Performance improvement of data transmission through DVB-T2 based Wireless system

DISSERTATION-II

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by

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Under the Guidance of

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TOPIC APPROVAL PERFORMA

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CERTIFICATE

This is to certify that the Dissertation-II titled " Performance improvement of data transmission through DVB-T2 based Wireless System" that is being submitted by " Manpreet Kaur " is in partial fulfillment of the requirements for the award of MASTER OF TECHNOLOGY DEGREE, is a record of bonafide work done under my guidance. The contents of this Dissertation-II, in full or in parts, have neither been taken from any other source nor have been submitted to any other Institute or University for award of any degree or diploma and the same is certified.

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Dissertation-II

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APPROVAL

This is to certify that I Manpreet Kaur bearing Registration no. 11508056 has completed objective formulation of Dissertation II title titled, "Performance Improvement of Data through DVB-T2 based Wireless System" under my guidance and supervision. To the best of my knowledge, the present work is the result of her original investigation and study. No part of the thesis has ever been submitted for any other degree at any University.

The thesis is fit for submission and the partial fulfillment of the conditions for the award of MASTER OF TECHNOLOGY DEGREE.

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DECLARATION

I, Manpreet Kaur, student of M-Tech Electronics and communication under Department of Electronics and communication of Lovely Professional University, Punjab, hereby declare that all the information furnished in this Dissertation-II report is based on my own intensive research and is genuine.

This thesis does not, to the best of my knowledge, contain part of my work which has been submitted for the award of my degree either of this university or any other university without proper citation.

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ABSTRACT

DVB-T2 is the world's most developed DTT framework offering higher effectiveness, robustness and adaptability. DVB-T2 is a system that transmits compressed digital audio, video and other data in PLP using OFDM with concatenated coding channel and Interleaver. The problem studying in our research work is due to the noise, interferences and loss rates are high. The system has been designed to solve a problem for repetitive change in the used location at high speeds the users can not always be fixed as per the problem. We have analysis the performance of random data through a terrestrial channel with OFDM techniques based DVB-T2. We have been used two different modulation techniques to calculate the BER performance with the help of BCH encoding as well as LDPC encoding which are the part of DVB-T2 standard. The Simulation shows that error calculation is less in 16 QAM over Nakagami (with Filter) channel as compared to other modulation with OFDM. From all the channels, Nakagami channel achieves better performance with 16 QAM modulations. In the case of 16 QAM, complexity of the system is less.

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CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Wireless Communication is specific communication system that conveys multimedia and alternative data services to the customer having smart gadget able to provide wireless link [1].Nowadays wireless system which is based on communication system standards are able to broadcasting and bring services related to audio, images, videos and other services essentially globally. User equipped along several kinds of wireless communication devices raising the need of tag with the network and need to pick up multimedia data, sending the file and message. Making progress in television broadcasting services day by day has approached the broadcasting technology among digitally. It has large numbers of standards that terminate by various world associations in its accomplished. Today, OFDM has become more an attractive system that is used for the transmission purpose. Previously, the survey has been done on the various problems of OFDM and got interest to do work on one of application of DVD-T2. DVB (Digital Video Broadcasting) was introduced in 1993 by ETSI (European Telecommunication standard institute) and is the standard option for broadcasting in lots of nations in Europe. The standards of DVB are: DVB-S, DVB-T & DVB-H. My work is based upon the DVB-T. DVB-T is an application of the OFDM. DVB-T is a designation specified to transmission system. DVB-T2 means digital video broadcasting –second generation terrestrial. It is the world's most developed DTT framework offering higher effectiveness, robustness and adaptability. This system is used to transmit compacted digital sound, video resources and information which is in "physical layer pipe", utilizing OFDM modulation with connected different encoding techniques and interleaving. It is a system that offered higher bit rate, with respect to its antecedent DVB-T. It also makes a system which is suitable for conveying HDTV signal on the earthbound TV channel. It enormously builds the channel transmission ability to meet HD and 3D bandwidth requests and offers adaptability through a scope of business model utilizing various Physical Layer Pipe (M-PLP) technologies, which gives services particular strength.

As the part of DVB-T2 system, different modulation scheme has been used to calculate the BER performance with hybrid encoding techniques which is a part of the DVB-T2 system. LDPC and BCH encoding techniques has been used to calculate the performance of the system with OFDM

using different modulation scheme and DVB-T2 are used four modulation schemes that is QPSK, 16QAM, 64QAM, 256QAM over the different channels.

1.2 WIRELESS MOBILE COMMUNICATION

Wireless communication is a communication that delivers voice and data to mobile user. The quantity of remote cell phones is expanding all around. Clients equipped with convenient PCs, PDAs (individual advanced aides), and an variety of little remote specialized gadgets progressively need to associate with corporate systems, perform database queries, transfer messages, exchange documents, and even take part in shared processing [3]. In the meantime, the remote system is accomplishing higher information rates to support Internet and other information related applications. The most up to date mobile communication are focusing on data rates as high as 2 Mbits/sec. Orthogonal frequency Division Multiplexing (OFDM) is executed in the remote wireless communication where the high bit rate over the frequency selective channel is ensured to some extent. OFDM is a multi-carrier modulation method where information symbol modulate a sub-bearer which is taken from orthogonally isolated subcarriers with a division of fk inside every sub-bearer. The spectra of sub-transporter are covered if there should be an occurrence of OFDM and the sub-carriers are likewise orthogonal to each other so by which the bandwidth use is more proficient with comparing other modulation methods. In wireless communication, Digital Video Broadcasting is a tremendous area. In 1991 establishment of the ELG (European Launching Group) goal is improvement of computerized TV in Europe and 1993 renaming into DVB goal is presentation of digital TV based on transmission of satellite, Cable network based and terrestrial network based. Cellular systems offer various features:

- More limit than a single large transmitter, since a similar frequency can be utilized for various connections as long as they are in various cells.
- Cell phones utilize less power than with a single transmitter or satellite since the cellular towers are nearer.
- Bigger coverage area than a single earthbound transmitter, since extra cell towers can be included inconclusively and are not constrained by the horizon.

1.3 OFDM

OFDM stands for Orthogonal Frequency Division Multiplexing [2].It is one type of modulation technique which is mostly used to permits digitally information proficiently. It dependably transmitted on a radio channel and performs well also inside the multi-path situations with reduced receiver complexity. Utilizing ODFM, it is possibility to misuse the time domain, the space domain, the recurrence space and even the code space to enhance radio channel utilization. OFDM transmits information by utilizing an extensive number of narrow band subcarriers. These subcarriers are routinely divided into frequency and blocks of spectrum are formed. The recurrence dividing and time synchronization of the subcarriers is picked in a manner that the subcarriers are orthogonal, implying that they don't make interference each other. This is regardless of the subcarriers overlapping each other in the frequency domain. The name "OFDM" is gotten from the way that the digital information is sent utilizing numerous subcarriers, each of an alternate frequency (Frequency Division Multiplexing), which are orthogonal to each other, thus Orthogonal Frequency Division Multiplexing. OFDM can be utilizing Fast Fourier Transforms (FFT) and DFT is a main part of the DSP. In advanced interchanges, data is in the form of bits. The term symbol refers to a gathering, in different sizes, of bits. OFDM information are created by taking images in the spectral space utilizing M-PSK, QAM, and so on, and change over the spectra to time area by taking the Inverse Discrete Fourier Transform (IDFT). Since Inverse Fast Fourier Transform (IFFT) has more cost effectively to execute, it is generally utilized. OFDM is used to reduce the complexity of the receiver and reduces bit error rate and PAPR and also improve the performance of the system. The features of a reasonable OFDM system are as per the following:

- Processing parts are completed on the basis of input information. Example, coded data for correction of error, bits interleaving is also done into symbol. A case of mapped data used is QAM.
- Orthogonal sub-carrier is generated when symbols are modulated. These whole processes are finished by using IFFT.
- When transmission of the channel is going on, that time Orthogonality of OFDM is keeping up. The experts can added a cyclic prefix which gives to the OFDM frame for sending purpose. The CP includes N frame that is duplicated and insert inside the beginning of the frame. This frame should be greater than impulse response.

- Synchronization: CP may be used to recognize start of each frame. It is done by using the process which is N first and last bits of data are similar and in this manner corresponded.
- The FFT is used for demodulation of received signal.
- Channel equalization: channel 3 could be fixed by using a preparation arrangement as pilot symbols that is predefined sub-bearers.
- Demodulation and de-interleaving are done at the end.

1.3.1 Advantages

- The main advantage of OFDM is robustness over multi path propagation.
- It eliminates ISI through utilizing of a cyclic prefix.
- OFDM is a more efficient technique.
- It provides better protection against fading and noise.
- Channel equalization gets to be distinctly less difficult than by utilizing adaptive equalization technique methods with single carrier system.

1.3.2 Disadvantage

- More sensitive to carrier frequency offset and drift than single carrier system.
- Synchronism accuracy is more.

1.4 DVB

DVB is a set of standards that define digital broadcasting using existing satellite, cable and terrestrial infrastructure [2].The main objective of DVB was to join and physical TV advances and development and synchronization of these. The DVB was introduced in 1993 by the ETSI (European Telecommunication standard institute)**.**Numerous DVB broadcast services are available in countries like Europe, North and South America and Asia. The advance television system committee is a standard committee which is digital broadcasting standard and used in US. It is a standard that are mainly maintain by DVB project that contains more than 270 employees and are published by joint technical committee of ETSI. The DVB structure is in position of view of coding of the photo and sound by MPEG-2. The MPEG (TS) includes in a group with modified length which allows to country and large no. of standard organizations sound and data in the same

plot. The length of a pack has 188 bytes which generally including with 1 byte of synchronization and 3 bytes of standards and data is of 184 bytes.

1.4.1 Extensions of DVB

DVB proposes merits in terms of greater efficiency in terms of spectrum consumption and power usage. The digital TV requires fewer frequencies than analog TV DVB system dispenses data using a diversity of approaches.

- Terrestrial Television: DVB-T, DVB-T2.
- Cable: DVB-C, DVB-C2.

CHAPTER 2

TERMINOLOGY

DVB	Digital Video Broadcasting
DVB-T	Digital Video Broadcasting-Terrestrial
OFDM	Orthogonal Frequency Division Multiplexing
PAPR	Peak to the average power ratio
FFT	Fast Fourier Transformation
IFFT	Inverse Fast Fourier Transformation
QAM	Quadrature Amplitude Modulation
AWGN	Adaptive White Gaussian Noise
BCH	Bose Choudhari Hocquenghem
LDPC	Low density Parity Check
DTT	Digital Terrestrial Television
MIMO	Multiple Input Multiple Output
MISO	Multiple Input Single Output
BER	Bit Error Rate
SFN	Single Frequency Network
LTE	Long Term Evolution
SNR	Signal to Noise Ratio
FEF	Future Extension Frame
SC-FDMA	Single Carrier–Frequency Division Multiple Access

FEC	Forward Error Control
BBFRAMEs	Base Band Frames
MI	Modulator Interface
DWT	Discrete Wavelet Transform
IDWT	Inverse Discrete Wavelet Transform
PLP	Physical Layer Pipe

CHAPTER 3

REVIEW OF LITERATURE

After studied different research papers, the summary of literature review is following as:

Sr. No.	Author	Year	Title	Approach	Result	Future work
1	Khaizuran Abdullah and Zahir M. Hussain	2007	Performance of Fourier-Based and Wavelet-Based OFDM for DVB-T Systems	In this paper, authors have analyzed have compared different types based OFDM using different channel that is AWGN and Rayleigh channel. AWGN channel has given better result by using Haar wavelet instead of FFT-OFDM [5].	At the end of this paper, the author concluded that AWGN channel has given better result than Rayleigh channel by using Haar wavelet. The SNR of AWGN channel is above 5db.	In future more advance wavelet would be taken into system and it would also improve the efficiency of the system.
2	Uwe Ladebus ch, Claudia A.	2007	Terrestrial DVB (DVB-T): A Broadcast	In this paper, authors introduced	DVB-T is taken into consideration	In future DVB-T standards

	Liss		Technology for Stationary Portable and Mobile Use	those cases of stationary and mobile user. The concept channel estimation removes the problem of reception of signal at receiving end. It estimates the nature, characteristics of the channel. In DVB-T receiver it becomes difficult to attain proper signal strength especially in the case of mobile user [4].	in many countries. The results that by using the concept of channel estimation we can attain the strength.	would become more advance and upgraded channel estimated techniques and advance LC-IDDICI would be launched to provide finest service on every place.
3	B.Sathish kumar ,K.R.Shankar Kumar,R.Radha	2009	An efficient Inter Carrier Interference Cancellation scheme for OFDM system.	In this paper, the author has done comparative study on different	The author showed that with proposed method mean value and the	Adaptive Digital FIR filter method could be used to decrease the problem of

