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MODELING AND ANALYZING DIGITAL TELEVISION SYSTEM TO IMPROVE VISUALIZATION AND RESOLUTION OF BROADCASTING BASED ON DIGITAL VIDEO BROADCASTING

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Abstract- **Recently, the DVB-C standard is used to perform the function of transmitting digital television signals through communication cables and transmitting signals with the ability to maintain the speed and reliability of digital video streams as well as audio streams to be displayed online via television without delay and with an acceptable low BER. In this article, the DVB-C standard was used to perform the same functions mentioned above by proposing a model using MPEG-4 streams of digital video and image from the transmitter with the use of QAM64 modulation technology with reliability assurance to meet the requirements of the future in television broadcasting. Communication system toolkit in MATLAB Simulink is utilized to implement the proposed model. In order to build the channel for the proposed system, the Adaptive White Gaussian Noise (AWGN) channel is utilized. The power spectrum density is calculated, which were acceptable with the guarantee of no delay. Also, the resolution is enhanced in rate of 98%. Also, the input signal and the output signal are compared, and the semi complete match has obtained. The proposed model was created using the MATLAB 2023B simulation and program packages.**

keywords: **DVB-C, Television broadcasting, QAM64, MPEG-4, Power spectrum density, AWGN.**

I. INTRODUCTION

Multimedia technologies used in television broadcasting systems transmitters, represented by audio, video and digital image, are basic electronic equipment and software used in television broadcasting systems for the purpose of recording, storing and then processing, after which they enter the stage of transmission to the recipient for the purpose of reproducing sound, music, audio, video, graphics, images and other digital audio and visual multimedia media used in television broadcasting systems. These technologies used in the fields of communications and Internet networks and their connection in television broadcasting systems have become the core of these systems and have brought about a great leap and revolution in modern technology [1 – 3].

The methods of creating, using, sharing and consuming these media in television broadcasting have opened horizons for media technology engineering to deal with these media in the best ways and achieve the greatest technological benefit from them, which provides storage and transfer of large amounts of data quickly, reliably and efficiently. These technologies have become the basis for the purpose of creating and sharing high-quality media content in a wide range of formats, and have had a profound impact on the way people communicate, enjoy and view it [4], [5].

In the last decade of the 20th century, European broadcasters, pioneers of digital television broadcasting systems, in collaboration with manufacturers and suppliers of electronic equipment for communications, networks, the Internet and television broadcasting, as well as regulatory bodies called the European Launch Group (ELG), proposed introducing Digital Television (DTV) throughout Europe [6]. These ideas and uses have since spread throughout the world, taking into account

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the various and different DVB standards, which including: DVB-T and DVB-T2 for terrestrial digital television systems, DVB-C and DVB-C2 for cable television systems, DVB-S and DVB-S2 for satellite television systems, and finally DVB-SH for microwave systems and technologies. The specifications have been approved by the DVB Steering Council, which in turn achieves different objectives. In the early 22nd century, the broadcasting system consisted of the DVB project, which includes more than 200 organizations in more than 30 countries around the world. There are many digital broadcasting services included in the systems that operate via satellite in Europe, North and South America, Africa, Asia and Australia. The term digital television is sometimes used as a synonym for DVB [7 - 9].

Digital televisions used in modern television broadcasting systems are highly capable systems that convert data into "packets" of compressed data, unlike analog televisions. The data undergoes encoding and decoding, ensuring multimedia quality without the delays encountered in analog television broadcasting. MPEG-4, which is one of the MPEG series of standards, has become the technology used to perform the compression process for audio and video signals. This technology reduces the bandwidth of a single signal from 166 megabits per second to 5 megabits per second, which provides the possibility for broadcasters to transmit digital signals using existing cable, satellite and terrestrial systems [10], [11].

II. RELATED WORKS

In this section, the previous studies related to the objectives and main core components and parameters to build the proposed model for DVB system for TV broadcasting have shown and studied briefly in the following paragraphs.

