An HYBRID Approach Using Beam forming and Cyclic Prefix in MIMO-OFDM System for Rayleigh Channel Estimation

DISSERTATION-II

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By

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Month and Year of Submission
(April 2017)

CERTIFICATE

This is to certify that Saivilas Goud, has implemented objective formulation of Dissertation-II project titled, **"An HYBRID Approach Using Beam forming And Cyclic Prefix in MIMO-OFDM System for Rayleigh Channel Estimation"** under my guidance and supervision. To the best of my knowledge, the presented work is the result of his original investigation and study. No part of the dissertation has ever been submitted for any other degree at any University.

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DECLARATION

I Saivilas Goud student of Master of Technology under Department of Electronics & Communications Engineering of Lovely Professional University, Punjab, hereby declare that all the information furnished in this dissertation project report is based on my own intensive research and is genuine.

This dissertation-II 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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LIST OF ABBREVIATIONS

1.	FDMA	Frequency Division Multiple Access
2.	AMPS	Advanced Mobile Phone Services
3.	TDMA	Time Division Multiple Access
4.	GSM	Global System for Mobile Communication
5.	OFDM	Orthogonal Frequency Division Multiplexing
6.	DFT	Discrete Fourier Transform
7.	IFFT	Inverse Fourier Transform
8.	QAM	Quadrature Amplitude Modulation
9.	SDMA	Space Division Multiple Access
10.	QoS	Quality of Services
11.	TDMA	Time Division Multiple access
12.	MIMO	Multiple Input Multiple Output
13.	WLAN	Wireless Local Area Network
14.	LTE	Long Term Evolution
15.	PAPR	Peak to Average Power Reduction
16.	MU	Multi user
17.	BPSK	Binary Phase Shift Keying
18.	QPSK	Quadrature Phase Shift Keying
19.	FSK	Frequency Shift Keying
20.	ICI	Inter-Carrier Interference
21.	ISI	Inter-Symbol Interference
22.	MMSE	Minimum Mean Square Error
23.	ZF	Zero Forcing
24.	ML	Maximum Likelihood
25.	CS	Compressed Sensing
26.	STF	Space Time Frequency
27.	DVB-T2	Digital Video Broadcasting

28.	LSE	Least Square Error
29.	SSS	Stochastic Sequential Search
30.	SPS	Stochastic Parallel Search
31.	IGS	Iterative Group Shrinkage
32.	JMAS	Joint Moving Average and sinusoidal
33.	OMP	Orthogonal Pursuit Matching
34.	BP	Basis Pursuit
35.	CRB	Cramer Rao-Bound
36.	HST	High Speed Train
37.	ACK	Acknowledgement
38.	VBLAT	Vertical BLAST
39.	DBLAST	Diagonal BLAST
40.	HBLAST	Horizontal BLAST
41.	SPM	Spatial Multiplexing

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CHAPTER 1 INTRODUCTION

In the Mobile Radio transmission, the people can communicate with each other without any physical connection through wireless, it was introduced more than hundred years ago. The Marconi has introduced wireless telegraphy technique, more than a hundred years ago. It is a major evolution in the wireless communication industry. May be it is not a mobile wireless system. The evolution of semiconductor technology had made possiblility, that affordable and communicates with one another other and serves the people around the world.

The mobile communication system is of different generations and depends on the service provided. The first generation technology contains with the analog technology frequency division multiple access (FDMA) system and it is in the form of Advanced Mobile Phone Services(AMPS).The second generation is comprises with the mobile digital communication system with the Time division multiple access (TDMA) on the Global System for Mobile communication(GSM), and Digital AMPS(D-AMPS), Code Division Multiple access (CDMA) based on the IS-95.The speech communication is offers mainly, low transmission rates is of data communication.

During the Recent few years, there is a revolution in the technology of wireless. There is a large growth in the upcoming wireless communication, whose major goal is to support multimedia communication with or without the knowing of location or quality with high data rates. The next generation communication network will be including wide range services, such as high quality audio, streaming video, data, pictures. The future service includes for the application of high data transmission rates of sparse Megabits per seconds (Mbps).

In present mobile communication system, the High bit rate data transmission is made essential on the video, high quality voice mobile integrated digital services network.

1.1 Orthogonal Frequency Division Multiplexing (OFDM)

Orthogonal frequency division multiplexing (OFDM) is the digital modulation signal, In this single data stream is split into the multiple data streams in order to avoid the cross talk and interferences.

In Recent Years, the channel estimation in orthogonal frequency division multiplexing (OFDM) has been in the present and upcoming wireless communication. In wireless transmission increase in the number of user's lead to the emerging to the new technologies like massive-MIMO.In wireless communication Bandwidth is the high concern. In wireless communication the OFDM has become advantage over the frequency selective fading channel for high bit rate transmissions. The OFDM is specially known to overcome the problem of the multipath fading channels. The multipath Propagation leads to the inter-symbol interference and (wideband) or fading (narrow band) inter-channel interference. The main concentration on upcoming fourth generation (4G) mobile communication system is on providing the high-data rate services and It ensures and supplies seamless of services across a multipath network and wireless system, for outdoor to indoor, interface from one to other, the infrastructure is like from public network to the private network.

Higher data rate allows the arrangement of the multi-media applications like audio, voice high quality video and high quality pictures. In this environment provision the data rates for the 4G networks is for the indoor 1 GB/s and for outdoor 100 Mb/s. The high data rate have the truly wideband in the waveform signal, there are more number of reconstructing multipath signals are situated in the Environment. Orthogonal frequency division multiplexing (OFDM), which is multi-carrier carrier system for the modulation technique, OFDM is mainly based on the 4G technology. Since it is used for decreasing the inter symbol interference and inter carrier interference in the multipath environment.

1.1.1 Principles Of OFDM

The principle of Orthogonal Frequency Division Multiplexing (OFDM) is the pulse for subcarrier used for transmission is must be in rectangular. The modulation technique and the pulse frequency by the Discrete Fourier Transform (DFT), which makes the low complexity.

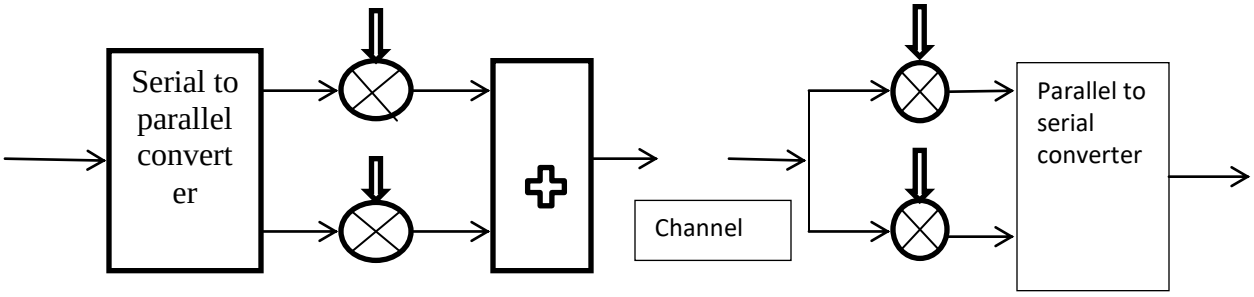


Fig.1 Basic Structure of a multicarrier system

The multi tone signals are effectively by the inverse Fourier transform. And at the receiver the Fourier transform. The Fourier Transform makes the signal into the original data stream at the receiver. Inverse Fourier transform can be implementation as an inverse fast Fourier transforms (IFFT).

From the Fig 1, The Input data signal consists of symbol sequence can be represented as an + jbn are representing the quadrature and the in-phase components. The waveform of transmitted can be represented by using Inverse Fourier Transform.

$$D(t) = \sum_{n=0}^{N-1} dne^{jwt} \quad 1.1$$

$d_{0,\ d_1 \ldots\ldots\ldots\ldots d_{N-1}}$ Result of the vector is the $D_{0,\ D_1 \ldots\ldots\ldots\ldots D_{N-1}}$

Where

$$Dn = \sum_{n=0}^{N-1} dne^{j(2\pi n)/N} = \sum_{n=0}^{N-1} dne^{j(2\pi fn)} \quad with\ m = 0,1 \ldots\ldots, N-1 \quad 1.2$$

$$fn = n\Delta f, \Delta f = \frac{1}{N\Delta t} \ and\ tm = m\Delta t \quad 1.3$$

The sΔt=$1/f_s$, fs is the symbol rate, and t= NmΔt substitute in 1.1 and 1.3 than the sample sequence of the D (mMT) in form of the sequence dn of the IDFT the entire OFDM symbols are converted into the particular sub carrier frequency of the RF band signal. In the OFDM we increase the signal interval T and it increase up to the Nmt, and then it makes the decrease in the delay of the signal and propagation. The Shortening of the rectangular signals at the interval of the (0, Nmt), in the time domain and the frequency response sin(x)/x for the each sub channel at 1/T multiples of zeros, this is the orthogonally principle of OFDM. The orthogonal principle is the form of the orthogonal subcarriers.

At the Receiving side, the Transmit signal is recovering and due to the multipath Propagation and noise or interference between the signal problems along with it.

1.1.2 Propagation Of Mobile Radio Channels

In the radio mobile channel, The receiving signal comprises of direct single path carrier signal and multipath carrier signal, which is good for the recovery of the transmitted signals. Here the

estimated channel is rectified during the transmission. In the Receiver, the received signal comprises of the attenuation, reflection, refraction, and diffraction of the transmitting signals. In the channel addition of the noise effects to the signal and change in the carrier frequency in the receiver or transmitter by the Doppler Effect in the signal.

1.1.2.1 Attenuation

The Attenuation is that the signal power is dropped when transmitter transmits the signals from one place to another. It may occur due to the obstruction of the signals and multipath propagation. The obstruction of signals from transmitter to receiver by any of the object may lead to occur attenuation. Signals also can obstruct when transmitter to receiver with the shadowing factor. It is usually caused by the hills, building vehicles are the most leads to attenuation. Shadowing factor is majorly due to the hills and buildings of large shadow from them. To reduce the problem of the shadowing impact the transmitter are elevated as possible as high to overcome the no of reduction.

