



Assessment of the Scope and Usage of Digital Dividend in Nigeria

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ABSTRACT

The rapid pace of innovation in wireless technology has placed increasing demand on the frequency spectrum in the last decade. The evolution of digital television provided a way of meeting this spectrum demand since a substantial part of the television spectrum could be released for other services after digital switchover. In this paper, we estimate the spectrum savings possible from digital television switchover in Nigeria. The paper shows that it is possible to save 168MHz as digital dividend after the transition to digital television. The paper also considers the country's decision to use this dividend for digital television and mobile broadband by determining if this is the optimal choice for Nigeria based on technical, economic and social constraints. Findings show that, technically, the services can coexist if proper measures are taken during the planning stage of the national digital television network. Findings also show that both services have huge economic and social value to the nation. The paper recommends that social value take a higher priority over economic value in a developing country like Nigeria to bridge the existing digital divide. Finally, recommendations on a feasible digital television migration framework for Nigeria were made to the government and stakeholders.

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INTRODUCTION

For decades, terrestrial broadcasting used significant parts of the VHF and UHF frequency spectrum, mainly in the VHF band (173-230 MHz) and UHF band (470-862 MHz). This spectrum was used mainly to deliver analogue terrestrial television services. However, the inefficient use of spectrum by analogue television led to the worldwide campaign of transition to the newer digital television technology. With the compression technique employed in digital television broadcasting, more signals can be aired using less spectrum space compared to analogue television. The use of less spectrum implies that some spectrum can be freed up and made available to new digital services. The

transition of terrestrial digital television broadcasting also offers other advantages to viewers including; improved signal quality, a greater number of channels and new services such as high definition television (ITU, 2012). A major importance of the digital dividend for developing countries like Nigeria is that it will help bridge the existing digital divide. This divide is assessed by the ability or inability to access information communication technologies, as well as skills to use them due to the differences in geography, race, economic status, and gender (OECD, 2018).

Digital television broadcasting has been in service for over a decade in many countries and full digital switchover has even been achieved in some of these



countries. Though the initial cut off date for analogue television in the UHF band was June 2015 (ITU-RRC, 2006), Nigeria is yet to switchover to digital television. After several failed dates for the transition, the new date is now set for 2021. Although Nigeria sought to embrace the new broadcast innovation, inconsistent policies and inadequate migration framework have hindered this.

The size of the digital dividend has been estimated in some developed countries, (Krišelj & Copot, 2013), and there is also the need to assess the size of this future digital dividend in Nigeria. This will help administrators and regulators determine ways to use and manage the released spectrum efficiently since there are many competing services for the spectrum. Also, there is need to estimating the size of this future digital dividend ahead of time because if the VHF and UHF bands are not available on time for these new digital services, an alternative spectrum would have to be used and changing spectrum to the freed-up bands at a later date will introduce extra cost and reduce overall cost-benefit from the transition. For example, the benefit from the release of the digital dividend was estimated to add \$325 million to New Zealand economy in 2012 but if delayed by three years, the nation would add only \$230 million to her economy (Vodafone, 2009).

Regulators have made predictions on the benefits of this transition to the Nigerian economy. It is hoped that at digital switchover, all the TV stations, both old and new, will operate in the frequencies below 700 MHz. This implies that frequencies in the 700MHz to 800MHz range can be re-farmed. The economic benefits will depend on the potential candidates to use this freed-up spectrum. Services lined up for the use of the freed-up spectrum worldwide include mobile television, more digital television services, High Definition Television (HDTV), broadband wireless applications, emergency, and

public safety services, and communications technologies for medical professionals and educational institutions (Kholod and Lewis, 2010). The decision on which service is best for the freed-up spectrum will be based on three considerations; technical constraints, economic benefit and social benefit.

In this paper, an estimation of possible savings from the transition from analogue to digital television in Nigeria was done since the size of the digital dividend will vary from one country to another, owing to national circumstances and type of technology used. The paper also considers potential service competing for the use of the future freed-up spectrum in Nigeria and analyzes the benefits it will offer for occupying this spectrum in a developing country like Nigeria. This is important as decisions to be made now on the use of the digital dividend will have major implications in the coming years because some changes will be irreversible. The paper concludes with recommendations to the government and policymakers on the future digital dividend.

