna and mobile reception.

4.2 Advantages of Digital Broadcast

4.2.1 Digital Terrestrial Broadcasting (DTT) uses data that is embedded in the transmitted data stream to guide the operation of the digital decoder. It utilises Service Information (SI) in decoders to tune to and decode information being conveyed in the signal. The identifiers in decoders are

⁶ The systems have been mentioned with other technical parameters discussed in detail in the Final act agreement document of ITU, RRC-06 chapter three

able to distinguish one service from another. It is these features that give digital broadcasting significant advantages over the analogue one.

- 4.2.2 DTT uses Coded Orthogonal Frequency Division Multiplex (COFDM) modulation making the signal highly immune to multi path reflections (ghosting immunity); hence operable where an analogue signals would suffer intolerable ghosting. It is by far tolerant to co-channel interference, particularly analogue co-channel interference. This allows introduction of DTT services into a band that is already heavily used by analogue services.
- 4.2.3 Digital broadcasting enables integration of broadcasting, telephone, multimedia, data services, etc in a single network as shown in fig. 3 and several programmes that needed separate channels in analogue broadcasting can use a single channel and transmitter which makes it more frequency efficient. The transmitter power is also much lower. Hence lower investment and operational costs for broadcasters.
- 4.2.4 Digital broadcasting potentially has high spectrum efficiency, lower transmission costs, rugged reception, superior sound and video quality, multimedia handling capability including interactive applications and offers increased access to diverse content & information
- 4.2.5 Digital broadcasting offers broadcasters greater access (space) for more broadcasters, opportunity to include variety of languages, easier regional coverage, improved picture and audio quality space, demand for new services not existing in the analogue environment, more targeted services, integration of services and sharing of infrastructure, distribution, operation and transmission costs. It also offer opportunity for new business models
- 4.2.6 Power consumption of digital transmitters is very low and enables provision of mobile TV services.
- 4.2.7 Consumer demand is expected to rise since it will be driven by; increased choice, desire to combine the theater experience with the convenience of home, and the lure of interactivity and the Internet.
- 4.2.8 Strong competition possibilities in content provision that shall be available from; independent producers, DVDs, analogue terrestrial

services initially, the Internet and other sources which are growing in quantities, qualities, and locations.

4.2.9 Broadcaster’s interest will be driven by chance to increase revenue associated with new features and controls, including interactivity, which can be derived from the next generation of home digital entertainment systems.

4.3 Transmission Chain from Studio to Transmitter⁷

4.3.1 Digital broadcasting can be via Cable Television (dominantly for pay TV), Satellite Television (DTH – Direct To Home), Terrestrial or Internet Protocol Television (IPTV).

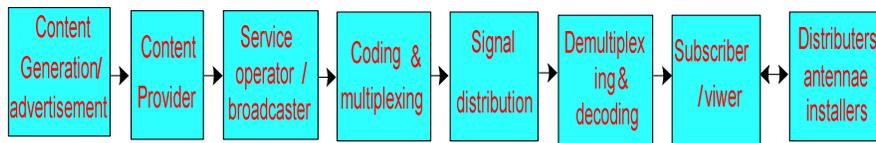


Fig. 4(a): The free-to-air digital broadcasting transmission chain

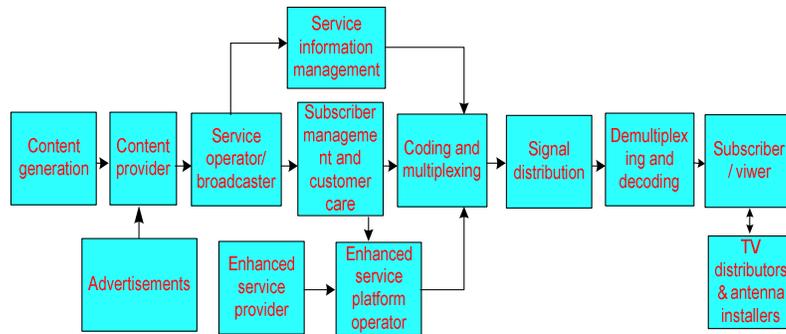


Fig. 4(b): The pay TV/subscriber digital broadcasting transmission chain

4.3.2 Digital broadcasting offers three basic models; the free-to-air, the pay TV/ subscription services (see fig. 4) and a hybrid model. All these models can coexist in a network as standalone or can work with mobile network operators to provide return path.

⁷ Figure 4a and 4b is extracted from the presentation of Mr. Aynon Doyle Chairperson – Policy Working Committee Digital Migration Working Group Presentation at SADC RRC-06 Review, Indaba Hotel 5-6 October 2006 South Africa.

4.3.3 Different TVs, audio stations, and added value services together with control signals are multiplexed in single channel and then transported to respective transmitter sites and then transmitted as illustrated in fig. 5.

4.3.4 Digital broadcasting transmission chain from studio to viewer has three principal players: content provider (broadcaster/service provider), multiplex operator and infrastructure (network) operator.

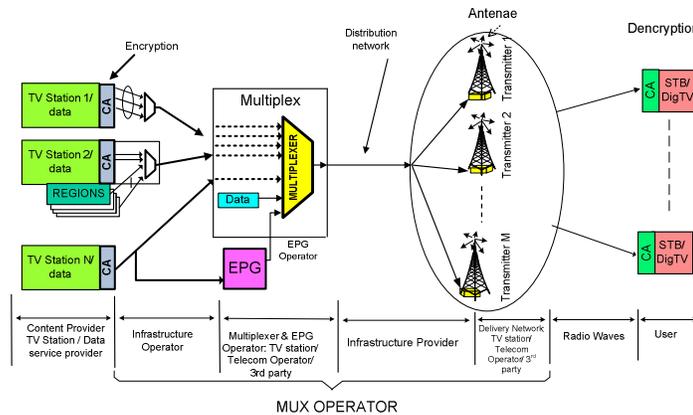


Fig. 5: DTT Technology and Services

4.4 The Multiplex Operator/Signal Distributor

Unlike the analogue television scenario, whereby the broadcaster is involved from production, to programming to transmission, DVB-T allows for multiplex operator(s) to “assemble” the different television programs and services and transmit it over the air in a channel(s). This can be seen fig. 5.

4.4.1 Definitions⁸

- a) A **multiplex** is a digital transmission channel which combines programme material and other data in a digital form for transmission via a frequency channel. The process of digital combination of the signals is called multiplexing.

⁸ The definitions indicated in 4.4.1, extracted from: “SADIBA, Analogue to digital television Broadcast migration strategy for South Africa” 28th January, 2002, release 1, page 28.

- b) **Multiplex Operator** is that entity that compiles operates and markets a content offering on a digital multiplex and that decides on the Condition Access and Subscriber Management System (SMS) to be used.
- c) **Content Service Provider (CSP)** shall be used to imply Broadcasters and other involved in providing content only, hence not involved in its distribution or transmission. This term is used to avoid confusion with the current understanding of the term broadcaster.

4.4.2 Functions of Multiplex Operator

The functions and obligations of the MUX operator have been discussed by TCRA, MACRA, SADIBA and the Commission of the European Communities (Brussels, 17.9.2003) in their papers on transition from analogue to digital broadcast. From their presentations, the following are the core functions of Multiplex Operators:

- a) Establish, operate and develop multiplex;
 - i) **Establish:** Consult CSPs and write proposals, submit to Regulator, purchase equipment, install equipment, inspection by regulator, get licence, acquire personnel and other facilities;
 - ii) **Operate:** Day to day operation of the system, maintenance, human resource; and
 - iii) **Develop:** Monitor and plan for expansion, upgrade, etc.
- b) Provide and manage connections to CSPs;
 - i) **Provide:** Negotiation of services, contract signing with CSPs, network connection; and
 - ii) **Manage:** Day to day monitoring of network, billing, etc.
- c) Provide and manage delivery of multimedia services to consumers;
 - i) **Provide:** Switch on programmes as per service level agreement with CSPs; and
 - ii) **Management:** Billing, monitoring, encoding (subscriber management).
- d) Comply with Regulator requirements as per licence.
 - i) Provide data on operations; and

- ii) Adherence to frequency allocations.

4.4.3 Obligations of Multiplex Operators

The obligations of MUX Operator are summarized as follows:

- a) Complies with Regulator requirements as provided for in licensing conditions, regulations and directives;
- b) Complies with the Service Level Agreements (Contract) with CSPs e.g. Quality of Service and network availability;
- c) Provides high quality multimedia services to consumers;
- d) Ensures that fees are such that they will not hinder CSPs from delivering timely, adequate and high quality services;
- e) Ensures impartiality in rendering services to CSPs;
- f) Complies with must-carry obligations to preserve public interest objectives such as diversity and pluralism;
- g) The Regulator to ensure that their fees and those of MUX are reasonable and do not unduly disadvantage CSPs who would in turn pass over the burden to consumers (for subscription services);
- h) Exercise fair, transparent and non-discriminatory conditions;
- i) Prepares and meets role-out plans and benchmarks approved by Regulator;
- j) At switch-off date MUX Operator attains coverage greater than that during analogue transmissions;
- k) The MUX Operator to accommodate new applicants for FM broadcasting to align themselves with the applicable Licensing Framework;
- l) To ensure that, does not inhibit any advancement of technology in terrestrial digital broadcasting chain;
- m) To guarantee dual illumination (simulcast) during migration period.

4.5 Implications of Migration to Digital Broadcasting

- 4.5.1 It will be necessary to replace all analogue TV transmitters with digital transmitters. Currently in Rwanda there are 11 analogue television transmitters which will need replacement. Similarly, there are 7 links from studio to transmitters which will also need replacement. For content production studios, 7 studios will need upgrading while 2 studios will need complete replacement. The population sensor taken in 2002 indicates that there were 80, 000 analogue receivers by then which will need STBs. The number of receivers is now estimated to increase up to 300,000.
- 4.5.2 The huge installed base of analogue receivers will need upgrading by introducing Set-Top Boxes (STBs) or acquisition of digital receivers and probably to re-alignment receiving antennas or to acquire new ones.
- 4.5.3 The impact of migrating to digital broadcasting is not only economic but has also social and political dimensions.
- 4.5.4 The migration to digital broadcasting will affect all segments in the broadcasting value chain, namely content production, signal distribution, transmission and reception.
- 4.5.5 There will be need for additional investment in infrastructure for production, distribution and transmission.
- 4.5.6 Dual Illumination will be required during migration period so that current customers have time to re-orient to digital broadcasting era. This means MUX Operators would have to pay additional costs for signal distribution for both analogue and digital transmitters over the transition period.
- 4.5.7 Interoperability of various services such as interactive TV services can be a problem for some DTT receivers since DTT is an open, retail platform making it more difficult to ensure that equipment and services work together successfully in a single receiver than for (vertical) platforms with a single controlling body. It is essential that a basic infrastructure be established to support interoperability.

- 4.5.8 Availability of affordable set-top-boxes and digital receivers is required for smooth take-off.
- 4.5.9 Content Service Providers could be faced with increased costs to change formats of content during purchase and selling of content to and from suppliers from countries with digital broadcasting. Similarly, depending on whether production suites upgrade to digital systems in order to reduce multiple content conversion, the actual cost of content production could increase.
- 4.5.10 CSPs and MUX Operators will have to plan appropriate marketing strategy in order to inform and educate the public on the switchover to digital broadcasting. The Regulator can share the related costs with other stakeholders.