1.1.2.2 Multipath Effects

a) Rayleigh Fading

If RF signals from the transmitter to the receiver, they may cause due to the reflection from the object such as vehicles, buildings and hills. These may raise the several multiple transmissions at the receiver. When the multipath signals can cause several reflecting signals could cause the useful or obstructive interferences near the receiver. These mainly occur at the short distances. This term relates the rapid fast fading. The Rayleigh distribution function is the form of varying the time at the received signal power.

b) Frequency Selective Fading

In radio mobile transmission, the channel bandwidth efficiency is not flat. The deep fades and the channel response on the reflections cancels the frequencies at the receiving side. Reflecting near and far objects are leading to the multiple signals at the similar power at the direct signal. These make a result of the nulls in the receiver side due to interference .For narrow spectral

efficiency transmissions are null due to the response of the frequency occurring at the transmission of the frequency the total signal is lost.

c) Delay Spread

The received mobile radio signal from the transmitter, it comprises with the original signal adds signal noise from the reflection from buildings hills. The reflected signals may be arriving late time than the original signal because the length of extra signal it is slightly gives rise to transmitted signal. The signal of delay spread is the measure of the power of signal spreading and time difference between the coming of the first and next coming multiple signals near the receiver side. In the digital communication the inter symbol interference caused by the delay spread. These effects are mostly by the greater than 50% of bit time it leads to delay spread.

1.1.3 Bandwidth Efficiency

In the spectrum the subcarrier is not separating but overlapping each other. Due to the overlapping the spectrum is more efficiently used by the multi-carrier system. In OFDM the M-array digital modulation technique used and can achieve the good spectral efficiency. It defines as the unit per bit rate and spectral efficiency and the of log2 M bits/Hz.

$$R_b = log_2 M/\Delta t \tag{1.4}$$

Cyclic prefix is added and effective bit rate is equal to

$$R_b = \frac{T}{Tg+T}\frac{log_2 M}{\Delta t} = \frac{N\Delta t}{Tg+N\Delta t}\ log_2 M/\Delta t \tag{1.5}$$

NY Quist rate, f is sub channel of bandwidth. Entire bandwidth of the OFDM is

$$B = N\Delta f/\Delta t \tag{1.6}$$

The bandwidth becomes

$$\beta = \frac{Rb}{B} = \frac{T}{Tg+T}\ log_2\ M \tag{1.7}$$

In optimal system without the guard time the bandwidth becomes log_2 M bit/s/Hz. Cyclic prefix is inserted due to the made the system opposite to the multiple path effects and to achieve the

efficiency. In practical it will not achieve the optimal bandwidth of B will be larger; it made to reduce the bandwidth efficiency.

1.1.4 OFDM Transceiver

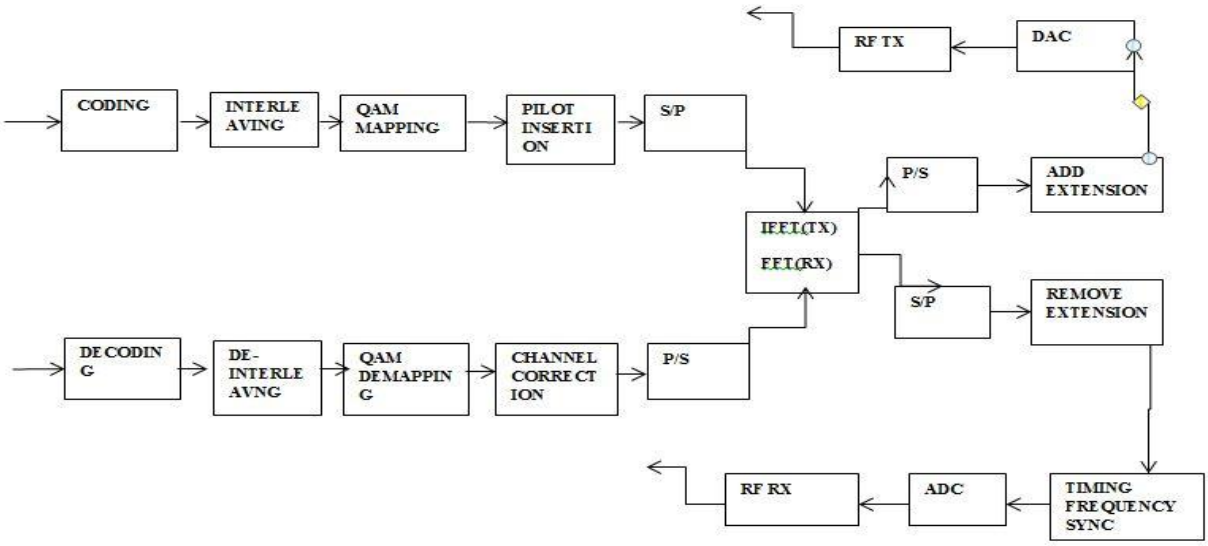


Fig.2 Basic structure of OFDM

1.4.1 Description of OFDM Structure

From the transmitter side the binary data is entered and convolutional data encodes the data, and the convolutional encoder encodes the data and it enters into the interleaving an then it moves to the transmitted binary values are mapping on to the Quadrature Amplitude Modulation (QAM).Then to receive the correct signals at the receiving side we need the pilot carriers and phase drift. Then the QAM the move to serial to parallel block QAM serial data is converted to parallel input.

By using the Inverse Fourier Transform, the parallel symbols are modulated onto the subcarrier. The FFT is chosen large the no of sub carrier are uses to transmitting the data.

Then after the IFFT block the parallel output stream is converted into the serial output stream. The cyclic prefix as guard interval is added to make the signal in the multipath effect. After that digital signal is converted into the analog signal, and then the analog signal are converted into the RF band, then they are amplification and transmitting data through an antenna.

In OFDM is the reverse operation of the transmitter carried out at the receiver. Then at the receiving side to estimate the frequencies values as offset and symbol training of the signal, then it performs the to reconstruct QAM values the fast Fourier transform. The QAM output values are demapped on to the binary data values and then de-interleaving block and then Viterbi decoder decode the bits.

1.2 MIMO System

In MIMO system the multiple antenna and multiple receivers are used to improve the performance and improve the spectral efficiency and number of the users in communication system. The MIMO system is a good technique for high data rate and bandwidth efficiency in the wireless transmission in better bandwidth efficiency. This can provide spectral efficiency in selected frequency channels.

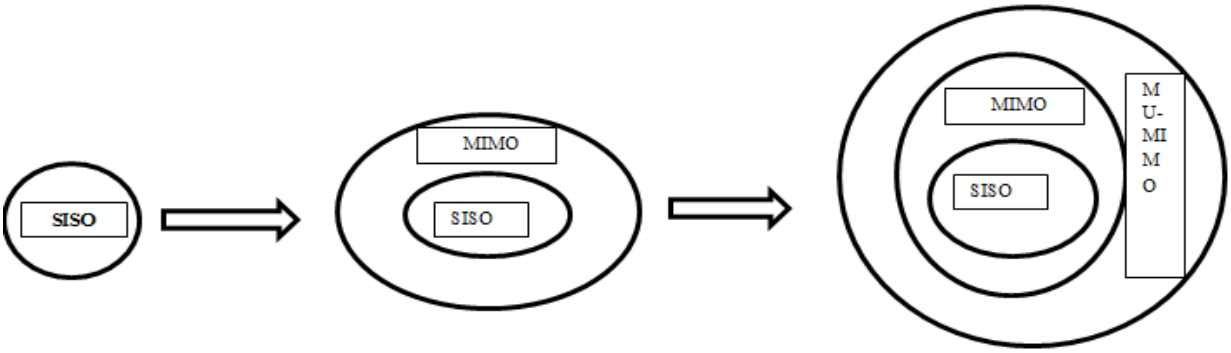


Fig.3 Evolution of MIMO

1.2.1 Space Division Multiplexing

To increase the spectral efficiency in the spatial dimension. The information revealed in the multiple paths wireless channel of capable of large number of capacity, supports and the multipath effect is very high.

The multipath effects like scattering can mitigate by the appropriate processing of the architecture. The diagonal layered space time introduced and is known as D- BLAST or diagonal

BLAST to some extent. The Diagonal BLAST is very hard and complex approach. The modified method of the BLAST are the V-BLAST or vertical BLAST is presented as a prototype function and made with the spectral efficiencies 20-40 bps/Hz which can achieve in the propagation of indoor at realistic in nature for error rates and SNRs.

The Space Division Multiplexing is space division multiple Access (SDMA) is more general term. SDMA technique is the spatial correlation using multiple antennas at the Receiving side and transmitter. The technique transmits different signals on different antenna simultaneously, for the performance of SNR and increase of capacity. At the receiving side the space division multiplexing can recover the various different signals. To reconstruct the proper transmitting signal at the receiver multiple antennas are required. Hybrid schemes are used, so that more users transmitting at a time from the multiple antennas is also possible.

SDMA technique are different from the tradition multiple access technique. There difference in the form of the spread spectrum multiple access or the code division multiple access techniques for the total channel spectral efficiency used by the SDMA technique is the more of the symbol rate. The more bandwidth used for transmission of the conventional technique like the Quadrature Amplitude Modulation(QAM).The transmitted signal is the Frequency Division Multiple Access(FDMA). These are the differences which are more precise and have the higher bandwidth efficiency for the other multiple access technique for SDMA.

1.3 MIMO-OFDM System

MIMO-OFDM transfers the wideband frequency selective fading to parallel flat fading MIMO channel**.** MIMO-OFDM is the technique used is as the LTE Downlink. MIMO-OFDM technique used in many applications for high data rates and more capacity.

1.3.1 Advantages Of MIMO-OFDM System

The MIMO-OFDM algorithms are the narrow band Algorithms. The MIMO are the function to the wideband wireless channel of the frequency selective nature. MIMO and OFDM can be combined the OFDM transforming the channel from the frequency selective fading channel to parallel flat fading sub channel. The sub carriers undergo the narrow fading. MIMO-OFDM is complementing each other. MIMO is mostly uses in the broadband mobile communication.