	Krishnan			methods in terms of BER and it tells the three methods that are ICI self cancellation, Maximum Likelihood estimation, and Extended Kalman Filter (EKF) method [6].	standard deviation for the PAPR is much lower than the original data by using proposed scheme that is adaptive digital FIR filter.	PAPR. In the future, higher Order digital filter FIR filter to improve the system performance.
4	J Morgade, Usandizaya, Pangueria, A.Arrinda, M.vellz, Ordiales	2010	3 DTV Roll-Out scenarios a DVB-T2 approach	The author have described of DVB-T2 to provide 3D TV services for both mobile and portable devices with the help of proper network planning high definition services also possible [7].	The authors have concluded that DVB-T2 standard has the enough capacity to transmitted high definition and 3D services in the efficient way for different Roll-Out cases.	In the future, Ultra High services and 4k will be conveyed through the DVB-T2 and also proper network planning is needed for the network setup.
5	Stylianos	2011	Performance	Authors have	In this paper,	In future,

	Papaharalabos, David Benmayor, P. Takis Mathiopoulos, Pingzhi Fan		Comparisons and Improvements of Channel Coding Techniques for Digital Satellite Broadcasting to Mobile Users.	presented the concept of different channel coding techniques i.e. 3GPP2 codes, CCSDS turbo codes, DVB-RCS turbo codes and LDPC codes to increase the efficiency of the system and also done the comparison between the different channel coding techniques [8].	authors concluded that coding rate of CCSDS turbo codes was high & DVB-RCS turbo codes was more powerful than 3GPP2 codes.	channel coding method would be used to design of mobile satellite broadcasting system.
6	Y. Alafta, P. Johnson	2012	High performance of OFDM system for digital video broadcasting.	In this paper, the author described transmission of digital data with very high spectral efficiency and low value of BER, PAPR can be	The Author concluded that DWT system with QAM modulation shows 7 times best result than DCT with QAM.	In future, the delay, SNR, BER, PAPR would be decreased and also increase the overall efficiency of the system.

				achieved by implemented DWT-DAPSK technique in the DVB-T2 system [9].	64DAPSK modulation shows better result over DCT-OFDM & Conditions remains same.	
7	Edmond Nurellari, Erhan A. Ince	2012	Image transmission over Gilbert-Elliot and ITU fading channel using DVB-T2 channel coding and QPSK-OFDM.	In this paper, the author introduced the concept of digital image transmission with the help of Bose Choudhari Hocquenghem (BCH) code, LDPC codes on the channel Gilbert-Elliot, & Rayleigh channel and technique used is FEC and OFDM [10].	Authors concluded that BER performance over Gillbert-Elliot channel introduced burst error and with LDPC, BCH-LDPC achieve low bit rate at SNR of 5 db. LDPC with ¼ code rate with BCH give best performance.	Future work to achieve the lowest bit error rate below the value of SNR is 5db achieve the overall efficiency.
8	Gary J. Sullivan,	2012	Overview of the High Efficiency	In this paper, author	Authors concluded	Future extension of

	Jens-Rainer Ohm, Woo-Jin Han, Thomas Wiegand		Video Coding (HEVC) Standard.	introduced an overview of technical features and characteristics of HEVC standard [11].	that utilization of decoding part which contains complexity of HEVC that was not major burden.	HEVC in JCT-VC would be examined.
9	Nicolas,Cornille,Matthieu Crussiere, Jean Francois, Helard	2012	Performance of DVB-T2 system in a single frequency network: Analysis of the distributed Alamouti scheme.	In this paper, the author has introduced the performance of DVB-T2 through the SFN. The concept of MIMO as well as SISO introduced by using two transmitting Antenna and one receiving antenna implemented these scheme with the help of Alamouti Scheme [12].	The author concluded that digital video broadcasting service integrated with multi antenna through Alamouti scheme and improved overall efficiency of the system.	In the future, possible of 3D MIMO services with SFN would obtain better result.

10	Aleksandar Sugaris and Irini Reljin	2012	DVB-T2 technology improvements challenge current strategies planning of Ubiquitous media networks.	Authors described the some advancement of DVB-T2 over the first generation by taking the concept of multi disciplinary approach. Cost effective and economical analysis carried out with the help of Bass model [13].	The author concluded that high profitability advance network achieved in the completion of 2 years when digital video broadcasting terrestrial scheme would be used in future.	In future work, when the number of users would be decreased. Capacity of the DVB-T2 would be increased and Noise, interference would be decreased.
11	Doaa H Sayed, Maha Elsa Brouty, Ahmed F Shalash	2013	Improved synchronization , channel estimation, and simplified LDPC decoding for the physical layer of the DVB-T2 receiver	In this paper, the author introduced a algorithm in signal processing chain to improve the mobile operation for DVB-T2 [14].	The Authors concluded that improved performance of advanced integrated standard and also provides better result.	In future the modified CFO stages would be used to improve the accuracy of the system.
12	K.Aperna, R.Divya	2013	MIMO based advanced	The author described that	The author concluded	The future scope would

	Bharathi		transmission in DVB-T2.	Carrier frequency Offset (CFO) in the DVB-T2 transmission system. Multiple CFO's estimated with the help of MIMO technology which has given to multi mode application in DVB-T2 system [15].	that transmission of random data send with the help of QAM modulation and MIMO technology is used which has given benefit for the number of users to achieve HDTV services.	be used 64QAM modulation to achieve high data rate and also reduce the interference which is introduced due to the multiple antennas.
13	Yasir Rahmatallah , Seshadri Mohan	2013	Peak-To-Average Power Ratio Reduction in OFDM Systems: A Survey And Taxonomy	In this paper the author tells about the high PAPR existence due to power amplifier and also introduced the several methods to mitigate the effects of PAPR by using	The author concluded that when we increased BER then PAPR reduced and there was always tradeoff between PAPR and BER, no one	In the future, Designer would be needs to design such a system that gives efficient tradeoff between BER and PAPR, high data rate.

				different techniques [16].	technique was best. It depends upon the application in which OFDM is used.	
14	N.S. Sugiharto, Iskandar, T. Hendrawan, and N. Rachmana	2015	Mobile TV Interactive in DVB-T Broadcast Network Hybrid with Wi-Fi.	In this paper, the author has developed an application which is based on the smart phone and this smart phone received the program & transmitted a request to server and also developed the system that converts DVB signal to Wi-Fi-IP based protocol [17].	In results, the last section of this paper, it is considered the application services that permits user to develop interactively connected with client server through the ECG server.	In future work, DVB-T would improve overhead for controlling the data packet.
15	Ladislav, Lukas Klozer, Ondrey	2015	Study of co-existence between indoor LTE femtocell	In this author have presented the new generation	In this paper, the author has concluded	In the future, would shift our proposed coexistence

	Kaller, Jiri sebesta, Martin slannia, Tomas Kratochvil		and Outdoor-to indoor DVB-T2 lite reception in a shared frequency band.	system for the transmission of Superior quality based multimedia applications such as video resources, audio, images transmitted over DVB-T2 with the help of LTE (Long Term Evolution) techniques for the indoor and outdoor environment [18].	that indoor reception of the signal has more immune than the fixed Outdoor reception. The performance of DVB-T2 system highly depends upon the overlapping of the channel.	model with different kind of parameter such as fading channel, Doppler shift, and power levels.
16	Jong Gyu Oh, Yong Yu Won, Jin Sub Seop Lee, Joon Tae Kim	2016	A convergence broadcasting transmission of fixed 4K UHD and mobile HD services through a single terrestrial channel by employing FEF multiplexing	In this paper, author used FER multiplexing technique through a single terrestrial channel for DVB-T2.Here, the author also	The author concluded that FER Multiplexing technique had better result than M-PLP technique.	In future work, it will employ LDM techniques in ATSC-3.0 system, performance & occurrence of terrestrial fixed 4k UHD & Mobile HD

			technique in DVB-T2	done comparison b/w M-PLP technique and FER multiplexing technique [19].		convergence broadcasting services through a single channel would be examined.

CHAPTER 4

RATIONALE AND SCOPE OF DVB-T2

4.1 PURPOSE OF DVB-T2 SYSTEM

- The purpose of DVB-T2 system is to provide higher data rates and signal strength.
- It is one type of digital terrestrial television which provides HD and UHD signal at receiver end and LDPC coding provides effective error protection
- Moving to DVB-T2 design infers the adding of the T2 Gateway at the head-end and also upgrade of DVB-T modulators to DVB-T2 modulators and in addition the replacing of STB or iTV with the new DVB-T2 front-end.
- DVB-T2 permits a finer utilization of the spectral assets by coordinating edge cutting signal processing techniques. The anticipated additions provide for up to half extra bit rate in the same frequency bandwidth system.
- A DVB-T Amplifier could be utilized to communicate DVB-T2 by updating its DVB-T modulator by a DVB-T2 one. DVB-T2 standard has characterized another new protocol interface i.e. T2-MI (T2-Modulator Interface). It is used to convey between the T2 Gateway and the Modulators.
- The design remains same for either Single PLP or M-PLP modes [20]. T2 Gateway goes for encapsulated the approaching MPEG-2 TS into frames and embedding synchronization data for SFN broadcasting, regulating modulators setup, setup M-PLP broadcasting and also the TFS distribution. T2 Modulators get design from the T2 Gateway. It performs the encoding techniques by including the FEC data, construct T2 outlines and modulate the signal before transmit it by the air.
- DVB T2 standard takes likewise consideration from claiming transmitter setup. It also created high power peaks are created inside the 32k particularly and also reduces amplifier effectiveness. An uncommon characteristic is called PAPR decrease need been incorporated in the standard determinations on limit these peaks control without losing data.
- With expand those ability to DTT multiplex is a standout amongst those way profits of DVB-T2 standard.

4.2 SCOPE OF DVB-T2 SYSTEM

The present study tells about the transmission of the data in DVB-T2 using OFDM. It decides definitely those channel coding, modulation systems proposed to HDTV terrestrial benefits. The following scopes are:

- It tells about brief description of DVB-T2 system for DTT.
- It describes the performance requirements and features of DVB-T2 system.
- It provides an extensive technological scope.

CHAPTER 5

OBJECTIVE OF THE STUDY

5.1 PROBLEM FORMULATION

DVB-T2 is a best technology for digital television broadcasting compared with other digital terrestrial television broadcasting system. Due to which several researchers have focused on providing higher broadcasting data rates as well as great signal robustness. In the traditional transmission system structure, FEC encoder and FEC decoder has been using which provides high implementation complexity, low SNRs and high decoding latency. Furthermore, DVB-T2 system is based on the OFDM technique which adopts FFT maximizing the data transmission capacity. But, it has seen that Fourier based system requires addition of cyclic prefix which is decreasing the efficiency of the bandwidth. Owing to these factors, a new encoding and transformation technique has to be proposed for improved scalability and flexibility.

5.2 PROPOSED WORK

From the problem formulation it has concluded that traditional systems provide efficiency but it also suffers from robustness, flexibility and other parameters. In order to improve traditional systems, it has upgraded with the LDPC coding rather than FEC encoding in the proposed work. LDPC decoding algorithm has more parallelization, low implementation complexity, low decoding latency and no error-floors at high SNRs as well. LDPC codes are considered for all next generation communication standards due to its relatively simple decoding algorithm. In addition, FFT system will be replaced by the Discrete Wavelet Transformation i.e. DWT as DWT based OFDM system do not require cyclic prefix because of overlapping nature and thus increasing the bandwidth efficiency.

5.3 OBJECTIVES

Above section concluded main objectives for the proposed work are:

- To study and analysis the use of OFDM in application of DVB-T2.

- To compare the system with different modulations over various channels for enhancement the performance of the system.
- To improve the performance of the system by the use of filter.
- To analyze the BER and the system performance using different modulation techniques with OFDM in DVB-T2 system.