4.6 Driving Forces to Adopt Digital Broadcast

The research conducted through questionnaire and verbal interview, indicates that most of the broadcasters, listeners and viewers doesn't understand what is terrestrial digital broadcast and the advantages against analogue. Some of them their perceptions on digital is that there will be improvement of the quality of video and audio only. This reveals the fact that the driving forces originate to the technology itself and not the people. However generally the following are summarized to be the driving forces:-

- 4.6.1 Agreement of ITU member states to migrate to terrestrial digital broadcasting and to have all analogue transmitters switched off by 2015.
- 4.6.2 To free the frequency resource tied up by analogue broadcasting for other services.
- 4.6.3 To take advantage of all the benefits (advantages) of digital broadcasting state in section 4.2.
- 4.6.4 Providing consumers with wider choice, access to wide-ranging services and guaranteed quality reception.

4.7 Key Players in Broadcasting Value Chain to Viewer

- 4.7.1 Experience of other countries show that there are three key players in the broadcasting value chain in the delivery process of broadcasting services. In countries like United Kingdom, South Africa, Hong Kong and Australia the role of the three key players namely; Multiplex Operator, Content Service Provider and Network provider are licensed in the process of delivery of content to consumers is recognized;
- 4.7.2 **Multiplex Operator:** That entity that compiles operates and markets a content offering on a digital multiplex and that decides on the conditional Access (CA) and Subscriber Management System (SMS) to be used;
- 4.7.3 **Content Service Provider:** A service participant (in analogue era commonly referred to as broadcaster) on a digital broadcast multiplex that contributes to the content offering in that multiplex whether be in a form of a audio or video or data services;
- 4.7.4 **Network Service Provider:** That entity that operates networks and transmitters (infrastructure) and distributes signals associated with a multiplex;
- 4.7.5 However, some of the above mentioned countries consider having two main key players where Multiplex Operator assumes function of Network Service Provider.

Advantages of having Three Different Key Players

- 4.7.6 With three key players namely Content Service Providers, Multiplex Operator and Network Service Providers, there are number of advantages:-

- a) Quick network rollout will be realized as the Network Service Provider will concentrate on installation of transmitter only while Multiplex Operator will dwell on Subscriber Management System (SMS), multiplexing and signal distribution;
- b) Expansion of services will move fast;
- c) Less investment as expansion investment capital is distributed to all three players.

Disadvantages of having Three Different Key Players

4.7.7 The three key players have disadvantages as follows:

- a) Involvement of the third party makes the delivery process of content service to consumers more complex.
- b) Since the three parties are inter dependent on giving content service to the consumers, in case one party violets regulatory requirement it will also cause inconvenience to other and inhibit delivery of services.
- c) The size of possible available programs would contribute in deciding as to how many players should be entrusted the work of disseminating content from studio to consumer.

4.7.8 Proposed approach

- a) Under separate licensing approach, two key players are proposed to handle all the processes leading to the delivery of broadcasting services to the consumers, namely **Content Service Provider** and **Multiplex Operator**. This is because the advantages of two key players surpass that of three players.
- b) Adopting two key players will reduce complexity in the course of delivering broadcasting services to consumers.
- c) Removing involvements of the third party in the broadcasting chain reduce interdependence while management of the entire delivery broadcasting service process becomes easier.

- d) The Multiplex Operator will take the role of providing infrastructure (Network Service Provider) and manage the entire process of transmission.
- e) The **MUX Operator** shall be the holder of a spectrum licence dependent on services required by CSPs and shall provide services to content service providers on contractual basis.
- f) The **MUX Operator** should not to be a broadcaster/service or content provider to ensure neutrality and independence of the operator with no agenda other than the success of the DTT platform, which gives significant advantage in seeking to address and resolve issues of 'Platform Management'. This is the practice in other countries that have gone digital.

4.8 Relationship between the Key Players in the Digital Broadcasting Chain

- 4.8.1 In the digital broadcasting value chain, the MUX Operator operates and manages aggregation, multiplexing, and transmission facilities to enable delivery of contents provided by the Content Service Provider. Relationship among these two key players should be well defined to achieve trouble-free transmission of content. Another important stakeholder is the Consumer who is the recipient of all the efforts made by the MUX Operator and CSPs. It is assumed that the Regulator stands for the government.
- 4.8.2 The relationships between these key players should be considered for developing an institutional arrangement for smooth operations.
- 4.8.3 Relationship between **MUX Operator** and **Content Service Providers**:
 - a) The MUX Operator shall avail all performance data to the CSP, provides plans for system upgrade, consider service plans for CSPs, bills CSPs promptly and lodge complains on CSP to regulator where appropriate.
 - b) The CSP informs MUX Operator on service plans timely, responds appropriately to MUX Operator upgrade/expansion plans and performance data, pays timely the MUX Operator and lodge complaint on MUX Operator when necessary to regulator.

4.8.4 Relationship between **Regulator** and **MUX Operator**:

- a) Regulator demands timely reports on network utilization and details interconnection as per licence and regulation and bill the MUX Operator while the MUX Operator responds appropriately and pays bills timely.
- b) The Regulator considers for approval where appropriate the fees structure and development plans that are prepared and submitted by MUX Operator.
- c) The regulator conducts dispute resolution between CSP and MUX Operator submitted by the later.

4.8.5 Relationship Between **Content Service Providers** and **Regulator**:

- a) The Regulator demands timely submission of data as stipulated in the regulation from and bills CSP while the CSP submits the required data accurately and timely and pays bills timely.
- b) The Regulator considers for approval business plan applications prepared and submitted by CSP.
- c) The regulator conducts dispute resolution between the CSP and MUX Operator submitted by the former.

4.8.6 Relationship between **Content Service Providers**:

- a) CSPs should discuss among themselves issues of mutual interest using unifying bodies for cooperation, and submitting their resolutions to other bodies e.g. Regulator, Government.
- b) CSPs should cooperate in production, leasing of contents, etc and in sharing of resources such as human, facilities, costs, training.
- c) CSPs to prepare and/ participate in activities of mutual interest like conferences, seminars, workshops, etc.

4.8.7 Relationship between **MUX Operators**:

The MUX Operator need to cooperate by establishing a unifying body and that can be used to discuss issues of mutual interest. They should work to share resources e.g. human, facilities, costs, training and to cooperate in resolving issues affecting them.

4.8.8 Relationship between **Consumers** and **Regulator**:

- a) The consumers to lodge complaints to Regulator on the quality, adequacy and standard and type of services received and facilities e.g. Content, services, TV and radio sets who is duty bound to address their complaints.
- b) The Regulator to provide awareness education on the migration through TV and radio programmes, newspaper articles, website, seminars, conferences, etc that the consumers are expected to participate.

4.8.9 Relationship Between **Consumers** and **Content Service Providers**:

- a) The consumers lodge complaints to CSP on the quality and adequacy of programmes and the CSP is to address the shortfalls.
- b) The CSPs to inform consumers on available services, changes and plans for advancement for the consumers note for consumption as appropriate.

CHAPTER FIVE: NUMBER OF MULTIPLEX OPERATORS

Economical consideration and creation of true competition in the sector should be the driving factor in determining the number of MUX Operators in the interest of providing viewers wide choice of programmes and services and attracting more players in the new broadcasting arena that has potential to offer wide range of services. It will be useful to understand pressures from stakeholders and to accommodate those factors that shall be in the interest of effective and quick digital broadcasting roll-out while maintaining the costs of broadcasters as optimal as possible. Monopoly tendencies in the communication sector need be avoided where possible when engaging MUX Operators.

The MUX Operator Service Areas are as follows:-

- a) **National Service Layer:** These Networks are intended to provide services throughout the entire country;
- b) **Province Service Layer:** These Networks are intended to provide services in administrative Provinces of choice by the Content Service Provider;
- c) **Local/Community Service Layer:** These Networks are intended to provide service in a small local area/or community.

5.1 Number of Multiplex Operators Countrywide

5.1.1 The core functions of the Multiplex Operators have to be considered when determining the number of Multiplex Operators, countrywide;

5.1.2 Multiplex Operators are regarded as infrastructure providers and Managers of distribution and transmission processes. They require hardware to transmit programmes and frequency spectrum resource to deliver content services to consumers. The regulator needs to assign spectrum as per need by CSPs;

- 5.1.3 The utilization of the frequency spectrum resource to be used by MUX Operator must be considered. An area having four programmes to be broadcasted will underutilise one MUX with capacity for 8 programmes;
- 5.1.4 Market demand forms (business case viability) is a very important factor to be considered in determining the number of MUX Operators that can be licensed to operate countrywide. The market demand includes radio and television programmes and enhanced services;
- 5.1.5 Consideration of ways to accommodate various types of services for every level of service area be made;
- 5.1.6 The levels are based on the geographic service area provided in the existing Regulator Broadcasting License;
- 5.1.7 In the existing analogue environment, there is a one-to-one correlation between the frequency channel and the broadcasting station, and it is possible to tailor the frequency coverage to the requirement of a particular station;
- 5.1.8 In a digital environment with multiplexes capable of carrying a number of different programmes and/ services, the coverage of each programme or channel has to be considered and a compromise reached between the MUX Operator and the Content Service Provider (broadcaster). It is important to remember that it is possible for the MUX Operator to trade quality with number of programmes in a channel, hence the need to guard against this.
- 5.1.9 Current broadcasters may aspire to be MUX Operators individually. This shall not be healthy for the development of the industry, hence should not be allowed. It can lead to landlord – tenant situation that need be avoided. Where broadcasters desire to be MUX Operators they should do so through a legal consortium of all significant broadcasters, current and future.

National Networks

- 5.1.10 National Networks are those intended to serve the whole country. Currently in the analogue environment, there are thirteen national level programmes for Radio including foreign ones like BBC, and

Deutschwelle and one programme for Television, the national television Rwanda Television;

5.1.11 In planning for Digital Broadcasting at National Network level, the following matters need to be addressed:-

- a) How many multiplexes can cater for current National programmes being Radio and TV and associated services or value added services and future broadcast development;
- b) Should National Networks be planned on the basis of common programming throughout the entire service area or should National Multiplexers carry Province Service programmes as well?;
- c) Should this apply for all multiplexers or only some?

5.2 MUX Operators for Province Networks

5.2.1 Currently there are no licenses for providing radio services in Province service areas. In order to determine requirements of multiplexes versus available transmitted programmes, the need for establishing the number of programmes in each Province service area is inevitable in order to have a matching multiplex;

5.2.2 Future requirements of programmes/services should be taken into account in the planning process;

5.2.3 There is need to consider added value services, if known, and future requirements of programmes partly initiated in Rwanda by the NICI initiative and the Karisimbi project.

5.3 MUX Operators for Community Networks

5.3.1 Community Radio/Television is becoming a vibrant area in the broadcasting sector in a number of countries in the world today. However, the areas served are normally small. In considering the area to be served, the provision of a multiplex to cover relatively small area is probably not economical;

5.3.2 Another approach would be to allow a certain number of programme channels on a National or Provisional Multiplexes be reserved for

community services and make some provision for these to be shared between various community services.

5.3.3 The issue of stand-alone multiplexes for community service area may be addressed at a later stage when it makes business sense.