1.3.2 MIMO-OFDM System Model

The MIMO-OFDM system is the form of the (NT) number of transmitter Tx and (NR) no of the Receiver Rx antennas. In the MIMO-OFDM the spatial dimension and temporal correlation of addition exploit the frequency dimension the incoming bits first encodes in a one dimensional encoder and which are mapped on to the correlation to the frequency of space time.

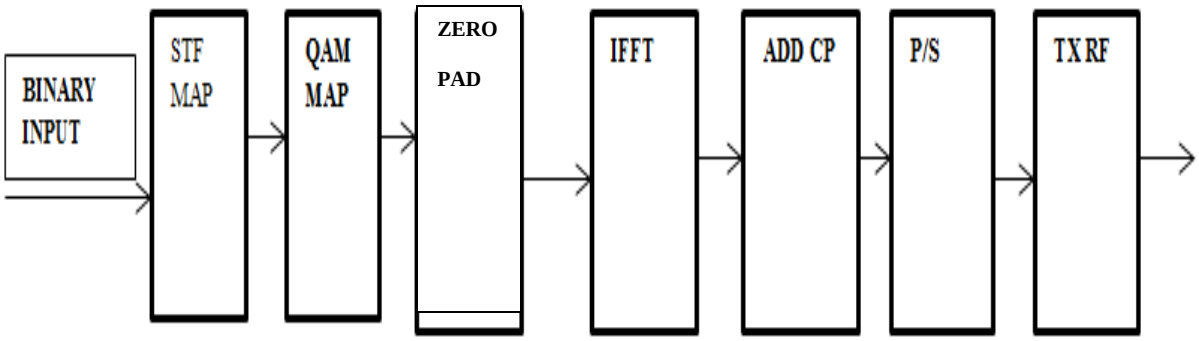


Fig.4 Transmitter of the MIMO-OFDM

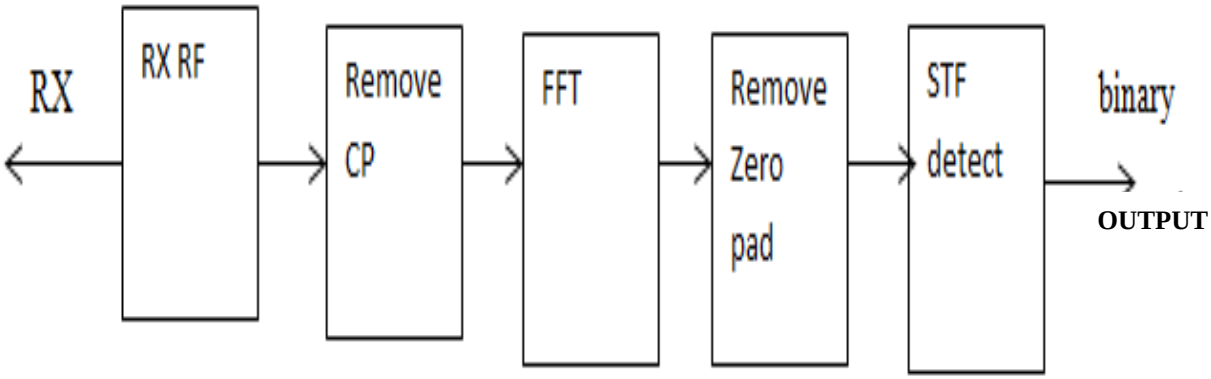


Fig.5 Receiver of the MIMO-OFDM

At receiver side, the cyclic prefix is removed and The FFT acting according to the receiving side. At this point of view the space time frequency detection and decoding are must be recovery of binary output.

The algorithm of the MIMO is the algorithm of the single carrier. The detection of the MIMO performing as per the OFDM subcarrier. And at the receiving side signals of the subcarriers are detected and to reconstruct the original QAM transmitting at the transmitter. The symbol per transmitted side is combining finally for the space time frequency demapping for the detection and decoding is done. The parallel output data results combined data to for the binary output stream.

1.3.3 Target Application OF MIMO-OFDM

Besides IEEE 802.11, the other two other standards and more groups are formed. Then in Europe, the telecommunication of the Europe standards institute form of the Broad band Radio Access Network (ETSI BRAN) and in japan equipment manufacturers and the support of the service providers and post of ministry and telecommunication are cooperative with the multimedia mobile Access communication (MMAC) .The ESTI BRAN is working on the extension of the broad band services like ESTI HYPERLAN is type of the standardization. The HYPERLAN/2 is the under development and extension of the wireless indoor LAN environment with the provision of the Quality of service. Three extensions are now going on working on the system. HYPERLAN is the indoor LAN with quality of service .HYPERLINK, a wireless indoor backbone; HIPERACCESS is the outdoor wireless fixed system and providing link to the fixed wiring services. MMAC looking for the ultra-high-speed for the indoor wireless communication. The LANs are provided and transmit the data large in terms of the speeds up to the Mbps and frequency bands. The three standardizations work closely cooperative to each other and they are the minimum equipment manufacturing the worldwide. The ESTI BRAN and the MMAC are the physical layer standards of the OFDM. Since OFDM is the next generation standards. And LANs are covering the lot of work in the world wide standards. And the form WLANs research is going on for getting the higher data rates like hybrid channel estimation and cyclic extension method. In this thesis we propose the model for the bandwidth efficient and the decrease the delay spread and for the robust algorithm. OFDM is mainly used for the 4G network and upcoming 5G networks.

Fig.6 WLAN Card

1.4 Major Issues

a) Peak to Average Ratio

The Main focus of the problem in the OFDM of the transmission is the high peak to average power ratio. This problem is mainly due to the detection and the change in the amplitudes and the extrusion of the transmitted signal. The signals of the OFDM are the form of the N complex random variables are at the various frequencies. Sometimes the signals components can add up in phase and may produce the large amount of the output and also cancellation of the total output and produce zero output. PAPR of the OFDM system is too large. The PAPR problem is more at the transmitter. To avoid the clipping of the transmitted waveform, the power amplifiers are placed at the transmitter front end and they wide range of linear to include the peaks at the transmitted waveform. Inserting Power-amplifiers with the linear ranges is the costly affair. This results to the high power consumption

b) Frequency Offset and Time Offset

The frequency Offset, when the mismatch in the frequencies at the transmitter and receiver side then there is a frequency difference and the inter carrier Interference Occur. If the time off set is caused due to the delay spread it, may leads to the inter-symbol interference.

CHAPTER 2 LITERATURE REVIEW

Due to increase in demand for comfortable life, MIMO-OFDM has become the major area of research in the communication field. Nowadays in all countries it is used for high data rates.

- Entertainment
- Data Sharing
- High Quality Videos

The Advantage of the MIMO OFDM is the increase in the Capacity of the users in the mobile communication as bandwidth efficiency. In single carrier system and multi carrier system the MIMO OFDM system is more efficient than single OFDM system. MIMO is the multiple inputs and multiple outputs for the multiple transmitting antennas and receiving antenna are same .In MIMO OFDM due to Multipath Propagation Increase in the Inter symbol interference and Inter carrier Interference. We use the beam forming and cyclic extension and decrease the bit error with respect to SNR.

To analyze the low-rank estimator for orthogonal frequency-division multiplexing (OFDM) system uses the channel frequency correlation. If the DFT is proposed for Low rank approximation it suffers from the bad performance when the channel is not sampled, **Ove Edfors et al. [1]** presented and proposed the technique of the optimal rank reduction to linear minimum mean square error (LMMSE) estimators when a fixed designing of the changing of the channel correlation and SNRs. They presented in the form of encoded symbol error rate using 16 -Quadrature amplitude modulation.

Kyung Won Park et al. [2], proposed the technique the macro cellular mobile communication and are confirm through the MIMO channel, I-METRA channel, MIMO-OFDM simulation. In this we proposed the new orthogonal frequency division multiplexing (OFDM) and multiple-input multiple output (MIMO) for reducing the Inter-carrier interference and the inter symbol interference. It is a special curve fitting technique and the weighting factor for the group transmission is optimized. They are compared with the conventional MIMO-OFDM Scheme.

R. S. Blum and Q. Yan et al. [3] presented and analyzed for the improvement of the MIMO OFDM technique for wireless communication system using the QPSK modulation for the four receiving and four transmitting antennas. The frequency flat fading channel is considered as OFDM. We first consider the state of employing with 2 antennas for cancelling and channel estimation which decreases the complexity of 4-antenna space time coding and 16-state. which is able to reduce the system complexity of 4 antenna space time coding .We propose a 16-state,4-antennas ,16-state state code achieving an total extra 2db gain for lower complexity,256-state code for the perform the 3db outrage capacity. There is no complex decoding in this paper.

The strong channel estimation algorithm to the effect of channel impact for the LTE Downlink system with an adaptive cyclic prefix. The MIMO-OFDM system is based on the LTE Downlink system. The OFDM signals are transmitted and at the beginning of the OFDM the cyclic prefix (CP) is used to reduce the Inter-Symbol interference and inter-carrier interference, which is caused due to the multipath propagation. **Abdelhakim Khlifi et al. [4]** proposed hybrid channel estimation to restrict the channel length. The hybrid channel estimation technique and Adaptive Cyclic Prefix Length (ACPL) to good performance of the system. In MATLAB the Monte-Carlo simulations are used to evaluate the proposed algorithm with Bit Error Rate for 2*2 LTE Downlink systems

Rajvirsinh C Rana et al. [5], prime focus of this paper is the performance of the two linear channel estimation techniques, The Least square error (LSE) and Linear Minimum Mean square error (LMMSE) for the VBLAST of 2*2 and 4*4 MIMO OFDM system with different modulation techniques like 16-QAM, 8-QAM, BPSK, QPSK as a MMSE equalization at the receiver. The channel state information is used to reconstruct the original signal at the receiving side and remove the effect of channel. The recovery of data and at transmitter it is useful to vary according to the wireless system. The performance analysis of LMMSE used instead MMSE for the linear constraints.

