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Performance analysis of MIMO-OFDM System for WIMAX (IEEE 802.16) based on Modulation technique

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ABSTRACT

The fundamental tasks that are used in the cognitive radio (CR) networks are spectrum shaping capability and multi carrier systems. In these structures activation of fundamental (primary) users will generate a defined number of sub carriers in the second users. Therefore overall capacity of cognitive radio network is minimized. The small capacities antennas are neutralized by using OFDM based cognitive radio system although various transmit antennas are applied. These considerations examine the complication of resource allocation in MIMO based cognitive radio networks. This paper discusses the model building of MIMO-OFDM using MATLAB R2012b version. This model is a using tool for BER (Bit Error Rate), PAPR (Peak Average Peak Ratio) and transmits spectrum performance evaluation for signal & multiple input output port by the WiMAX (IEEE 802.16) system.

Keywords: WiMAX, MIMO-OFDM, Cognitive Radio, MATLAB

I.INTRODUCTION

Wireless communications is a rapidly growing part of the communications field, with the believable to provide high-speed and high-quality information swap between portable devices located anywhere in the world. It has been the topic of study since last two decades the terrific development of wireless communication technology is due to several factors. The demand of wireless connectivity is exponentially increased. Second, the dramatic progress of VISL technology has enabled small-area and low-power implementation of sophisticated signal processing algorithm and coding algorism. Third, wireless communication standards, like CDMA, GSM, TDMA, make it possible to transmit voice and low volume digital data. Further, third generation of wireless communications can offer users more advanced service that achieves greater capacity through improved spectral efficiency [1].

Potential applications enabled by this technology include multimedia cell phones, smart homes and appliances, automated systems, video teleconferencing and distance learning, and autonomous sensor networks. However, there are two significant technical challenges in supporting these applications first is the phenomenon of fading the time variation of the channel due to small-scale effect of multi-path fading, as well as large-scale effect like pass loss by distance attenuation and shadowing by obstacles. Second,since wireless transmitter and receiver need communicate over air, there is significant interference between them [2].

The intelligent wireless system is called as Cognitive radio (CR) that identifies the spectrum movement in surroundings at each instant. Thus it adapt its parameters such as modulation type, carrier's frequency etc. It has two fundamental purposes they are highly reliable communication whenever and where ever needed and efficient utilization of radio spectrum. Cognitive spectrum sharing was recently studied to allow increasing demands for wireless broadband access which can reduce the problem of under-utilization of licensed spectrum. These techniques can be generally classified into three types: one is interweave, second is underlay and third is overlay [3].

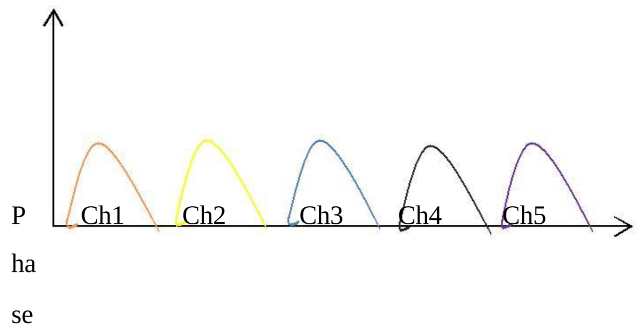
The secondary system can opportunistically access spectrum holes for interweave spectrum sharing. And for the spectrum underlay second users (SUs) transmit simultaneously with fundamental (primary) users (PUs) under the constraint that interference caused by the SUs on the PUs must be below a certain threshold. In spectrum overlay SUs actively help primary data transmission in exchange for a spectrum access in time domain, spatial domain or frequency domain [4]. The locations of SUs are usually fixed or limited into a small area without suffering interference from other concurrent transmissions. For more than a decade, Adaptive resource allocations (RA) for the OFDM systems have been studied [5]. As the OFDM-based CR systems are arising, the adaptive Resource Allocation (RA) attracted much attention starting from the broaching. Thus in the case of single SU, Resource Allocation in an OFDM-based CR system degenerates in to power distribution. The capacity of CR networks can be expanded by using the approach OFDM based CR networks for which different transmit antennas are applied to that approach. Recently, the great attention has been attracted by the combination of MIMO and OFDM [6-7]. The capacity and divergence gain can be increased by using the MIMO in the hybrid pattern channel while the frequency selective channel is converted in to flat fading channels by using the OFDM.

