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Digital Switch Over: Essential for the Creation of a Viable Digital-Tv Sector and Enhancing Creativity in Nigeria, A Review

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Abstract:
A study of the system of information dissemination in Nigeria presents a set of emerging issues that needs addressing by the modernization of existing frameworks. A key enabler in this study points to digital switch over for a healthy and sustainable media ecosystem. This study has shown that Nigeria with about 155 analogue television stations that operate mostly on regional and state basis, has no truly national spine for TV channels; and that 70 per cent of the over 200 million population have access to only 4 or fewer TV broadcast channels. The study also reveals that the analogue TV contents currently being disseminated are relatively weak, and the pay as you use digital terrestrial broadcasting platforms offer a few new digital – only Nigeria channels primarily for entertainment. Hence, getting the digital broadcast market to work is essential for the creation of a viable terrestrial broadcasting industry in Nigeria.

Keywords: Bandwidth, Digitization, Quantization, Switchover, Terrestrial standards.

INTRODUCTION

The key to information transformation from analogue to digital demands digitization. Digitization is the process of converting analogue information of any form e.g., text, photographs, voice, etc., to digital form with suitable electronic devices such as scanner or specialized computer chips, so that the information can be processed, stored, and transmitted through digital circuits, equipment, and networks [1]. According to [2], digital switch over (DSO) is described as the process of launching the digital terrestrial broadcasting platform and switching off analogue terrestrial broadcasting platform. A digital television is a TV broadcasting system that can transmit images with about 720 to 1080 horizontal lines of resolution as compared with about 480 lines of the ordinary (analogue) television system [3]. Digital television offers interference free, CD-quality sound and has the capacity of multiplexing at least 6 broadcast channels under one transmission bandwidth.

Nigeria keyed into achieving the mandate of digitization of broadcasting initiated by the International Telecommunication Union, ITU mandate, to transmit from analogue to digital broadcasting by June 17, 2012. This followed the treaty agreement that was signed at the Regional Radio Communication Conference (RRC-06) in Geneva, Switzerland in 2016, that ushered in an "all-digital terrestrial broadcast service for sound and TV. This was aimed at creating a more equitable, just and people centered information specifically for connecting underserved population and remote communities, thereby bridging the digital divide. The realization of this had not been easy for some countries including Nigeria. Part of the problems is that digital frequency plans must be put in place and coordinated with regional, states and even neighbouring

countries. Secondly, viewers must change their television reception equipment (set-top boxes, etc.) and many transmission sites must be upgraded over a relatively short period of time [4]. On her part, Nigeria is a large country and the number of viewers affected by the analogue switches over is enormous.

One of the greatest challenges surrounding digital switchover in Nigeria and indeed some developing countries is that nations that do not undertake the switchover now and in the nearest future will find it extremely difficult and expensive to source and repair their analogue equipment. This is because in future, the status of digital switchover would change rapidly. The statistics of the countries that have successfully switched over has it that in 1995, the USA became one country that completely switched over from analogue through ISDS and had raised a switch over standard known as ATSC. China in 2006 followed suit with its own digital terrestrial standard also known as DTMB. In North America, Europe and some parts of Asia, analogue switch over has been completed [5]. It must be noted that Nigeria depends to a large extent on these countries for the repair and supply of her needed spare parts. Hence, there is therefore the need for Nigeria to keep pace with the changing times.

Drawing from the UK experience, the Visual Baseline Studies opined that the switch over to digital television in the UK was the biggest single change to broadcasting. The switch made more choices available for millions of viewers and made way for new services that could confirm its role as one of the global leaders in broadcasting and creative industries [5] [6]. It is believed that with a large viewing population, Nigeria would achieve more dividend when she eventually transits to digital broadcasting. Nigerian broadcasters will no doubt enjoy an era of cost effectiveness as a station could be made to carry up to six or more channels of signal on the same frequency. Since digital programming are flexible and faster than analogue, stations may gradually rely on syndicated programmes because the digitization process encourages equal opportunities that results in healthy competition.

There are two primary aims of this study: 1) to review transmission bandwidth in digital transmission and to show that bandwidth in digital systems can multiplex many more transmission channels, unlike in analogue transmission. 2) to emphasize other benefits of digital switchover in Nigeria.

DSO TECHNIQUES

The major techniques of digital TV broadcasting involve the following stages, Signal sampling, Signal quantization, Signal encoding, Transmission of encoded pulses, Decoding of encoded pulses, etc. These techniques are all typified in pulse code modulation principle, PCM.