Broadcasting is very important in Nigeria because a majority of Nigerians get their information, education, and entertainment from primarily radio and television. Despite the proliferation of mobile phones and computers, analogue broadcasting still constitutes a vital part of the average Nigerian's daily life. In the last few years, Nigeria has been planning the television broadcast switchover from analogue to digital because of the latter's many benefits. New developments in wireless communication technologies are continually threatened by the scarcity in the frequency spectrum and the transition from analogue to digital television is one way of solving this problem. Though it is a well-known fact that one main advantage of digital television over analogue television is spectrum efficiency, there is however the need to quantify this efficiency and estimate this digital dividend to be able to



determine which wireless communication service should benefit from this dividend. Several services are competing for the use of this dividend after the transition to digital television and there are some national and international policies to be considered in the allocation of the digital dividend. This is important because the decisions to be made now on the use of the digital dividend will have major implications in the coming years because some changes will be irreversible.

This paper estimates the digital dividend using planning parameters that best suit the Nigerian environment. The paper also assesses the digital service proposed to use this dividend after switchover through thorough analysis using technical, economic and social factors to determine if it the best decision for Nigeria. The objectives of the study are as follows:

- i. Determination of the size of the spectrum that can be freed up as digital dividend for new digital services in the VHF and UHF frequency bands,
- ii. Proposal of a plan for the use of the freed-up spectrum in a way that allows the co-existence of digital services and benefits the citizens of Nigeria, and
- iii. Recommendations for government and stakeholders on a feasible framework to speed up the migration process.

SCOPE OF DIGITAL DIVIDEND

Asides being more spectrum-efficient, digital terrestrial television offers broadcasters a higher number of television programmes, higher sound and video quality, and opportunities for new services. Compared to analogue television that can broadcast on one transmission channel with 6-8MHz bandwidth, a digital television multiplex can be used to broadcast several digital programmes

using a single channel. This reduction in the amount of spectrum required for digital television makes it possible to release the freed spectrum for other services. The size of the digital dividend varies from country to country and is determined by the trade-offs derived from the choice of parameters of the digital transmission particularly the type of digital television reception, the quality required and the respective use of multi-frequency network (MFN) and single-frequency network (SFN), (ATU/ITU, 2012).

According to projections given by the Nigerian government, it is possible to re-farm frequencies in the 700MHZ to 800MHZ range after the transition to digital television. However, in this research work, the author seeks to find the optimal digital dividend possible after the transition. Previous work by the author of this paper compares the spectrum used by current analogue television to spectrum usage by future digital television in Nigeria (Gbenga-Ilori, 2010). Figures 1, 2, and 3 show the spectrum used in different geo-political zones of the country by analogue television in both the VHF and UHF bands while Figure 4 shows the spectrum that is predicted to be needed by digital television.

Analogue television in Nigeria makes use of the VHF band III which consists of 8 channels and UHF band which consists of 49 channels, making a total of 57 channels available for television broadcast services. There are 129 analogue television terrestrial broadcast stations across the nation of which 51 stations are owned by the federal government, 45 stations are state-owned and the remaining are privately-owned (Sanusi, 2014). From Figures 1, 2, and 3, a total of 42 out of the 49 channels are used by analogue television and the total size of the spectrum used by analogue television is 328MHz.

To be able to predict future spectrum use by digital television as



shown in Figure 4, some assumption has been made (Gbenga-Ilori, 2010). First, the paper assumes that Nigeria will use the DVB-T2 system variant with the MPEG-4 coding technique coupled with statistical multiplexing. Also, the paper assumed that existing analogue television station locations would be reused for digital television. This means that some infrastructures can be reused and the cost of transition can be reduced. Owing to

ethnic and cultural diversities in Nigeria, a mixture of SFN and MFN will be used to deploy national multiplex. The paper also used the IRT prediction model, which has been tested to be appropriate for our environment (Gbenga-Ilori & Ibiyemi, 2009). The entire digital television network was planned with 87 main transmitters and 42 relay stations.