The increasing development in the wireless communication for the upcoming generation by using the MIMO-OFDM structure, with this there is possible to improve the number of the user, high bit rate, reliability and less error rate. MIMO have the transmitting and receiving antenna. **C.Padmaja et al. [6],** proposed a Technique to achieve high speed data transmission, which are beam forming, spatial multiplexing and the spatial diversity technique. The goal of this paper is

the analyze space Time Frequency code for MIMO OFDM system designing for frequency selective fading and flat fading channels. The pairwise error probability of space time code technique is analyzed by increasing the diversity performance of the increase of the high complexity associate with the maximum likelihood (ML) at the receiver

Xin Wang, et al. [7], presented a resource allocation issues for multiple user wireless data transmission based on the orthogonal frequency division multiplexing (OFDM).In this paper based on the tools of the stochastic and convex optimization. The approach resources of the Novel algorithm are i) the sum-average rate maximization for the development of the rate allocation and the jointly subcarrier optimal power. ii) The average user for maximizing the utility with optimal allocation of resources of the derivation and formulation of judicious. iii) From the stochastic resource allocation we get the optimality and convergence proof from the novel schemes.

Mona Z. Saleh, et al. [8], proposed the Enhanced pilot aided channel estimation algorithm to improve the performance of the 2^{nd} generation of the standard of the digital video broadcast for terrestrial (DVB-T2).In this we use the at 1^{st} based on the averaging of the 3 points for the channel estimation technique. And at the 2^{nd} they use and receive the channel response based on the pattern of the frequency domain. Difference between the conventional estimation and second technique 0.5 reduction in SNR for the recommendation of guidelines implementation of DVB-T2.

Shubhangi R. Chaudhary et al. [9], presented a wireless broad band communication has gain an access due to gained services in multimedia access and internet services. The problems are available in the wireless communication are like the spectral efficiency and transmitting power. In this,wireless channel suffers the multipath propagation for MIMO-OFDM system. These are the techniques used for the mitigate interference using the equalization technique. The different techniques of equalization are Maximum Likelihood (ML), Minimum Mean square Error (MMSE) and Zero forcing Equalizer (ZF) are carried in a Rayleigh flat frequency channel.

Navdeep Singh Randhawa et al. [10] presented the system and hybrid linear and nonlinear equalization for the optimal detection to minimize inter symbol interference (ISI). MIMO-OFDM is the foundation of future wireless LAN and broadband services and LTE. This provides

the spectral efficiency and better bandwidth, data throughput for higher data rates. In this ISI may leads to the error rate increase and decrease in the system performance. But As in the environment the wireless there is dispersion, attenuation present in it. We compare the existing equalizer with the linear and non-linear function.

Alexandra Duel-Hallen, et al. [11], proposed Adaptive transmission method for the achieving of the high-data rates for radio mobile communication. In this paper the transmitter needs the accuracy of the information of the channel state to estimate at the receiver and send feedback to the transmitter. The system prediction is for adaptive transmission for mobile radio system the transmission quickly outdated due to rapid channel variation. The fading prediction algorithm is used to reduce the Noise, algorithm validation, complexity, and robustness.

For the prediction of the Long-range channel are the major technologies in the upcoming wireless technology. The sinusoidal modeling frame are the studied and Rayleigh channel prediction. The sinusoidal stochastic model represent the Rayleigh fading channel.in this method the linear predictor (LP) outer performing the in Monte Carlo Simulations, and underperforming in the form of the data measuring. **Ming Chen et al. [12],** proposed the form of the data to reduce the errors by joint moving average and sinusoidal algorithm (JMAS) as the prediction algorithm associate with the joint least square as the predictor.

The vector broadcast channel signals are for the separation of the signals, for to know the position of the channel sate is the must be at the receiver .we are jointly designing the channel estimator and the feedback from the receiver to transmitter as feedback for the precoder-centric criterion. **Michael Joham et al. [13],** proposed work are joint optimization each receiver are having the feedback of index and gives the appropriate precoder. Since the quantization of various receivers have to work individually for the partition may not be expressed with mean squared error. The total outperforms the optimization of feedback and precoder.

Stefano Tomasin et al. [14] introduced a new technique called for the cancellation of the inter-carrier interference and Iterative Interference cancellation. The reliability of the orthogonal frequency division multiplexing is because for the varying the time in the nature. In this paper we use the ICI using derivatives for the channel amplitude. This design is iteratively reduced and cancels the ICI. At the input we are maximizing the signal to noise ratio plus ICI at detector. And

proposed a channel estimator and it achieves reliable mobile reception in relevant in practical situation. From digital video broadcasting Channel estimation allows a reliable reception at the vehicle speed above 100 km/h.

Christian Berger et al. [15] presented in this paper the estimators that utilize the channel sparse in the Doppler or time for multicarrier underwater acoustic system. The path based used for the channel type for the where the limited no of paths derived from the channel. And they are characterized by the Doppler spread, delay and multipath propagation and derive the information of Inter carrier interference. For Doppler spread they have the subspace algorithm from array processing are the Root-MUSIC and ESPIRIT can be for the channel estimation. And for the compressed sensing approach they adopt the Orthogonal Matching pursuit (OMP) and Basis Pursuit (BP) .Then they are increase in the path delay OFDM receiver block by block is evaluating with conventional least-square channel estimation. In this paper Doppler effects outperforms LS when channel is in sparse. The compressive sensing algorithm is handling effectively channels with the Doppler spread.

Han Wang and Qing Guo et al. [16], proposed the Estimation distribution Algorithm for optimization of pilot pattern to improving the technique channel estimation. This is the compressive based sparse channel estimation which requires the pilot patterns of optimal. They have proposed the scheme, for optimal pilot process making samples the probability distribution function for training the pilot indexes. The optimized pilot patterns perform well in the channel estimation.

Xianbin Wang et al. [17], proposed new method iteration Inter symbol Interference and Inter carrier interference based on the both estimation and cancellation techniques are used for both the demodulation technique and channel estimation technique. The ISI and ISI mainly due to the suppressed feature for cyclic prefix are used. In channel impulse response and the joint frequency Offset are on the basis of the Maximum likelihood. The fast Fourier transform pruning and ML metrics are approximated. The performance is verified and proposed feature of the suppressing system of channel estimation is verified through numerical simulations.

Chenhao Qi et al. [18] presented new schemes for the sparse channel estimation in OFDM design is depends on the mutual incoherence property. It is with respect to the impulse channel

response. Different cyclic set are generated from the optimal pilot. The algorithms are the stochastic sequential search (SSS) and stochastic parallel search (SPS) is are depends on the stochastic search. iterative group shrinkage is the is a tree based searching removes the rows instead of each row step by step .In case of MIMO system the 2 schemes are designed to sequential, schemes and joint design scheme for the transmit antenna using the joint estimating design the pilot pattern for remaining transmit antennas. The SGS and SSS outperform the IGS in the form of channel estimation.

Xiang Ren et al. [19] proposed the new pilot pattern design algorithm to improving the compressive sensed accuracy in channel estimation and decrease the coherence in the system. The optimal pilot pattern is having the individual no of antennas the Doppler speed of the train location of the train velocity. This is widely used and in high speed train (HST) for high data rate communication. This method is used in the High speed environment they cause to make the inter carrier interference. To mitigate the ICI this algorithm is used.

Carlos Prieto del Amo et al. [20], presented a in this paper it successfully cancels the interferences in the location of the preamble OFDM frame for the iterative joint estimation procedure. At it is mainly due to insufficient cyclic prefix, it is less than channel length. This paper strategy is due to the after the iteration cancel of interferences and additionally frequency Offset and the whole ,Mean Square Error(MSE) and it conjunction to Cramer-Rao bound (CRB).Later on the removal of interferences in the joint estimation for the data part and frame may be insufficient Cyclic Prefix. In the iteration type, The IJEP clearly proves the improving the performance of the system.

In this paper the problem of challenging and timely for the detection of data and channel equalization for the orthogonal frequency division multiplexing (OFDM) system for the presence of rapidly time varying channels and frequency selective fades. This is based on the algorithm of the space alternating and the generalized expectation maximization (SAGE) technique which is for the multicarrier signals and the easily extending to the MIMO-OFDM system. In the fast fading channels there is destruction of the orthogonally between the subcarriers and it may cause the Inter-symbol Interference and the Inter-carrier Interference and for the conventional frequency domain error-floor. **H. Dogan et al**. **[21],** proposed the equalization and the joint data detection algorithm that updating the sequence of the series and leading to operate the ICI

cancellation for the High speed Vehicles. The computational complexity of the MATLAB simulations for the complexity and existing simulations are compared and performance increase in the proposed algorithm.

MIMO-OFDM systems supports high data rate and provides the high bandwidth efficiency in wireless communication system. However, the major drawback of the system is high PAPR which leads to the insufficient use of power and also improper detections. Now a days, in wireless communication systems, channel estimation is mandatory for higher data rates with low bit error rates. **B.Sarada et al.[22]**For reducing burden on system the channel estimation results are exploited to reduce the high PAPR by using the technique called SVD based Generalized Inverse. From the results we can estimate Sparse MIMO OFDM Channel Estimation Using Spatial and Temporal Correlations is the best for channel estimation.

CHAPTER 3 OBJECTIVES

3.1 Objectives

The main objectives of this thesis are:

- To propose an enhanced channel estimation technique using hybrid Rayleigh channel, cyclic prefix and beam forming.
- To Improve BER while comparing with the existing OFDM System and also comparing with MMSE.
- To decrease the Inter-symbol Interference and Inter carrier Interference using the cyclic extension.
- To Propose SLM method which can achieve good PAPR than Traditional method.

CHAPTER 4 RESEARCH METHODOLOGY

As there is a fast increase in the expansion of communication system The MIMO-OFDM technique has lot in the upcoming generations. The MIMO has the multiple antennas at the transmitter and at the receiver. OFDM is the Orthogonal frequency division multiplexing and it has the modern technique to enhance the system by the spectral efficiency and the network performance as according to its service[20].The High speed Doppler shift destroy and increase in the rate of the Inter carrier Interference[19]. The Hybrid channel estimation is the form of the used as the Rayleigh channel as the form of the estimating the channel. As based on the literature survey the some of the channel length is more than the cyclic prefix and increase in the Inter-symbol interference and Inter carrier Interference [3]. The Beam forming is the smart antenna used for the cancellation. Due to behaviour of the channel length there is increase in the inter-symbol interference and the inter carrier interference. The MIMO-OFDM has the frequency selective fading to the parallel flat fading. They are the form of the present in the world for the communication. Due to the subcarrier there are the errors in the function that can be changed in the world. Now-a-days the more research is going on the MIMO-OFDM technique for the formation of the high data rates and the form of the capacity of the users. The growth in communication system, there is growth in the MIMO-OFDM technique .The form the MIMO-OFDM is the used in the LTE, WLAN, and LAN and DVB-T2.