5.4 Value Added Services

5.4.1 Due to convergence and ability to use broadcasting technologies to deliver other services, it would be possible to allow multiplexes to provide both broadcasting services and data services. However, a decision shall have to be made whether to use separate multiplexes or not;

5.4.2 Provision of take-up, during transition period, should be encouraged because of its distinctive demand in the market place compared to analogue services. Wide-ranging Take-up can be realized only under digital platform. This measure will encourage and accelerate migration process, and attract investments;

5.4.3 Advertising material in digital additional service should be legal, honest, decent and truthful.

5.5 Public Service Broadcaster

5.5.1 The Public Service Broadcaster (PSB) Rwanda Television and Radio Rwanda have got unique obligations different from that of commercial, non-commercial and community broadcasters. Public Service Broadcaster carries educational, entertainment and information programmes which the government finds it to be a public good;

5.5.2 The infrastructure used by the Public Service Broadcaster belongs to tax payers that have to be accountable for to the public. This makes it mandatory for the Public Service Broadcaster to have National coverage in fulfillment of Universal Service obligations;

5.5.3 The Public Service Broadcaster need be allowed to establish its own MUX so that it can achieve its main objectives of serving the public without discrimination in the digital platform.

Initial Number of Multiplex Operators Countrywide Analysis

- 5.5.4 Considering the factors above for multiplex requirements, coverage and commercial viability, it is now desirable to propose number of Multiplex Operators countrywide. In order to arrive at justifiable decision, spectrum availability, potential demand for programmes, available programmes and potential demand for take-up are the key elements to determine economic viability of the Multiplex Operators;
- 5.5.5 Considering the number of broadcasters, programmes and customers (including advertisements) at the moment there is no business case for multiplexes to be located at Province and Community levels;
- 5.5.6 It is proposed that initially TWO National Multiplex Operators be licensed, ONE for Public Service Broadcasting and ONE for Commercial Service Broadcasting where the public MUX can carry commercial CSPs/services to foster competition;
- 5.5.7 It is proposed that the PSB MUX (PMUX) be jointly under Rwanda Television and Radio Rwanda because they are public funded PSBs. It is the role of the Government to ensure that the digital broadcast infrastructure is in place to guarantee provision of public broadcasting services in the digital platform;
- 5.5.8 Public Multiplex (PMUX) Operator will have the obligation of continuing giving service to the public, especially programmes which are not commercial but needed by the public. This will guarantee continuity in the provision of public content services and ownership of public infrastructure (transmitting sites, towers, buildings) in order to guarantee their commercial viability. Excess space in the PMUX can be made available to the public at all levels;
- 5.5.9 The Commercial Multiplex (CMUX) Operators, operating at national level will carry national as well as provisional and community programmes. This will optimize the usage of number of channels available in National Multiplexes;

5.5.10 The need to have more national, provisional and/or community multiplexes shall be determined by the market growth and commercial viability.

5.6 Proposed Initial Multiplex Operators Countrywide

5.6.1 Public MUX (PMUX) Operator

This is the MUX Operator for PSBs. Details of PSB MUX Operator are covered in section 6.3 and 6.4.

5.6.2 Commercial MUX (CMUX) Operator

Initially one CMUX Operator can be. This limitation is based on commercial viability consideration while allowing it to compete with PMUX Operator thus introducing limited competition in offering the service. A second can be considered when the broadcasting industry grows. Their functions and obligations are as explained in section 4.4.2 and 4.4.3. There are options to consider initially:

- a) The operator can be purely commercial entity that are neither mobile network operators nor current or future broadcasters.
- b) A consortium of all significant broadcasters current and future ones having established a legal business entity and having a viable MUX Operator business proposal and rollout plan.
- c) The regulator need to be satisfied if there will be no problems in mobile operators being a CMUX Operator or conflict of interest in realizing all possible digital broadcasting offering? Furthermore shall such undertaking foster or undermine competition in the sector? However, it is not a common practice for the countries that have got digital to use mobile network operators to provide and manage MUX Operator function.

5.6.3 Value Added Services Multiplexes

- a) Initially, it may not be necessary to impose a rule on how many channels should be reserved for Value Added Services. This will depend on demand for such services and that the core function is broadcasting.
- b) In arriving at the figure on how many channels should be used for Value Added Services in a multiplex the following should be taken into account:
 - i) That the multiplex is primarily for TV and radio broadcasting;
 - ii) The upper limits internationally, currently at 20%;
 - iii) Technological advancements.
- c) At this stage to consider and propose separate Multiplex Operators for added value services will be counterproductive and indeed does not make any business case.
- d) MUX Operator may decide on the space for take-up after conducting surveys and ascertain the demand supported by business plan, to be submitted to the Regulator for licensing consideration. The issue of stand-alone multiplexes for community service area may be addressed at a later stage.

CHAPTER SIX: PUBLIC SERVICE BROADCASTING

There are a number of issues to be looked at regarding public service broadcasting in the digital broadcasting era to ensure that it plays its expected roles functions to the society. These are covered here.

6.1 Background Information

- 6.1.1 Public service broadcasting provides the whole of society with information, enhances social, political and culture, education and entertainment, enhances social, political and cultural citizenship and stimulates the cohesion of society. To that end, it is typically universal in terms of content and access; it guarantees editorial independence and impartiality; it provides a benchmark of quality; it offers variety of programmes and services catering for the needs of all groups in society and it is publicly accountable;
- 6.1.2 In Rwanda, Radio Rwanda and Rwanda Television have to a great extent been performing the functions of public service broadcasting; currently, there is one body named ORINFOR which govern Radio, Television and one Public newspaper.
- 6.1.3 In an effort to improve the functioning of two entities, the Government may wish to develop an administrative unit to operate the PMUX which shall apply between and binding upon the Rwanda Radio and Television Rwanda and the Minister responsible for Broadcasting. The PSB, in essence, calls for the administrative unit for PMUX to be issued a licence to provide public broadcasting services. One CMUX Operator can be issued a licence for commercial broadcasting services after fulfilling the necessary requirements set by the Regulator. Exclusivity should be for a limited period not exceeding five years.

6.2 Objectives

In order to fulfill these functions, PSB needs to organize its activities to attain the following objectives:

- 6.2.1 Offer a wide range of varied, high quality programmes that reflect the common denominator of good taste and provide unbiased information with educative, cultural or entertaining contents that are of interest to the public;
- 6.2.2 Promote and preserve national culture and heritage;
- 6.2.3 Ensure that all types of programmes can reach everybody. In no case should access of services and programmes of cultural and national importance be limited to reach well-off groups;
- 6.2.4 Coordinate offerings of programmes that reflect the tastes of both the majority and the minorities. This will contribute to creating social cohesion, regional balance and a sense of belonging, particularly among minorities;
- 6.2.5 Undertake to have a strong national production base. This will provide programmes that reflect national values and the near environment better than foreign products. This will help to contribute to sustaining and revitalizing national culture and the characteristics of its identity. Furthermore, it will help to promote the audiovisual sector and the economy;
- 6.2.6 Form a complex communicative institution that acts on all available platforms. To fulfill these objectives, public broadcasting needs to be viewed by a large enough audience to be able to exercise a social influence, to influence its competitors by example and to justify the investment that it receives.

6.3 Functions

In the present situation of globalisation of the information society and digital switchover, the functions of PSB include:

- 6.3.1 Guaranteeing universal access to important information and major communication products. Such products should not be exclusively reserved for users who can pay for them or people with online access;
- 6.3.2 Producing information that is socially necessary. In market conditions the production of socially necessary information is not guaranteed. Instead, information that is economically viable is produced. Therefore, if we want an Information Society for everyone, public communication systems need to produce socially necessary information;
- 6.3.3 Acting as an informed guide in the face of the wide variety of information on offer. The user has access to a vast amount of information that makes it difficult to carry out an effective selection from all of the programmes and services available. The electronic programme guide has arisen as a public service function to provide people with the information needed to make an informed choice;
- 6.3.4 Balancing and curbing new communication services. The public sector should counterbalance the extraordinary concentration in the audiovisual system. This concentration is caused by convergence. In the face of this situation, public broadcaster should be a guarantor of plurality of their contents and democracy in decision-taking. Thus, public broadcasting stations should be financially, technologically and professionally solid;
- 6.3.5 Acting as a driving force in the processes of convergence between the communication sector and other social sectors, such as: culture, education, health, social welfare, etc. Public broadcasting should expand their communication activity beyond traditional broadcasting to respond as multimedia communication institutions;
- 6.3.6 Can include in some of its offering conditional access functionality;
- 6.3.7 Should play a leading role in broadcasting industry.

6.4 Obligations

- 6.4.1 To provide a reference point for all and a factor for social cohesion and integration of all individuals, groups and communities;
- 6.4.2 To provide a forum for a broad public discussion;
- 6.4.3 To broadcast impartial and independent news, information and comment;
- 6.4.4 To develop pluralistic, innovatory and varied programming, meeting high ethical and quality standards;
- 6.4.5 To serve both wide public and the needs of minority groups;
- 6.4.6 To promote mutual understanding and tolerance and community relations in pluriethnic and multicultural societies;
- 6.4.7 To ensure that the programmes offered contain a significant proportion of local content;
- 6.4.8 To extend the choice available to viewers and listeners by offering programme services which are not normally provided by commercial broadcasters;
- 6.4.9 To safeguard cultural diversity;
- 6.4.10 To develop tools of obtaining audience feedback for their content to help maintain the quality of the content, and to provide mechanisms for accountability, which is a vital attribute of public broadcasting;
- 6.4.11 To play an active role in promoting common, open standards in the broadcasting industry since PSB participates in all elements of the delivery system;
- 6.4.12 To provide national coverage to the level of rural areas in order to fulfill the Universal Service provision obligations;
- 6.4.13 To comply with professional standards of accuracy, fairness and impartiality; and
- 6.4.14 To be accountable to general public in terms of programming as well as financial prudence and propriety.

6.5 Financing

6.5.1 The following are the possible PSB financing options:

- a) Government grant
- b) Subscription
- c) Customers Payments
 - i) Pay per view
 - ii) New services
- d) Sponsoring
- e) Grants
- f) Advertisement
- g) Broadcast network access fees
- h) Sales of programs

The license fee for TV option is not a viable option for consideration.

6.5.2 In a country with the tax-base the size of Rwanda, the Government cannot hope to make sufficient funding available to fully support a public broadcasting service. While the Government will provide extra money to support the PMUX, government run radio and television nevertheless need to work so as to increasingly rely on commercial revenue from advertisements to pay for much of its services.

6.5.3 **Governance:** It may be useful to institute a single legal PSB administrative unit to coordinate content service provision by Rwanda Radio and Television Rwanda and PMUX operation.

6.5.4 Role of PSB during Migration Period:

- a) To enable public service broadcasters to fulfill their remit and adapt to the new digital environment including provision of Value Added Service such as broadcasting to handheld and new interactive services;
- b) To publicise digital broadcasting;
- c) To spearhead the migration process;

- d) To set-up as soon as possible a digital terrestrial broadcasting pilot project so as to play a leading role of spearheading the whole migration process; and
- e) To have a timely appropriate training programme for its technical staff to ensure smooth DTT operation.

CHAPTER SEVEN: LICENSING ISSUES

7.1 The Licensing Structure

7.1.1 The licensing structure needs a new look under digital broadcasting era. The underlying position should be; new policy and regulations are required for digital because digital broadcasting differs significantly from analogue hence the need for a fresh approach, e.g, 'analogue' regulation would be incapable of addressing:

- a) dynamic system configurations;
- b) frequency assignments;
- c) the multiplex operator;
- d) Multiplex operation;
- e) Content provision;
- f) Converged data, telephony, and multimedia services in a single network; and
- g) Network provision-infrastructure sharing.