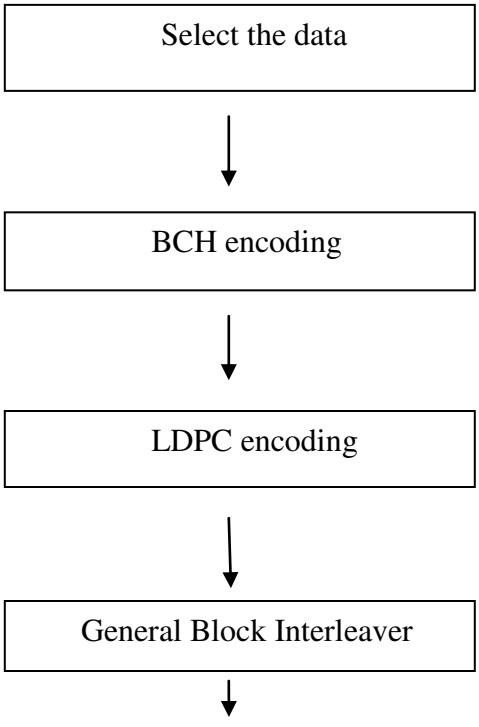
CHAPTER 6

RESEARCH METHODOLOGY

Random data is transmitted over DVB-T2 System through various channels with the help of different modulation techniques. These techniques are used to evaluate the performance of the system.

1. Study of the DVB-T2 based wireless System.
2. Analysis of various modulation techniques with the help of BCH and LDPC encoding techniques.
3. Performance Analysis of different modulation techniques in the DVB-T2 System over the various channels (Without Filter).
4. Performance analysis of different modulation techniques in the DVB-T2 System over the various channels using Digital Filter.
5. Comparison of the results of DVB-T2 System using Filter with previous one and find the best channel and modulations.

The procedure of Research Methodology followed is:



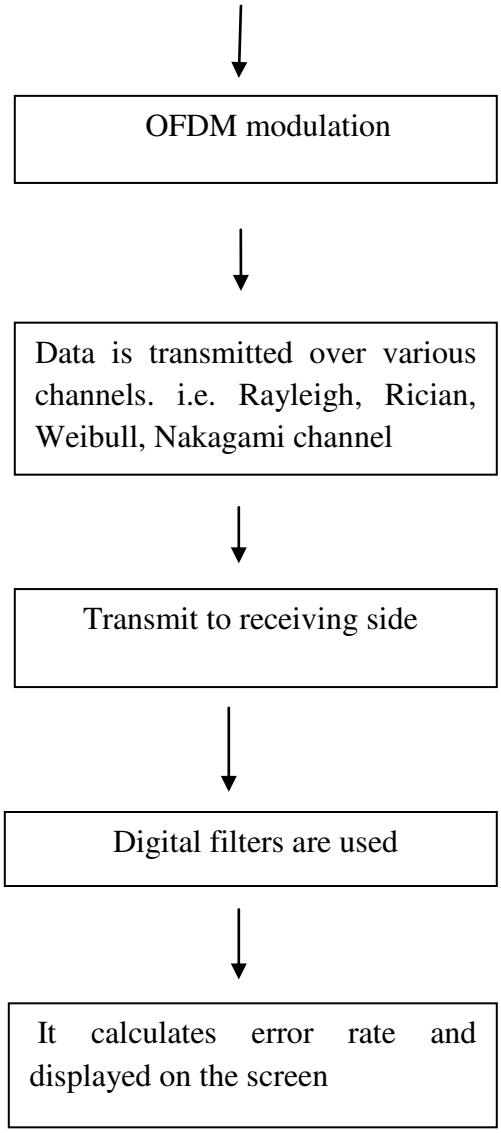


Figure 6.1: Research methodology Algorithm

CHAPTER 7

DVB-T2 SYSTEM

7.1 DVB-T2

DVB-T2 (digital video broadcasting-second generation terrestrial) which is a part of television standard of DVB-T [2]. It is issued by association of DVB. This technology has great success on DVB-T which provides extra efficiency and category, highlights in accordance with the creating DTT (digital terrestrial television). DVB-T2 is systems that transmit compressed digital audio, video resources and different types of data in PLP by utilizing OFDM with different coding channel and Interleaver. This is wanted to deal with it besides the recently DVB-T organization for a number of years and to develop the alteration to DVB-T2. It provides additional features like enable the broadcasters, to offer new and decent services.

7.1.1 Terrestrial Broadcasting

terrestrial TV or communicate TV is a kind of TV broadcasting in which the TV signal is transmitted by radio waves from the earthbound (Earth based) transmitter of a TV channel to a TV recipient having a reception antenna [3].Earlier, there was only one TV channel was being transmitted by single transmitter which was operating on same frequency, this means only analog transmission is used. Terrestrial broadcasting has many advantages: radio frequency spectrum is used very efficiently, upright image sound and quality, viability of high definition picture (HDTV).

7.1.2 HDTV Signals

DVB-T2 guides' high definition television signals.HD means high resolution, more clarity power and quality. Features of HDTV signal are listed below:

- It guides up to 1080 horizontal lines of boldness while that of SDTV was 525.
- It is one of the most suitable improvements over the SDTV.
- It is always digital system and it removes the analog interference that is caused by the electrical currents and magnetic fields.
- HDTV having more boldness over the SDTV.
- HDTV makes image look more representational and clear.

7.1.3 Specification of DVB-T2

DVB –T2 standard was developed by DVB steering board on 26 June 2008, which was published on the DVB home page. European telecommunication standard institute by DVB which was handled the DVB-T2 standards on 20 June 2008. ETSI process was adopted on 9 September 2009.This process contained many phases but the main modification were text clarification. The day when physical layer of DVB-T2 was completed, no further technical enhancement was made in physical layer of DVB-T2.

7.1.4 Single Frequency Network

DVB-T2 permits single frequency systems (SFN) operation inside a given geological range, where at least two transmitters conveying similar information work on a similar frequency. In such cases the signals from every transmitter in the SFN should be precisely time-adjusted, which is finished with synchronization data in the T2MI stream included by the T2 Gateway [20]. The DVB-T2 standard additionally incorporates Multiple Input Single Output (MISO) based on Alamouti coding mode. The key advantage originating from the MISO SFN is seen by less degradation in term of least receiver input control, while a degradation of a few dB is measured in SISO-SFN.

7.1.5 Physical Layer Pipe (PLP)

The PLP idea is acquired from the DVB-S2 standard. It permits benefit particular robustness. Each PLP can have its own modulation scheme, FEC code rate and interleaving. All PLPs are communicated over a similar frequency that it is considered as a DVB-T2 channel only [20]. DVB-T2 multiplex can convey a solitary PLP, characterized as information mode A, or various PLP, characterized as input mode B of the T2 System. A T2 system can communicate a greatest of 255 PLP per multiplex. There are 3 standards of PLP: regular PLP of type 0 that conveys data extricated from the other information PLP. For example, program control, or other basic information.PLP sort 1 contains 1 slice for each T2 frame while type 2 contains a few slice to convey the genuine data. The information PLP of sort 1 can be utilized for administrations that require a decent power saving. The information PLP of sort 2 is conveyed in various sub-slices per T2 frames expanding time diversity qualities and afterward giving better robustness to mobile services. The quantity of sub-cuts ought to be as vast as possible. In M-PLP mode, the demodulator should get in the meantime the normal PLP and information of PLP to have the

capacity to manufacture the MPEG-2 Transport Stream as it is gotten at the input of the PLP developer. The demodulator can be tuned to the fancied PLP on account of the data removed from the SI tables or recovered from the filtering.

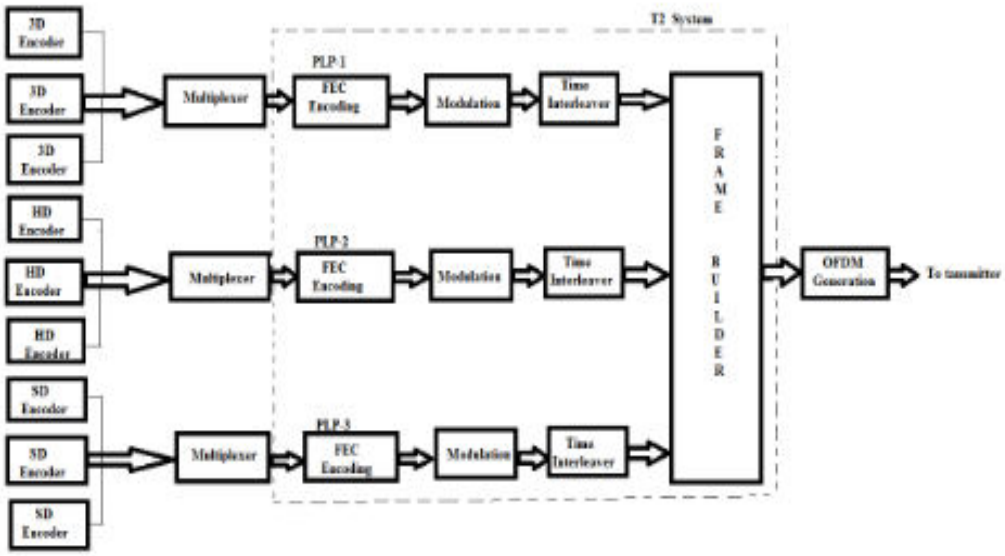


Figure: 7.1 high level M-PLP T2 Block Diagram

As the demodulator should read just a single PLP at a given time there is no confinement in the recipient side on the quantity of upheld PLP. In a standard DVB-T system only a single MPTS can be communicate per DVB-T channel. In a DVB-T2 system each PLP must contain predictable TS. So an improved T2 framework can be viewed as a few MPTS having a similar channel without the need of multiplexing these MPTS together at the head-end. The PLP idea permits an extensive variety of business model. Administrators can separate effectively benefits on a PLP premise with an offering that differs as per the robustness level. M-PLP gives most extreme adaptability, with no disadvantage or overhead. Network equipment is accessible and conveyed. There is likewise no extra unpredictability in the system, when we are compared with single PLP arrangement. DVB-T2 chipsets are now M-PLP consistent and end-client receivers are presently accessible without additional cost for the support of M-PLP. On account of the progressing organizations one can expect that the new receiver available will all supports M-PLP as a standard feature.

7.1.6 Block Diagram of DVB-T2

Digital video broadcasting (DVB-T2), it is a designation specified to the terrestrial transmission system. DVB system is used to choose as a study choices in March, for an overhauled DVB-T

standard [5]. A review assembles called as TM-T2 which is discovered in June 2006. It built up by the DVB Group to build up advanced modulation plan which might be received by a 2nd generation digitally earthbound TV standard, which is called as DVB-T2.

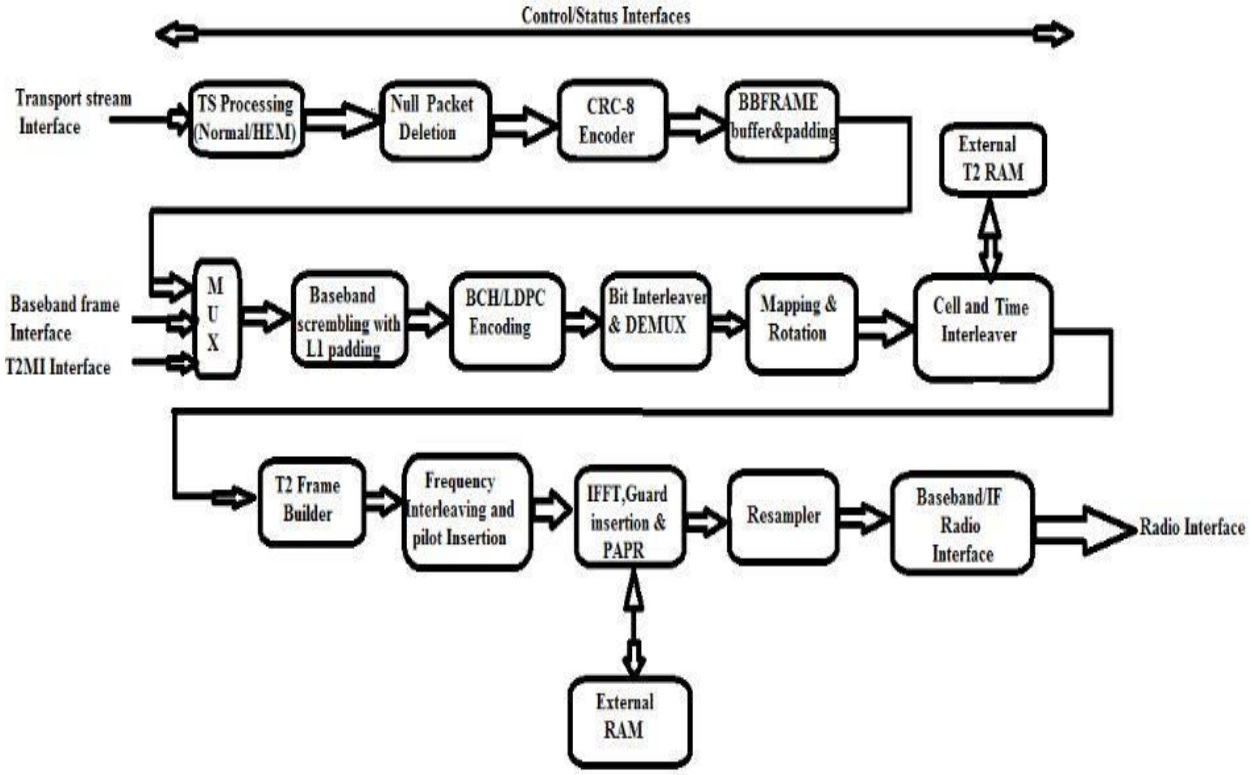


Figure: 7.2 DVB-T2 Modulator [23]

This system splits into several parts: Input processing for input mode 'A' and Input processing for input mode 'B'. At the input, PLP (physical layer pipe) is used. PLP are consistent channels conveying at least one advantage having modulation plan and strength specific which is indivisible. At input processing, null packet deletion and CRC-8 are used. The groups of Information are collected called Base Band Frames (BBFRAMEs) having dimension of K_{BCH} bits defined as modulation and coding (MODCOD) specification. The DVB-T2 standard has characterized another protocol interface the T2-MI (T2-Modulator Interface) to convey between the T2 Gateway and the Modulators. The T2-MI packets convey the information encapsulated into BB Frames, accommodate synchronization data when broadcasting over SFN and incorporate all the signaling data for the transmission [21]. All the PLP, TFS, SFN components are planned from the T2 Gateway and depicted inside particular T2-MI packets. Multiplexer is a device that converts

the one or more input signals into one output line. The entire BBFRAME should be randomized. The randomization sequence of data should be synchronous with the BBFRAME, beginning from the MSB and completion after K_{bch} bits. The scrambling succession might be created by feedback shift register. Padding might be connected in conditions when the user information accessible for transmission which is not adequate to totally fill a BBFRAME, or when a whole number of UPs must be allocated in a BBFRAME.

