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"BER and PAPR Reduction for MIMO Systems using Modified PTS with DWT Scheme"

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SUMMARY

INTRODUCTION

The developing interest for administrations with high information rates and high ghastly productivity is the way to quick mechanical advancement in the field of remote correspondence. Over the most recent two decades, remote correspondence has encountered a monstrous development with a mission to furnish new administrations with high information rates. Numerous new remote frameworks. These systems must have the capacity to give high information rate at passable bit error rate (BER), and least postponement. Orthogonal Frequency Division Multiplexing (OFDM) in conjunction with different radio wires MIMO-OFDM is one of such innovation anticipated that would give coveted administration measures [3, 4]. The main business OFDM based framework was Digital Audio Broadcasting (DAB.

BACKGROUND AND MOTIVATION FOR RESEARCH

The users can browse the internet; make VoIP calls using software such as skype, access mail, or upload pictures and videos from digital cameras. They can also watch video by streaming from any of the video sources or downloading video files. The claim for broadband mobile services continues to grow. Typically, fast broadband arrangements depend on wired-get to innovations, for example, endorser line (DSL). This sort of arrangement is difficult to send in remote provincial regions, and besides it needs bolster for terminal portability computerized.

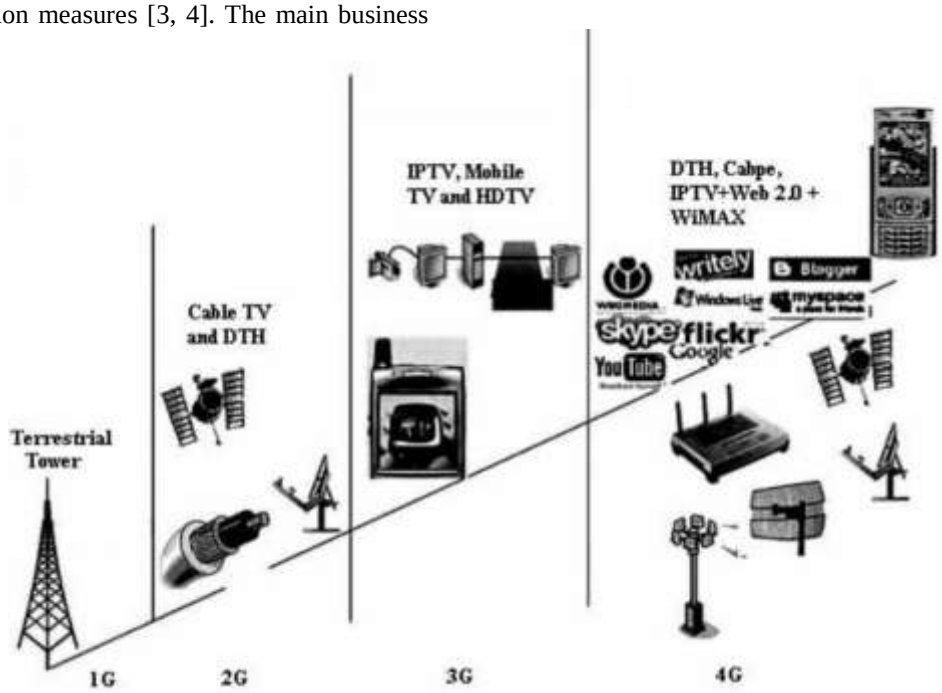

Figure 1.1: Wireless system generation scenario [7]

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CHANNEL ESTIMATION AND DATA TRANSMISSION IN TDD SYSTEM

In TDD system, the signals are transmitted in the same frequency band for both uplink and downlink transmissions but at different time slots.

