A Novel Higher Order Modulations Based WiMAX Framework for Mobile Broadband Communications

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Abstract— with the recent advancement in the field of mobile broadband communication using wireless mediums, the concept of WiMAX has gain lot of attention from the researchers. WiMAX is considered as one of the most prominent technology in the field of wireless broadband communication as it has efficient interoperability for microwave access. In the past the WiMAX basically has been implemented for the fixed topologies and it has been denoted by IEEE 802.16d standard. The conventional WiMAX models have been implemented using Orthogonal Frequency Division Multiplexing (OFDM) modulation technique which results high PAPR ration. The concept of Orthogonal Frequency Division Multiple Access (OFDMA) has been adopted by the mobile WiMAX which has been denoted by IEEE 802.16e. The OFDMA concept can be utilized in the WiMAX model as well as for the portable services as it has the capability to achieve high data transfer rate. This proposed study aims to develop a novel WiMAX model using different sub carrier modulation techniques (QAM/PSK). The proposed model also uses the concept of OFDMA and OFDM modulation in order to achieve bandwidth utilization. The experimental outcomes are demonstrated using the performance parameters SNR and BER.

Index terms- Crop Yield Prediction, Agricultural Data Mining, Artificial Neural Network , low complexity.

I. INTRODUCTION

In the recent times the concept of WiMAX has gained a lot of attention from the researchers. WiMAX is basically conceptualized in order to enhance the broadband communications in terms of high speed, interoperable and secured access of microwave channels. The WiMAX model has been designed to establish a secure and efficient wireless communication to provide 30 to 40 megabits per sec data in a wireless medium. WiMAX has been introduced and developed as indoor equipment which is needed to be installed and activated into any kind of mobile devices in rural areas. It can be seen that most of the existing studies highlights that WiMAX has become an emerging trend in the field wireless broad band access as compare to the conventional 3G technologies [1] [2]. In the year of 2001 the WiMAX model has been integrated and designed with an IEEE 802.16 standard. The mobile WiMAX model supports Orthogonal Frequency Division Multiple Access (OFDMA) technology which is one of the current research trends associated with a multiuser mode digital modulation scheme.

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The data communication in between the IEEE 802.16e standard defines three different types of physical layers which are 1. Single Career Access 2. OFDMA and 3. Orthogonal Frequency Division Multiplexing.

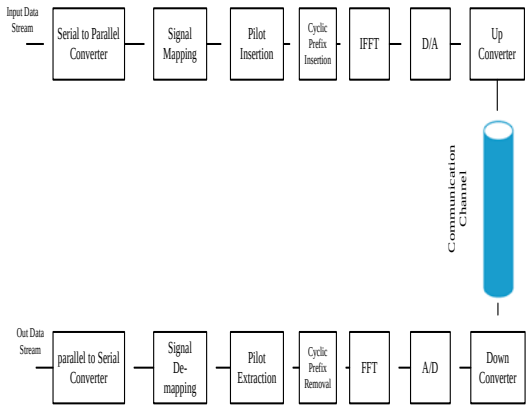

Fig 1. Block Diagram of an OFDM Modulation System

The above figure highlights an OFDM system which shows various procedures associated with OFDM data transmission.

II. PROCEDURE FOR PAPER STUDY

2.1 Review Stage

The existing research works carried out by many researchers which shows that most of the techniques which are used to enhance the performance metric of an WiMAX model are basically three different types of sub carrier modulation mechanisms such as BPSK , QPSK and QAM [3]. This study introduces an enhanced and effective WiMAX Tool anticipated an integration of sub carrier modulation techniques (QAM/PSK) into this. It also utilizes the techniques like 16-QAM as well as 64-QAM considering OFDMA, simulated over an experimental testbed [4].

2.2 Final Stage

The proposed study aims to develop a novel higher order modulations (OFDMA/QAM) based WiMAX model in order to achieve high data rate transmission over an wireless medium. The performance of the proposed system has been improved considering higher order subcarrier modulation techniques such as (QAM/OFDMA). The performance analysis of the proposed system shows how bit error rate of a modulated signal in mobile WiMAX communication can be minimized with respect to different types of higher order carrier modulation techniques.