Two types of encoding techniques are used i.e. LDPC and BCH [10]. LDPC are a linear correcting method that is used for transmitting the data over noisy transmission channel.BCH and LDPC encoding are used multiple error correcting and error detecting purpose. LDPC code further sent to the BCH codes. Interleaving is further two types: Parity bits block interleaving and Twist column interleaving [22]. The output of the LDPC encoder should be bit interleaved that comprises parity interleaving took after by second type of interleaving. The parity Interleaver output is meant by U and the column twisted Interleaver output by V. Demultiplexer is used to convert the bit into cell word. Rotation means constellations might be inclined encircling by a measure of up to 30 degree. Besides, the matched parts of the units are consistently moved by one unit. Frame builder is a one frame in which transmitted braches are sorted out in super frame that is formed by T2 frame and Future Extension Frame parts and Mapping of these units to OFDM symbols. The Pseudo Random Cell Interleaver (CI), might consistently spread the cells in the FEC codeword, to guarantee in the sink end an uncorrelated circulation of channel contortions and conflict within the FEC codeword's, and should in an unexpected way "turn" the interleaving grouping in each of the FEC system of one Time Interleaver Block. The time Interleaver (TI) should work at PLP level. The parameters of the time interleaving might be diverse for various PLPs inside a T2 system. After the frame builder, IFFT and Guard insertions are used and also used the cyclic prefix that is inserted before the IFFT. Especially in the case of 32k, where the powerful peaks are produced and in this way minimize the Amplifier efficiency (or can even harm it). A unique feature named as PAPR (Peak Average Power Ratio) decrease has been incorporated into the standard details to restrict these powerful peaks without losing data [21]. At the end of the system, T2 signal is converted into analog baseband signal.

7.1.7 Standard of DVB-T2

- Modulation of COFDM with QPSK, 16-QAM, 64-QAM and 256- QAM constellations.

- Modes of OFDM are 1k, 2k, 4k, 8k, 16k and 32k.
- FEC is concatenated LDPC and BCH codes with the rates of ½, 3/5, 2/3, 4/5 and 5/6.
- Here, some pilots are also there which are in 8 different pilot pattern and equalization that may be based upon RAI CD 3 system.
- For 32k mode, 8MHz standard is the larger part of channel that can be used for adding extra capability about 2%.
- The range of DVB-T2 channel is 1.7, 5, 6, 7, 8 and 10 MHZ bandwidth.
- So MIMO will not be used and MISO can be used in DVB –T2.

7.1.8 Advantages of DVB-T2

- It is most advance digital terrestrial television [DTT] in the world.
- More flexible and robustness and 50% more efficient than other DTT system
- Enhances or increase the performance of the system.
- Better sound quality.
- For transporting HDTV signals, DVB-T2 is more preferable.
- With comparison to DVB-T, DVB-T2 offers higher bit rate.

7.1.9 Disadvantages

- Cost is too high to afford.

7.2 WORKING MODEL OF DVB-T2

7.2.1 Proposed DVB-T2 System without filter

Digital video broadcasting (DVB-T2) is a designation specified to the terrestrial transmission system. In this system, we are using the random data for convergence broadcasting transmission purpose. The random data is in 0 or 1 form. Buffer is used to convert scalar samples to a frame output at a lower rate. After the buffering, it sends to the padding block. Padding provides Append or prepend a constant value to the input along the specified dimensions. In DVB-T2 model, we are use BCH encoding as well as LDPC encoding to encrypt the data. Interleaving is used for reorder the elements of the input signal. After the interleaving part, we use the different QAM modulator that is 16 QAM, 256 QAM, and 64 QAM with OFDM modulation over AWGN channel and Multipath Rayleigh fading channel and transmits the data to the receiver side. At the last, we have calculated the error ratio for 16 QAM and 256 QAM.

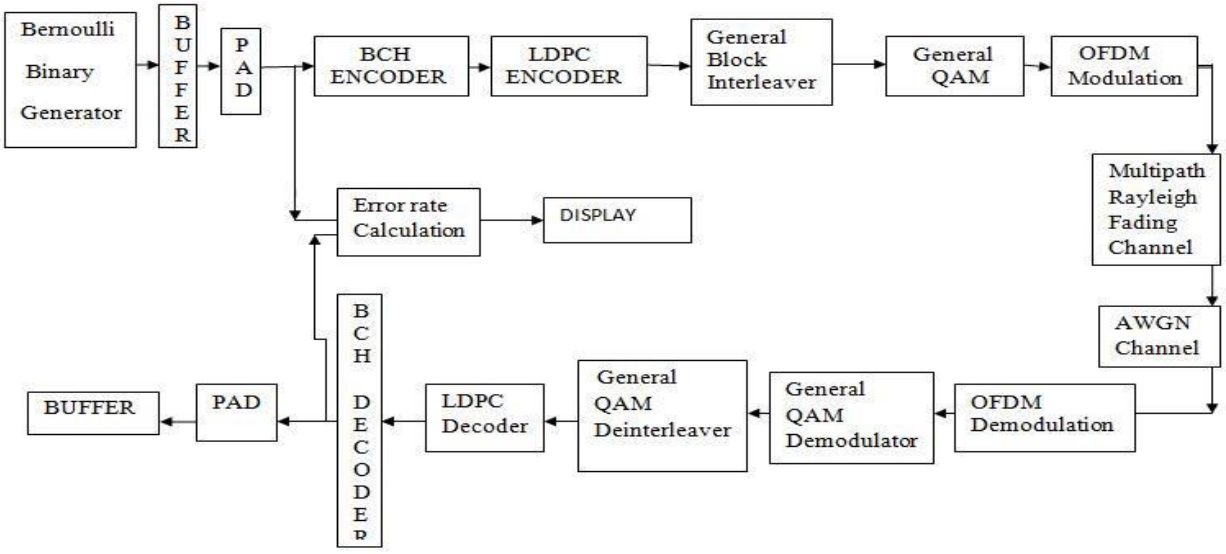


Figure 7.3: Working model of DVB-T2 System without Filter

7.2.1 Proposed DVB-T2 System with filter

In DVB-T2 using filter based system, the entire working is same as DVB-T2 System without filter. There have a two encoding techniques that is LDPC and BCH. This system has designed only

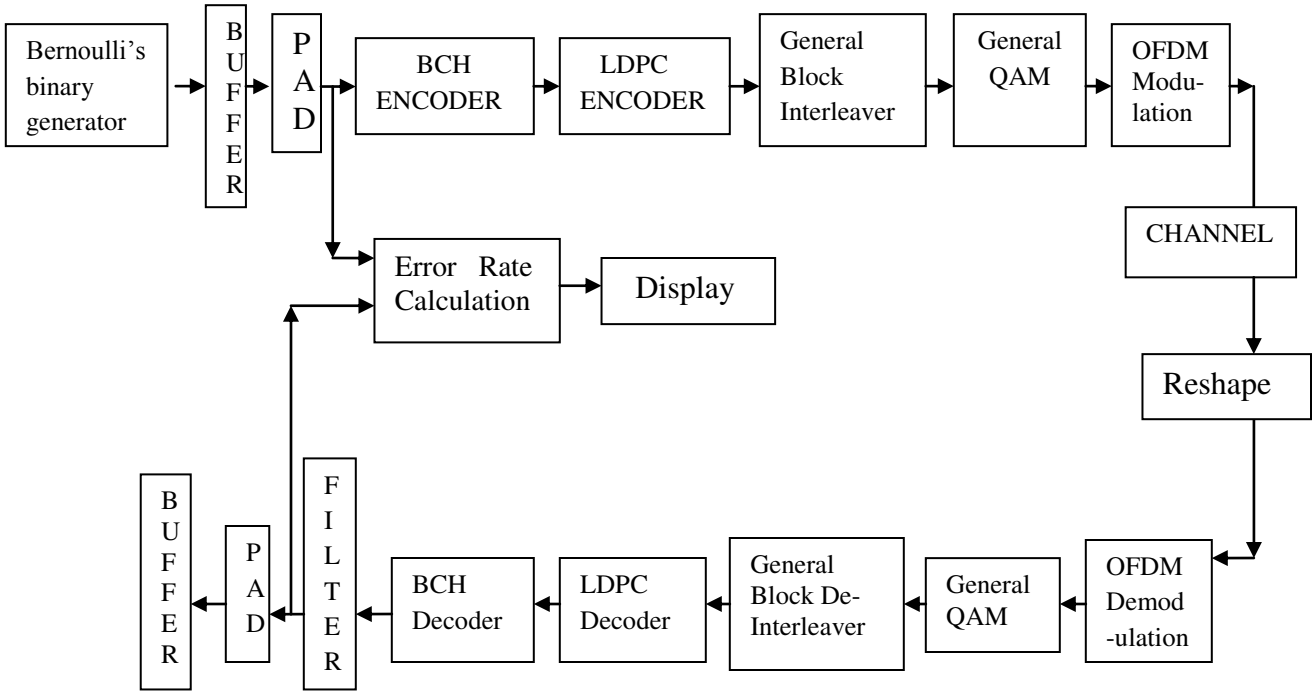


Figure 7.4: Working model of DVB-T2 System with Filter

QAM modulation. In my research work, DWT (Discrete Wavelet Transform) technique is used in OFDM and digital filters are also used for reducing the BER performance in the system. A discrete wavelet change (DWT) may be whatever wavelet convert for which those wavelets would discretely samples. Likewise with other wavelet transforms, a way playing point it need over Fourier transforms may be transient resolution: it captures both Frequency and Furthermore area data. Digital Filters would utilize to two all purposes: (1) detachment of signal that has been combined (2) rebuilding of signals that have been bended somehow. It consists of A to D converter that is used for sampling of the input signal. It accomplished by peripheral elements for example such that memory with store information. Digital filters might make more costly over analog filters because of their expanded complexity; anyhow they make useful a lot of people outlines than analog filters.

Table 7.1 Difference b/w DVB-T & DVB-T2 Parameters

Parameter	**DVB-T**	**DVB-T2**
Input Interface	Single transport Stream	Multiple transport stream and GSE
Encoding Techniques	Convolutional codes + Reed Solomon encoding	LDPC + BCH
Modulation Scheme	QPSK,16QAM,64QAM	QPSK,16QAM,64QAM,256QAM
PLP	No	Yes
Guard Interval	¼,1/8,1/16,1/32	¼,1/8,1/16,1/32,19/128,19/256,1/128
Modulation	OFDM	OFDM
FFT Size	2k	32k
Modes	Constant coding + Modulation	Variable coding + Modulation
Continual Pilot	2.6%	0.35%
Scattered Pilot	8%	1%,2%,4%,8%
Bandwidth	Standard	Extended

CHAPTER 8

RESULT AND DISCUSSION

As the part of analysis, two different modulation techniques are used to calculate the BER performance with the help of BCH encoding as well as LDPC encoding which are the part of DVB-T2 standard. DVB-T2 works on different modulation techniques. i.e. 16 QAM, 64 QAM, and 256 QAM, but I have used only 16 QAM and 256 QAM. BER value is increasing as order of signal to noise ratio increasing. The simulated results are showing that error calculation is less in the case of 16 QAM as compared to 256 QAM with OFDM over an AWGN channel and multipath Rayleigh fading channel.