Pulse code modulation PCM is a technique used to convert the amplitude of an analogue signal to binary value and thereby digitally represent the binary values into streams of quantized amplitude with regular intervals. The use of PCM for TV signal transmission is the fastest method of getting information from one place to another. This is because PCM lends itself comfortably to time division multiplexing TDM, and also it is adoptable to microprocessor/microcontroller-controlled communication equipment, and to the transmission of digital data. Because of this, PCM is used in the distribution of live TV broadcasts from one end of a country to the other. This is made more possible by the use of microwave towers usually positioned with about 32 – 48Km interval to relay the TV signals right around the country. Each tower station contains a receiver that receives the signal, reamplifies it and transmits it to the next tower location at a reasonable

line-of-sight. However, since each reamplification of signal and noise can only aggravate the signal-to-noise ratio, it is only critical that PCM be employed in TV transmissions because it has the most noise immune system of modulation possible.

TRANSMISSION BANDWIDTH IN A PCM SYSTEM

At the rate determined by the original information content (which may be analogue in nature e.g., speech or picture content), the information signal is sampled at regular interval by the digital carrier to produce sampled pulses that could be rounded off (quantized) to the nearest approximatable amplitude values. These amplitude values help to shape up the quantized levels, that it introduces some noise at these stages.

If we assume that the quantizer uses ν number of binary digits to represent each quantized level, then the number of levels that may be represented by ν digits will be. $q = 2^{\nu}$, where q = total number of digital levels of a q - level quantization [7].

Again, let us assume the number of samples of the analogue content per second = f_s

Therefore, the number of bits/secs can be expressed as

Number of bits/secs = Number of bits per sample x number of samples per second = ν bits/sample x f_s samples per seconds.

As a matter of fact, the number of bits/secs = signalling rate of pulse code modulation (PCM) and could be denoted by " τ ". Hence, for signalling rate in PCM, $\tau = \nu f_s$, where $f_s \geq 2 f_i$.

Also, since bandwidth needed for PCM transmission is given by half of the signalling rate, transmission for bandwidth in PCM, $Bandwidth \geq \frac{1}{2}\tau$. But $\tau = \nu f_s$. Therefore, $Bandwidth \geq \frac{1}{2}\nu f_s$. Again since $f_s \geq 2 f_i$. Hence, $Bandwidth \geq \nu f_i$ for PCM digital TV transmission. The interpretation of the above equation is that within a given bandwidth of a digital TV transmission, for instance, a ν number of extra channels of signal can be multiplexed without and inter-channel interferences. This goes to explain why the DSO TV platform, often referred to as free TV, could offer its viewers with more than about 6 digital channels, including sports, music, movies, and news. In PCM TV transmission, higher bit codes are required at 10MHz sampling rate or more [7] [8]. This ensures better picture resolutions resulting from increased number of quantized signal levels. It also gives rise to excellent fidelity of TV signal that is not discernibly different from a standard continuous modulation transmission.

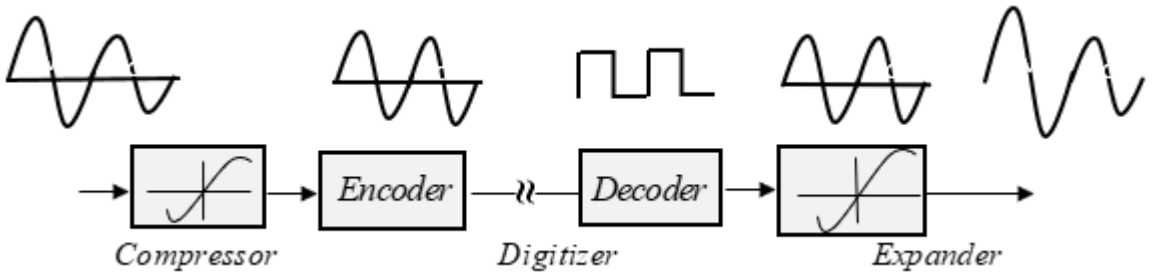

Figure 1: Companding Process

QUANTIZATION ERROR

Quantization error is as a result of the approximation made in rounding off signal levels in order to enable signal amplitudes to be easily encoded into binaries. The amount of this error can be minimized by increasing the number of quantization levels, which of course lessens the space between each other. For instance, a 4-bit code has a minimum of 16 sample levels, while a 5-bit code has 32 levels. This higher bit code decreases the error at the expense of transmission time and bandwidth of transmission. The sample rate is also critical and must be greater than twice the highest significant frequency [7] [8] [9].

The quantization error of PCM systems can be made negligible for strong signals but the very weak signals result in very significant errors regardless of the number of levels used. This problem can be overcome by the use of companding. Companding is the process of volume compression before transmission and expansion after detection [8]. This can be illustrated below.

From Figure 1, it can be observed that the weak portion of the input signal was made strong and nearly equal to the strong portion by the compressor but restored to proper level by the expander. This process is very essential in transmitting quality signals using PCM.

By the use of time-division multiplexing (TDM), PCM transmission for telephones has proved its ability to package more signal messages into short-haul cables, especially in digital PCM television transmission. This has found use in phone-in programmes, and outside broadcasting and reporting in TV transmission. Once digitalized, these voice signals can be electronically switched and restored without degradation. Because PCM could comfortably lend itself to time-division multiplexing, it is very adaptable to microprocessor–controlled communications equipment and to the transmission of digitalized data.