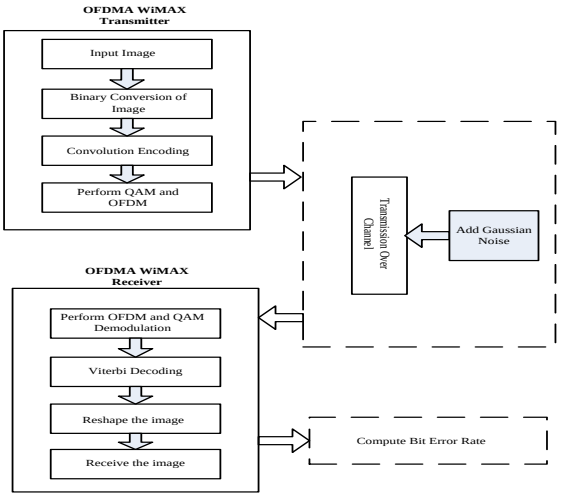

Figure 1 System Architecture of the Proposed Model

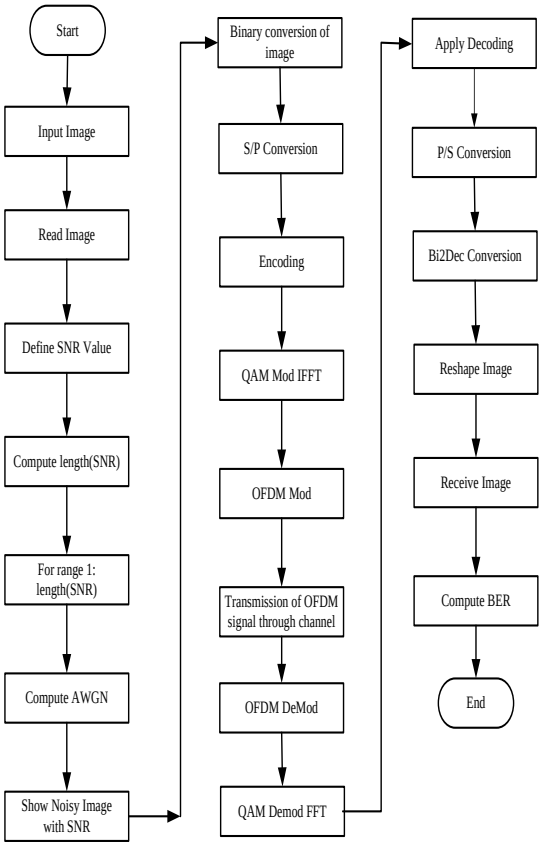

Figure 2 Process Flow Diagram of proposed Yield Model

III. RELATED WORK

This section discusses about the existing studies that has been carried out in the past regarding achieving efficient performance in sub carrier modulation based WiMAX broadband communications.

The study of **Agarwal et al. [7]** has scrutinized Bit Error Rate (BER) execution of the WiMAX Physical layer baseband fitting in with the parameters set up by IEEE 802.16 benchmarks under genuine blurring IEEE institutionalized channels known as the Stanford University Interim (SUI) channels for broadband remote access.. These channels were displayed as three ways blurring channels. From the examination it was watched that Rayleigh blurring channel with high Doppler spread is the most noticeably awful channel corrupting the framework execution.

Nisar et al. [8] introduced a review and builds up another conveyed model to enhance QoS

execution for VoIP over WLAN and Fixed WiMAX framework with respect to (ART). The model was reproduced in the OPNET modeler (16.0) with (APs), Base Stations (BSs)as well as mobile phones, (SSs), and some server BSs that were chosen in view of Nearest Neighborhood Algorithm and Orthogonal Frequency Division Multiplexing (OFDM) procedures. The outcomes acquired from this proposed model demonstrated huge execution in system application reaction time.

As institutionalized, settled WiMAX utilizes OFDM as its physical air interface. Consequently, it additionally experiences high PAPR. To take care of this issue, Partial Transmit Sequence (PTS) is utilized as a part of the paper of **Wael et al. [9**] because of its better execution among other PAPR lessening methods. Sadly, in routine PTS, a thorough inquiry over all mixes of permitted stage weighting components is required. This procedure prompts high computational multifaceted nature. Consequently, Grouping Phase Weighting (GPW) is utilized to disentangle seek unpredictability and still keep up to give compelling PAPR decrease as routine PTS.

Liu et al. [10] proposed a multi-mode WiMAXSAR to conquer this impediment. In particular, we first set forward an outline of output mode WiMAX SAR, which altogether grows the inclination range swath for reconnaissance and imaging applications. Along these lines, spotlight and squint-mode WiMAX SAR are likewise proposed to improve imaging quality. At long last, a windowing plan on reference information at the beneficiary is proposed to lessen apparition pictures toward reach. The legitimacy of proposed configuration is affirmed through point by point recreation results.