Shah et al. investigated the Digital Video Broadcasting Second Generation Satellite (DVB-S2) standard which is used for the purpose of linking news via digital satellites (DSNG) [12]. The authors have worked with the communication system toolkit in MATLAB Simulink for the purpose of implementing the proposed system. They have used the DVB-S2 standard and also an RF Satellite channel has been used.

Santos et al. showed the sustainable development trends for digital television broadcasting using satellites located around the world and dealing with those that provide reliable connectivity [13]. The results are presented based on the research and analysis presented in the recommendations and in the ITUR database.

Botirkul et al. studied the noise-resistant receivers of DVB-T2 digital television systems using MATLAB Simulink [14]. They analyzed and studied the technical parameters of international standards related to noise immunity to enable the proposed system to receive the signal of the known standard type of DVB-T2. They used Gaussian channel, Rice channel type and Rayleigh channel type to calculate the signal-to-noise ratio.

Pradnyana et al. evaluated the performance of DVB-T2 digital television advertising in a special study area called Bali Service [15]. They produced a special map of the quality of broadcasting services in Bali which enabled the researchers to use it as an indicator and alert for the purpose of preventing Bali from being a blank spot area and which can be recommended to Bali digital television operators for the planning process of the duplicate type installation.

Febiyani et al. proposed a system for measuring digital terrestrial television broadcasting (DVB-T2) [16]. This measurement was carried out in urban areas. The proposed system consists of two TV stations in addition to the terrestrial television broadcasting system to perform the function of converting digital terrestrial television broadcasting to DVB-T2. The results

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were compared with existing results of two special models, Okumura-Hatta and Walfisch Ikegami, which are suitable for urban areas.

Putri et al. analyzed the performance of two different antenna boosters, TOYOSAKI and MATRIX [17]. The analysis conducted in this research was done using digital antennas specific to each antenna booster, i.e., using TOYOSAKI, MATTRIX and TAFFWARE antennas in order to make a comparison between the antenna and the booster and find out which one is better. The SINPO method is the method used in this research. The results showed that the image quality produced by TOYOSAKI and MATRIX antennas is actually better using MATRIX than using TOYOSAKI.

Guo et al. developed a method to cancel DLI for AB communications using the surrounding DVB signals [18]. As a first step, a signal processing system was built to be able to cancel DLI at the AB receiver. As a next step, the remaining reception power after canceling DLI was reduced. The researchers developed a proposed search algorithm that has the ability to search for three-layer parameters to be able to separate the base station from the DVB signal.

III. METHOD

In this section, two main things are listed and explained below in order to get a full understanding behind the methodology for this article as follows:

A. *Proposed model*

The television signals are transmitted through cable television network in copper cables with less external interference. The QAM modulation scheme is specified in the DVB specification. Depending on the transmission environment condition, different modulation rates of 16-QAM, 32-QAM, 64-QAM, 128-QAM or 256-QAM can be used. For systems with long transmission and high noise, a low modulation rate can be used, for example, 16-QAM, 32-QAM, otherwise a high modulation rate should be used. DVB-C cable television transmission is also called CATV (community antenna television or cable television) system. It is a combination of radio, television, radio technology and computer technology. The proposed DVB-C or so called CATV network currently uses 64-QAM modulation rate with a data rate of up to 38.5 Mbit/s in a bandwidth of 8 MHz as shown in Fig. 1.

B. *Individual components*

There are many individual components, parameters and techniques are utilized to deal with the proposed model in the proposed TV broadcasting system as shown below:

1) MPEG-4 approach: Many types of data have an ability to be embedded in the (MPEG-4) files during a private stream. A separate hint track can be utilized, consisting of information stream in a desired file. The main codecs of MPEG-4 files can be published online but may some of them not supported by MP4 players. The almost supported codecs and additional data streams are. This type generates random data and at the same time header bits. Then, it used to append a header for synchronization the desired byte.