The Parameters causes to this paper are the like:

- Delay
- Inter-Symbol Interference
- High Bit Error Rate

4.1 MIMO-OFDM Proposed Model:

The MIMO-OFDM Technique used in this process of the technique used to reduce the inter-symbol interference and inter carrier interference by using enhanced channel estimation technique for the hybrid Rayleigh fading, cyclic prefix and the beam forming.

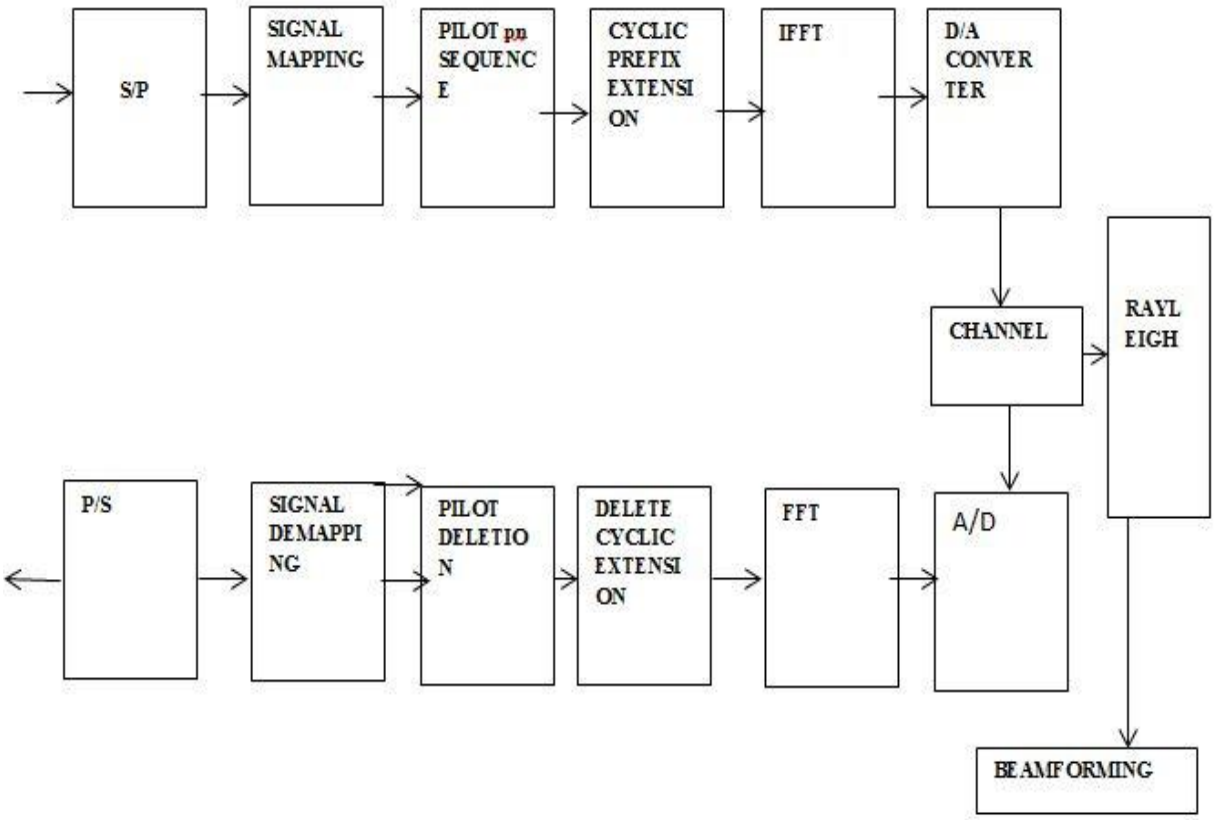


Fig.7 Proposed Model Block Diagram

4.1.1 Description Of the Model

The Binary data added entered into the convolutional encoder encodes the data and it transferred to the modulation technique. Then converting serial to parallel for block process and signal is mapped on to the pilot sequence.

And then cyclic extension is added to the signal at the beginning for the signal to decrease the delay spread. And IFFT is used as the And channel sending the data to the channel for the Rayleigh model and the beam forming for the phase noise hybrid Rayleigh channel for the change in the process.

Then from the receiver we have found the Equalization process is done. And Received signal are the form of the after receiving the data the Removing of the cyclic extension and the FFT is used

to extract the function. And the Demodulation technique is used as the detection of data. And checking whether the data is on the form of to transmit the signal of the data.

4.1.2 Steps of Proposed Model

- Enter the Binary Input data
- Modulation of the Binary Input data
- Taking IFFT of the Data
- Adding cyclic Extension
- Channel ,sending signal Over a Rayleigh channel
- Adding White Gaussian Noise to the signal
- Beam forming
- Received Data of the transmitted signal
- Equalization
- Removing Cyclic Extension
- Demodulation Of the Data
- FFT of the Received signal
- Error checking
- PAPR function

4.2 Algorithm of Proposed Model

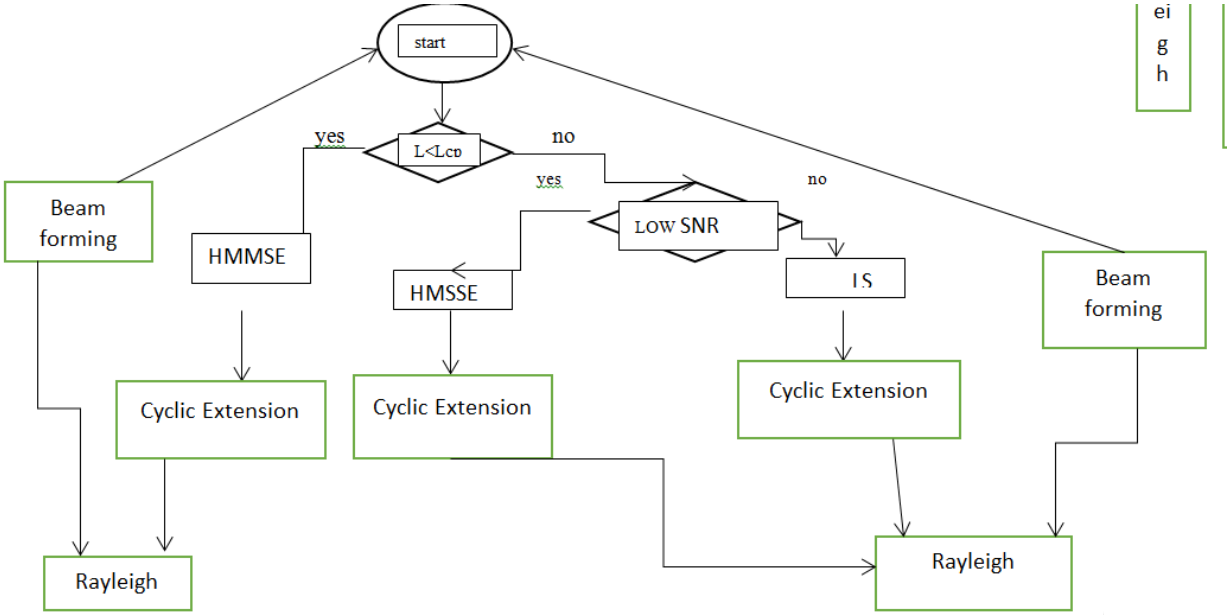


Fig.8 Proposed Algorithm

4.2.1 Cyclic Extension

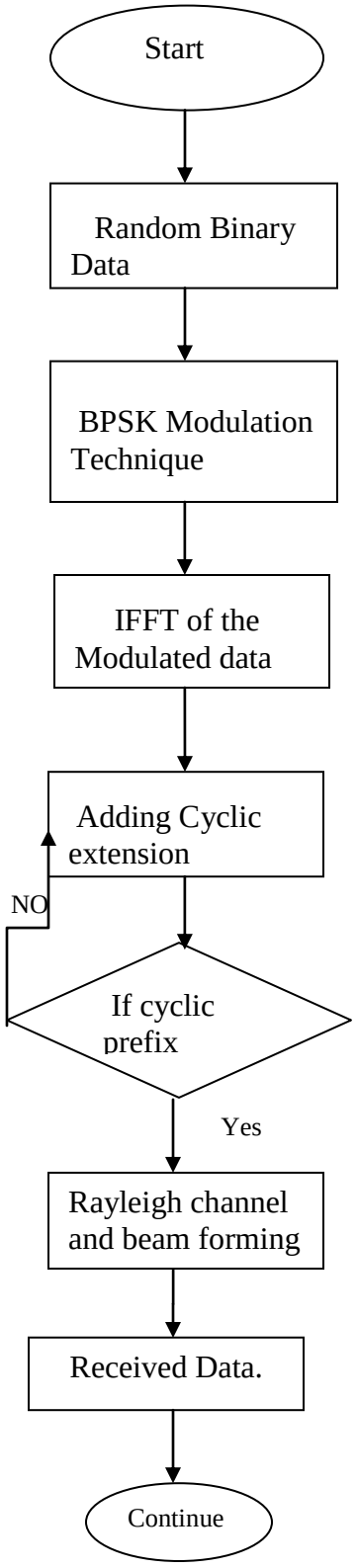
The proposed model is of the cyclic extension and the approach of the hybrid approach to the function is the form of the when the length of the channel is less than the cyclic prefix, the it goes to the LMMSE and the prefix at the function of the L_{cp} is the function that can increase the performance of the channel.