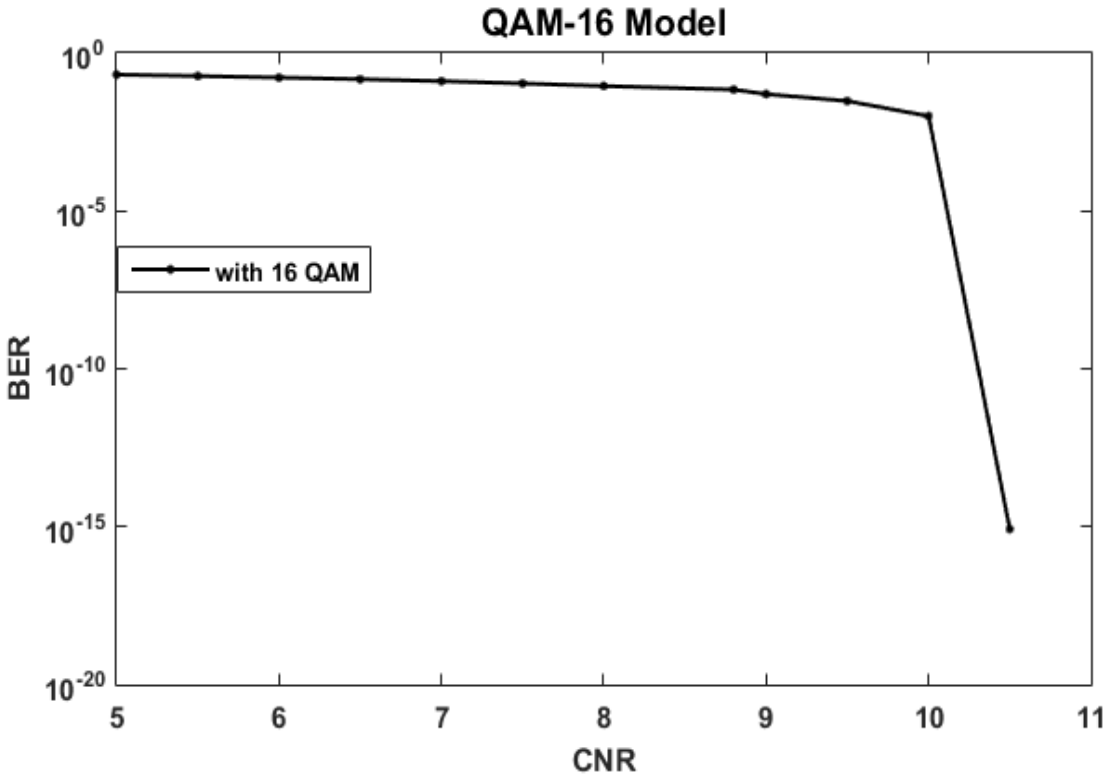


Figure: 8.1 BER Performance of 16QAM Model

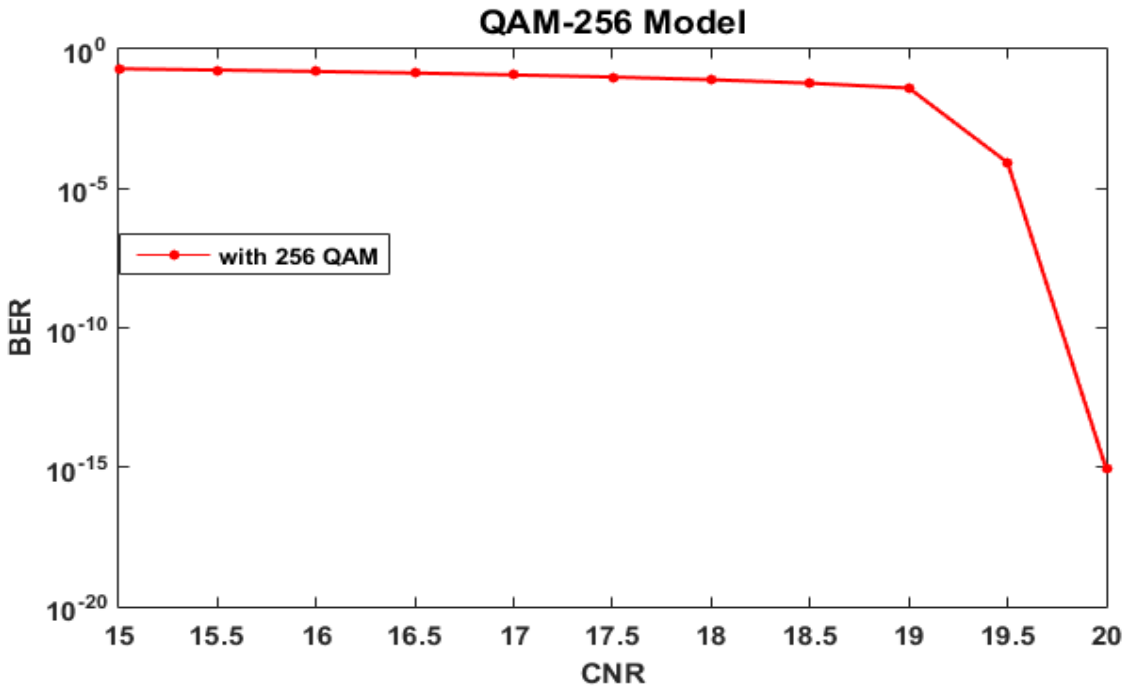


Figure: 8.2 BER Performance of QAM256-Model

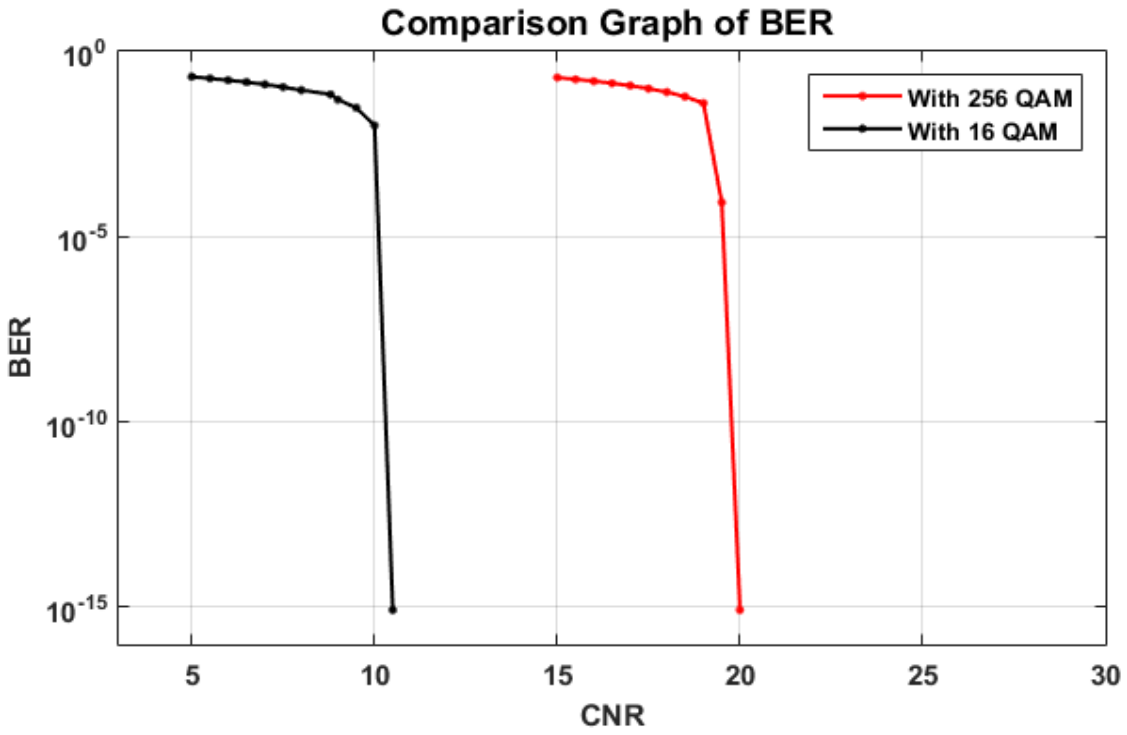


Figure: 8.3 Comparison BER Performance using 16 QAM & 256 QAM

8.1 Simulation Result With and Without Filter

From the Simulation part, different modulation techniques are used in various channels to calculate the BER performance with the help of BCH encoding as well as LDPC encoding that are the part of DVB-T2 standards. Different modulation techniques.i.e.16 QAM, 32 QAM, 64 QAM, and 256 QAM are used in DVB-T2 system. Various channels like Nakagami, Weibull, Rician, Rayleigh uses different QAM modulation which is a part of OFDM based DVB-T2 system. Using Simulation model calculates the error rate with different channel and find out which channel is best. Digital filter are used for improving the performance of the system and it also reduces the error rate. At the last, I have done the comparison of different modulation techniques over various channels with filter and without filter. It showed Nakagami channel gives better results for all the modulation because error rate is less and performance of the system is better as compared to other fading channels with the help of different encoding techniques.

8.1.1 Various Graph Plotted between BER and CNR with different modulation over different channels without Filter:

The figure 8.4 shows the comparison of 16 QAM modulations over various channels without filter. In 16 QAM modulations, Nakagami (without filter) channel gives better result. When the value of BER is 10-10 then CNR value is 7.6776 which is less than other channels.

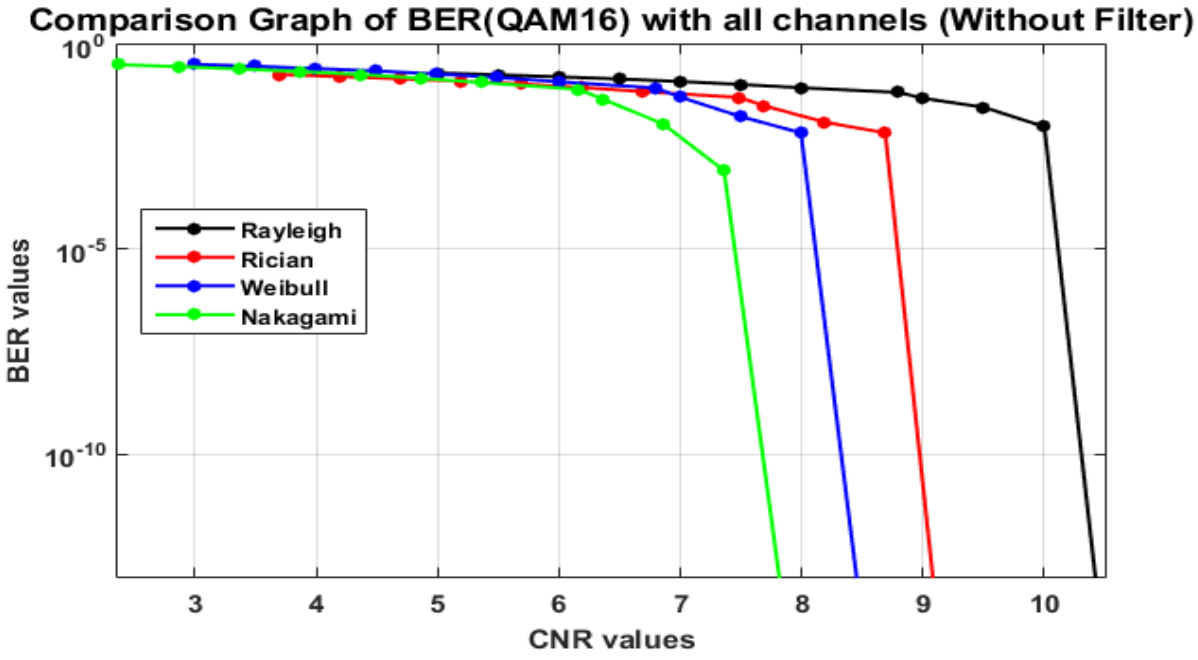


Figure 8.4: BER Performance with all channels in 16 QAM

The figure 8.5 tells about the comparison of 32 QAM modulations over different channels without filter. In 32 QAM, Nakagami (Without filter) provides good result as compared to other channels because CNR value is 10.379 which is less than Weibull channel.