Martin et al. [11] have deployed a 802.16d WiMAX system that works at 4.9 GHz at Clemson University. In this paper, we exhibit the outcomes from an execution examination we have directed of the WiMAX system. To the best of our insight the work reported in this paper is the primary scholarly investigation of an operational 4.9 GHz WiMAX in which controlled examinations could be led. While neither the 4.9 GHz range nor the ebb and flow WiMAX profiles settings may be ideal for space or lunar interchanges, an investigation of WiMAX at any recurrence is of quality to both the aeronautic trade and the exploration group.

The study of **Jha et al. [12]** has presented the based asset allotment in WiMAX and WiMAX - WLAN interface development. In first stage we research how to trounce radio association affiliations rejected by BS (Base Station). It will judge clients with better QoS for different applications dynamically examination for any range based frameworks.

Miao et al. [13] examined these two diverse system facilitating models for the venture. Specifically, The also examined 1) what the WiMAX system design ought to resemble; 2) by what method cooperate consistently to give the client a brought together ordeal. The substance in this paper depends on our late research here.

The investigation of **Lu et al. [14]** proposed a safe and administration situated system control structure for WiMAX systems. In the configuration of this structure we consider both the security prerequisites of the correspondences and the necessities of potential WiMAX applications that have not been completely tended to already in the system layer outline. The proposed system comprises of two essential parts: an administration mindful control structure and a bound together directing plan. Other than the outline of the system, we facilitate study various key empowering advancements that are vital to a handy WiMAX system. Our study can give a rule to the outline of a more secure and down to earth WiMAX system.

Kim et al [15] proposed an outline and execution strategy called minor WiMAX association about, the t-WCM is confirmed to demonstrate verging on equivalent strength and postponement exhibitions numerous sorts of unique reason implanted frameworks, and therefore to give different WiMAX system administrations to them..

IV. PROPOSED SYSTEM

The WiMAX model has successfully achieved very efficient an errorless successful data packet transmission from transmission end to the receiver end as compare to existing 3G mobile broadband communication services. This section introduces the overall system design concept associated with the proposed WiMAX tool which includes the system requirements, operating environment, system and subsystem architecture etc. Therefore WiMAX Model basically uses the concept of OFDMA modulation in order to utilize the

bandwidth and it is also capable of enhancing the channel access in a parallel computation in terms of fast and reliable data transfer rate. It has been evaluated after analyzing so many existing research trends that the mobile WiMAX which belongs to the family of IEEE 802.16 standard can provide mobility, nomadic access and can be configured with portable applications where the fixed WiMAX (IEEE 802.16d) supports non efficient nomadic and also it performs routing with respect to the applications configured and enabled in fixed topologies. The mobile WiMAX adopted the concept of Orthogonal Frequency Division Multiple Access (OFDMA) and also enables a predefined scalable bandwidth up to 20KHZ. However, the design specification of mobile WiMAX inherits all the features associated with fixed WiMAX and extended it with some new entities. OFDMA WiMAX aims to provide a roaming capability and Quality of Services (QoS) with respect to higher utilization of bandwidth, less bit error rates and considerable transmission delay of packets.

The proposed WiMAX System basically composed of four different types of sub modules which are as follows

1. OFDMA Transmitter (Tx) Module
2. OFDMA Signal Transmission Module
3. OFDMA Receiver (Rx) Module
4. Computation of Bit Error Rate (BER)

The next section will highlight the core design principle associated with the proposed Higher order (OFDM/QAM) sub carrier modulation based WiMAX Model.

V. IMPLEMENTATION

The implementation of the proposed system has been carried out using MATLAB,

a. OFDMA WiMAX Transmitter (Tx) Module

The proposed WiMAX model utilizes the concept of Orthogonal Frequency Division Multiple Access (OFDMA) modulation which is implemented using IFFT and FFT in the transmitter as well as receiver sides. The proposed model evaluates OFDMA modulation in the transmitter end in order to achieve high data rate transmission over the wireless medium (e.g. air). The proposed model also evaluates QAM modulation before performing OFDMA in the transmitter end. The advantage of using OFDMA modulation is it can support more sub carriers using more sub channelization as compare to the conventional OFDM. The transmitter model also computes Signal to Noise ratio before transmitting the carrier signal over wireless medium.

b. Pseudo Codes for OFDMA WiMAX Transmitter Model

The Pseudo code of the transmitter model is described below with its input, variable initializations, computational statements and functions.