1.1 OFDM

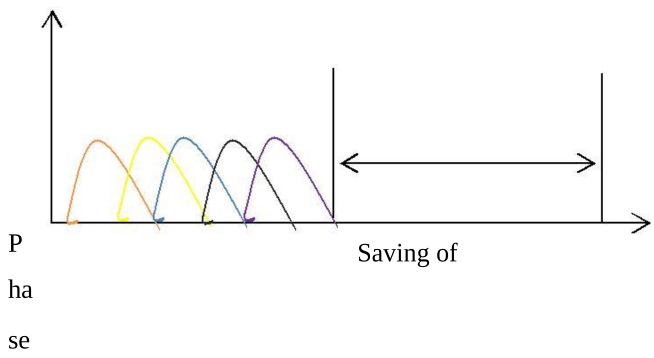
II. OVERVIEW OF OFDM AND MIMO SYSTEM

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[7-8].

The basic principle of OFDM is to split a high data rate streams into a number of lower data rate streams and then transmitted these streams in parallel using several orthogonal sub-carriers (parallel transmission). Due to this parallel transmission, the symbol duration increases thus decreases the relative amount of dispersion in time caused by multipath delay spread. OFDM can be seen as either a modulation technique or a multiplexing technique.



(a) Frequency



(b) Frequency

Figure 1: Comparison between conventional FDM(a) and OFDM (b)

2.2. MIMO

MIMO has been developed for many years for wireless systems. One of the earliest MIMO to wireless communications applications came in mid-1980 with the breakthrough developments by Jack Winters and Jack Saltz of Bell Laboratories [9]. They tried to send data from multiple users on the same frequency/time channel using multiple antennas both at the transmitter and receiver. Since then, several academics and engineers have made significant contributions in the field of MIMO. Now MIMO technology has aroused interest because of its possible applications in digital television, wireless local area networks, metropolitan area networks and mobile communication. Comparing to the Single-input-single-output (SISO) system MIMO provides enhanced system performance under the same transmission conditions. First, MIMO system greatly increases the channel capacity, which is in proportional to the total number of transmitter and receiver arrays. Second, MIMO system provides the advantage of spatial variety: each one transmitting signal is detected by the whole detector array, which not only improved system robustness and reliability, but also reduces the impact of ISI (inter symbol interference) and the channel fading since each signal determination is based on N detected results. In other words, spatial diversity offers N independent replicas of transmitted signal. Third, the Array gain is also increased, which means SNR gain achieved by focusing energy in desired direction is increased.

2.3. MIMO-OFDM

OFDM reduces BER performance and ISI with using multiplexing and modulation techniques to get higher data rate over wireless channels, the use of multiple antennas at both ends of the wireless link provide better performance. The MIMO technique does not require any extra transmission power and bandwidth. Therefore, the promising way to increase the spectral efficiency of a system, the combination of MIMO and OFDM is used over fading channels [10-11].

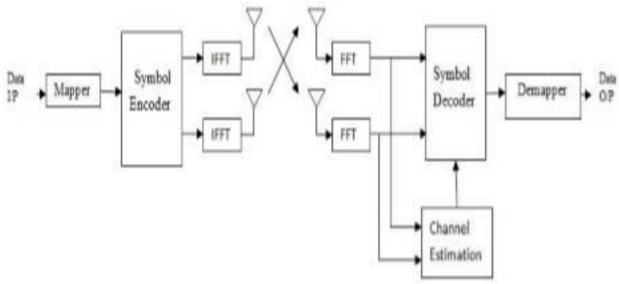


Figure 2: MIMO-OFDM system model

The received signal at j^{th} antenna can be expressed as

$$R_j[n.k] = \sum H_{ij}[n,k]\, X_i\, [n,k] + W[n,k] \qquad (1)$$

Where H is the channel matrix, X is the input signal and W is noise with zero mean and variance.Also $b_i[n,k]$ represents the data block i^{th} transmit antenna, n^{th} time slot and k^{th} sub channel index of OFDM. Here i and j denoted the transmitting antennas index and receiving antenna index respectively.