CATEGORIES OF DIGITAL TERRESTRIAL TV SERVICES IN NIGERIA

Licensing of DDT services in Nigeria can be grouped as below.

Digital TV Program Channel Service

This service consists of the provision by any type of TV program for the purpose of broadcasting digital form for general reception [10]. There are two main business modes of this type of TV program, namely:

Free-to-Air (FTA)

In free to air television, viewers do not have to pay to watch the television service. The stations depend largely on advertising and sponsorship to generate revenue. Organisations that seek to provide FTA services require to obtain an authorization for each digital program service. All FTA channels are usually classified as public, commercial or community and shall be carriered by a common carrier

Pay/Subscription Based

In this class, television viewers have to pay a subscription fee to watch the television service. The model requires the television to be encrypted and subscribers have to obtain a module that encrypts the service in their service. This is sometimes called conditional access (CA) module. Most pay TV operators often provide a banquet of channels to their subscribers. Hence, organizations that seek to provide pay TV services shall be authorised to provide a collection of programs services which shall be stated in the Pay TV Authorization [3].

THE BENEFITS OF DIGITAL SWITCH OVER

There are a lot of benefits derivable from switching from analogue to digital TV broadcasting in Nigeria. Some of them include

1. **Freeing of Spectrum Band:** It is expected that when the process of DSO is completed in Nigeria, some frequency bands of the spectrum would be vacated by broadcasters and would be ceded to the telecommunication regulatory agencies for sale and used in the mobile broadcast industries. The spectrum according to [11] which is expected to worth over one billion dollars would change the entire creative industry ecosystem. This is also capable of creating millions of jobs in the years to come.
2. **Utilization of Broadband:** Everywhere in the world, video consumption has been the key driver for majority of homes acquiring broadband. Consequently, the commercialization of broadband requires homes to consume the large pipes of data which uniquely video can do. An example of such commercial utilization is the thriving local film industry with lots of home-grown contents. Most other uses do not require much data. FreeTV and DSO can provide the best of local content to drive purchase of last mile home data. Also, the home equipment used for the home can be the FreeTV boxes which already have the data port to bring data to the home [11] [12].
3. **Encourages Multiplexing:** Analogue broadcasting provides a limited choice of programming due to restricted bandwidth, and it is no longer an efficient technology. The same transmission channel used to broadcast a single analogue programme could carry a multiplex of up to 10 or more digital programs of equivalent quality. Free TV is available nationwide on both digital terrestrial TV DTT and direct-to-home DTH transmission [11] [12] [13].
4. **Value Added Services:** In addition to broadcast services, Free TV also provides value added services such as enforcement and collection of TV licenses, Premium PayTV channels, Push video on Demand, Information Service Audience Measurement, etc [14].
5. **Job Creation:** The DSO is not just about high-fidelity sound, and picture, it is about creating jobs, especially for our teeming youth, stimulating local content and empowering channel owners. It is estimated [14] that in the next three years, the DSO in Nigeria will be capable of creating more than one million jobs in the manufacturing of set-top boxes or decoder manufacturing, TV production, film production, distribution (supply of STBs, TVs, and dongles for the internet), as well as TV and Online advertising.
6. **Payment of One-a-year Access Fee:** Another major advantage of the DSO is that viewers will not pay subscription fee. Once a subscriber has acquired the set-up box and pays the once-a-year access fee, which of course is a token, the subscriber is connected for free viewing all the way. By this, millions of Nigerians who cannot afford to pay the rising subscription fees being charged by the Pay Tv platforms are assured of free digital viewing. This is the meaning of bridging the digital divide [15].

CONCLUSION

This study has reviewed bandwidth, DSO, and the benefits of introducing it to the overall economy of Nigeria. In it also, the bandwidth of digital transmission especially PCM has been assessed. The most important limitations found in the study lies in the fact that most developing countries and including Nigeria, could not key into the DSO for universal implementation, either due to lack of commitment or lack of the needed funds. Overall, this study has strengthened the idea that many benefits exist in switching from analogue to digital transmission of signals (especially TV and radio) and has also encouraged Nigeria (and other nations that have not switched) to fully key into the program for their national growth and development. It will be

interesting to assess the long-term effect of DSO to cover these arears: the economy of the nations that have not recently switched over; local content development; creative works in tertiary institutions; management of the spectrum dividend and re-establishment of public broadcasting.

Barring some exception, any TV set (be it black and white analogue or coloured) can be switched to digital. All that is needed is to attach a set-top-box to the existing television, or alternatively programs can still be viewed, if the TV has a built-in TV digital tuner. However, while acquiring a set-top-box, it is appropriate to ensure that a certified product that supports the DVB-T2 standard is acquired. This makes the TV type compatible with the generation of new TV technologies to come. The DVB-T2 is the next development of the digital video broadcast terrestrial standards.

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