Zone	5	6	7	8	9	10	11	12	21	22	23	24	25	26	27	28	29	30
South-East	Yellow	Yellow		Yellow				Yellow	Yellow			Yellow			Yellow		Yellow	Yellow
South-South			Red		Red	Red	Red	Red		Red			Red		Red	Red	Red	
South-West	Purple		Purple			Purple	Purple	Purple	Purple	Purple			Purple	Purple	Purple	Purple		
North-Central	Green		Green	Green	Green	Green			Green		Green		Green					Green
North-East	Blue	Blue	Blue	Blue	Blue	Blue				Blue			Blue	Blue		Blue	Blue	Blue
North-West	Brown	Brown		Brown	Brown	Brown					Brown	Brown					Brown	

Figure 1. Spectrum used for Channels 5 to 30

Zone	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
South-East					Yellow						Yellow		Yellow					
South-South	Red	Red			Red						Red				Red			
South-West		Purple			Purple		Purple		Purple		Purple		Purple		Purple			
North-Central	Green				Green		Green	Green		Green	Green	Green						
North-East		Blue				Blue		Blue										
North-West								Brown	Brown						Brown			

Figure 2. Spectrum used for Channels 31 to 48

Zone	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67
South-East		Yellow			Yellow						Yellow								
South-South						Red	Red												
South-West	Purple				Purple										Purple				
North-Central			Green		Green		Green												
North-East																		Blue	
North-West						Brown													Brown

Figure 3. Spectrum used for Channels 49 to 67



	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40
MUX1	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
MUX2	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
MUX3	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
MUX4	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
MUX5	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
MUX6	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
MUX7	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█
MUX8	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█	█

Figure 4. Spectrum Used in Nigeria by Digital Television.

As shown in Figure 4, VHF channels will not be used for digital television deployment in this digital network planning and 20 out of the 28 UHF channels are used for the 8 multiplexes deployed nationwide (Sanusi, 2014). Multiplex 1 was planned to consist of six main digital television transmitters from Ondo and Ekiti states of the south-west zone. Multiplex 2 is made up of 14 primary transmitters from Oyo, Kwara and Osun states. Multiplex 3 is made up of sixteen main digital television transmitters from Lagos and Ogun states. Multiplex 4 consists of sixteen transmitters from the south-east region. Multiplex 5 consists of twenty-one transmitters from Edo, Delta, Rivers, Cross River, Akwa-Ibom and Bayelsa states. Multiplex 6 is made up of twenty transmitters from Gombe, Zamfara, Sokoto, Kano, Kebbi, Jigawa, Plateau, and Federal Capital Territory. Multiplex 7 comprises of sixteen transmitters from Taraba, Yobe, Borno, Bauchi, and Adamawa states. Finally, multiplex 8 comprises of twenty transmitters from Niger, Kaduna, Katsina, Nasarawa, Kogi, Benue, Plateau and Kwara state. This implies that we can save 168MHz as digital dividend after the transition to digital with our planning parameters.

Factors used in multiplex grouping include the physical size of the service area and the possibility of providing regional content; the same programming, channel, advertising, and

data services. Though the digital television network was planned with the assumption that existing analogue television services will transit to digital television in the future, Figure 4 shows that there is an opportunity for future addition of digital television programmes in each multiplex as there are extra channels left in each multiplex for expansion in the network.

Migration from analogue to digital television has faced a lot of challenges in Nigeria. One major challenge is the provision and affordability of set-top-boxes (STBs) in the country. Funding remains the biggest limitation to the process of STB subsidy since Nigeria has about 50% of its population living in poverty (Bertoni et-al, 2016) and STB boxes have to be either subsidized for affordability or manufactured locally. Slow governmental intervention in this regard is an issue. According to a government white paper, 28.8 million STBs are required nationwide for a successful digital switchover and 10 million of these must be subsidized for identified poor households in Nigeria (Adepetun, 2017). Going forward the federal government needs to agree with stakeholders on a feasible migration framework that should address critical infrastructure needed for digital switchover, and digital services which should benefit from this digital dividend.