Figure 1.2:

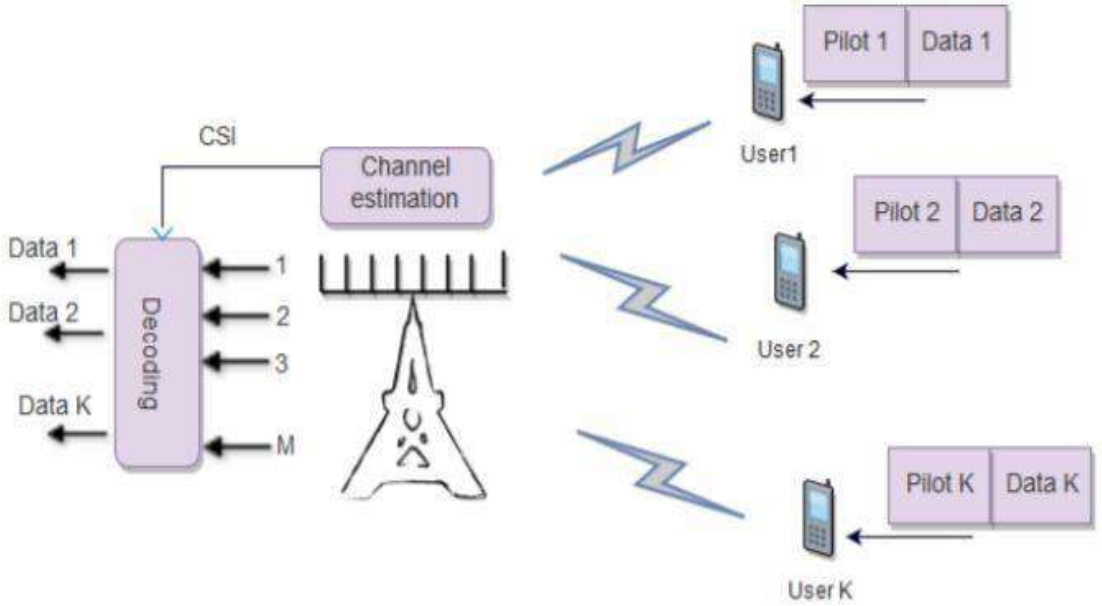

Figure 1.2: Uplink transmission in a TDD Massive MIMO system

Hence, uplink and downlink channels are reciprocal. During uplink transmission, all the users in the cell synchronously send the pilot signal to the BS. The antenna array receives the modified pilot signal by the propagation channel. pilot signal, BS estimate the CSI and further, this information is used to separate the signal and detect the signal transmitted by the users as shown in Fig 1.2. In downlink transmission, due to channel reciprocity, BS uses the estimated CSI to generate precoding/beamforming vector. The data for each user is beam formed by the precoded vector at the BS and transmitted to the user through propagation channel as.