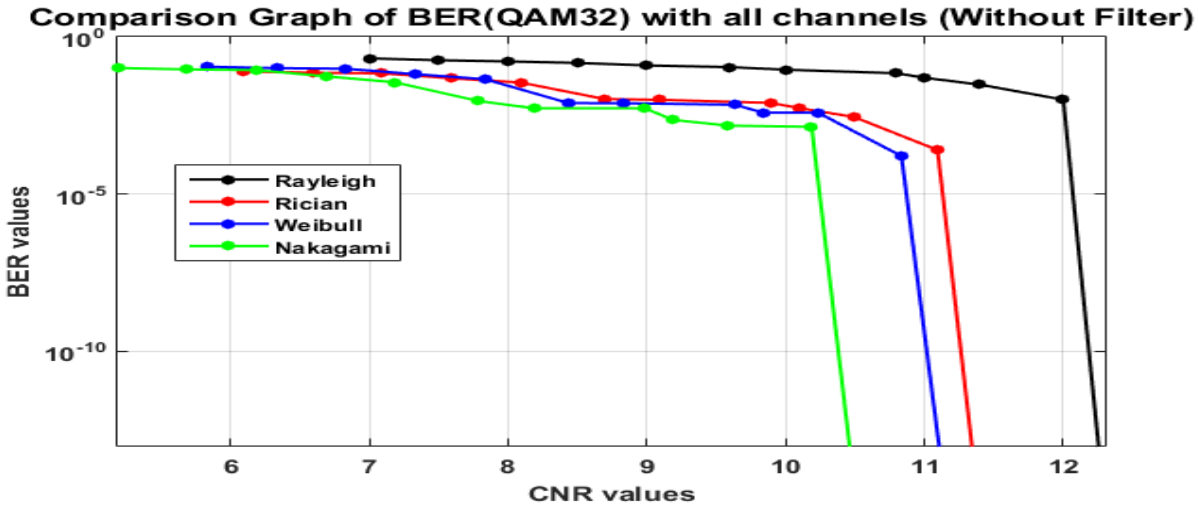


Figure 8.5: BER Performance with all channels in 32 QAM

The figure 8.6 shows the comparison of 64 QAM modulations over various channels without filter. In 64 QAM modulations, Nakagami (without filter) channel gives better result. When the value of BER is 10^{-10} then CNR value is 11.684 which is less than other channels.

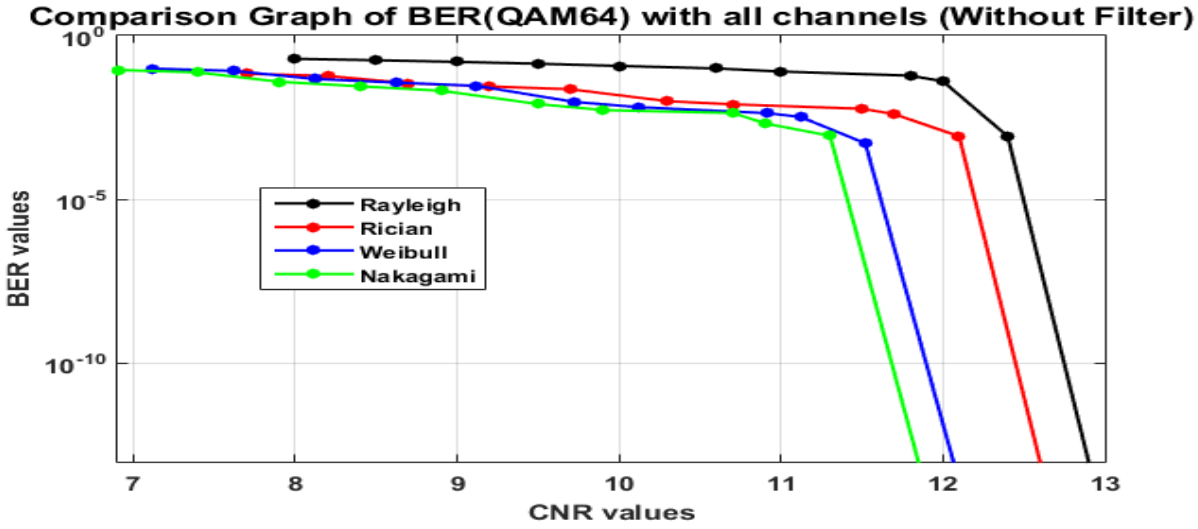


Figure 8.6: BER Performance with all channels in 64 QAM

The figure 8.7 shows the comparison of various channels in 256 QAM modulations without filter. In 256 QAM, Nakagami gives better result because CNR value is less than all other channels.

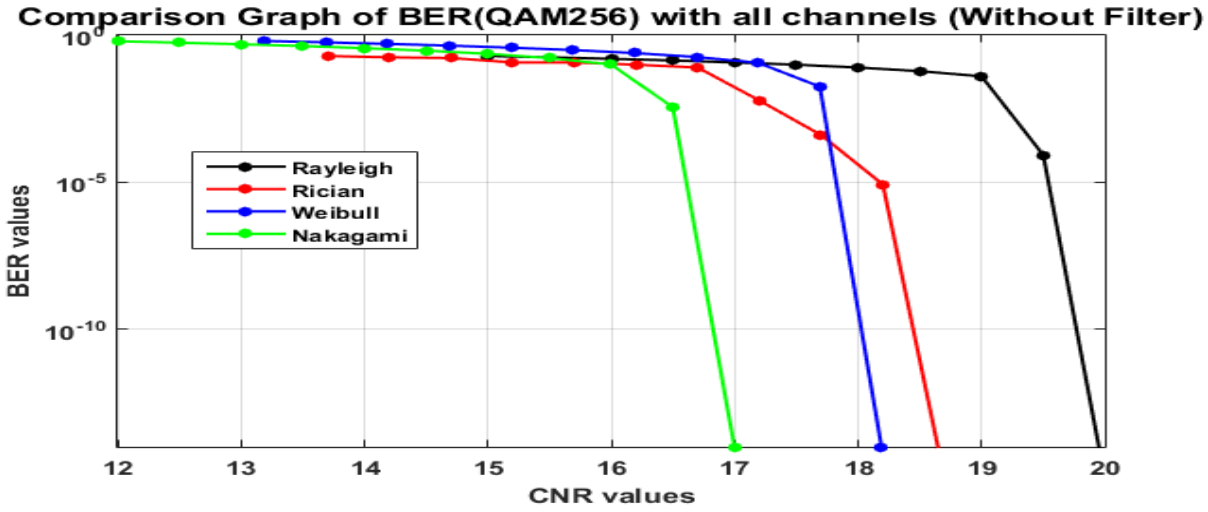


Figure 8.7: BER Performance with all channels in 256 QAM

8.1.2 Various Graph Plotted between BER and CNR with different modulation over different channels using with Filter:

The figure 8.8 tells about the comparison of different channels in 16 QAM modulations with filter. In this graph, Nakagami (with filter) provides good result as compared to other channels because CNR value is 7.6464 which is less than others channels.

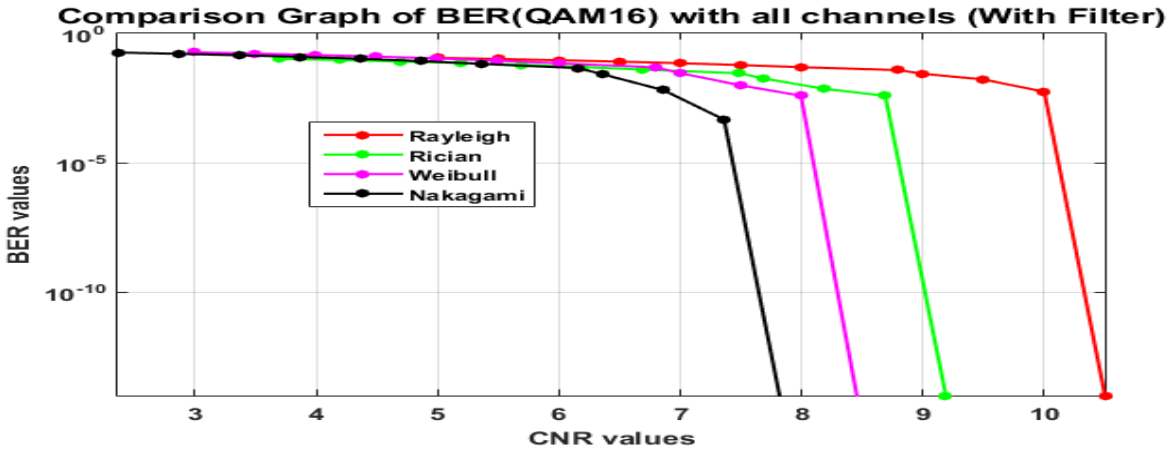


Figure 8.8: BER Performance with all channels in 16 QAM

The figure 8.9 described the comparison of 32 QAM modulations over different channels with filter. In the case of Nakagami having 32 QAM modulations, the value of CNR is 10.3617 when we set the value of BER is 10^{-10} and it indicates that Nakagami is better.

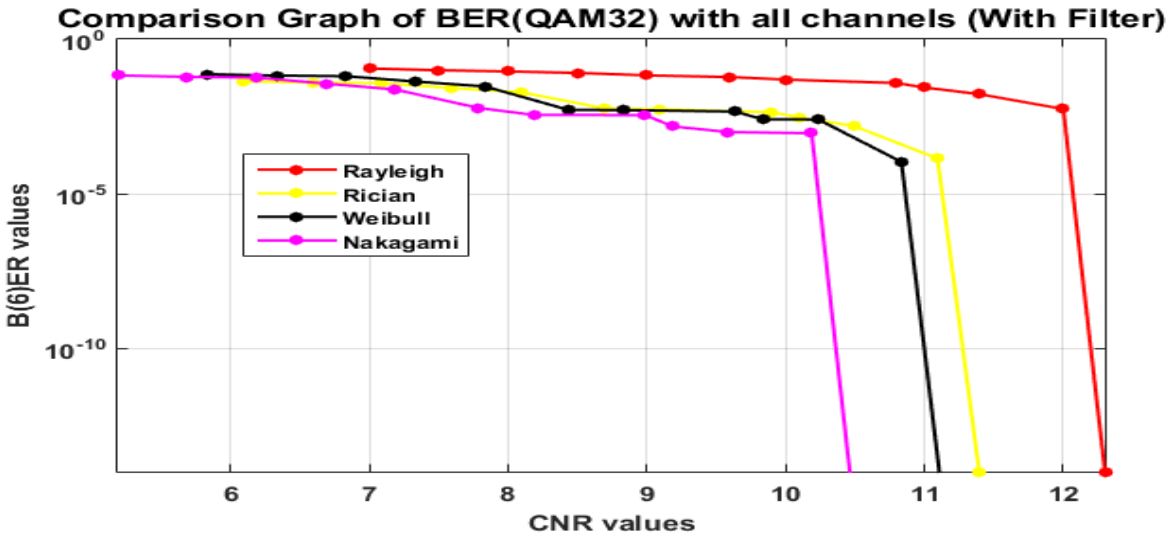


Figure 8.9: BER Performance with all channels in 32 QAM

The figure 8.10 described the comparison of different channels having 64 QAM modulations with filter. In this graph, Rayleigh channel provides worst result as compared to other channels. In the case of 64 QAM, the value of CNR in Nakagami and Weibull is 11.647 and 11.86.so, it means Nakagami offering better result.

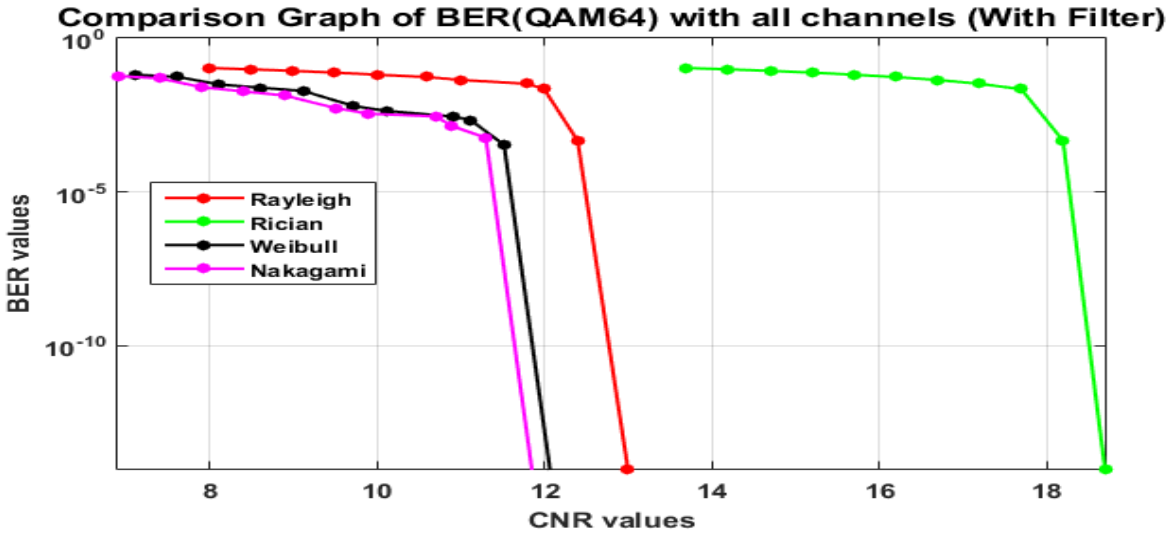


Figure 8.10: BER Performance with all channels in 64 QAM

The figure 8.11 tells about the comparison of various channels in 256 QAM modulations with filter. According to this graph, when we set the value of BER is 10^{-10}, the value of CNR in Nakagami, Weibull, Rician and Rayleigh channels are 16.788, 17.992, 18.446 and 19.769.This value indicates that Nakagami is better because CNR value is less.