SERVICES COMPETING FOR DIGITAL DIVIDEND

In Africa, it has been agreed that mobile services should take over the use of digital dividend (ATU/ITU, 2012). In Nigeria, however, mobile broadband is planned to take over the freed-up spectrum after digital switchover. In this section, the paper considers the suitability of the two services that will coexist in the UHF band.

Digital Television

The allocation of digital dividend to mobile services was initiated at the World Radiocommunication Conference 2007 (WRC-07) where the 790-862 MHz frequency band, originally owned by broadcast services, was allocated to mobile service (ITU Acts, 2007). At another conference held in 2012, known as WRC-12, it was agreed to extend the allocation of the mobile service to the 694- 790 MHz frequency band (ITU Acts, 2012). It is therefore clear that the services competing for the use of this digital dividend after the transition to digital television will include digital broadcast services and mobile services. In Nigeria, Digital television services will be Standard Definition Television (SDTV) and High Definition Television (HDTV) while the mobile service proposed is mobile broadband (NCC, 2019). Some international policy issues that must be considered in the allocation of the digital dividend to any service includes consideration of its educational benefits to the society, promotion of informed democracy, promotion of culture, promotion of community engagement, impact on digital access and inclusion, and impact on the quality of life (ITU, 2012). These policies must be considered critically as it is important to use the dividend in a way that will also benefit the

citizens of the country and not just driven solely by the market gains.

Mobile Broadband

According to available statistics, mobile broadband has a promising market with an increase of more than 16 times since 2007 (Umezuruike, 2015), and a global penetration reaching 59% in 2017. Statistical report by the International Telecommunication Union (ITU) indicates that broadband penetration in Nigeria is still very low and stood at 22% of the population as at April 2018 while internet users, in general, amounted to 47.1% of the population in 2018 as shown in Figure 5 (ITU/UNESCO, 2019). The NCC acknowledged this and initially targeted an increase in broadband penetration to 30% of the population by the end of 2020, (ITU, 2015). The government has however updated its broadband ambitions, aiming to increase penetration from 30% by 2020 to 70% by 2021 and most connections will be via mobile networks (ITU/UNESCO, 2019).

Mobile broadband is fast evolving in the communication industry in Nigeria and this is evident given the proliferation of broadband-enabled smartphones and other handheld devices in our markets. This growth is understandable considering the population of the youth in the country that is around one-third of the country's population. It would, therefore, be an ideal technology for the extension of broadband services to the unreached. The importance of broadband in the 21st Century cannot be overemphasized. It enables access to business and job opportunities, improves healthcare, education and government services, and facilitates social interactions. Mobile broadband is already deployed in Nigeria using the LTE standard but there is still needs to invest in more infrastructure in the country.

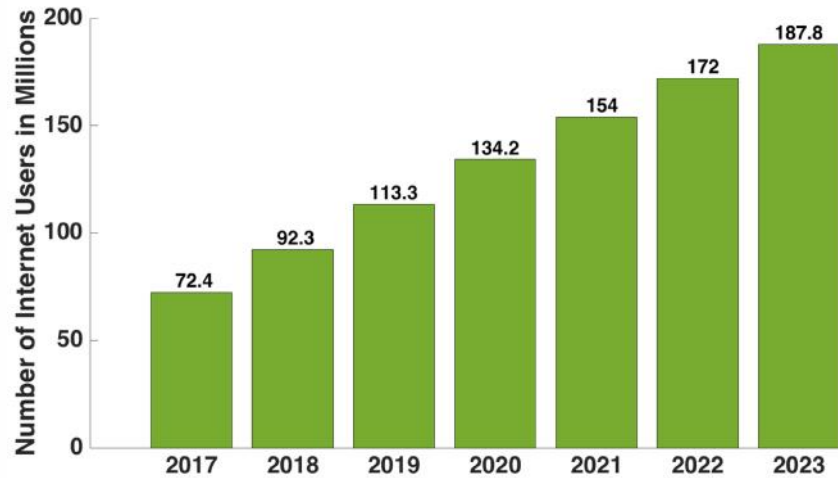


Figure 5. Internet Users in Nigeria (Source: ITU/UNESCO, 2019).