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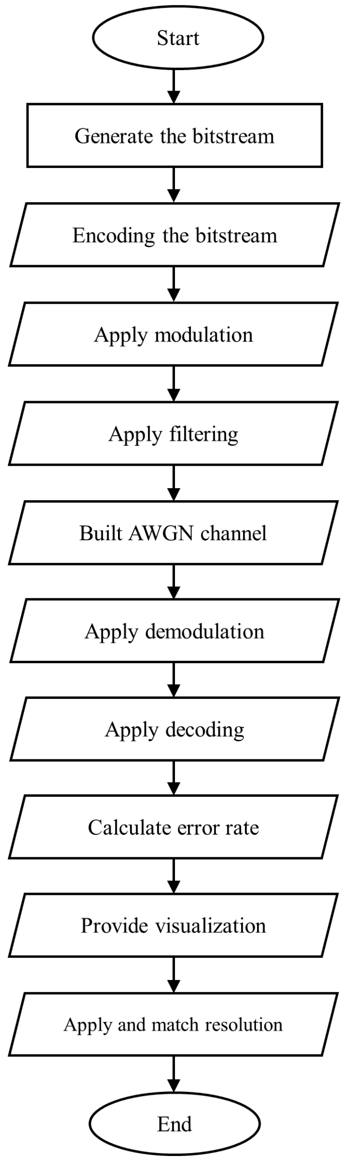

Figure 1: The proposed DVB-C TV broadcasting system.

2) Transmitter operation: This section used to randomize the desired data utilizing a sequence of pseudo-noise. Mainly, the transmitter used to apply (RS) encoding and at the same time utilize a convolutional interleaving. There is a main function used to making a convert for (8-bit) bytes into (6-bit) chunks of (64-QAM) modulator-approach. Therefore, it will be applied a square of root-raised-cosine-filter with (8x) oversampling next the modulation. The modulation scheme's order defines how many bits are used in each symbol in Quadrature Amplitude Modulation (QAM). By using this formula calculate number of bits:

$$BpS = 2\log_2(NCP) \tag{1}$$

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Where, BpS is a bits per symbol and NCP is the number of constellation points.

While there are 64 constellation points in the proposed QAM64, the following formula ca be applicable as: $BpS = 2\log_2 64 = 26 = 3$.

As a result, each symbol in QAM64 is encodes three bits. Three bits of information can be transmitted using the QAM64 modulation scheme because each symbol in the scheme represents a distinct amplitude and phase combination.

3) Channel delivery: The required signal used to be transmitted over an AWGN channel by utilizing the AWGN function as follows. The proposed AWGN channel used to be represented by the variable Y_i , which is expressed as the outputs-series at the event-index of discrete-time i. Therefor, Y_i could be defined as the direct sum of both of input (X_i) and (noise), while Z_i is normally assumed as an independent and distributed optimally. Which could be created from: (zero-mean) for the normal-distribution with noise (or variance N). The Z_i are expressed to not be correlated with the input X_i as shown in equations (2) and (3):

$$Z_i \sim \mathcal{N}(0, N) \tag{2}$$

$$Z_i = Y_i + X_i \tag{3}$$

The channel capacity normally is expressed infinite, in the condition of nonzero noise N . Then, the input X_i could be assumed sufficiently-constrained. Sometimes, the input X_i is called: (power) constraint, that needs for the following codeword series $(x_1, x_2, \ldots, x_k)$ in order to be transmitted through the channel as follows:

$$\frac{1}{k}\sum_{i=1}^{k} x_i^2 \leq P \tag{4}$$

Where, P is the maximum power of the channel.