Start
Input: Image file
Output: Modulated Image
Initialize I

1. Read ← Input Image (I)
2. Imagefile ← Write(I)
3. Initialize the SNR range for the signal
4. for range(1←length(SNR))
5. Plot and show the input image
6. Store input image into Iorg
7. Convert the image into binary format.
8. Convert into single column
9. Perform convolution encoding
10. Perform → QAM (M=4)
11. Perform OFDMA Modulation
12. End for
13. Save the image info into a net mat variable
14. Transmit the modulated signal.

End

The above mentioned algorithm shows how a signal is modulated using OFDM and QAM in the transmitter side using the concept of IFFT.

c. Pseudo Code for Signal Transmission Module

The pseudo code of the signal transmission module is described below with its input, variable initializations, computational statements and functions.

Start
Input: Transmitted Modulated Signal
Output: Noisy Signal

1. Pass the OFDM modulated signal through channel.
2. Compute Sigma ← sqrt (10^(-SNR/10))
3. Add → AWGN Gaussian noise to the signal;
4. Compute the SNR using Ynoise;

End;

The above mentioned algorithm shows how noise is added to an OFDM modulated signal during the transmission through wireless channel. This module also computes SNR values for different channel conditions during the transmission phase.

d.Pseudo Code for OFDMA WiMAX Receiver (Rx) Model

This module is evaluated for receiving the modulated signal and performing QAM and OFDMA demodulation in the reverse process. This module also executes the vertibri decoding scheme.

Start
Input: Modulated Signal
Output: Demodulated noisy signal
Initialize Im ;

1. For (range = length(SNR))
2. Perform OFDM Demodulation
3. Perform QAM Demodulation
4. Perform Viterbi Decoding
5. Reshaping of the Image
6. Plot the received Demodulated image
7. End for

End

The above pseudo code shows how the modulated signal is received at the receiver end demodulated including OFDMA and QAM demodulation.

VI. RESULT DISCUSSION

This section discusses about the important findings of the proposed study. It also highlights experimental outcomes of the proposed OFDMA based WiMAX model. The following figure 3 highlights the experimental outcomes of the proposed system where the bit error rate s for the transmitted OFDMA signal has been evaluated considering different types of higher order sub carrier modulation techniques. It also shows that configuring the proposed WiMAX model with OFDM and QAM modulation can increase the data transfer rate during the communication.

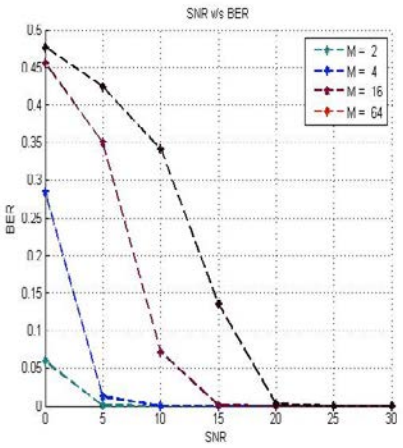

Figure 3 SNRVs BER for different higher order modulations

It can be also observed that increasing the SNR values for different channel conditions can decrease the bit error rate (BER) in the received demodulated signal.

VII. CONCLUSION

The concept of OFDMA WiMAX using higher order modulations such as PSK/QAM and OFDM has become worldwide interoperable system for wireless communications standard which provides a very fast data transfer rates (30 to 40 Mbps) in order to activate an efficient multiple channel access. The proposed study developed a prototype of higher order subcarrier modulation based WiMAX model. The proposed model also evaluated using MATLAB simulink. The proposed model uses QAM and OFDM modulation techniques for data compression and fast data transmission over a channel. The adaptability of Orthogonal Frequency Division Multiplexing

eases the bandwidth utilization also the proposed model computes the Bit Error Rates (BER) and Signal to noise ratio (SNR) associated with an OFDM modulated signal in the presence of AWGN noisy environment for different channel conditions. The experimental analysis and the investigational phase shows that the error rate has been optimized with the value of BER= 10^-2. The comparative analysis in between different sub carrier modulations shows the effectiveness of the proposed OFDMA WiMAX model.

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