Figure 1.3: Downlink transmission in a TDD Massive MIMO system

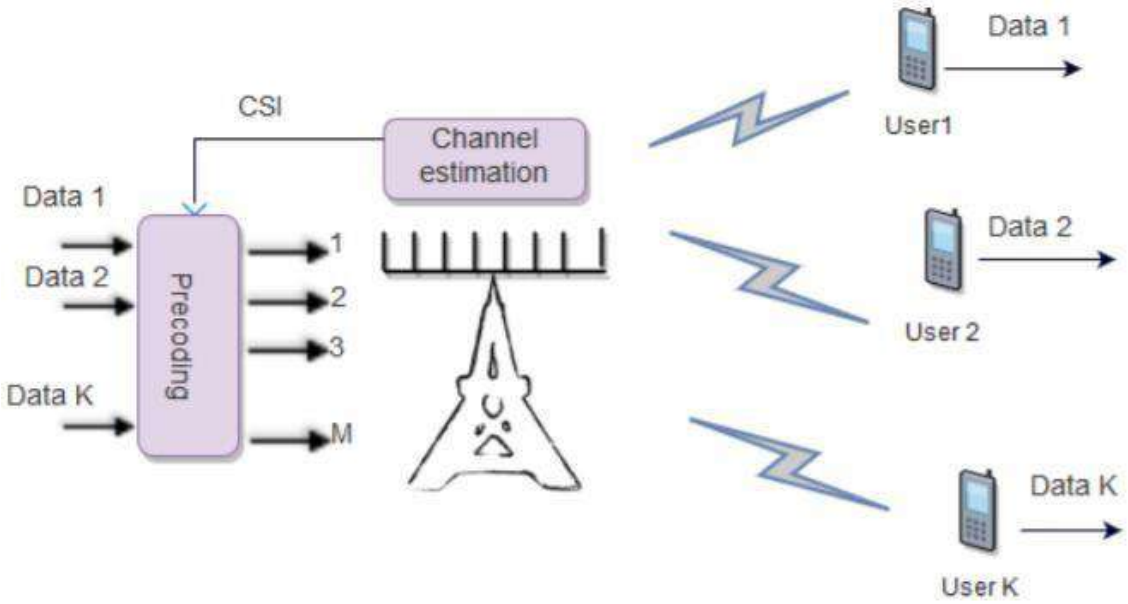

Figure 1.3: Downlink transmission in a TDD Massive MIMO system

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CHANNEL MODEL FOR SINGLE CELL IN TDD SYSTEM

In finite scattering channel model, the propagation is modeled in terms of a finite number of multiple path components [16]. Each path is specified by AoA, complex gain, and delay. Delay of each path is neglected, since narrow band system is considered. The following assumptions are made regarding the channel model

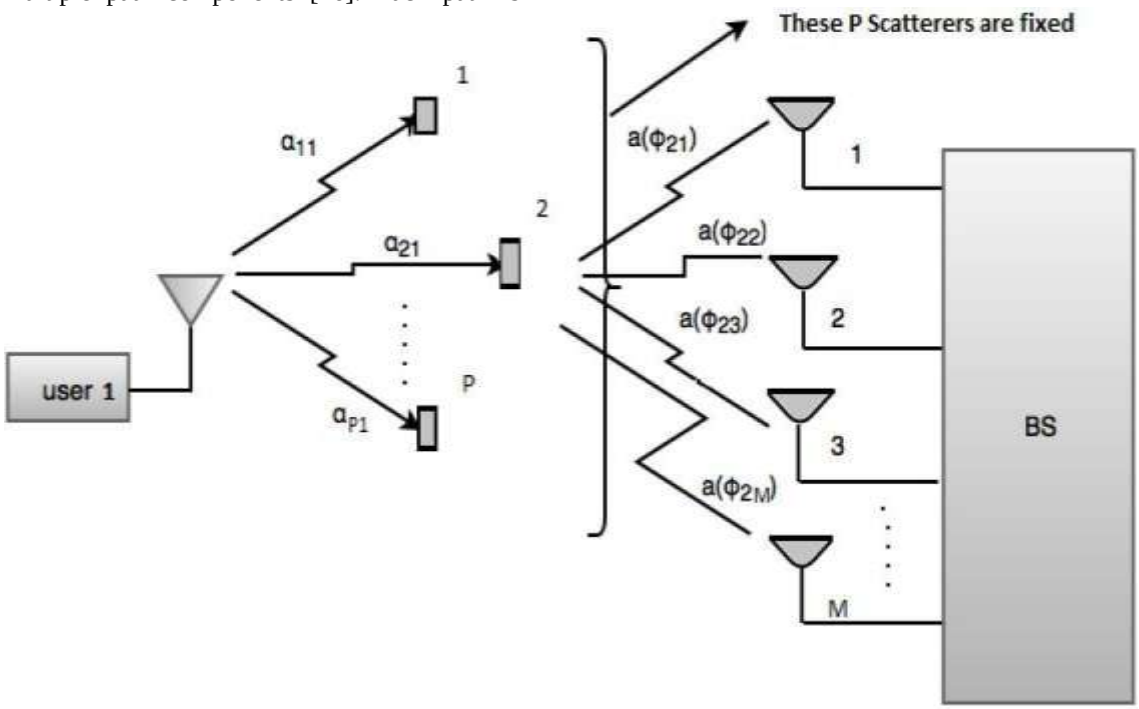

Figure 1.5: Physical finite scattering channel model for single user (the above scenario holds for all the users as well as scatters

CHANNEL ESTIMATION

For the most part in the majority of the live applications and in the earth data of related approaching data measurement isn't accessible at that point versatile channel is an automatic framework that takes the assistance of a recursive calculation for handling. Also, it is automatic channel which uses some preparation vector that conveys different appreciations of an ideal reaction can be converged with reference to the approaching sign. First info and preparing is looked at appropriately mistake sign is created and that is utilized to modify some recently accepted channel parameters under the impact of approaching sign. Channel parameter alteration proceeds until unfaltering state condition.

Linear Prediction

If we want to design a wiener filter we need to solve the general equation which is given as below, i.e.