4) Receiver operation: The reverse operation of the modulation is applied at this stage called demodulation. It is used to make the demodulation of the received-symbols and then used to converts the (6-bit) chunks to the (bytes) using the (reverse) operation of equation (1). Since the filtering operation define a delay, the received bytes are synchronized to the packet-edge. Therefore, interleaver delay is expressed as a multiple of the size of the size of packet. After that, making synchronizing mechanism to the packet-edge. Finally, the receiver used to de-interleaved the packet which are have synchronized bytes and then the decoding is turned on by it decodes utilizing the (RS) decoder approach.

5) Visualization: Optional instrumentation provides visualization. At this stage, it divides things into three basic parts, which are as follows: TV, which is a receiver that receives signals and then reproduces the images and displays them on the screen, as well as reproducing the audio signals accompanying the images on the speakers; films, which are a series of images of moving objects filmed by a camera that provides the optical illusion of continuous movement during the display stage on the screen; advertising films, which are treated similarly to films, but with regard to commercial display; and finally, live programs, which are shown on screens live during filming and display on screens.

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IV. Results and Discussion

After implementing equation (1) on the proposed model shown in Fig. 1. While Fig. 2 shows the result for generation bit stream and applying modulation scheme QAM64 correctly and it is produced 64 symbols and that mean the proposed modulation works properly while it is applied on the proposed TV broadcasting system. The input signal should be

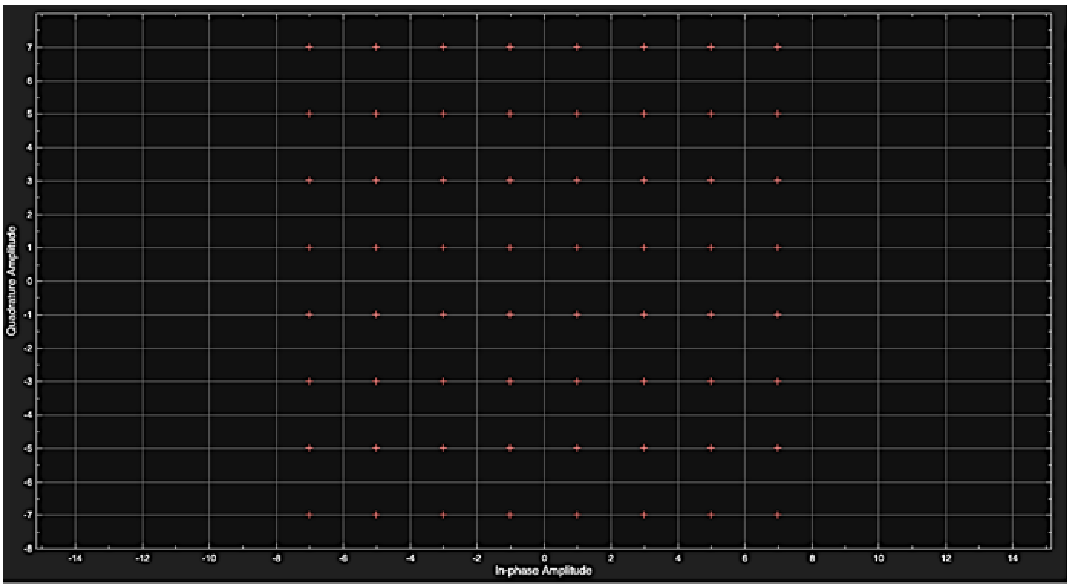

Figure 2: The proposed QAM64 result.

matching the output signal for any media: TVs, films, advertising films and live programs to ensure that the delay caused by broadcasting or channel didn't affect on the visualization of the proposed system as shown in Fig. 3 and Fig. 4 respectively.

A Power Spectrum Density (PSD) defined as the measurement of the signal's power content compared to the signal frequency. Therefore, PSD mainly utilized to characterize the broadband random-signals. The PSD amplitude has been normalized through a spectral resolution which is investigated in order to make digitization for the signal, see Fig. 5, which is frequently applied in the application that have 2 different channels in the TV broadcasting system(s). It is produced a good and accepted values because the noise power could be neglected and the resulted output have a good resolution and visualization.