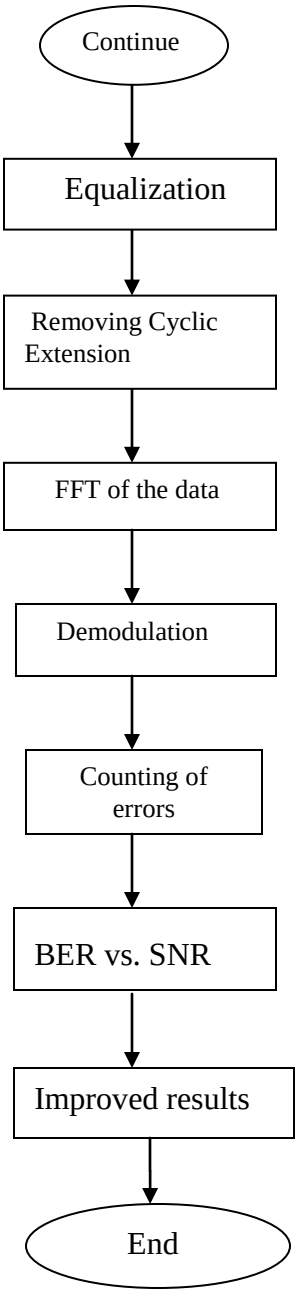
In this we have used the cyclic extension process for reducing the Inter-symbol interference and reduce the Bit-error rate. This proposed method is for the reducing and Analgising the OFDM technique.

The proposed technique is hybrid channel estimation is of cyclic extension process is better than the performance improved than the Adaptive cyclic prefix.

4.3 Research Methodology in Flow Chart

The whole process by which the research work has been carried out is being shown with the help of flow chart as shown below.





4.4 Work Plan

a) Semester-I

In the 1st semester, the idea we have with us we explore the idea and search the topics related to that idea and then we select the desirable topic and do the detailed survey for that topic.

- Keeping daily access on the pre-dissertation.
- Accessing the goals and working on the some part of the topic.
- Making the habit of hard work to work before the deadlines.

b) Semester-II

In this 2nd Semester after the literature survey, we select the paper in which we want to carry our dissertation and then we implement that paper until our results are matched.

- We have to select some papers based on the topic we have selected.
- Reading and accessing them daily.
- Good Literature Survey.
- After the Literature survey that we choose a best paper as a base paper.
- And we implement the Base paper up to the results are obtained.

c) Semester-III

This is the final and most important semester of the dissertation. In this phase we modify the design according to our ideas and thoughts and analyze it until we get the improved results as compared to Semester-II.

- After the literature survey and implementation of base paper we keep idea on the base paper.
- Implementation of idea to improve the result of the base paper.
- And writing the report for the improved result as compared to the base paper.
- Report in the Format.

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CHAPTER 5 SIMULATION AND RESULTS

5.1 Base Paper Implementation

The selected base paper is 'An Enhanced Channel Estimation Technique with Adaptive Cyclic Prefix Length for LTE Downlink Systems.' The strong channel estimation algorithm to the impact of channel length for the LTE Downlink system with an adaptive cyclic prefix. The MIMO-OFDM system is based on the LTE Downlink system. The OFDM signals are transmitted and at the beginning of the OFDM the cyclic prefix (CP) is used to decrease the Inter Symbol interference (ISI) and inter carrier interference (ICI), which is caused due to the multipath propagation. Then we tend to propose a hybrid channel estimation to restrict the channel length. The Adaptive cyclic Prefix Length and hybrid channel estimation for the good improve in the system. MATLAB evaluation of the Monte-Carlo simulation is with the proposed algorithm with Bit Error Rate for 2*2 LTE Downlink systems.

5.1.2 Simulation Parameters

The Parameter and the output values are given in Table.1 which is used to evaluate the hybrid channel Estimation in the Adaptive Cyclic Extension Algorithm.

TABLE .1 Simulation Parameters

sr no	Name	Values/Type
1	LTE Bandwidth	5
2	FFT size	256
3	Number of subcarriers	100
4	Cyclic prefix Length	16
5	No of transmitted antennas	5
6	No of Receiving Antenna	5
7	Modulation Technique	QPSK,QAM,16 QAM
8	Channel	Rayleigh Fading