W □ R□ 1r
0 X dX
(1.2)

Where W0 is the output weight, rdX is the cross correlation of linear prediction and multistep prediction and RX is the input cross correction. The only difference between linear prediction with and without noise is the autocorrelation matrix for the input signal but where as in noise it is uncorrelated so then is replaced by

OBJECTIVE OF THE RESEARCH

The objectives of the present research work include the performance analysis of following points:

- To study and to analysis the performance of forthcoming future generation wireless networking technique i.e. WiMAX as the upcoming 4G standard for meeting the requirements of last mile end to end wireless network with greater system capacity with improved bit error rate.
- To model the complete WiMAX system as per the IEEE 802.16 standards.
- To study the various types of modulation techniques for transmitter and receiver antenna of wireless communication i.e. effects of peak-to-power ratio (PAPR) and bit error rate (BER).
- Implementation of various antenna diversity techniques, Alamouti coding and MIMO-OFDM in

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the WiMAX model for the improvement of system performance in terms of bit error rate and capacity.
 Real time data implementation in WiMAX system by real time transmitting and receiving the signals such as image and speech inputs.

LITERATURE REVIEW

INTRODUCTION

(MRRC) technique which uses one transmit and two receive antennas. This scheme does not require any bandwidth expansion, any A simple transmit diversity technique was proposed by Alamouti. It presents a simple two branch transmit diversity scheme and one receive antenna. This technique using two transmit and one receive antenna provides the same diversity order as like the Maximal Ratio Receiver Combining feedback (channel state information) information and its computation complexity is simple. In many research works the information about the fading and co efficient of the receiver were assumed as constant. Due to the rapidly changing condition in channel fading environments, perfect knowledge of the fading co efficient might not be available at the receiver. It was known that the class of unitary space time constellations is the most suitable constellations with respect to the channel capacity.

PROBLEM FORMULATION

To design the MIMO – OFDM system for IEEE 802.16e i.e. WiMAX by using space time block coding (STBC). The MIMO-OFDM system gives higher data rate, diversity and channel capacity which plays a major role in various applications like digital audio broadcasting (DAB). The number of antennas at the transmitter and receiver end provides reliability, higher throughput and robustness to the system.

The main problems are o The available OFDM spectrum (SISO) is fixed but the demand for high data rate and high reliability is growing day by day to suite the more improved PAPR (Peak to Average Power Ratio) and BER (Bit Error Rate) and attractive applications.

o Multiple input multiple outputs (MIMO) use multiple antennas at both the transmitter and receiver side.

o In recent times the demand for the use of MIMO systems has increased due to its capability of robustness against Multipath fading and increasing the Spatial Multiplexing Gain and Spatial Diversity Gain. Orthogonal Frequency Division Multiplexing (OFDM) is one of the best digital modulation schemes, where signal is divided into number of narrow band channels to obtain spectral efficiency and minimizing the Inter Symbol Interference (ISI).

MIMO-OFDM SYSTEM

INTRODUCTION

In radio, multiple-input and multiple-output, or MIMO, is the use of multiple antennas at both the transmitter and receiver to improve communication performance. The terms input and output refer to the radio channel carrying the signal, not to the devices having antennas. MIMO technology has attracted attention in wireless communications, because it offers significant increases in data throughput and link range without additional bandwidth or increased transmit power. It achieves this goal by spreading the same total transmit power over the antennas to achieve an array gain that improves the spectral efficiency (more bits per second per hertz of).

WIRELESS COMMUNICATION

Wireless communication is characterized as the exchange the data between two or more gadgets with no electrical or wire associations. Wireless communication frameworks have expanded the throughput over channels and systems. At same time the unwavering quality of Wireless communication has been expanded.

WiMAX

WiMAX refers to interoperable implementations of the IEEE 802.16 family of wireless-networks standards ratified by the WiMAX Forum. (Similarly, Wi-Fi refers to interoperable implementations of the IEEE 802.11 Wireless LAN standards certified by the Wi-Fi Alliance) WiMAX Forum certification allows vendors to sell fixed or mobile products as WiMAX certified, thus ensuring a level of interoperability with other certified products, as long as they fit the same profile. It is a telecommunications tecwireless data in a variety of ways, from point-to-point links to full mobile cellular type access [11].