The following is proposed to be among the primary licenses;

- a) Multiplex Operator
- b) Infrastructure (Network) Service Provider
- c) Content Service Provider (broadcaster)

This is a significant deviation from the licenses issued at the moment since it shall need provisions in the current structure to enforce the above distinct areas of licensing. Therefore, it better that they are made distinctly clear to avoid areas of overlap and potential conflicts at a later stage.

7.1.2 Broadcasting licence (content/service provider) should no longer be tied to specific frequency channel.

7.1.3 Digital Policy has to be established through a Ministerial Task Force to draw up appropriate policy and regulatory framework for migration to digital broadcasting. The policy should aim at the following:

- a) Securing a future for existing broadcast stakeholders;
- b) Attract investment;
- c) Attract the interest of manufacturers, retailers etc;
- d) Attract investment in the provision and production of new content services;
- e) Encouraging consumer uptake;
- f) Ensuring a future for existing services and accommodate new services;
- g) Providing for mix of free-to-air and pay services; and
- h) Providing a good and deliberate policy to encourage digital broadcasting especially on the network competition versus number of operators, roll out calendar and road map.

7.1.4 Licensing provisions for digital broadcasting should address appropriately interconnection between competing operators; technical interoperability, fair pricing regime.

7.1.5 Regulations for various categories of licences must be reviewed to accommodate the new scenarios that digital broadcasting presents.

7.1.6 Licensing framework need to provide incentives during migration that is phased out with time based on additional services offered over the basic broadcast services to facilitate faster response of customers.

7.1.7 Licensing frequency spectrum for individual multiplexes could result in a fragmentation of the available spectrum and limit opportunities for the establishment of competitive and viable networks.

7.1.8 Licensing individual broadcasters as MUX Operator should be avoided since there will be conflict of interest in offering impartial and transparent services to other broadcasters. If all significant broadcasters can form a legal entity that is accessible to present and future broadcasters and present a viable business proposal, they can be considered for licensing.

7.1.9 Licensing of Mobile Network Operator as MUX Operator for broadcasting will not be in the interest of divergence and expansion of competition opportunities in the communication sector. They can however be MUX Operator for own services.

7.2 Analogue Broadcasting Scenario

7.2.1 The Regulator is operating as guided by the Telecommunications Law No. 44/2001 of 30/11/2001 and Ministerial order No. 9/DC/04 of 07/06/2004 on conditions to be incorporated into telecommunications and radio communications licenses which provides for three types of licences:

- i) Radio Communications Licence;
- ii) Individual Telecommunications Licence; and
- iii) Standard Telecommunications Licence.

7.2.2 The Standard Telecommunications Licence holder is entitled to perform a certain category of telecommunications activity occurring within, to and/or from the Republic governed by standard terms provided for in the Licence. The activities include:

- i) The installation of the network ;
- ii) The supply of services; and
- iii) Marketing.

7.2.3 The Individual Telecommunications Licence holder is entitled to undertake certain telecommunications activities within, to and/or from the territory of the Republic, in accordance with standard and, deemed necessary, supplementary particular terms. Hence, the holder can perform all activities of the standard licence but with conditions.

7.2.4 The Radio Communications Licence holder is entitled to make use of a certain radio-frequency range or range(s) hence can have network, can provide service and is assigned frequency.

7.2.5 Currently the Broadcasters are allowed to own and operate studio and transmission facilities, provided that they don't lease transmission channel to other parties;

7.2.6 For that matter one licence is granted to broadcasting operators to deliver content through the existing transmission facilities;

7.3 Digital Broadcasting Scenario

- a) Under the digital platform format, multiplexing processes are necessary for efficient and effective delivery of broadcasting services to consumers. This process requires separation of content service provision and network service provision; and
- b) There are a number of possible structures for multiplex and transmission management to enable the dynamic characteristics of the digital platform to deliver content to consumers. Two options are being suggested⁹:

7.3.1 Option One: Combined Licensing

- a) Combined licensing option, means allowing broadcasters to provide the content services and retain control of transmission as applicable in analogue platform.
- b) Under this option, the broadcaster will establish and operate studio and transmitters.
- c) This approach would effectively reflect the way in which the current terrestrial broadcasting services are provided.

Advantages:

- d) The advantages of this option are that content providers will own studio and transmission systems, which is not different from analogue system; and that, excess capacity of channels accrued from inherited digital capability will be leased to other Content Service Providers;
- e) This approach allows the Content Service Provider to operate without involving another party and that the Content Service

⁹ The two mentioned options are referenced from the “consultation document on switchover from analogue to digital broadcasting in Tanzania” august 2005, page 15,16.
http://www.tcra.go.tz/consultative_docs/digitalSwitchOver.pdf

Provider will be able to monitor and control the entire broadcasting chain and act accordingly in case of problems (as is the case now under analogue broadcasting);

- f) The Content Service Provider will master expertise for the whole broadcasting chain;

Disadvantages:

- g) Content service provider will own multiplex which may not be fully utilized. This is due to the fact that the broadcaster may not have enough programmes to utilize all channels capacity available in the multiplex;
- h) It is expensive for an operator to own a multiplex that is not fully utilized;
- i) Management of spectrum utilisation becomes a complex process;
- j) The combined licensing approach cannot guarantee efficient utilisation of spectrum; and
- k) Will bring multiple contracts of frequency leasing which can amount to commercial conflicts.

7.3.2 Option Two: Separate Licensing

- a) This approach provides for the creation of a Multiplex Operator as discrete function separate from that of Content Service Provider. The provision of content services is separated from transmission process.
- b) MUX Operator be recognised and regulated as a technical facilitator or infrastructure provider with no control over or responsibility for, the nature or content of programme transmitted on behalf of the Content Service Provider (broadcaster) other than required to satisfy the technical general condition of operation.

Advantage of Separate Licensing

- c) Content Service Provider will concentrate on production of more content and enjoy economies of scale;
- d) Off load Management expense used to control transmitter chain and expansion of network;
- e) There is no multiple contracts and therefore smooth operation of delivery of broadcasting content services;
- f) Guarantees efficient utilisation of frequency spectrum;
- g) It encourages sharing of resources i.e. towers and transmitting sites;
- h) Take-off time for new comers will be very short;
- i) It reduces costs of Staff, Administration; and
- j) It is environmentally friendly i.e reduce Mushrooming of masts.

Disadvantages of Separate Licensing

- k) It causes inconvenience on transmission if either party (Multiplex Operator or Content Service Provider) will not meet regulatory requirements;
- l) No possibility to master expertise of the whole broadcast chain.

7.3.4 Recommended Licensing Approach

- a) As has been generally practiced elsewhere where digital rollout is in advanced stages **SEPARATE LICENSING** is recommended and because the advantages surpass the disadvantages of the combined approach;
- b) In digital broadcasting scenario Content Service Providers (broadcaster) should not be allowed to own and operate transmission (network) facilities including a multiplex unless they operate as an entity of a consortium of CSPs;

- c) Content Service Providers be allowed to deliver their content through a MUX Operator;
- d) MUX Operator be licensed to own and operate network facilities and frequency on need to be basis inline with confirmed projected CSPs services;
- e) The Mobile Network Operators although have the potential to rollout quickly and are knowledgeable of the local conditions but their licensing will potential hamper growth of competition in the sector to the detriment of broadcasters and viewer alike. Where possible they should not be given priority during migration except for own services.
- f) Where broadcasters (content service providers) wish to be MUX Operator they should be licensed only when operating as legal entity that is a consortium of all broadcasters that matter.
- g) The PSB be licensed to operate PMUX.
- h) The relevant laws used for licensing broadcasting be revisited and amended to accommodate the above recommendations.

7.4 Licensing Process of a Multiplex Operator

The process of granting licences to MUX Operator:

- 7.4.1 The Regulator advertises the intention to grant Multiplex Operators licence and stipulate the scope of the licence i.e. community or provincial or national and other conditions.
- 7.4.2 Prospective companies submit applications and Regulator evaluates and shortlists companies who enter into negotiations with CSPs and negotiate a multiplex content offering that they would like to provide.
- 7.4.3 Short listed applicants confirm from CSPs quality and capacity allocation per service and commercial terms.
- 7.4.4 The final applications to the Regulator are then compiled and submitted containing the following details:
 - a) Content offering (existing analogue programmes, new programmes and Value Added Services);
 - b) The network requirements (number of multiplexes);

- c) Market initiatives;
- d) Roll-out plan;
- e) Capital investment and financial capability;
- f) Provides samples of contracts entered between the two parties;
- g) Management and shareholding structure; and
- h) Other things as per current arrangement.

7.4.5 The Regulator evaluates and considers the applications from various companies and grants licences to the winning applicants.

7.4.6 The process is a minimum requirement for regulation. It reduces the workload of the Regulator as it facilitates and encourages commercial negotiations outside the regulatory process on core issues such as the content offering, quality of services and the rights of content provider on a multiplex.

7.5 Pre-Conditions for Negotiation

7.5.1 An applicant for multiplex licence should know in advance the license fee charged by the Regulator before entering in negotiation with CSPs.

7.5.2 An applicant should as well know, in advance, the role and obligations in delivering broadcasting services to consumers.

7.5.3 An applicant should adhere to adopted working relationships, terms and conditions between the two parties.

7.6 Proposed License Categories for Multiplex

7.6.1 It is proposed that the MUX Operator licence include: to operate MUX, distribute content and transmit content and frequency licence on need to be basis.

7.6.2 This will enable the MUX Operator to provide the core functions of providing infrastructure for delivery of broadcasting services to consumers.

7.7 Licence Period

7.7.1 International experience has shown that the duration of licences for MUX Operator ranges from 10 to 15 years (Hongkong (10 years), UK (12 years) and Germany (15 years)).

7.7.2 This document recommends that Rwanda adopts a 10 years period due to the fact that prospective investors need to have ample time to recoup their investments.

7.8 Licence Fees

7.8.1 There are several methods of determining licence fees of a MUX Operator. One of them is auctioning. However, experience has shown that auctioning is very expensive and counterproductive because of its inherent high costs which are passed over to consumers.

7.8.2 Benchmarking is yet another approach to license a MUX Operator. Benchmarking should be taken with much care because of the economic disparities from country to country.

7.8.3 Considering that the MUX Operator licence includes infrastructure and frequency the licence fee should reflect so. There should be an initial licence fee for owning and operating facilities plus that of radio communication services which implies frequency usage and subsequently payment of fixed percentage of gross annual turn over.

7.9 Criteria for Assessment of Licensing MUX Operator

The following criteria should be considered in the assessment of suitability of an applicant for MUX Operator licence:

7.9.1 Realizable roll-out programme, benchmarks and geographical coverage;

7.9.2 Plans for investment and development of the network, including marketing and availability of decoders, pace of development and costs to the general public;

- 7.9.3 Service profiles of MUX Operator including the mix of audio/television programmes and take-up;
- 7.9.4 The promotion of competition and efficient use of MUX capacity;
- 7.9.5 Confirm to provide services in a non discriminatory way;
- 7.9.6 The quality of the technical solutions, including the degree of flexibility of the chosen solutions to offer to the end-users regarding broadcasting and added value services;
- 7.9.7 Readiness to comply to must-carry;
- 7.9.8 Demonstrate ability to provide dual illumination of content during SIMULCAST;
- 7.9.9 Demonstration of non-monopoly tendency in the broadcasting sector and related services.