5.1.3 Results

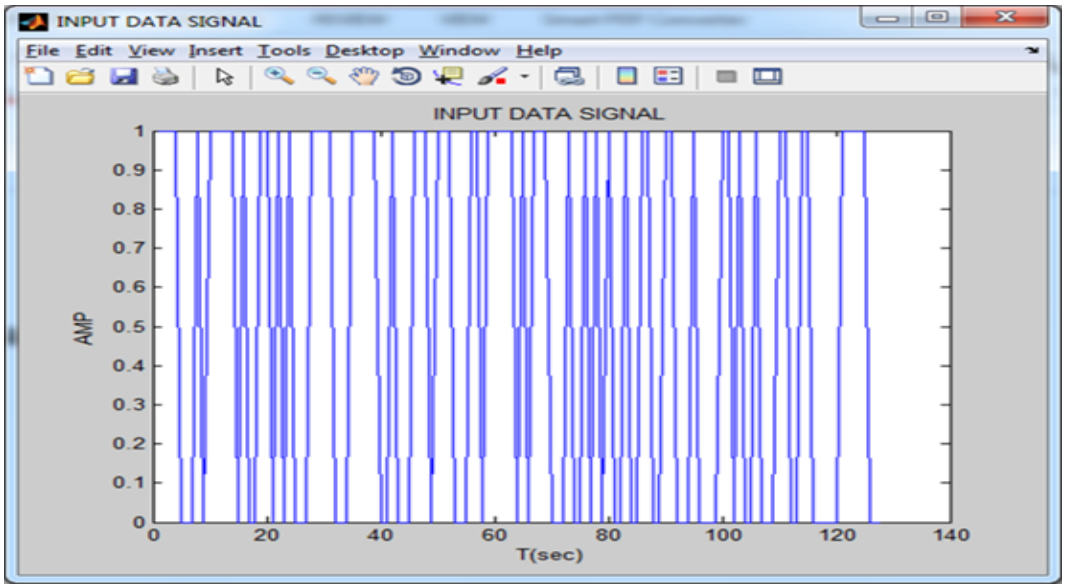

Fig 9 Input Data Of the signal

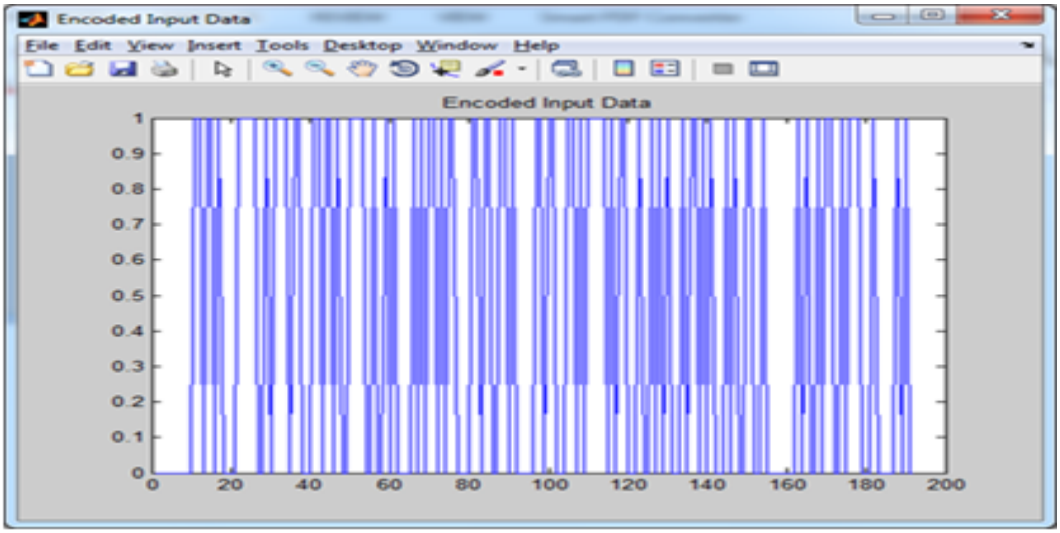

Fig.10 Encoded data

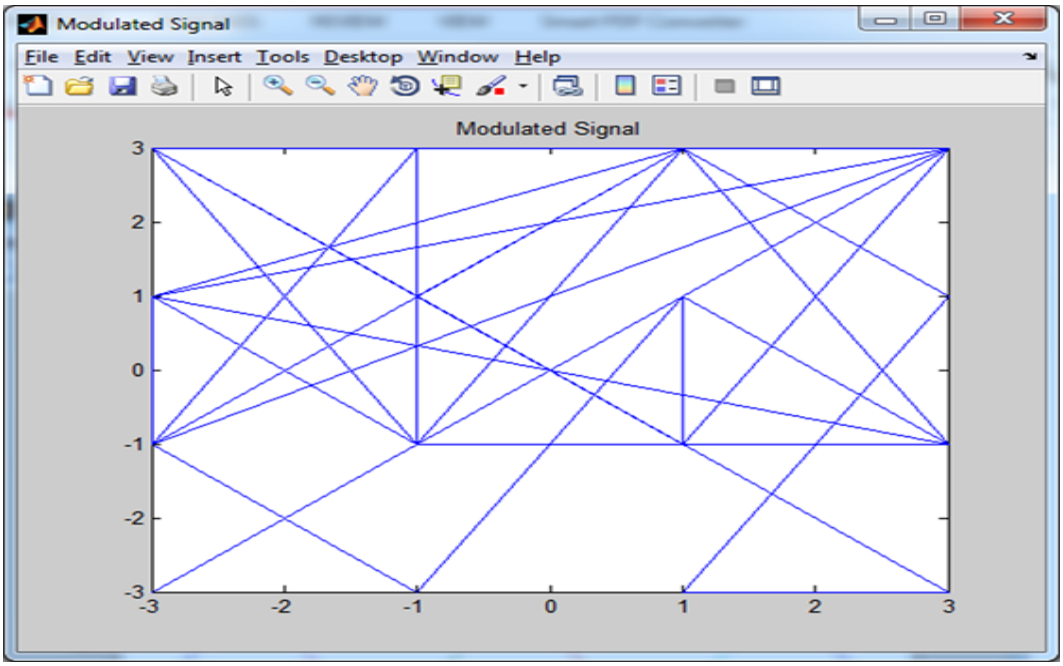

Fig.11 Modulated Signal

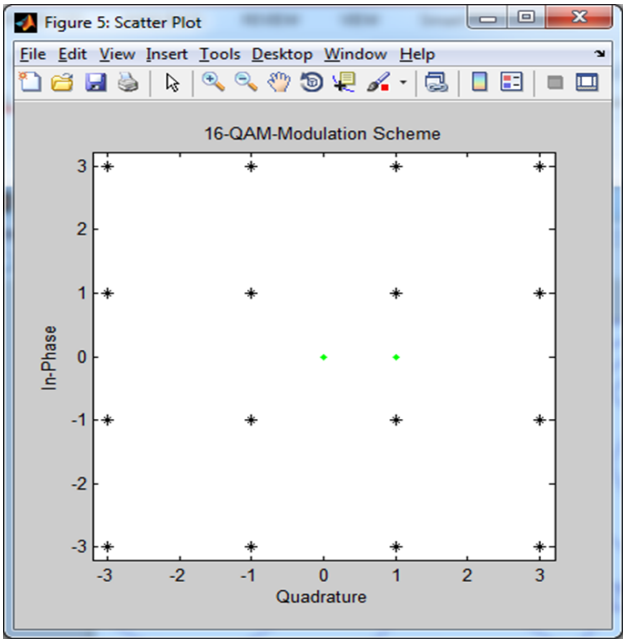

Fig.12 Scatter Plot of 16QAM

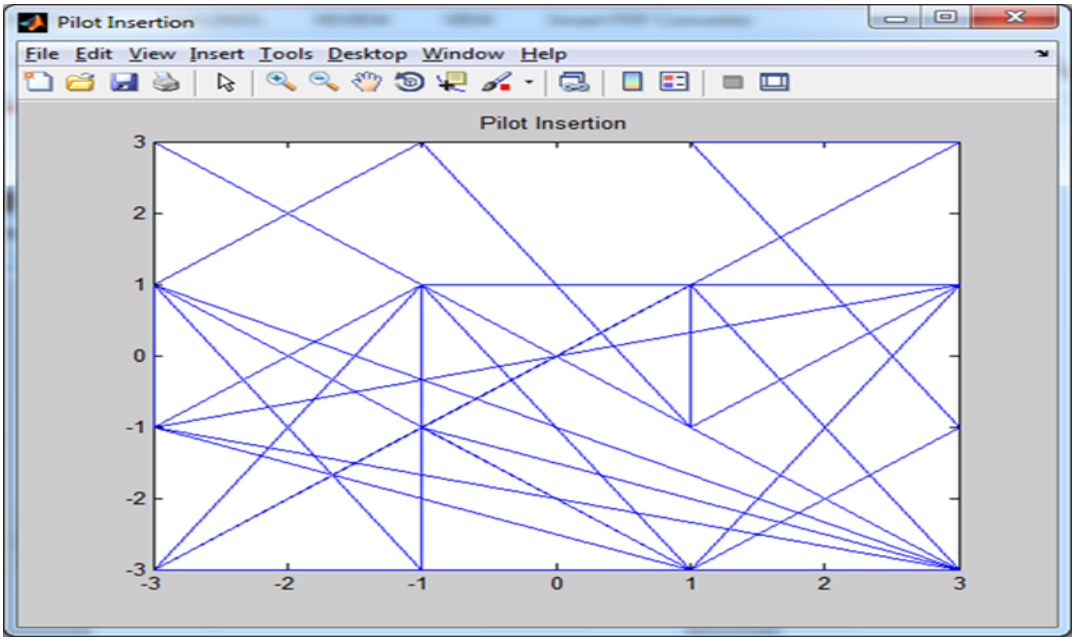

Fig.12 Pilot Insertion

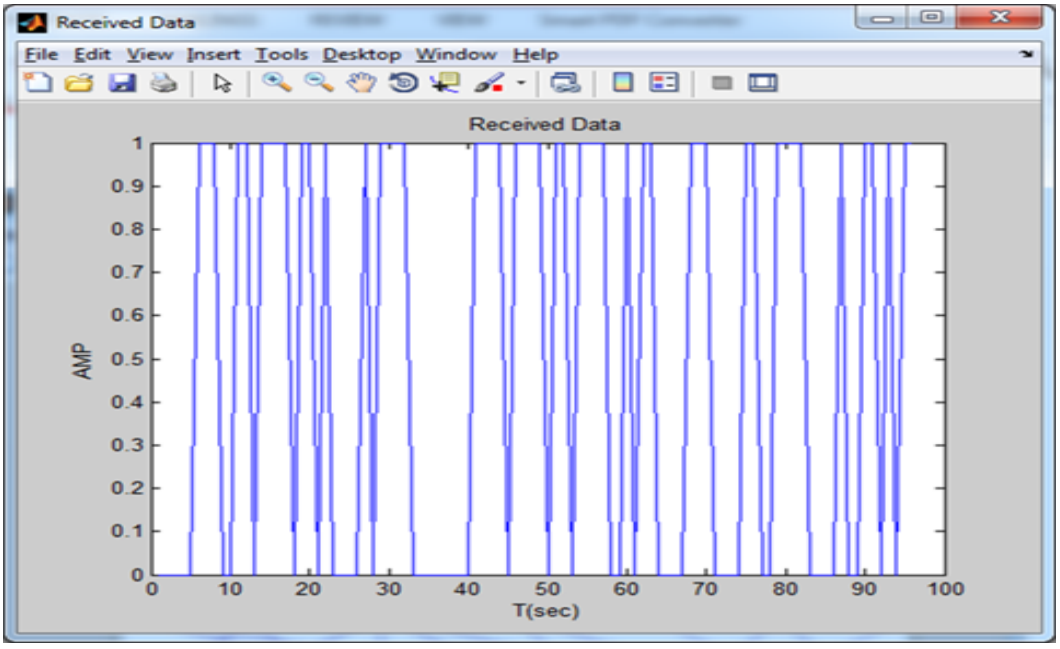

Fig.13 Received Signal

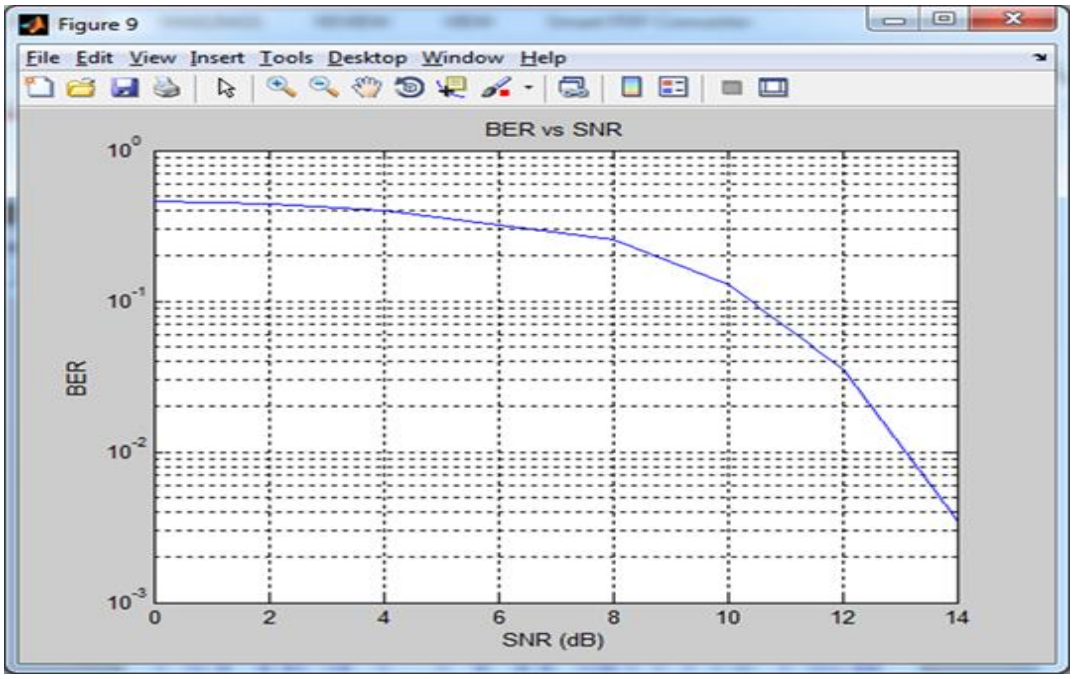

Fig 14 BER vs. SNR

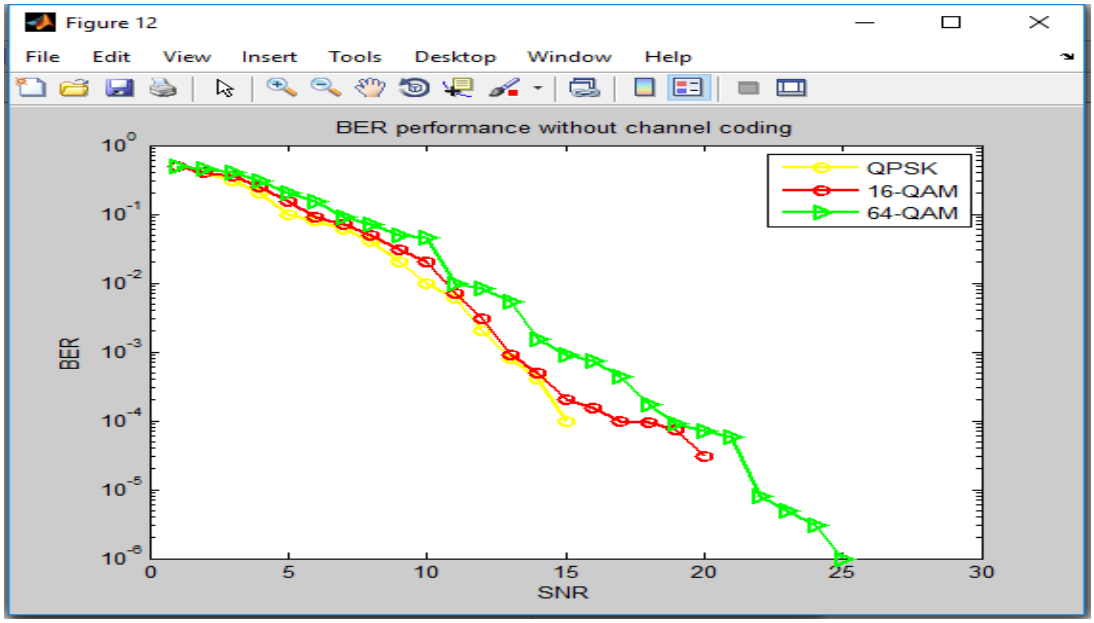

Fig.15 BER vs. SNR Using different Modulations

5.2 Proposed Implementation

Analyze of the channel estimation and proposed the robust channel estimation algorithm with a cyclic extension technique known as guard interval to the channel length impact. This technique is based on MIMO-OFDM technology. In MIMO-OFDM technology to reduce the inter symbol interference (ISI) and inter carrier interference (ICI) by inserting cyclic prefix (CP) at the beginning of the transmitted OFDM is to be caused by the Multipath Propagation. Now-a-days the smart antennas are widely employed in the wireless communication, because they have the capability to increase the number of users in the communication system. The smart antennas are the beam forming as the main function. The inserted Cyclic Prefix must be larger than the channel length. Due behavior of the channel the Channel length is more than the cyclic prefix and causes to the inter symbol interference and inter carrier interference. In this paper, we propose that hybrid Channel estimation technique to resist the channel length using the technique of Cyclic Extension and the beam forming to better the performance of the system. The performance and enhancement of evaluation is in the MATLAB for the proposed technique in form of the Bit Error Rate (BER) for MIMO-OFDM technique using the Rayleigh fading.