The original IEEE 802.16 standard (now called "Fixed WiMAX") was published in

The IEEE standard of 802.11 should not be confused with these two standards 802.11 And 802.11x because the 802.11 standard defining wireless local area network (WLAN) while the other 802.11x standard defines the port based network. The IEEE accepts the standard of 802.11 for air interface between patrons wirelessly connected either by the subscriber with the base station or in other words like between two wireless subscribers in 1997. So some of the IEEE standard 802.11 define the wireless local area network

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(WLANs) and become the developing base for further enhancement and improvement in data rate for derived standards of 802.11. It uses the Frequency Hoping Spread Spectrum (FHSS) and Direct sequence Spread Spectrum (DSSP), and supports throughput of 1 or 2 Mbps in 2.4

The Wi-Fi consists of two parts:
- Wi-Fi Tower
- Wi-Fi Receiver

OFDM

Orthogonal frequency-division multiplexing (OFDM) is a method of digital modulation in which the data stream is split into N parallel streams of reduced data rate with each of them transmitted on separate subcarriers. In short, it is a kind of multicarrier digital communication method. OFDM has been around for about 40 years and it was first conceived in the 1960s and 1970s during research into minimizing interference among channels near each other in frequency [2].OFDM has shown up in such disparate places as asymmetric DSL (ADSL) broadband and digital audio and video .
broadcasts. OFDM is also successfully applied to a wide variety of wireless communication due to its high data rate transmission capability with high bandwidth efficiency and its robustness to multi-path delay .

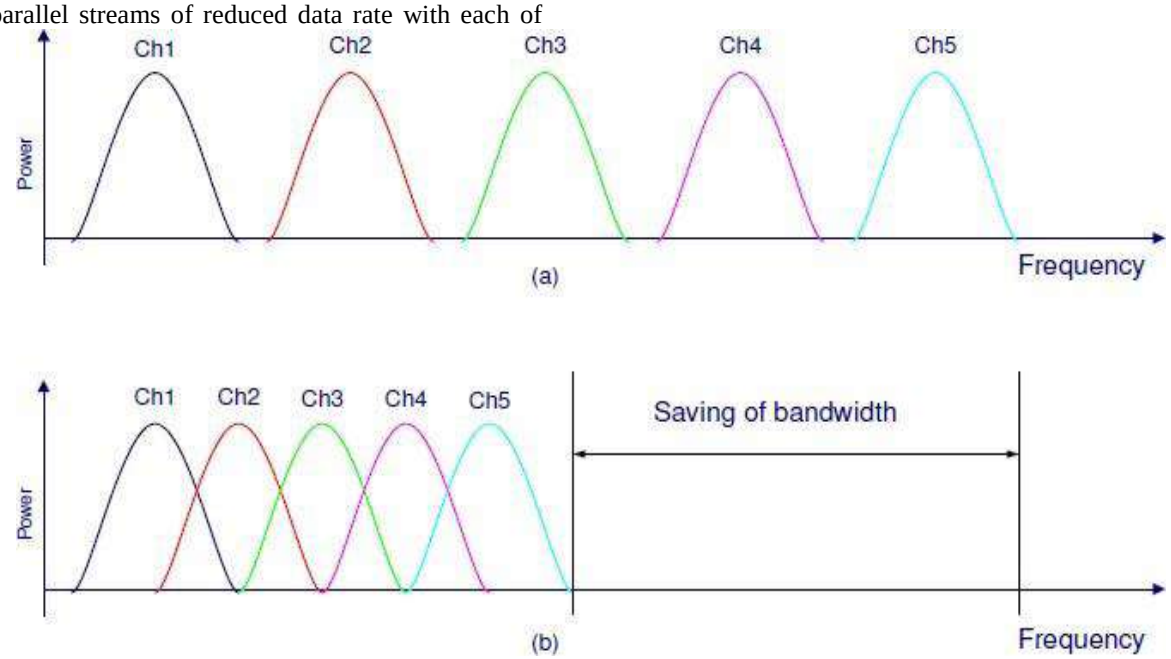

Figure 3.1: Comparison between conventional FDM (a) and OFDM (b

System Model

The basic principle of OFDM is to split a high data rate stream into a number of lower data rate streams and then to transmit these streams in parallel using several orthogonal sub-carriers. By using this parallel transmission, the symbol duration increases and the relative amount of dispersion in time caused by multipath delay spread decreases. If 1/T is the symbol rate of the input data to be transmitted then the symbol interval in the OFDM system is increased to NT. For reducing the inter- symbol interference, a guard band is inserted between successive OFDM symbols.