CONSIDERATIONS FOR USE OF RELEASED SPECTRUM

This paper looks at the factors that need consideration before any digital service is assigned the freed-up spectrum. This is done in order to justify the allocation of the digital dividend to mobile broadband. These factors are categorized into three; technical preconditions, economical factor, and social factors.

Technical Coexistence Preconditions

This section takes a technical look into the coexistence implications of spectrum sharing between digital television and mobile broadband. Table 1 shows the compatibility levels of the two

digital services to coexist in the UHF band in the future. Data used for the result summarized in Table 1 are derived from simulations conducted by the authors on interference analysis in digital television services, (Gbenga-Ilori, 2010) and also from previous studies on the impact of various communication services on digital television using actual field strength measurements, (ITU-R BT Series, 2017), (Fuentes et al, 2014). Results show that generally, from a technical point of view, the two services can co-exist in the UHF band. The risk of interference with the adjacent band generated in the LTE uplink must be considered during the digital network planning stage in Nigeria.

Table 1: Interference between digital television and Mobile Broadband, (Fuentes et al, 2014).

	Interference to others	Interference from others
Digital television	Interference to mobile broadband is low because of the low field strength requirements of digital television. However, an extra low pass filter with an out-of-band attenuation of 12dB is suggested.	Susceptible to interference from Mobile Broadband especially when there is an LTE uplink service in an adjacent channel. Appropriate guard bands are required.
Mobile Broadband	Not generally compatible with digital television services especially those in the adjacent spectrum when the transmission is uplink. Appropriate guard bands are required.	Interference from digital television is low; however, it is advisable to have a minimum distance of 6m between a mobile broadband user equipment and the digital television receiver.

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Economic Evaluation

This section sheds some light on the economic value of the digital dividend to Nigeria as a nation. The analysis shows the estimation of revenue potential from digital television and mobile broadband services. The revenue potentials of having more SDTV programmes have been predicted to bring enormous improvement to the Nigerian economy. According to statistics (Oxford Business Group, 2017), the present proceeds from advertising in the country is about \$750m, of which about \$300m is from television advertisements. It is also predicted that proceeds from television advertisements will increase three times after digital switch over. After the digital switchover,

the overall revenue is predicted to be about \$6.7 billion as the new Free-to-Air digital television will provide huge economic value through the manufacturing and sale of set-top-boxes, and advertisements in the over 200 free-to-air television channels expected after the digital switch over. It has been predicted that because of the Nigerian population, the country to have the largest economic value from the digital dividend in Africa (Nkwazema, 2019). The revenue from HDTV has been estimated as the same with that of SDTV but additional revenue will come to the national economy from sales of HD-ready flat-screen television.

Table 2: Revenue Potential

	Digital Television (SDTV/HDTV)	Mobile Broadband
Estimated Subscribers	76,000,000	156,533,875
Advertisement and other revenue (₦ per year)	24.22 billion	14.46 billion

Mobile broadband also offers great economic value to the country. Revenue from this will be mainly from the license fees for the freed-up spectrum and subscriber fees. Revenue from the sale of the freed-up spectrum alone is estimated at \$4 billion (Gbenga-Ilori, 2010). Revenue from both digital television and mobile broadband is summarized in Table 2.

Social Evaluation

The paper considered the social value of these two digital services to quantify their contribution to the Nigerian society. Social values can be quantified by determining the contributions of this service to a better and informed society, educational development, research and development, public health consciousness, and promotion of culture and national growth.

In a developing country like Nigeria, the educational benefit of television is enormous and is especially noticeable in rural areas where locals do

not have access to other communication services. SDTV can offer formal educational benefits or informal benefits through knowledge gained from the programmes offered. It seems likely that HDTV will primarily focus on entertainment like sports, movies and drama rather than educational content. Mobile broadband, on the other hand, is the key to bringing education to all irrespective of their location. It is a technology that can be used to reach Nigeria’s poorest and rural communities. The educational benefit of mobile broadband is also huge in urban areas where information and communication technologies (ICTs) needed for classroom teaching are not enough. Some of the ICTs transforming the education sector include the use of digital textbooks, Internet-based research and learning, interactive teaching and learning software, open-access digital libraries and courseware, and remote distance learning (UNCTAD, 2015). A study by the United Nations (UNCTAD, 2015) highlights the tremendous gains being made in the

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deployment of advanced technologies in education and the continuing divide in ICT access between students in the developed and developing countries. The use of digital dividend for mobile broadband services can be used to bridge this divide in Nigeria.