7.10 Licensing CSP

- 7.10.1 Broadcasters in analogue scenario be licensed to operate as CSPs in digital environment conditional to meeting new requirements for digital broadcasting. Their licence can acknowledge inclusion of added-value-services.
- 7.10.2 Licence for only added-value-services through DVB-T MUX Operator should not necessarily be tied to broadcasters.

The following procedure should be used in processing applications for CSP licences:

- 7.10.3 CSP lodges application to the Regulator containing the following information:
 - a) Types of services to be rendered;
 - b) Service areas;
 - c) Proposed MUX Operator to be used; and
 - d) Other information as per analogue broadcasting licensing requirements.

7.10.4 The Regulator processes the application as per regulations taking into account the following:

- a) Availability of channel by MUX Operator in the applied service areas;
- b) Curtailing monopoly of service and resources by one CSP by ensuring that the maximum capacity allocated to any one CSP, or to any particular type of programming material is not exceeded; and
- c) Standards of equipment to be used.

7.10.5 Successful applicants receive construction permit for the content production facilities (studio) and transmission links to the MUX. The Regulator in turn informs the proposed MUX Operator on the provisional frequency and service areas; and

7.10.6 The Regulator awards CSP licence upon certification of compliance to requisite standards.

CHAPTER EIGHT: THE PLANNING PROCESS AND THE OUTCOME OF RRC-06¹⁰

8.1 Background

8.1.1 Radio spectrum bands used for broadcasting have traditionally been planned at an international level. This has been done under the auspices of the International Telecommunication Union (ITU).

8.1.2 To facilitate the development of both digital sound broadcasting and terrestrial television, the ITU proposed two conferences to be attended by the member states of the Regions one.

8.1.3 The first session of the Conference was held in May 2004. Its purpose was to address the technical basis for the planning of the Digital Radio and Television Terrestrial Broadcasting Services in the VHF & UHF frequency bands and prepare work programme for the period between two sessions¹¹.

8.1.4 The second session convened from 15 May to 16 June 2006. The respective National Administrations signed the Final Agreements and Acts on regulatory framework and technical characteristics of the planned digital broadcasting stations during the last conference.

8.1.5 The Geographic areas involved in the planning process which signed the Final Act were, Europe, Africa, Middle East (including Iran) and states belonging to the former Soviet Union.

8.2 Technical Standard and Frequency Bands

8.2.1 The selected standard should be widely adopted internationally and facilitating the provision of highest possible channel transmission capacity

¹⁰ The planning process of the Regional radio communication conference 2006, and the outcome results may be accessed through the website <http://www.itu.int/ITU-R/conferences/rrc/rrc-06/index.asp>

¹¹ Resolutions arrived by this conference are accessible through the website <http://www.itu.int/ITU-R/index.asp?category=information&mlink=newsflashes&id={39049369-325C-420C-9526-C0CF3DE61112}&lang=>

to meet new demand for broadcasting services during and after the simulcast period to maximize coverage.

- 8.2.2 In the interest of consumers and for quick adoption, a standard that is widely adopted internationally be adopted to ensure affordability of receivers.
- 8.2.3 The agreed technical standard during the planning process is T-DAB for sound broadcast and DVB-T for television broadcast. Currently MPEG4 compression standard and 64QAM 8k mode are used for DVB-T to maximize channel capacity, hence should be the minimum requirement since MPEG3 is being phased out elsewhere.
- 8.2.4 The frequency band planned for digital broadcasting services are VHF band III (174 to 230 MHz) and UHF bands IV & V (470MHz to 862 MHz).
- 8.2.5 DVB-T standard will use Band IV and V while Band III will be shared by DVB-T and T-DAB.
- 8.2.6 VHF band II, which is heavily used by FM Sound broadcast stations is excluded from consideration and no changes are envisaged for this band for the foreseeable future.
- 8.2.7 Contrary to GE89 PLAN (Analogue Television Plan), digital plan used frequency assignment and allotment to describe technical characteristics of the requirements.
- 8.2.8 Basically frequency assignments describe all technical parameters of the transmitters equipment i.e. antenna height, power, geographical location while allotment describe geographical coverage of the assigned channel without giving other detailed technical parameters.
- 8.2.9 The number of programme channels is a function of the bit rate in the 8MHz channel and that for individual programmes which are typically between 20 and 24 Mbit/s for DVB. Digital programmes require between 2 Mbit/s(Low Definition) and 6 Mbit/s (Standard Definition) which a maximum of 7 programmes of quality similar to current analogue transmissions in a channel. New compression techniques enable higher number of programmes in a channel.

8.3 Rwanda Planning Approach

8.3.1 Rwanda used both assignments and allotments as a planning approach during the process of RRC-06. The Allotments approach was basically used for areas where decisions on the locations of the transmitters have not yet been established.

8.3.2 The assignments approach was used in locations where there are analogue stations operating.

8.4 RRC – 06 Planning Results

8.4.1 The outcome of the Regional Radio Communication Conference established GE-06 PLAN for implementation of terrestrial digital plan in bands 174 – 230 MHz, 214 – 230 MHz and 470 - 862 MHz.

8.4.2 The GE-06 planning results indicate that Rwanda has been afforded at least one multiplex in each town at district level which will be used for DVB-T and one multiplex for T-DAB respectively.

8.4.3 The summaries of results are as follows:-

New digital bands will therefore cover

- a) DVB-T and T-DAB in band 3 will use channels 5 – 12 (**174 –230**)
Assuming Rwanda shall use 8 MHz channel spacing.
- b) DVB-T band 4 & 5 channels 21 -69 (**470 – 862 MHz**).
- c) 62 assignments in UHF for DVB-T
- d) 13 assignments in VHF for DVB-T
- e) 60 assignments in VHF for T-DAB
- f) 3 allotments in UHF for DVB-T.

8.4.4 Transition Period

The agreed transition period to migrate from analogue to digital broadcast began on 17 June, 2006 at 0001 hours UTC and will end 16 June, 2015 at 0001 hrs UTC.

8.4.5 Analogue Broadcasting Systems During Transition Period

During the transition period from 2006 to 2015, Digital broadcasting system should not cause any interference to analogue system or claim any protection from interference.

8.4.6 Analogue Frequency Application during Transition

- a) GE89 plan for analogue frequency assignment indicates available frequencies for assignment for each province and district level.
- b) During transition period application for analogue broadcasting frequencies may still be lodged to the Regulator for consideration. However the Government of Rwanda has already taken the decision of not receiving analogue application for Televisions broadcast.
- c) Continuing assigning planned analogue frequencies without determining the limit may inhibit migration process and growth of digital broadcasting.
- d) The rest be left unassigned. The aim is to limit entry to analogue broadcasting operator and meet agreed SWITCHOFF date of 2015 without creating many constraints.
- e) During the transition period analogue broadcasters may wish to purchase upgradeable analogue transmitters to enable them upgrade to digital platform.
- e) However Content Service Providers during transition period may wish to use Multiplex Operators to carry analogue transmission, and be left with core business of content provision.
- f) It is therefore proposed that Content Service Provider negotiate with Multiplex Operators and agree on the terms of operations during the transition period as per planned timetable.
- g) Likewise the analogue frequency applicant may wish to continue with the role of offering content provision and transmission during the SIMULCAST period provided that such analogue systems are SWITCHED OFF by the year 2015.

CHAPTER NINE: MIGRATION STRATEGY

It is important to discuss the migration process, by considering factors that may contribute to the smooth switch over to digital broadcasting illustrated in fig. 6. Mismanagement of the migration process may disrupt even the existing analogue systems and cause big negative impact to the social welfare of the people. The key element in the migration process lies in a coordinated approach. Successful switchover will be facilitated by coordinated actions from all key players involved.

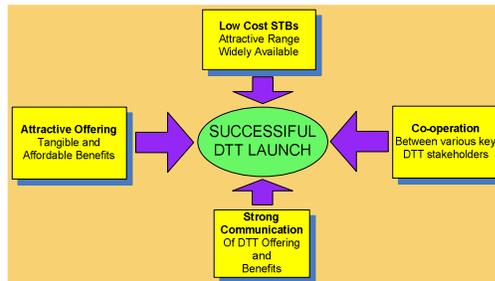


Fig. 6: Strategy for success in migration

9.1 Spectrum Planning

9.1.1 Efficient frequency planning will facilitate smooth transition from analogue to digital broadcasting. It should protect existing and planned analogue broadcasting stations during migration, be flexible and forward looking to cover future developments and frequency spectrum requirements, provide a framework to satisfy individual requirements on an equitable basis.

9.1.2 Digital transmission allows the use of these adjacent channels and requires less distance between co-channel services in the same area of coverage unlike analogue transmission thus maximizing the use of spectrum.

9.1.3 The approach to frequency planning in terrestrial TV transmission (digital or analogue) is different from that employed in mobile communications. The allocation of channels to terrestrial TV transmission can be constrained by site locations and border co-ordinations which limits the availability of channels nationwide. The planning is also guided by the “widest possible coverage” principle, whereby a high power transmitter

(kilowatts) will be located at high altitudes to cover the widest possible coverage.

9.1.4 Frequency planning and utilisation near border areas have to be coordinated with neighboring countries to avoid interference.

To secure smooth migration path, the Regulator therefore needs to:

9.1.5 Prioritise strategise the introduction and migration to digital. If such prioritisation does not take place the inevitable future introduction and migration to digital will be seriously hampered;

9.1.6 Reserve spectrum to ensure that the current analogue services are accommodated and also provide for future expansions;

9.1.7 Make provisions for two multiplexes (two analogue television frequency allocations) at each current transmission site (if available);

9.1.8 Advocate the use of appropriate technology to maximize the number of television channels accommodated in any one multiplex. Avoid using technologies being phased out elsewhere;

9.1.9 Define clear whether to utilise single frequency network operation or multi-frequency network or a mixture of them. Where a mixture is advocated, the criteria for areas to use SFN and MFN must be clearly defined;

9.1.10 Define what shall be done with analogue channels at each current transmission site;

9.1.11 Define what to do with current analogue assignments at the transmission sites after analogue transmission switch off;

9.1.12 Define what happens to allocation to facilitate simulcast when it ends;

9.1.13 Maximizing spectrum use; and

9.1.14 Planning for future use of other channels in the bands;

9.2 Single Frequency (SFN) or Multiple Frequency (MFN) Networks¹²

- 9.2.1 The frequency network of an analogue broadcasting system would tend to evolve to Multiple Frequency Network (MFN), where a national television station in Kigali will transmit its programs nationwide using various channels made available to it. Proper network planning required in MFN to avoid interference can lead to collection of unused channels in an area.
- 9.2.2 The study made in UK suggest that use of MFN multiplex need accurate planning of present and future capacity requirement since scaling up may no be feasible where low number of channels per multiplex is initially assigned.
- 9.2.3 Viewers in MFN scenario may need more than one antenna pointing different directions to receive different television signals.
- 9.2.4 Most countries have adopted SFN for digital broadcasting to foster mobility and indoor reception.
- 9.2.5 A number of countries that adopted a mixture of MFN and SFN in the effort to maximize efficient usage of frequency have either switched to SFN or have agreed or required all MFN be adoptable to switch to SFN.
- 9.2.6 Depending on transmission standards, digital transmission allows the use of same frequency channel (SFN) to transmit television broadcast throughout a wide coverage area, or even nationwide.
- 9.2.7 Careful planning would allow low power transponders (gap-fillers) be installed using the same channel to provide coverage in dense and stratified housing areas.
- 9.2.8 Rwanda though have the choice to make whether to adopt a mixture of the two or to use just one of them but it needs to learn from those who have implemented broadcasting for sometime now whom have chosen to adopt SFN.