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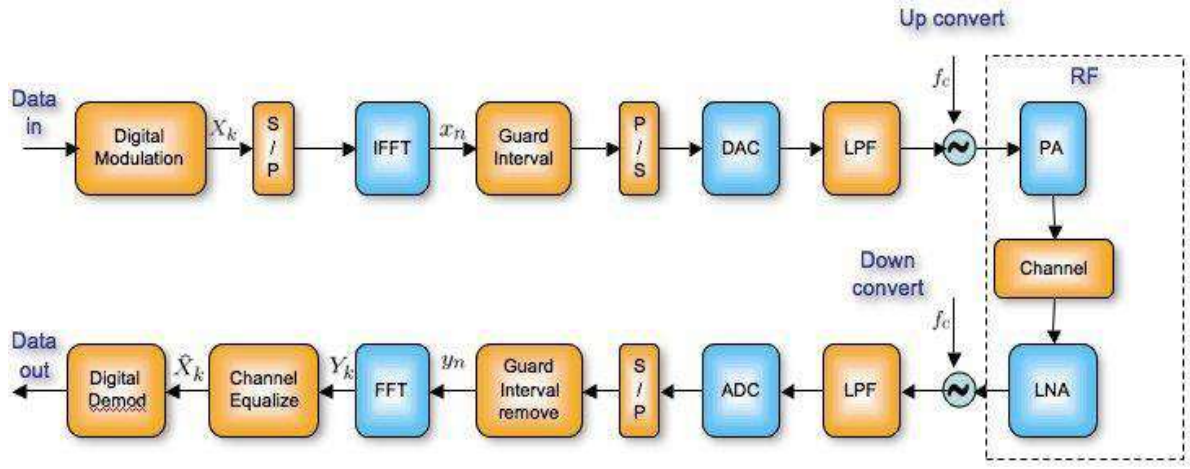

Figure 3.2: System model for OFDM System [18]

PAPR REDUCTION TECHNIQUES

Several PAPR reduction techniques are available in the literature. These methods are basically divided in four categories:

1. Signal Distortion.
2. Coding Methods,
3. Probabilistic (Scrambling) Techniques
4. Pre-distortion Methods.

Every method has some drawbacks and merits. There is always a trade-off between PAPR reduction and some other factors like bandwidth, computational complexity, average power etc. An ideal PAPR reduction technique should have following characteristics:

o High capability of PAPR reduction with few harmful side effects such as in- band distortion and out-of-band radiation.

o Low implementation complexity: Due to high implementation and computational complexity the delay in transmission increases which reduces data rate.

o Low average power: any increase in average power requires a larger linear operation region in HPA and thus resulting in the degradation of BER performance.

o No bandwidth expansion: The bandwidth is a costlier resource for any wireless communication

Iterative Clipping and Filtering:- Jean Armstrong proposed the repeated clipping and filtering scheme [14], in which clipping and frequency domain filtering operations are repeated several times to reduce both the out of-band radiation and PAPR to the desired level. The PAPR performance and amount of out of-band radiation mainly depends on the number of iterations to be performed, more the number of iterations lesser is the value of out-of-band radiations and PAPR. But, the computational complexity of iterative clipping and filtering scheme increases with the number of iterations. We have studied the effect of iterative clipping and filtering of OFDM signal through computer simulation. In this simulation, we have considered an amplitude clipper with a threshold γ o = 0.01 and four iterations. The time domain and frequency domain OFDM signals are shown after each iteration in Figure 3.4. It is observed from Figure 3.4 that the original time domain OFDM signal has large envelope fluctuation and has a PAPR of 3.425dB.