5.1.2 Simulation Parameters

TABLE 2 for Simulation Parameters

s.no	Name	Value \Type
1	No of carriers	64
2	FFT	128
3	SNR	30
4	No of transmitter	8
5	No of receiver	8
6	Modulation	BPSK
7	Channel	Rayleigh Fading

5.2.1 BER v/s SNR

In this model the Cyclic Extension is added according to the No of channels. And when the IFFT of the data is obtained from the Signal is mapped and the Cyclic Extension is added to the Signal to decrease the delay spread of the signal. For every transmitted signal the cyclic prefix is added at the beginning of the signal.

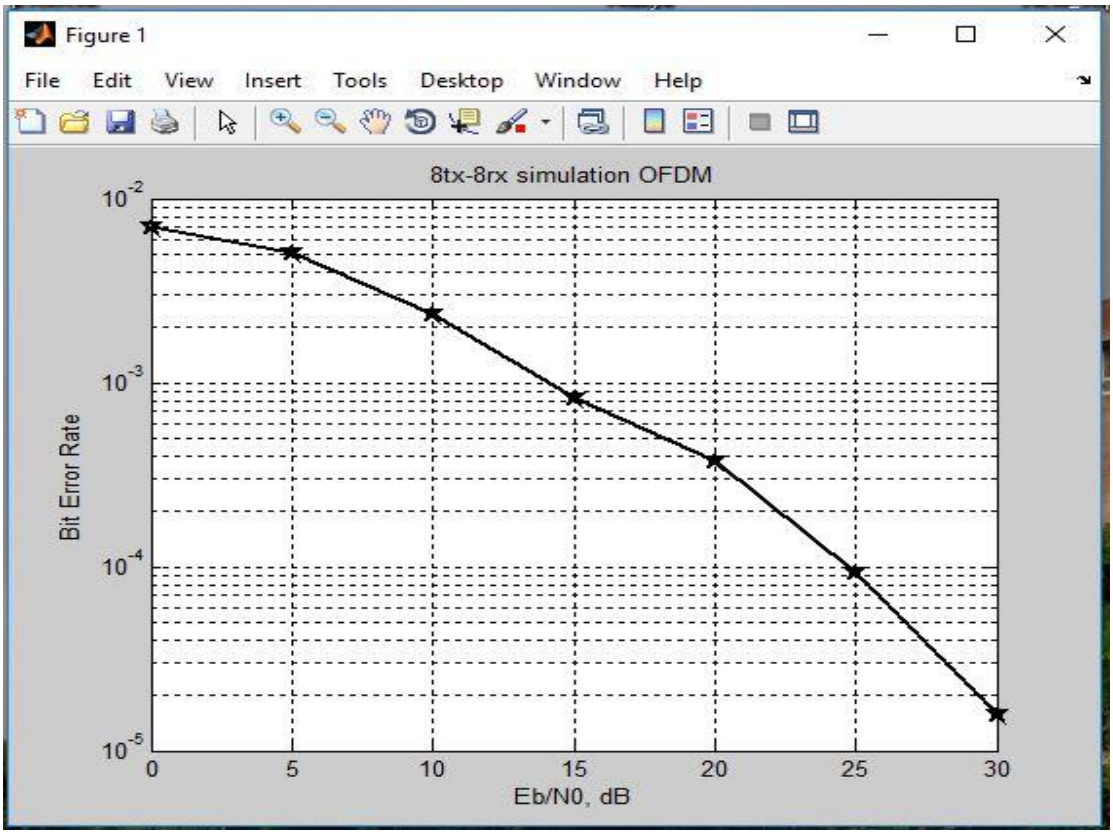

Fig.16 BER V/S SNR

As we analyzed from the implantation of base paper the Result is improved and better performance than the previous result. From the graph we can assume that increase in the error may leads to the decrease in the performance, but here there is increase in the performance of the system.

5.3 Peak to Average Power Ratio (PAPR)

The peak to average power ratio is the type of decreasing the power consumption according to the hybrid approach of the channel estimation. These might result to the form of the problem at the transmitter.

5.3.1 Simulation Parameters

Table.3 Simulation Parameters

s.no	Name	Value/Type
1	No of carriers	128
2	Over sampling factor	8
3	Constellation	QPSK

5.3.2 Results

Analyze of PAPR and Cumulative distributive function for the reducing the power consumption at the transmitter side. In OFDM is a linear then large PAPR requires linear dynamic range of the transmitter Tx and Receiver Rx. As we use the Selective mapping (SLM) method to decrease the PAPR. The CCDF and PAPR are depends on the β value. And the Channel capacity depends on the SLM order.

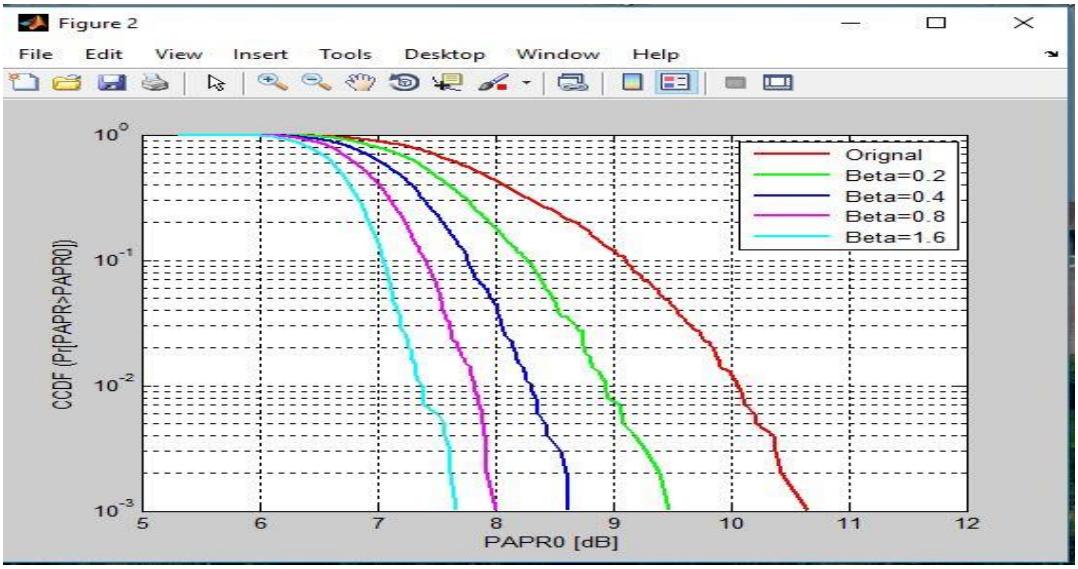

Fig.17 PAPR v/s CDF

Analyze of the graph, SLM method is good as compared with traditional method, as from the reduction of the power based on the values of the β, as there is increase in the β value there is decrease in the PAPR value. And as per the original signal and the decrease of the signal frequently when there is increase in the β as Empirical cumulative distributive function. From this we can analyze decrease in the PAPR leads to increase the Power amplifier efficiency.

CHAPTER 6 CONCLUSION AND FUTURE SCOPE

An MIMO-OFDM technique with the help of the hybrid channel estimation the decrease of the Inter-carrier Interference and also the Inter-symbol interference with help of the cyclic extension. If the cyclic prefix is larger than channel length, then there is reducing of inter-symbol interference. To increase the power efficiency, PAPR should be decreased. The SLM method is the cyclic extension is more reliable and entered at the beginning of the OFDM signal. The MIMO-OFDM is used for the various applications. The MIMO-OFDM technique is employed to enhance and improve and increase bandwidth in the wireless communication. Like LAN, WLAN, LTE and DVB. The MATLAB simulations are used for evaluated and carried out the performance of the system.

The proposed work can be utilized in different direction in the future as:

- This MIMO-OFDM technique is will be used in LTE Downlink speed.
- It will be used primly for the high data rates in mobile communication.
- The future technology is predicated on the 5G technology.

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Report

ORIGINALITY REPORT

%12	%7	%10	%3
SIMILARITY INDEX	INTERNET SOURCES	PUBLICATIONS	STUDENT PAPERS

PRIMARY SOURCES

1	Khlifi, Abdelhakim, and Ridha Bouallegue. "An enhanced channel estimation technique with Adaptive Cyclic Prefix Length for LTE Downlink systems", 10th International Multi-Conferences on Systems Signals & Devices 2013 (SSD13), 2013. Publication	%1
2	Padmaja, C., and B.L. Malleswari. "Review: Performance analysis of space-time-frequency MIMO OFDM techniques", 2014 International Conference on Advances in Engineering & Technology Research (ICAETR - 2014), 2014. Publication	%1
3	Submitted to SASTRA University Student Paper	<%1
4	R.S. Blum, Q. Yan, Y. Li, J.H. Winters. "Improved techniques for 4 transmit and 4 receive antenna MIMO-OFDM for wireless communications", IEEE VTS 53rd Vehicular Technology Conference, Spring 2001.	<%1