¹² SFN is a network of synchronized transmitting stations radiating identical signals in the same RF channel. MFN is a network of transmitting stations using several RF channels as defined in the Final acts of the Regional Radio Communication conference for planning of the digital terrestrial broadcasting services in parts of Region 1 and 3, in the frequency bands 174MHz and 470MHz, pg 75

9.3 Interoperability

Interoperability is an important issue to ensure access of free-to-air broadcastings from broadcasters using same end equipment as shown in fig. 7. Therefore the Regulator should look in this to protect consumers.

9.4 Migration¹³

The following is being recommended to the regulator with respect to migration to digital broadcasting platform:

- 9.4.1 “Managed” migration scenario where the migration to digital is encouraged and promoted;
- 9.4.2 Market uptake of new digital receivers and set-top-boxes;
- 9.4.3 Establish digital infrastructure strategy;
- 9.4.4 Encourage market uptake of digital services;
- 9.4.5 Allow existing and new content providers access to the digital broadcasting platforms;

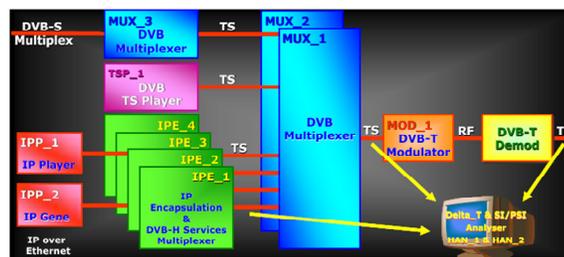


Fig. 7: Need for Interoperability in DTB

- 9.4.6 Allow mix of free-to-air and subscription services, hence MUX Operator Licence to acknowledge Conditional Access (CA), Subscriber Management System (SMS);
- 9.4.7 Analogue content provider licensees be allowed to automatically acquire CSP licence in the digital platform;
- 9.4.8 Ensure fair competition so as to encourage investment in digital broadcasting;

¹³ The information discussed in this paragraph has been sourced from: SADIBA, Analogue to digital television broadcast migration strategy for south Africa, 28th January, 2002, release 2, page 28

- 9.4.9 Identify areas that could be affected by dual illumination (in border areas) and develop means to address them;
- 9.4.10 MUX operator coverage to be as large as possible in accordance with a managed approach in order to create a large market and induce economies of scale benefits and
- 9.4.11 Determine analogue services to be gradually be reduced once DTT services are widely available, nudging consumers towards digital.

9.5 National switchover roadmap and action plan

9.5.1 To draw up a national digital switchover (SWO) roadmap with objectives and target dates. A roadmap and time-frame could provide projections on market evolution, and create common expectations amongst the players involved. This would then facilitate players' decisions and investments, encourage co-ordination around common objectives in response to known future scenarios, so as to ensure a faster and more efficient process, for players themselves as well as for Society. Some of the European countries have already provided Switch off dates for analogue transmission.
(See annex 3)

9.5.2 To establish a national SWO action plan defining criteria, actions and responsibilities, indicators of achievement, etc. The SWO process is long and complex one requiring co-ordination between many actors and interests

9.6 Intervention by DTT Players

The Regulator needs to guide against market players exerting pressure to ensure that public intervention and regulations reviews/settings occur in a direction which favor their own interests and not necessarily that of general public or that of digital switchover general objectives.

9.7 Actions Regarding Consumers

9.7.1 Improve consumer information about digital broadcasting so as to encourage its spontaneous adoption;

- 9.7.2 Study consumers' behavior and expectations towards DVB-T through various access platforms and the prospect of analogue switchover through joint initiatives from market players regarding consumers to build common knowledge amongst all market players on consumers' attitudes and behavior, in order to help them co-ordinate their strategies;
- 9.7.3 Put in place Policies that address the needs of all groups of citizens, even those that are less profitable under market mechanisms, and especially those in the rural areas.

9.8 Migration Options

The following are outlined as various options which may be considered for migration from analogue to digital broadcasting.

- 9.8.1 Based on benchmarks and international practice, the following are options that may be adopted in Rwanda.

9.8.2 Option One

- a) Allow analogue terrestrial broadcasting to continue without introducing any proper planning for migration or impose any restrictions for importing or using analogue equipment before technology obsolescence would force broadcasters and audiences to migrate to digital broadcasting.

Short fall

- b) Digital broadcast will start without proper planning and results in miscellaneous technical standards.
- c) Broadcasters would be faced with high cost per viewer budgets to meet universal service obligation through expansion of the existing analogue transmitter network.

9.8.3 Option two

- a) Introduce digital broadcasting with market forces shaping entry and existence.

- b) Government to purely facilitate the introduction of new services and the granting of licences.
- c) This approach would not be linked to other National objectives to create an information society in Rwanda.
- d) This approach would therefore not be directed by strong drivers to influence the shape of digital broadcast.

Shortfall

- e) Mostly upper income group would benefit from digital broadcast.

9.8.4 Option Three

- a) This option advocates the introduction of digital broadcasting facilitated by managed market take-up strategy.
- b) No clear market demand for start of digital broadcast, but Government would give proper plan and timetable leading to switch off at analogue network transmitters.
- c) This would be a managed and forced migration which is an effective way of achieving various goals within desired timeframes e.g. universal service, minimising digital divide, etc.
- d) Subsidised receiver equipment for consumers could be used as an incentive and catalyst if and whenever possible.
- e) In addition government would have to subsidise the migration for the public broadcaster.

Shortfall

- f) No clear market demand and government should set aside budget for migration process.

9.8.5 Option Four

- a) Introduce digital broadcasting in urban areas first with a plan to expand services to the rural areas.
- b) The profile of the consumer in these areas could lead to successful commercial and advertising revenue-driven broadcast models, which in

turn ease financial investment for expansion. Cost will come down slowly through successful roll-out in the urban areas.

Shortfall

- c) This approach adds to the rural-urban digital divide instead of using digital broadcasting to contribute to redressing the current situation.

9.8.6 Recommendation

Observations for Option One

- a) In accordance to the above analysis, option one gives a scenario that ignores technological development and happening elsewhere in the world.
- b) The option allows the possibility of continued usage of an outdated equipment/technology and hence sustainability of both technology and equipment to be at risk. This scenario culminates into high operation cost, as the developer of equipment may cease to manufacture such equipment.
- c) The digital broadcast in such situation would catch the society unprepared.

Observation for Option Two and Four

- d) Option two and four both allow the well to do class of society to have access to digital broadcasting services aggravating the rural-urban digital divide. To meet obligations of universal access becomes more difficult and will take long time.

Recommended Option: Option Three

- e) This document proposes option three, using managed market take-up strategy. Full involvement of the Government in migration process is recommended to achieve various goals within desired timeframe. Universal access obligations may also be achieved with low cost relatively compare to other three options.

CHAPTER TEN: LEGAL CONSIDERATIONS

- 10.1 When Rwanda Utilities Regulatory Agency issues a consultation document on switchover from Analogue to Digital broadcasting for Rwanda it is necessary that it includes proposal document for consultation for appropriate legislative amendment of all laws that regulate broadcasting in Rwanda.
- 10.2 Such amendments to include but not limited to spectrum use, licensing, standards, pricing structure, investment, taxation, switching from analogue to digital, replacing analogue transmitter or upgrading the analogue infrastructure.
- 10.3 In this document it is recommended to amend the Act that addresses Broadcasting Services to accommodate Terrestrial Digital Broadcasting in Rwanda. Such amendments should take cognizance of other existing laws.

CHAPTER ELEVEN: BROADCASTING TO HANDHELD (BTH)

11.1 Services

The migration to digital broadcasting has facilitated broadcasting to mobile and portable consumer devices that provide an opportunity for the provision of new free-to-air services, new subscription and pay-per-view services. It has also enabled integration of broadcasting with other multimedia services.

Broadcasters therefore can diversify their activities beyond their core function of television and radio broadcasting by incorporating Internet and broadband services. Broadcasters may also introduce connectivity to their customers.

11.2 Technology

11.2.1 There are numerous mobile TV broadcast technologies which do not require a network operator's mobile network to function and can bypass it completely, transmitting directly to users' handsets. The major technologies are T-DMB, DVB-H, DABIP, CMMB, MBMS, ISDB-T and MediaFLO.

11.2.2 The technology is still developing and therefore all issues cannot be captured at this time, however T-DMB and DVB-H are the most applicable in terrestrial broadcasting. Technology adopted so far is region based. The future of mobile broadcasting appears to be dominated by technology fragmentation because of the number of competing system at present which makes choice of technology to adopt complex and easily subjected pressure from interest groups/manufactures.

11.2.3 There are three bands for BTH; L-band, band V and band III.

- a) The effective bandwidth for band III is lower than that of L-band.
- b) A TV programme in T-DMB requires 1.6 MHz; hence 4 blocks can be carried in a single 8 MHz multiplex, whereas for DVB-H only a single block of 8 MHz can be accommodated.
- c) DVB-H can carry more programmes in a channel but needs large transmission power.

- d) For efficient use of spectrum, is better to allocate band III for T-DMB and band V for DVB-H in line with GE-06 Agreement on spectrum. L-band is being used for T-DAB in Europe but this will require larger number of repeaters.
- e) DVB-T is planned to operate in band III and V.
- f) T-DMB and DVB-H do not necessarily need to operate through the mobile operators; they can be routed through DVB-T MUX operator.
- g) The Regulator needs to make provision that will enable BTH service to reach people from all segments of the society (poor and rich, urban and rural) in the most economical way. Hence, the existing broadcasting infrastructure should be utilized as much as possible with minimal additional resources while fostering competition in the sector. In this regard therefore, band III when used for T-DMB and band V for DVB-H can make this possible since there will be no need for additional transmission repeaters.
- h) In Rwanda the L-Band can also be considered for DVB-H when need arises out of frequency limitation in other bands since existing telecommunication network can be utilised where transmission repeaters are relatively closer, hence need for addition of towers shall be minimal.
- i) T-DMB and DVB-H allows simultaneous transmission of multi-channel radio, television, video, audio and IP data to a range of multimedia receivers including table top and car radios, cellular phones, PDAs, PCs and other handheld devices.
- j) The content providers for the BTH should acquire appropriate licence.
- k) DVB-H has higher data rate capabilities than T-DMB but requires higher bandwidth and transmitter power.
- l) DVB-H is being developed and promoted by mobile telephone operators while T-DMB is being promoted by broadcasters.

11.3 Business Models¹⁴

BTH technical solutions have been developed based on different transmission systems and using different frequency resources. There is drive to have system that provides hybrid terrestrial and satellite solution. Several business applications and concepts, based on various realizations of converging networks and terminals, have resulted using different models. The most relevant models here are:

- a) MUX Operator led model;
- b) Free-to-air model;
- c) Mobile Network Operator led model; and
- d) Combined model.

11.3.1 MUX Operator Led Model

In this model the MUX Operator is central to all functions provided. The services include operating the broadcast network and capturing the role of Mobile Network Operator (MNO). The MUX Operator will run its own e-commerce and billing services in addition to handling the existing content aggregation business.