Figure 3.4: Time and frequency domain OFDM signal after Clipping and frequency domain filtering [21]

The frequency domain filtering is used to eliminate the out-of-band radiation but the peaks .

ADVANTAGE AND DISADVANTAGE OF OFDM

o As OFDM is a parallel transmission system which converts the difficulty of frequency selective fading to flat fading by distributing data to sub channels, it seems to be better candidate to combat multipath fading and randomizing the errors in burst.

o In OFDM systems equalization is made very simpler and reduces the complexity at receiver, equalization is only applied to effected sub channel to reduce the error rate.

o Delay profile of channel is nicely handled by insertion of appropriate size guard band.

OFDM provides a higher spectral efficiency due to orthogonally amongst the sub-carriers.

o It is attractive for broadcast applications by using single frequency.

o OFDM is major role playing in development of standards of a broadband access and compatible with existence infrastructure.

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o Sub-carrier spacing could be adjustable according to requirements of an applications and data rate, it supports different modulation schemes for different sub channels.
o There exists high peak to average power ratio which could drift the system into the region of non-linearity and saturation, which reduces the power efficiency of systems.
o The insertion of guard band reduces the spectral efficiency and thus total channel capacity
o There exists high peak to average power ratio which could drift the system into the region of non-linearity and saturation, which reduces the power efficiency of systems.
o The insertion of guard band reduces the spectral efficiency and thus total channel capacity is decrease.

The demerits of high PAPR acquired in OFDM framework is for the most part routed to by a few PAPR diminishment procedures which decrease the PAPR incentive to a specific limit with the end goal that the disparaging impacts are wiped out. A portion of the methods have direct PAPR lessening capacity however have bring down intricacy while some have great PAPR decrease ability at the cost of high many-sided.

Advantage and Disadvantage

Like some other procedure or calculation, the PTS method has various preferences and additionally downsides or detriments. The focal points that have been brought up by the creators of the first strategy are portrayed in the accompanying areas. They have additionally brought up the conceivable detriment of the procedure.