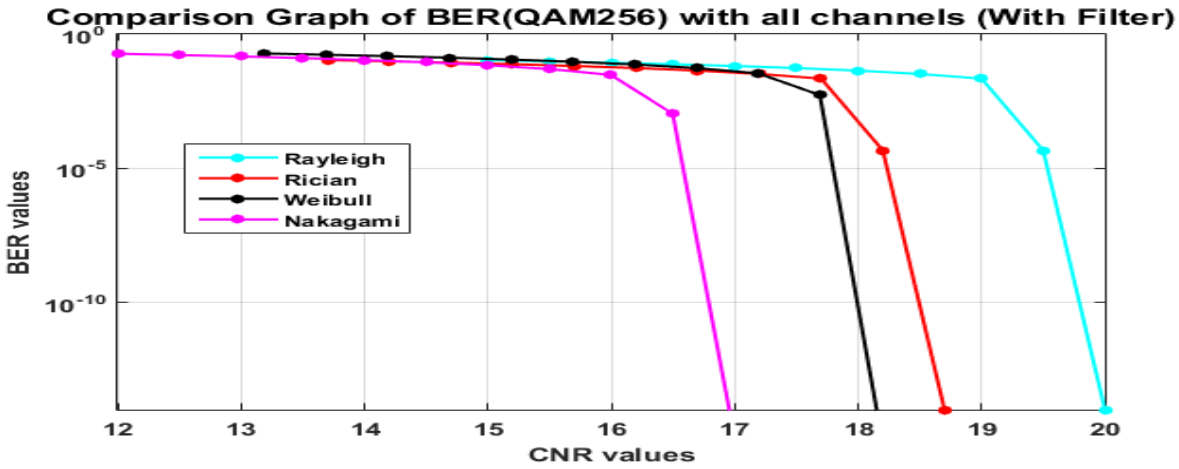


Figure 8.11: BER Performance with all channels in 256 QAM

8.1.3 Various Graph Plotted between BER and CNR with different modulation over various channels with and without using Filter:

The figure 8.12 clearly indicates the comparison of various channels in 16 QAM modulations with and without filter. At fixed point of BER value is 10^{-10}, the value of CNR in Nakagami (with filter) is 7.6464 and in Nakagami (Without Filter) is 7.6776. These value shows that Nakagami (with filter) is good.

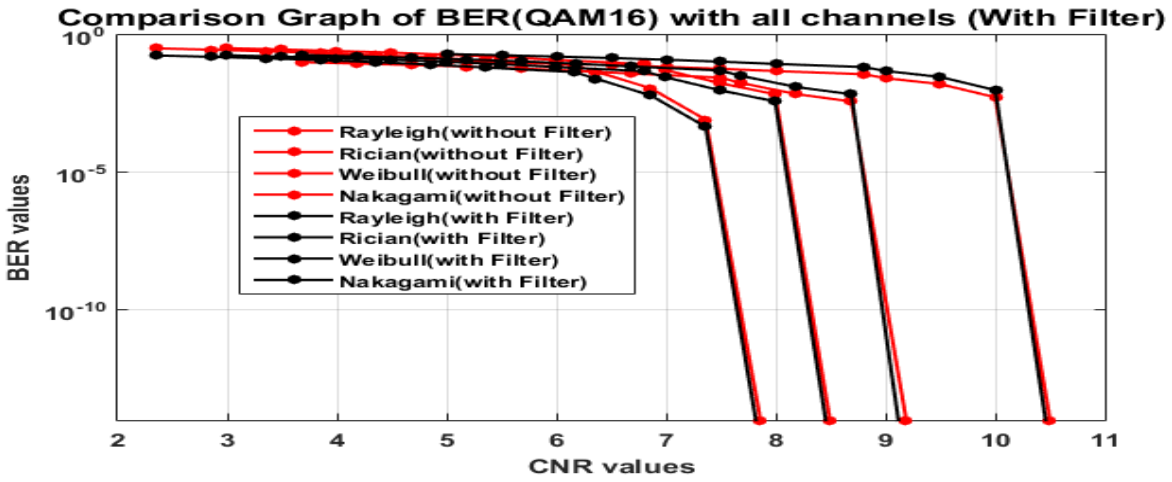


Figure 8.12: BER Performance with all channels in 16 QAM (With and Without Filter)

The figure 8.13 shows the comparison of various channels in 32 QAM modulations with and without filter. If we set the value of BER is 10^{-10}, the value of CNR is minimum in Nakagami (with filter) than Weibull (with filter).

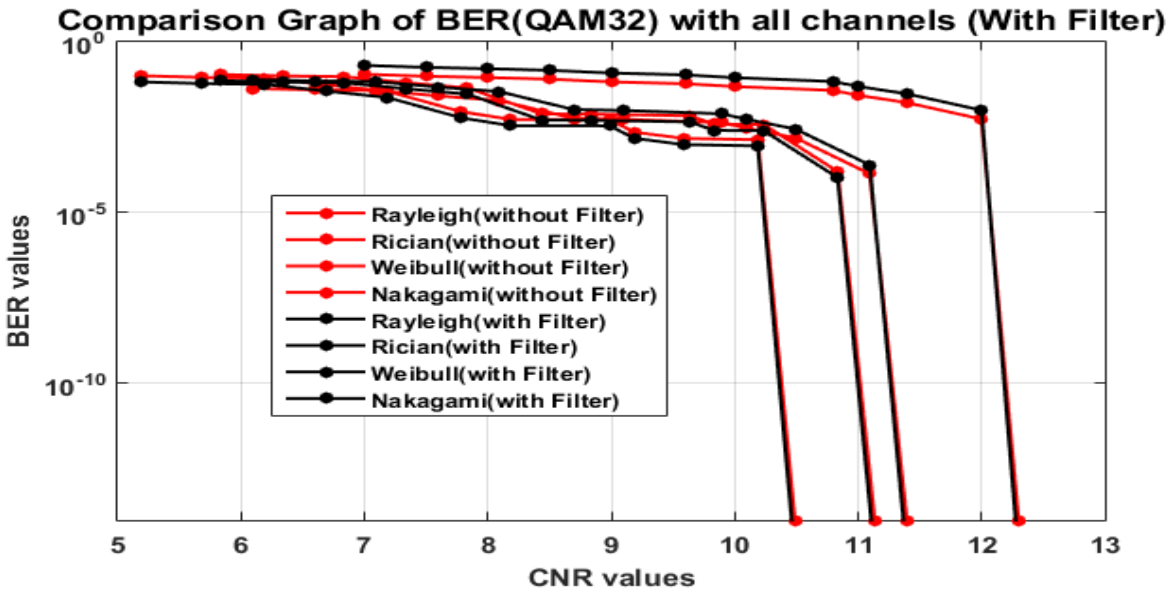


Figure 8.13: BER Performance with all channels in 32 QAM (With and Without Filter)

The figure 8.14 describes the comparison of various channels in 64 QAM modulations with and without filter. In 64 QAM, Nakagami channel (With Filter) offering superior result than Weibull, Rician, Rayleigh channels (with and without filter).

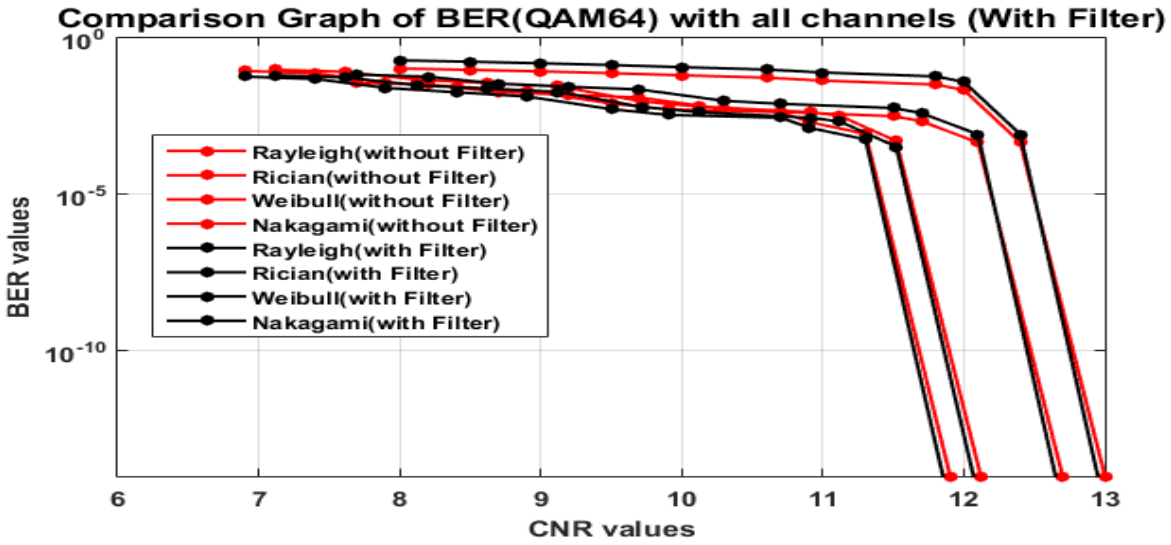


Figure 8.14: BER Performance with all channels in 64QAM (With and Without Filter)

The figure 8.15 describes the comparison of various channels in 256 QAM modulations with and without filter. In 256 QAM, Nakagami channel (With Filter) provides good result because CNR value is 16.788 which are less than Nakagami (without filter) is 16.823.so, these values proves that Nakagami (with filter) channel achieves the optimum result.

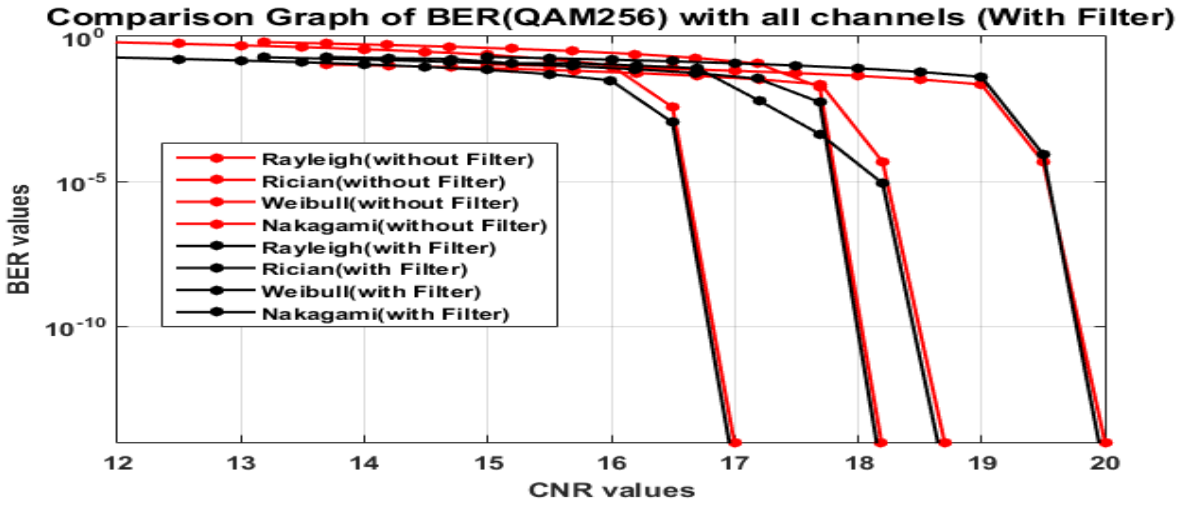


Figure 8.15: BER Performance with all channels in 256 QAM (With and Without Filter)

The figure 8.16 describes the comparison of various modulations in Nakagami channel with and without filter. In Nakagami channel, 16 QAM (with filter) gives better result than other modulations because CNR value is 7.6464 which is less than others values at the BER is 10^{-10}.