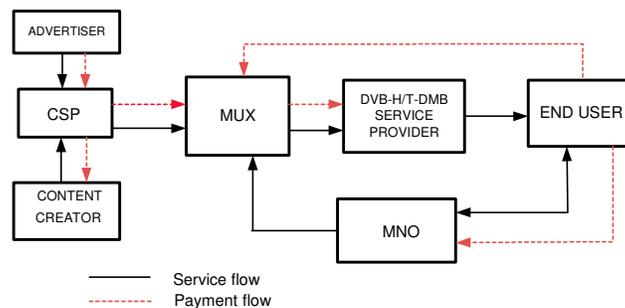


Figure 8: MUX Operator Led Model

¹⁴ Source: Eder Zoller and Vincent Poulbere, Mobile TV business models, April 2006

Benefits of this model to MUX operator:

- a) Existing content aggregation role provides contacts and agreements with CSPs on content distribution rights;
- b) MNO offers an additional delivery channel to capture new audiences or new prime time; and
- c) Independency from mobile operator billing and e-commerce solutions (no commissions to MNO), hence the price for end user and CSPs may go down which can assist in business takeoff.

The MUX Operator independency can be achieved by:

- d) Setting up own virtual mobile network by setting up own cellular home registry and charging system and providing the crucial function of customer interface; OR
- e) Buying the service from MNO (Outsourcing).

Benefits to the MNO:

- f) The MNO will benefit from this model since many mobile broadcast

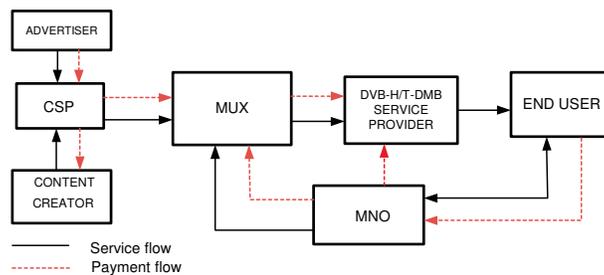


Figure 9: Free-to-Air Model

services will need user interaction of some kind. Examples:

Service/content subscriptions or purchases; Interaction with the actual service by sending data; Fetching content information from the Internet.

11.3.2 Free-to-Air Model

The main source of revenue in this model is through advertisements. However, all models one will use advertisements and promotion of available services in the BTH. The MNO will benefit from this model since the end user will pay the MNO for ordinary mobile services related to BTH including premium SMS charges.

11.3.3 MNO Led Model

MNO operators shall be central in this model. The operator owns cellular network and provides traditional mobile cellular services and shall also be

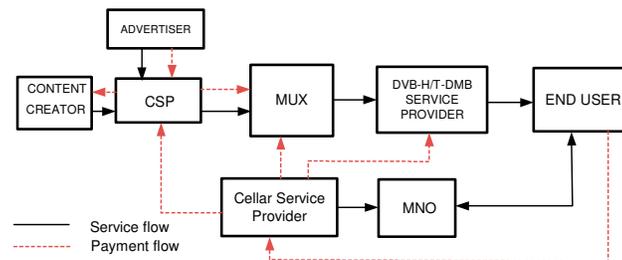


Figure 10: MNO Led Model

the MUX operator for own mobile broadcast services.

The MNO benefit:

- Mobile broadcast services to mobile phones will present MNO with the possibility of offering new services including TV programmes.
- Increase mobile traffic and hence increased revenue from users since the mobile terminal will provide the return channel (interactivity) for all forms of broadcasting services.
- The MNO has the advantage of its customer base, the existing customer management interface and charging and billing system.

The CSPs Benefit:

- d) MNO may have to obtain content from CSPs
- e) CSPs shall have more outlets for their contents that can lead to exclusivity agreements in competing for attractive content.

11.3.4 Combined Model

- a) A dedicated cellular service provider to act as a facilitator for mobile network operators in the aggregation of channels and the usage of

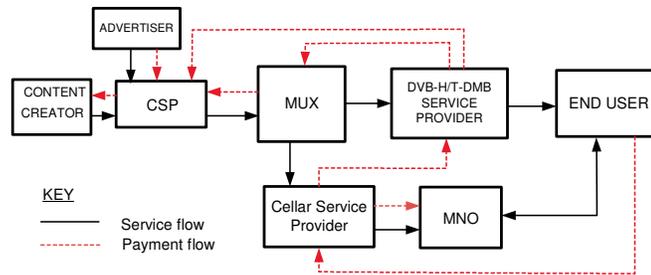


Figure 11: Combined Model

broadcast transmission capacity in this model. The cellular service provider will purchase content from CSPs and other content providers including mobile network operators.

- b) The Cellular service provider may become a BTH broadcaster establishing his own channels by acquiring a CSP licence. The mobile network operators customers will have access to an integrated service proposition. Each MNO will have to offer a complete package.
- c) The MNOs will bill the Cellular Service Provider who in turn will bill their customers for the service. Fully interactive services are possible, and no separate billing procedure will be necessary.
- d) General marketing will be done by the MNOs while CSPs will be responsible for marketing their own programmes and services. For services that facilities in delivery, revenue will have to be shared.
- e) The MNOs will have full control over the mobile device.
- f) The Cellular Service Provider needs to set the standards for the services including broadcast reception and purchase and protection.

- g) The model overcomes the inefficient usage of frequencies of the mobile network operator-led model.
- h) Commercial Risk:** The commercial risk in this model is with the Cellular service provider being a mobile CSP in that he has to hire network and operation services from MNOs at a cost which he does not have control.

11.3.5 Revenue Sources for the Business Models

- i) Customers
 - ii) Advertising
 - iii) Broadcast network access fees
- a) **Customers revenues:** are based on the additional value of mobile TV services
- i) Monthly subscription fees (most acceptable according to surveys)
 - ii) Pay-per-view
 - iii) Time based charging
 - iv) Premium SMS charging for interactive services
 - v) Internet charging mechanism
- b) **Advertising:**
- i) Selling airtime
 - ii) Combined broadcast advertisement and personalized advertising features using interactive channel
- c) **Broadcast network access**
- Potential interest in securing access to mobile broadcasting to extend coverage of area and/or time of the day

11.4 Recommendations

11.4.1 Broadcasting to Handheld (BTH) may tend to affect the traditional services of broadcasters and telecommunication operators, and there will therefore be gains and losses on both sides. The best chance for BTH

success is therefore to develop business models and alliances across the various elements of the value chain.

11.4.2 This offering of another platform for broadband services it will be appropriate to be handled through the MUX Operator to foster competitive climate in the liberalized economy being advocated worldwide in the interest of Rwandan dwellers instead of using mobile telephone operators as BTH MUX Operator since they are already data services.

11.4.3 In view of the fact that BTH technologies are evolving, the Regulator should keep abreast with the evolution and advocate the best solutions for Rwanda avoiding offloading technologies that are being phased out elsewhere.

CHAPTER TWELVE: INTERNET PROTOCOL TELEVISION (IPTV)

12.1 The Internet Protocol Television (IPTV) is highly interactivity.

12.1.1 IPTV is implemented in broadband networks, is inherently bi-directional which enables interactive television services and the Internet on television.

12.1.2 IPTV can be used to provide consumers with a larger variety of content and services on the television screen than other digital television distribution technologies.

12.1.3 IPTV utilizes IP networks, allowing consumers to use the same IPTV service on several immobile and mobile terminal devices, such as televisions, mobile stations and portable computers.

12.2 IPTV can be used to implement services requiring high data capacities

12.2.1 Video-on-demand and HDTV transmissions rather than other digital television distribution technologies.

12.2.2 Distribution capacity can be increased flexibly and, theoretically, there are no restrictions on the number of television channels provided, as is the case with the other distribution methods.

12.2.3 Can realize IPTV-level interactive services in the least complicated in other distribution channels using hybrid distribution model since broadband connections inherently include a return path.

12.3 The IPTV technology will enable the provision of versatile digital television services to a larger group of users through IP networks and will introduce an element of competition to cable television networks.

12.4 In terms of regulatory approaches to IPTV

12.4.1 In Hong Kong, Brazil and Taiwan, IPTV services is used to provide audiovisual content on a subscription basis appear to be regulated on the same basis as existing pay television services in those jurisdictions.

- 12.4.2 In India is considering the option of regulating IPTV services as part of its general telecommunications regime, separate from the regulation of pay television.
- 12.4.3 In Japan, IPTV is considered broadcasting, under a category of broadcasting in Japanese broadcasting law of “broadcasting using a telecommunications services”.
- 12.4.4 The European Union is proposing a two-tiered regulatory structure for all audiovisual media services, distinguishing “linear” services (where the service provider decides the programming schedule) and “non-linear” services (on-demand audiovisual services, where the user decides what to watch and when). Non-linear services will be subject to minimum content and advertising regulation, while linear services would be subject to regulation similar to that which currently applies to television broadcasting services.
- 12.4.5 In the US, regulation of IPTV is affected by state-based regulation of telecommunications and local community cable franchises. Some states have passed legislation defining IPTV as not being equivalent to cable television, releasing IPTV from some or all of the regulatory burdens that come with cable, while other states are proposing similar regulation of IPTV services to cable services.

12.5 **Recommendation:** The Regulator is advised to take note of the IPTV developments worldwide and formulate regulatory mechanisms that are appropriate for Rwanda.

CHAPTER THIRTEEN: CONCLUSION

- 13.1 Managing the change from analogue to terrestrial digital broadcast in Rwanda needs to be carried systematically as it involves many variables and affecting all social groups- consumers, industry and public authorities and present and future broadcaster. The comprehensive roll out plan needs to be developed and communicated to the public
- 13.2 The research done indicates that most of the people in Rwanda don't understand what digital broadcast entails. The success factors for migrating to digital broadcast shall require Public awareness campaign for broadcasters, consumers and the government itself. Cost of Set Top Boxes might be the barrier to meet switch off deadline set by ITU (June, 2015)
- 13.3 The appropriate licensing framework , amendment of legislation and regulations which shall provide the roles of MUX operator, Content service providers and the regulator needs to be effected for proper implementation of digital broadcasting
- 13.4 The government shall be required to subsidize the cost of the Set Top Boxes to expedite the migration process

CHAPTER FOURTEEN: RECOMMENDATIONS

Recommendations:

- 14.1 Switchover has to be handled systematically since it involves many variables and affecting all social groups - consumers, industry and public authorities and broadcasters so as not to be a protracted process.
 - 14.1.1 Adopt “Managed” migration scenario where migration to digital is managed and promoted with clear strategies and plans while involving all stakeholders in every stage of the migration process.
 - 14.1.2 Ensure fair competition to encourage investment in digital broadcasting.
 - 14.1.3 Have a national switchover roadmap and action plan.
- 14.2 Rwanda being part of ITU region 1 need to adopt DVB-T system as agreed at the Regional Radio Conference (RRC 2006) to replace the analogue system (GE 89) currently in use.
- 14.3 Rwanda should adopt the three reception modes applicable to DVB-T: Portable reception for indoor/outdoor, fixed reception requiring rooftop antenna and mobile reception.
- 14.4 The three basic models that digital broadcasting offer namely free-to-air, the pay TV/ subscription services and a hybrid model need to be enabled in the regulations and licence provisions.
- 14.5 The regulator needs to acknowledge the need of a MUX Operator in the digital broadcasting environment. The MUX operator shall be responsible for content aggregation, multiplexing, distribution and transmission.