PROPOSED METHODOLOGY

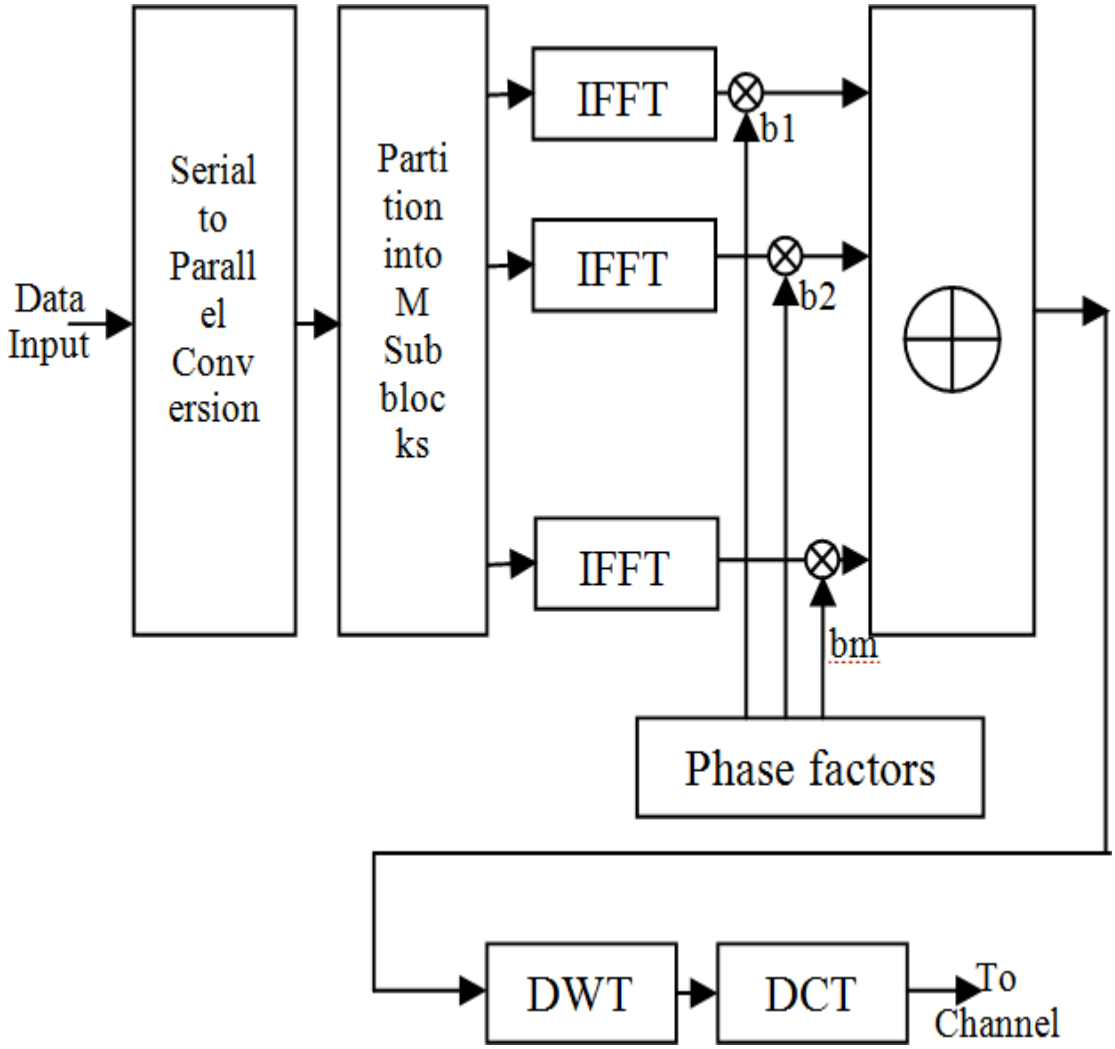

Figure 4.2: Block diagram of the PTS scheme with DWT and DCT Technique

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RESULT AND ANALYSIS

Implementation of Proposed Model

This section discusses the methodology of the research work and tools that involved in the process to complete the design and implementation of MIMO-OFDM system based on PTS with DWT and DCT technique in the MATLAB tool. The methodology of the research is basically divided into four main phases. These phases are started with detailed study of the relevant topics followed by the design process, implementation, and test and result analysis.

This dissertation provides a comprehensive introduction to the basic theory and practice of wireless channel modeling, OFDM, and MIMO, with MATLAB programs to simulate the underlying techniques on MIMO-OFDM systems.

RESULT

Simulation experiments are conducted to evaluate the transmit spectrum, BER, PAPR reduction performance of the MIMO-OFDM scheme. In addition, it is assumed that the data are QPSK, BPSK, 16-QAM modulated and are transmitted using N=256 .

Parameter	
Antenna	2*1
Carrier Frequency	5 GHz
System Frequency	20 MHz
Oversampling Factor	4
Modulation	BPSK, QPSK, 16-QAM
Number of Subband	256

BER (dB)			
Energy per bit (EbNo)	BPSK	QPSK	QAM-16
10^{-3}	16.1	12.2	6
10^{-2}	13.2	10	3.5
10^{-1}	7	4	0
10^{-0}	0	0	0

CONCLUSION AND FUTURE SCOPE

WiMAX MIMO-OFDM in the 3.5 GHz to 4.0 GHz band is of practical interest due to the potential for large-scale WiMAX (IEEE 802.16) deployment communication system can operate with a minimum transmit power, transmit over larger distances, tolerate more interference, use smaller antennas and transmit at a higher data rate.

These properties make the code energy efficient. Hence, new codes were sought that would allow for

easier decoding and encoding. The task of the decoder and encoder easier is using a code with mostly high-weight code words. Error detection and correction techniques are essential for reliable communication over a noisy channel.
We know that a tradeoff is between peak power peak ratio (PAPR) and bit error rate for WiMAX IEEE 802.16. In this dissertation, low-complexity transmitter architecture

FUTURE SCOPE

Therefore, following are the works that may be considered as a future scope in this direction:
1. The proposed techniques can apply on some other standard application of MIMO-OFDM, namely, LTE, DAB, HIPERLAN/2 and 3GPPP systems.
2. The channel estimation is an area which required a lot of attention and improper channel estimation degrades the performance of the multi-carrier system. The channel estimation using soft-computing methods is also a new research area for future.
3. The designing of smart antennas is also providing great explore to the research.