With the addition of new programmes that digital television will offer through SDTV and HDTV, the amount of time spent by the people watching television will be significantly increased. Homes with multichannel satellite television like DSTV are likely to spend more time watching television than those without because they are offered more choices. This hopefully will improve class inequality in Nigeria since those that were unable to afford pay satellite television will be provided the free-to-air digital terrestrial television. Digital television will also create an informed society in Nigeria. One of the evaluations of a successful democratic society is to determine how the citizens are empowered to obtain information that relates to issues concerning them, and in which they have an interest. Mobile broadband will support entrepreneurial activities and make it easier to provide equal opportunities for rural and urban dwellers. Mobile broadband will provide new platforms for access to news on the move and prevailing technologies for business.

There is no controversy that the media can create positive and negative externalities in terms of their impact on cultural understanding. They are also important in maintaining local and national identities. Digital television and mobile broadband services are both useful in promoting culture through arts, drama, film and documentaries. Broadband plays a major role in distributing and enabling access to all forms of human artistic and cultural endeavors. It enables unlimited access to creative works in high-quality formats and offers new generations of artists the

opportunity of producing their works using digital tools.

Assess and inclusion may refer to extending access to previously excluded groups or achieving a universally acceptable level of access. Digital television is the equivalent of the present analogue television services that have been the most inclusive and easily affordable service in both rural and urban areas of Nigeria. Mobile broadband networks can also be used to extend access to rural areas in the area of health, agriculture, and many more. In the area of health, for instance, broadband can help link doctors, clinics and treatment centers in rural areas to national medical resources. Finally, both services can offer a better quality of life in terms of welfare services, security, emergency services, and food security.

CONCLUSION

In this paper, the decision to use the digital dividend for digital television and mobile broadband in Nigeria has been considered to determine if this is the best way forward in Nigeria. This consideration has been based on technical, economic and social factors. In summary, both services have been found to contribute significantly to the social and economic development of the nation. Technically, the services can also coexist if proper measures are taken during the planning of the national digital television network. Though these services have a huge economic value to the nation, it is essential that the social value takes a higher priority in a developing country like Nigeria and decisions should not only be based on the monetary benefits. This will ensure that these services are able to benefit to the average Nigerian and close the digital divide in the country. Going forward, the country needs to establish a feasible digital migration framework that incorporates a vibrant research and development environment. The digital migration is an expensive process and this could be the reason why the Nigerian



government is having challenges with the digital switch over. However, for the growth of any developing country, it has to prioritize the digital switchover because it is a key to bridging the divide between the developed and developing worlds. The digital migration process has been successful in a few other African countries and Nigeria can successfully migrate with the willingness of the government and co-operation of major stakeholders.

RECOMMENDATIONS

The paper recommends the following considerations in planning the digital network:

1. The government also needs to be more proactive with regards to appropriate policies and regulations that need to be put in place for a successful digital switch over so that the value of the dividend does not diminish.
2. The government needs to put in place schemes to overcome these challenges. One way is for the government to introduce a subsidy for those that are unable to afford the set-top boxes. A better way is for the government to encourage the local production of these set-top boxes in Nigeria.
3. Governments should also not focus on generating enormous income from the digital dividend, as this will negatively impact national development by increasing the prices of these services and limit the potential benefits they have to offer.
4. There should also be policies put in place in the country now to promote the usage of ICTs and encourage the deployment and utilization of ICTs across all socio-economic sectors in the country.
5. The country, through a vibrant research and development environment, needs to establish a framework for the development of local content in preparation for the

broadcast of programmes in regional multiplexes.

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