- 14.6 The MUX Operator be licensed to own and operate infrastructure and applicable platform, subscriber management system, conditional access and any other facility necessary to facilitate the effective and efficient delivery of services by the operator.
- 14.7 MUX Operator be provided with necessary frequency to meet needs of its customers (CSPs).
- 14.8 The Regulator to establish the functions and obligations of the MUX Operator.
- 14.9 During migration period, the regulator has to provide for Dual Illumination and recognise the associated costs.
- 14.10 It is essential that a basic infrastructure be established to support interoperability in the digital broadcasting environment otherwise consumers will find themselves requiring different receiver for different offerings.
- 14.11 CSPs and MUX Operators will have to plan appropriate marketing strategy in order to inform and educate the public on the switchover to digital broadcasting. The Regulator can share the related costs with other stakeholders.
- 14.12 The analogue broadcasting switch-off to remain 2015 as agreed by ITU member states.
- 14.13 There are three key players in the broadcasting value chain in the delivery process of broadcasting services: the MUX Operator, the Content Service Provider (Broadcaster) and the Network (infrastructure) Service Provider. However, it is recommended that only two players be adopted; the Content Service Provider and the MUX Operator. The MUX Operator to play the roles of operating MUX and that of Network Service Provider.
- 14.14 There are four key players in the digital broadcasting chain; the Regulator, the MUX Operator, the Content Service Provider and the Consumer. The role of each of them and the relationship among them has to be recognized to facilitate smooth migration process.

- 14.15 There are three service area networks for MUX Operator envisaged; National Service Layer, Province Service Layer and the Community Service Layer.
- 14.16 There is no business case to have Province and Community MUX Operators in Rwanda at present hence province and community services initially be provided by the countrywide MUX Operator. This may be reviewed as the broadcasting industry grows in Rwanda.
- 14.17 There is no business case for a separate MUX Operator for added value service at present.
- 14.18 Two MUX Operators are being recommended initially: the PMUX and one CMUX reflecting broadcasting activities in Rwanda at present.
- 14.19 Carrying value added services either as part of offering by a broadcaster (CSP) or as an additional service from other sources be part of the role of the MUX Operator. However, it should be emphasised that advertising material in digital additional services be legal, honest, decent and truthful.
- 14.20 The Regulator needs to be conscious in licensing Mobile Network Operators to being MUX Operators since there can be conflict of interest and can lead to monopoly tendency in the communication sector.
- 14.21 With exception of the PSB a CSP should not be a MUX Operator since this cannot guarantee impartiality in rendering services to all CSPs or can be a potential reason for clash in the name of foal play. The CSPs having a viable business case that have a legal entity can be considered.
- 14.22 PSB be allowed to own and operate a MUX and to allow public use of extra space in the PMUX.
- 14.23 The government may consider establishing an administrative unit (PSB) that shall oversee and coordinate the running of PMUX, Rwanda Radio and Television Rwanda.

- 14.24 The PSB be facilitated by the government to spearhead migration process by providing it with resources to rollout digital infrastructure to cover areas beyond those covered in analogue broadcasting today and for retraining the core staff timely.
- 14.25 There is need for review of the current law governing broadcasting in Rwanda to enable it capture the dynamic and wide offering possible with digital broadcasting. The current law will not prevent abuse of the functionalities possible in digital environment. The review should however create conducive climate for investment in broadcasting and added value services.
- 14.26 The licence conditions for the current broadcasters need be revisited inline with the new development and re-orientation of the broadcasting industry.
- 14.27 The selected broadcasting standard for adoption should be that widely adopted internationally and that shall facilitate the provision of highest possible channel transmission capacity to meet new demand for broadcasting services during and after the simulcast period to maximize coverage. However, T-DAB is for sound and DVB-T is for video broadcasting as agreed during planning process. Use of technologies being phased out elsewhere should be avoided.
- 14.28 DVB-T standard will use Band IV and V while Band III will be shared by DVB-T and T-DAB.
- 14.29 Using current DVB-T technology, a single channel can accommodate 7-8 programmes while maintaining current reception quality. This can increase as technology develops further.
- 14.30 Frequency planning should be efficient to facilitate smooth transition from analogue to digital broadcasting. The existing and planned analogue broadcasting stations need be protected during migration while being flexible and forward looking to cover future developments and frequency spectrum requirements. A framework should be provided to satisfy individual requirements on an equitable basis.

- 14.31 Frequency planning and utilisation near border areas have to be coordinated with neighboring countries to avoid interference.
- 14.32 Rwanda need to consider adopting single frequency networks (SFN). SFN can be used to cover the whole country and use filler gaps of low power to remove coverage gaps that may occur.
- 14.33 There is need to study customers' behaviour and expectations towards DVB-T through joint initiatives from market players to build common knowledge amongst all market players on consumers' attitude and behaviour.
- 14.34 Review broadcasting law so as to accommodate the digital terrestrial digital broadcasting. All laws that that have impact in one way or another on the migration process need be revisited when reviewing the law that govern broadcasting in Rwanda.
- 14.35 Broadcasting to Handheld (BTH) is subjected to a number of major technologies which are T-DMB, DVB-H, DABIP, CMMB, MBMS, ISDB-T and MediaFLO. The adopted technology is regional based; the main ones being T-DAB and DVB-H. There are four possible business models. Hence, BTH presents a real challenge to regulators who have to evaluate at the time of introduction of the service the most rational technology and business model otherwise it will result in fragmented offering as the technology itself is at this material time.
- 14.36 Broadcasters should invest in the aspect of capacity building and human resource development by ensuring necessary training in all critical skill areas in the digital broadcasting chain.
- 14.37 The minister responsible for communication sector to consider forming a Task Force which shall oversee smooth migration process till its completion.

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Activity	2007	2008	2009	2010	2011	2012	2013	2014	2015
Prepare migration Strategy									
Consultation with stakeholders on licensing framework									
Prepare Tender document for MUX Operator									
Develop Digital Broadcasting Policy									
Amendment of ACT to accommodate digital Broadcast									
Consumer awareness Campaign									
Coordinate with Industry and manufacturer									
CMUX Licensing									
CMUX Operator gradual roll-out of digital Infrastructure									
CMUX Infrastructure roll –out target 25%									
PSB start process of establishing PMUX Operator									
PMUX gradual roll out									

ANNEX 2

IMPLEMENTATION OF DIGITAL BROADCAST IN EUROPEAN COUNTRIES AT DIFFERENT STAGES

Country (ITU Code)	Co-ordination in progress (yes / no)	Number of transmitters (not number of stations)				Percentage of households that can already, or are expected in the near future to, receive the quoted number of multiplexes						Number of DVB-T receivers in use (sold or rented)	Date of last update
		In operation		Total after one year from now		1 MPX	2 MPX	3 MPX	4 MPX	5 MPX	6 MPX or more		
		e.r.p. < 1kW	e.r.p. ≥ 1kW	e.r.p. < 1kW	e.r.p. ≥ 1kW								
AUT	Yes	-	2	-	-	5	-	-	-	-	-	200	10-02-05
BEL	Yes	1	9	1	12	80	40	0	0	-	-	10000	06-10-2005
BIH	No	0	0	0	0	-	-	-	-	-	-	0	17-10-03
BUL	Yes	1	1	7	-	26	12	-	-	-	-	unknown	06-10-2005
CZE	Yes	-	5 ¹⁾	-	-	>10	>10	-	-	-	-	~2000	06-10-2005
D	Yes	19	208	29	298	-	-	-	-	-	-	> 3.000.000	29-09-2005
DNK	Yes	0 ¹⁾	2 ¹⁾	4 ¹⁾	17 ¹⁾	>90	-	-	-	-	-	>15000	29-09-2005
EST	Yes	-	1	-	2	40	-	-	-	-	-	-	27-09-2005
F	Yes	-	17	-	-	-	-	-	-	-	-	-	03-10-2005
FIN	Yes	77	97	120	100	99	99	85	-	-	-	> 500 000	03-10-2005
GRC	No	-	-	-	-	15	-	-	-	-	-	-	10-06-03
HNG	Yes	2 ¹⁾	3 ¹⁾	2 ¹⁾	3 ¹⁾	-	-	-	-	-	-	-	06-10-2005
HOL	Yes	25	96	-	136	25	25	25	25	25	-	-	06-10-2005
HRV	Yes	-	3 ¹⁾	-	7	40	-	-	-	-	-	-	28-09-2005
I	Yes	700	900	800	1000	60	50	25	10	5	-	>1.000.000	04-10-2005
IRL	Yes	-	-	-	-	-	-	-	-	-	-	-	26-09-2005
LTU	Yes	-	(1)	-	≥1	25	-	-	-	-	-	>10	06-10-2005
LVA	Yes	1 ¹⁾	-	-	-	-	-	-	-	-	-	~ 2500	06-10-2005
LUX	yes	-	3	-	4	-	-	-	-	-	-	-	06-10-2005
MDA	Yes	-	2 ¹⁾	-	2	10	-	-	-	-	-	3	17-10-03
MLT	Yes	-	5	~8	~56	-	-	-	-	-	100	n/a	23-09-2005
NOR	Yes	-	5 ¹⁾	-	6	30	22	-	-	-	-	-	06-10-2005
POL	Yes	1	4 ¹⁾	1	16	~21	~16	-	-	-	-	> 20 000	27-09-2005
POR	Yes	0	0	0	0	-	-	-	-	-	-	-	06-10-2005
ROU	Yes	-	-	-	-	-	-	-	-	-	-	-	16-09-03
RUS	Yes	1	4	1	5	-	-	-	-	-	-	-	06-10-2005
S	Yes	34	249	~80	~277	90 (98)	90 (98)	90 (98)	90 (98)	50	-	550,000	04-10-2005
SUI	Yes	114	13	201	21	20	-	-	5	-	-	15000	26-09-2005
SVK	Yes	-	3 ¹⁾	-	7 ¹⁾	17	-	-	-	-	-	5500	04-10-2005
SVN	Yes	-	2 ¹⁾	-	2 ¹⁾	15	-	-	-	-	-	20	06-10-2005
TUR	No	-	-	-	-	-	-	-	-	-	-	-	28-09-99
UK	Yes	231	267	231	267	81	80	78	79	76	74	5,180,000	30-09-2005
UKR	Yes	-	1	-	1	< 1	-	-	-	-	-	-	06-10-2005

(1): Test transmission

te: No information is available for those countries that are not included in the table above.

Annex 3

The following table shows launches of DTT and the closing down of analogue television in several countries:

Country	Official launch	Start of closedown	Closedown finished	System used
United Kingdom	15 November, 1998	Planned 2008	Planned 2012	DVB-T
<u>Sweden</u>	April, 1999	19 September, 2005	21 November 2007	DVB-T
Spain	May 2000	2008 (Local channels)	2010 (Other channels; 2009 in Catalonia)	DVB-T
Finland	August 27, 2001	August 31, 2007		DVB-T
Germany	November 2002	August 2003	Planned 2008	DVB-T
Portugal	2002/2003		2010	DVB-T
Faroe Islands	2002/2003	December 2002		DVB-T

Belgium	2002/2003			DVB-T
Netherlands	2003			DVB-T
Italy	January 1, 2004			DVB-T
Switzerland	Began 2005			DVB-T
France	March 31, 2005			DVB-T
Greece	January 16, 2006			DVB-T
Denmark	March 31, 2006	November 1, 2009		DVB-T
Turkey	February 2006			DVB-T
Albania	August 2005			DVB-T

Australia	January 1, 2001	Planned 2010		DVB-T
South Africa	March, 2006	Planned 2009		undecided