It is produced semi theoretical and accepted values because the noise power could be neglected and the resulted output have a good resolution and visualization as shown in Fig. 6 and Fig. 7 respectively.

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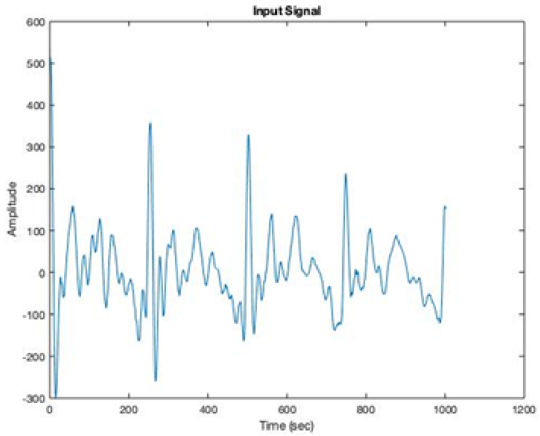

Figure 3: The input signal.

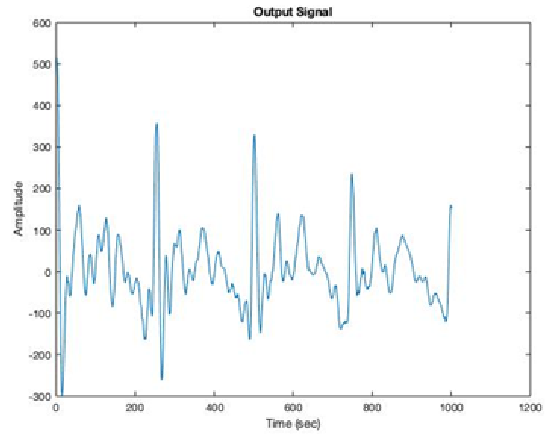

Figure 4: The output signal.

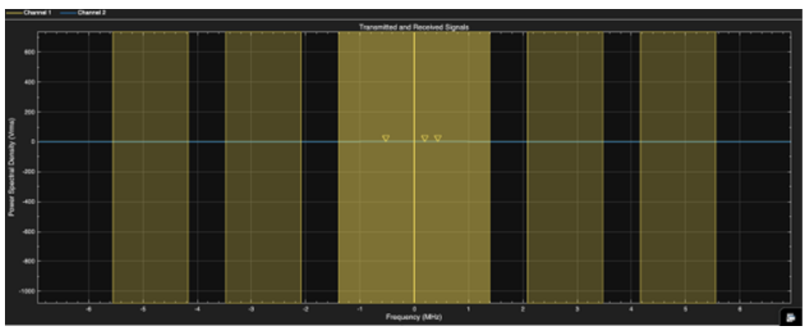

Figure 5: PSD vs frequency.

Figure 6: The input video signal.

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Figure 7: The output video signal.

V. CONCLUSION

A television communication model was built using MATLAB simulation and all the types mentioned in the presentation, which are TV shows, movies, advertisements, and online programs, were used using simulation and applied to the proposed system using twenty videos as input to the system. The simulation system used is expressed as a part of (DVB-C) system(s) based-on modeled AWGN channel that was built. Therefore, it frequently shows flexibility and reliability properties by modeling many parts (which mainly expressed as different) of (DVB-C) system(s) like the randomization property, coding technique and interference. Then, results showed the system used to delay the objects in order to making synchronization for both the transmitter and receiver. The system performance was measured using power spectrum density measurement and also viewing the results displayed on the TV and comparing the clarity between both input and output signals, which achieved a clarity rate of approximately 98%. The proposed digital television system built in this article provides various benefits such as high picture and sound quality, interactive features, and more efficient use of (spectrum) compared to the analog television system. The digital television broadcasting system is widely applied in many parts of the world.

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CONFLICTS OF INTEREST

The author declares no conflict of interest.

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