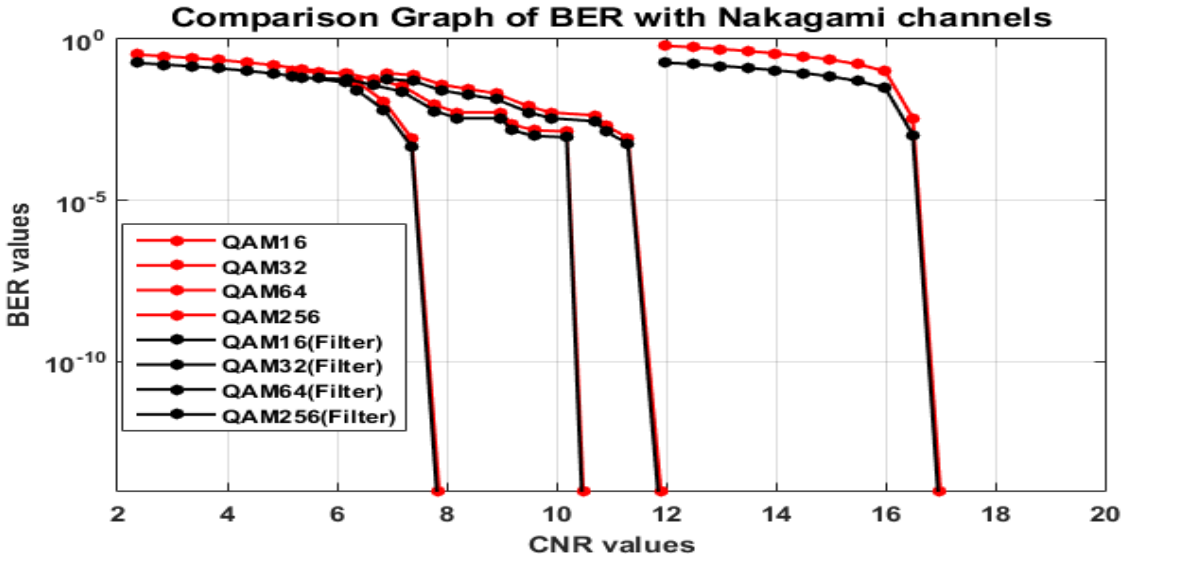


Figure 8.16: BER Performance with all modulations in Nakagami Channel

The figure 8.17 shows the comparison of various modulations in Weibull channel with and without filter. In the case of 16 QAM, the values of CNR are 8.295 and 8.3254 in Weibull (with filter) and Weibull (without filter).These value indicates that Weibull with filter is better in 16 QAM modulation.

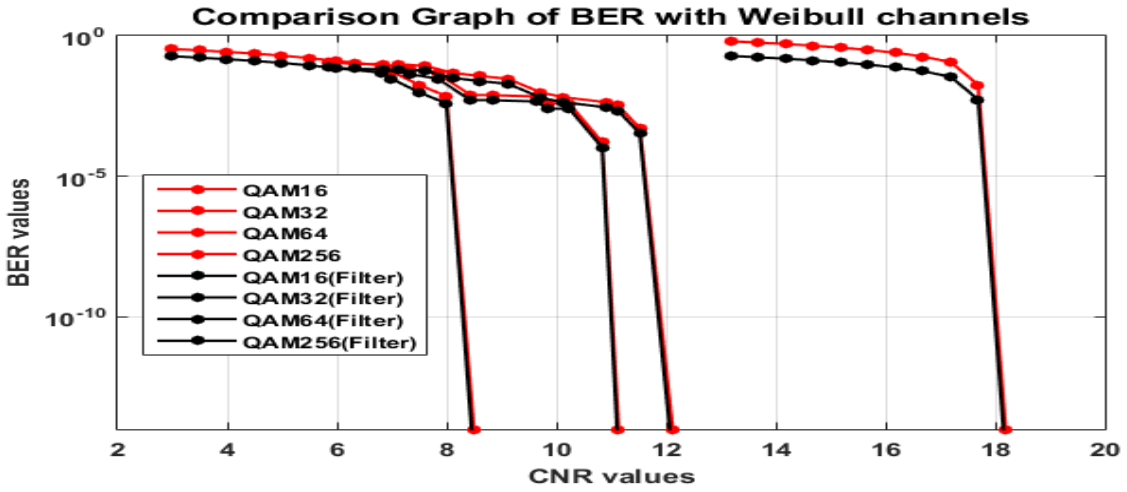


Figure 8.17: BER Performance with all modulations in Weibull channel

The figure 8.18 shows the comparison of various modulations in Rician channel with and without filter. In Rician channel, 16 QAM (with filter) achieves optimum result because CNR value is 8.973 which is less than other values.

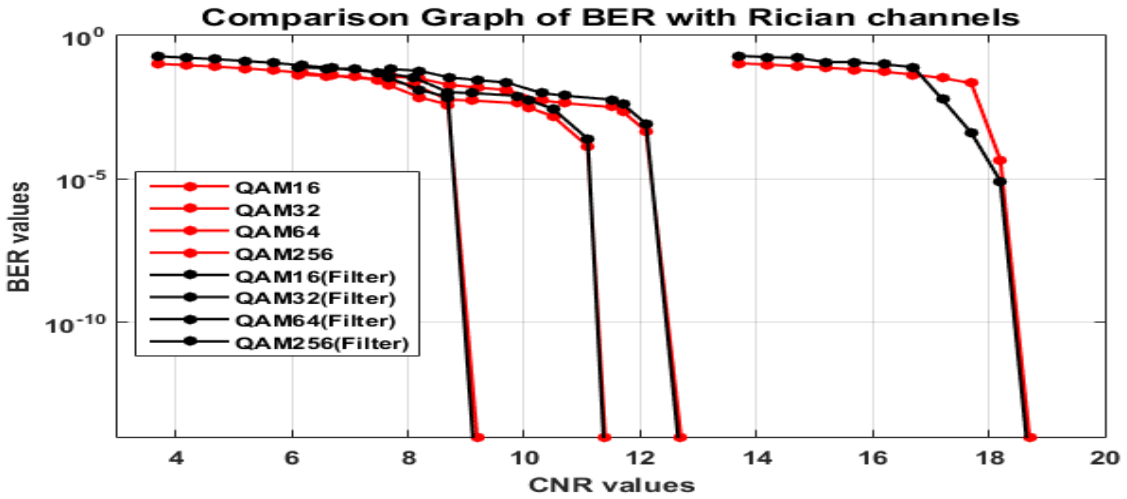


Figure 8.18: BER Performance with all modulations in Rician channel

The figure 8.19 shows the comparison of various modulations in Rayleigh channel with and without filter. In Rayleigh channel, 16 QAM (with filter) is more superior to other modulations because CNR value is 10.307 which is less than other values.

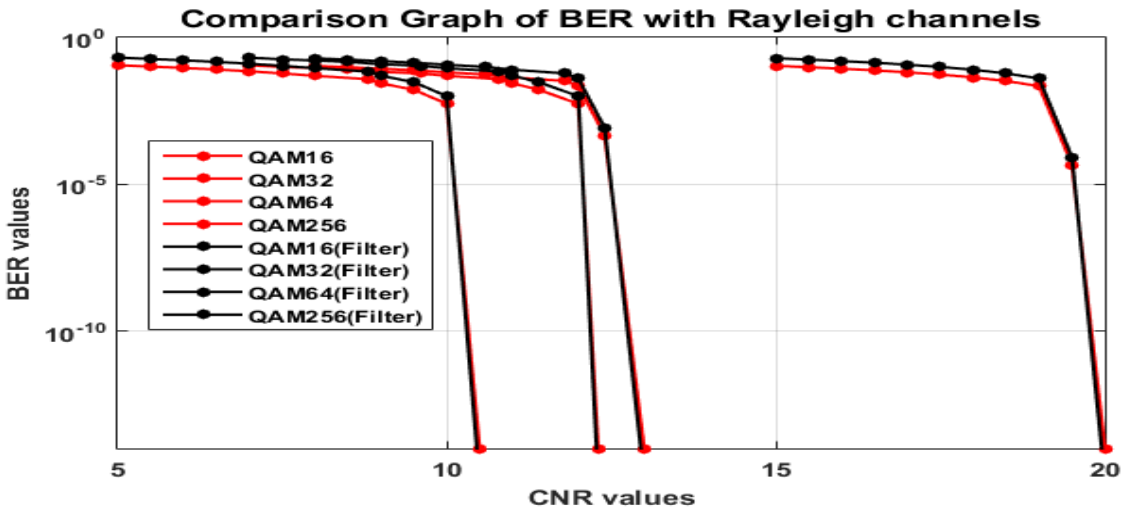


Figure 8.19: BER Performance with all modulations in Rayleigh channel

CHAPTER 9

PERFORMANCE EVALUTION

9.1 COMPARISON OF CNR VALUES OF NAKAGAMI CHANNEL

In this table, we calculate the value of CNR in different-2 modulations over the Nakagami channel with and without filter. In the 16 QAM, value of CNR is 7.6464 in NAKAGAMI channel with filter is best as compared to other modulations.

Table 9.1 Comparison of CNR values of Nakagami Channel

BER VALUE	MODULATION	NAKAGAMI WITH FILTER (CNR VALUE)	NAKAGAMI WITHOUT FILTER (CNR VALUE)
10^{-10}	16 QAM	7.6464	7.6776
10^{-10}	32 QAM	10.3617	10.379
10^{-10}	64 QAM	11.6476	11.684
10^{-10}	256 QAM	16.788	16.823

9.2 COMPARISON OF CNR VALUES OF WEIBULL CHANNEL

In this table, we calculate the value of CNR in different-2 modulations over the Weibull channel with and without filter. In the 16 QAM, value of CNR is 8.295 in Weibull channel with filter is best as compared to other modulations.

Table 9.2 Comparison of CNR values of Weibull Channel

BER VALUE	MODULATION	WEIBULL WITH FILTER (CNR VALUE)	WEIBULL WITHOUT FILTER (CNR VALUE)
10^{-10}	16 QAM	8.295	8.3254
10^{-10}	32 QAM	10.998	11.0167

10^{-10}	64 QAM	11.86	11.896
10^{-10}	256 QAM	17.9928	18.026

9.3 COMPARISON OF CNR VALUES OF RICIAN CHANNEL

In this table, we calculate the value of CNR in different-2 modulations over the Rician channel with and without filter. In the 16 QAM, value of CNR is 8.973 in Rician channel with filter is best as compared to other modulations.

Table 9.3 Comparison of CNR values of Rician Channel

BER VALUE	MODULATION	RICIAN WITH FILTER (CNR VALUE)	RICIAN WITHOUT FILTER (CNR VALUE)
10^{-10}	16 QAM	8.973	9.016
10^{-10}	32 QAM	11.363	11.2758
10^{-10}	64 QAM	12.448	12.475
10^{-10}	256 QAM	18.446	18.493

9.4 COMPARISON OF CNR VALUES OF RAYLEIGH CHANNEL

In this table, we calculate the value of CNR in different-2 modulations over the Rayleigh channel with and without filter. In the 16 QAM, value of CNR is 10.307 in Rayleigh channel with filter is best as compared to other modulations.

Table 9.4 Comparison of CNR values of Rayleigh Channel

BER VALUE	MODULATION	RAYLEIGH WITH FILTER (CNR VALUE)	RAYLEIGH WITHOUT FILTER (CNR VALUE)
10^{-10}	16 QAM	10.307	10.328
10^{-10}	32 QAM	12.185	12.197

10^{-10}	64 QAM	12.7485	12.775
10^{-10}	256 QAM	19.7693	19.794

CHAPTER 10

CONCLUSION AND FUTURE WORK

10.1 CONCLUSION

The digital video broadcasting system is used for high range data transmission and reception through different encoding techniques and encrypted environment using a high bandwidth channel which can transmit higher data rate than the conventional system which works on lower data rates. The proposed system was designed to solve a problem for repetitive change in the used location at high speeds the users can not always be fixed as per the problem. This system is used to reduce the loss in data and also reduce the noise and interference. The Simulation shows that error calculation is less in 16 QAM over Nakagami (with Filter) channel as compared to other modulation with OFDM. From all the channels and modulations, Nakagami channel achieves better performance with 16 QAM modulations. In the case of 16 QAM, complexity of the system is less.

10.2 FUTURE SCOPE

- DVB-T2 would be used using the concept of MIMO-OFDM.
- Satellite media can be used to provide high data rates and fast reception of system.

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