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Spectral Efficiency Evaluation of Digital Transmission Communication System

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***Abstract*—** In the beginning of the 80's the digital era started and a lot of companies began to develop digital systems. Digital TV transmissions have three big areas depending on the type of technology that is used. The principals are transmission by satellite, terrestrial and cable radio, this last one is known as DTTV. Digital television (DTV) covers all the technologies of transmission and reception of images and sound through digital signals. This paper provides a brief introduction to the Digital Transmission. The system provides direct to- home (DTH) services, as well as collective antenna systems (satellite master antenna television SMATV) and cable television head-end stations.

***Keywords*—** DTV; DTTV; digital transmission.

I. INTRODUCTION

In the beginning of the 80's the digital era started and a lot of companies began to develop digital systems. One of the main challenges was to the digitization of television. This one was divided in two different parts. On one side was the digitization of production and on the other side the digitization of transmission. The digitization of production developed many systems. The first one was based on digitizing composite video signal without success. The video signal is composed by luminance and colour difference and digitization of each signal separately of the other was the most suitable. It was originally developed signalizing the signals in parallel, with thick cables that needed one for each bit, but was soon replaced by the time multiplexed transmission of each of the signal's components. This system also allowed including audio, included in the information that is transmitted, and other utilities that make it perfect to develop the digital TV.
Another challenge was the maintenance of the quality needed for TV production that is higher than the transmission.
Digital TV transmissions have three big areas depending on the type of technology that is used. The principals are transmission by satellite, terrestrial and cable radio, this last one is known as DTTV. The advances in computing, hardware and software, led to produce systems based on computer processing of the television signal. Storage systems that were used until then became replaced by video and computer servers and, to store files, the information was passed on hard drives and data tapes. Digital television (DTV) covers all the technologies of transmission and reception of images and sound through digital signals. In contrast to traditional TV, which encodes the data in analogue, digital television signals encodes in binary form, making possible ways between user and producer of content, creating, in such a way, interactive applications and the ability to transmit multiple signals on the same channel.

The digital television is composed by different elements as digital video cameras that work at resolutions much higher than analogue cameras, digital transmission and reception, high resolution. Digital TV supports multiple transmission formats, different resolutions, allowing TV producers to create sub-channels of transmission.

II. DIGITAL TRANSMISSION STANDARD

DVB is nowadays an efficient communication technology for TV broadcasting. It is the world's most advanced digital television system which offers more robustness, more efficiency and flexibility than any other Digital TV system. This standard supports HD, SD, UHD and mobile TV. It is a 2G terrestrial broadcast transmission since 2006 whose main purpose was to increase capacity, ruggedness and flexibility. Higher spectral efficiency means that with the same amount of spectrum, a larger number of programs can be broadcast or the same number of programs broadcast with a higher audio/video quality or coverage quality. With the addition/employment of improved source coding (MPEG-4), the gain in broadcast transmission is remarkable [3].

This standard permits the simultaneous transmission of various services having different configuration and therefore with different robustness and quality. This allows new type of reception scenarios for these digital terrestrial signals, like mobile and handheld pedestrian reception scenarios. Therefore this standard can be used for providing both fixed and mobile services within the same channel thanks to the number of configurations supported [4].

Digital television is steadily gaining a large interest from users therefore this standard design a new physical layer for digital terrestrial television whose main goal were to achieve more bandwidth targeting HDTV services, provide service specific robustness, improve single frequency networks and target services for fixed and portable receivers.

In Tanzania, the process of migration from analogue to digital terrestrial television started in 2005 and in 31st December 2012 the first phase of analogue switch off took place to migrate to digital broadcasting and effectively from 1st January 2013 they were already in this digital standard.

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The second phase of migration in the other regions has started on 1st April 2014.

Digital television appeared as a natural evolution of analog television. Early on all the parts of television use sound and image which are generated in the studios as analog. Every improvement in technology enables the creation of new possibilities for the transition from analog to digital.

III. DIGITAL TRANSMISSION STANDARD

Digital transmission is designed to perform adaptation of the baseband TV signals from the output of the multiplexer to terrestrial channel characteristics. Main blocks of the system are defined in [38] and summarized as follows:

- Radom PR Sequence Generator
- Outer coding (RS coding)
- Inner coding (Convolutional coding)
- Interleaving
- Mapping and modulation
- IFFT (OFDM) transmission

There are two modes of operations, "2K mode" and "8K mode", for digital transmission. The system allows different levels of QAM modulation and different inner code rates to be used to trade bit rate versus ruggedness.

Table I lists the physical layer parameters that affect the channel bit rate and robustness against channel errors. For modulation type, from QPSK to 16QAM, channel bit rate and error probability increases.

TABLE I. Physical layer parameters.

Parameter	Options	Explanation
Modulation	3	QPSK, 16-QAM, 64-QAM
FFT-Size	3	2K, 4K, 8K
In-depth inter-leaver	2	On/Off (for 2K & 4K)
Guard Interval	4	¼, 1/8, 1/16, 1/32
Convolutional Code Rate	5	1/2, 2/3, 3/4, 5/6, 7/8

IV. RESULTS

The performance of the developed system is analyzed with BER under varying parameters. Figure 1 shows the simulated model of the developed system.

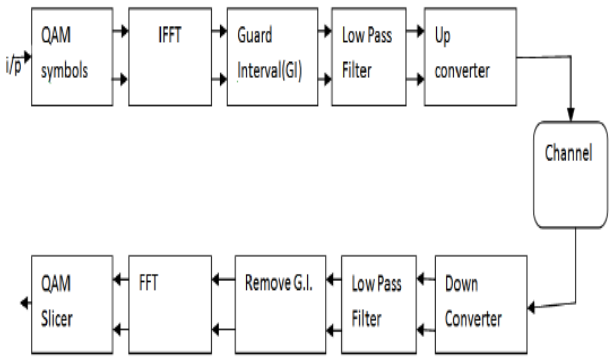

Fig. 1. Developed system model.

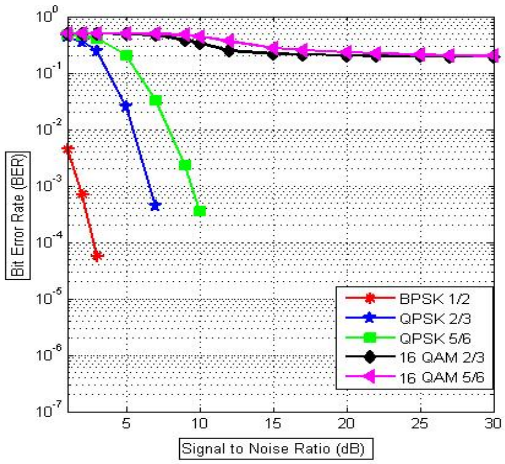

Fig. 2. BER under rayleigh channel.

V. CONCLUSIONS

From figure 2, we concluded that the Lower modulation and coding scheme provides better performance with less SNR. Bit Error Rate is minimum for lower coding rate.

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