The MIMO-OFDM system model [4] with NR receives antennas and NT transmits antennas can be given as:

$$\begin{bmatrix} Z_1 \\ Z_2 \\ \vdots \\ Z_N \end{bmatrix} = \begin{bmatrix} H_{1,1} & H_{1,2} & \dots & H_{1,NT} \\ H_{2,1} & H_{2,2} & \dots & H_{2,,NT} \\ \vdots & \vdots & \ddots & \vdots \\ H_{NR,1} & H_{NR,2} & \dots & H_{NR,NT} \end{bmatrix} \begin{bmatrix} A_1 \\ A_2 \\ \vdots \\ A_{NT} \end{bmatrix} + \begin{bmatrix} M_1 \\ M_2 \\ \vdots \\ M_{NT} \end{bmatrix} \quad (2)$$

III.SPECTRUM SENSING

A major challenge in cognitive radio is that the secondary users need to detect the presence of primary users in a licensed spectrum and quit the frequency band as quickly as possible if the corresponding primary radio emerges in order to avoid interference to primary users. This technique is called spectrum sensing. Spectrum sensing and estimation is the first step to implement Cognitive Radio system [5]. We can categorize spectrum sensing techniques into direct method, which is considered as frequency domain approach, where the estimation is carried out directly from signal and indirect method, which is known as time domain approach, where the estimation is performed using autocorrelation of the signal. Another way of categorizing the spectrum sensing and estimation methods is by making group into model based parametric method and period gram based nonparametric method.

a. Primary transmitter detection: In this case, the detection of primary users is performed based on the received signal at CR users. This approach includes matched filter (MF) based detection, energy based detection, covariance based detection, waveform based detection, cyclostationary based detection, radio identification based detection and random Hough Transform based detection.

b. Cooperative and collaborative detection: In this approach, the primary signals for spectrum opportunities are detected reliably by interacting or cooperating with other users, and the method can be implemented as either centralized access to spectrum coordinated by a spectrum server or distributed approach implied by the spectrum load smoothing algorithm or external detection.

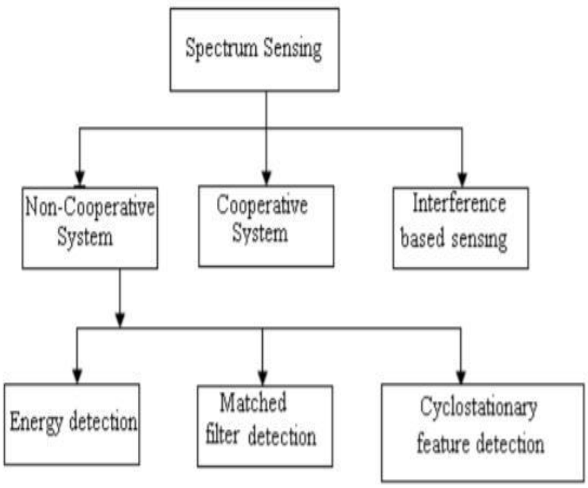


Figure 3: Classification of spectrum sensing techniques

Figure 4 shows the detailed classification of spectrum Sensing techniques. They are broadly classified into three main types, transmitter detection or non-cooperative sensing, cooperative sensing and interference based sensing. Transmitter detection technique is further classified into energy detection, matched filter detection and cyclostationary feature detection [12].

IV.PROPOSED METHODOLOGY

The format of the transmitter is proven in Figure 2. Based on person equipment (UE) comments values, a scheduling algorithm allocates aid Blocks (RBs) to use aand units, right mobile modulation and coding schemes, (coding prices among 0.076 and zero.926 with 4, 16, or sixty four-QAM modulation), the MIMO transmission mode (Transmit diversity (TxD), Open Loop Spatial Multiplexing (OLSM), or Closed Loop Spatial Multiplexing (CLSM)), and the preceding /range of spatial layers for all served customers.

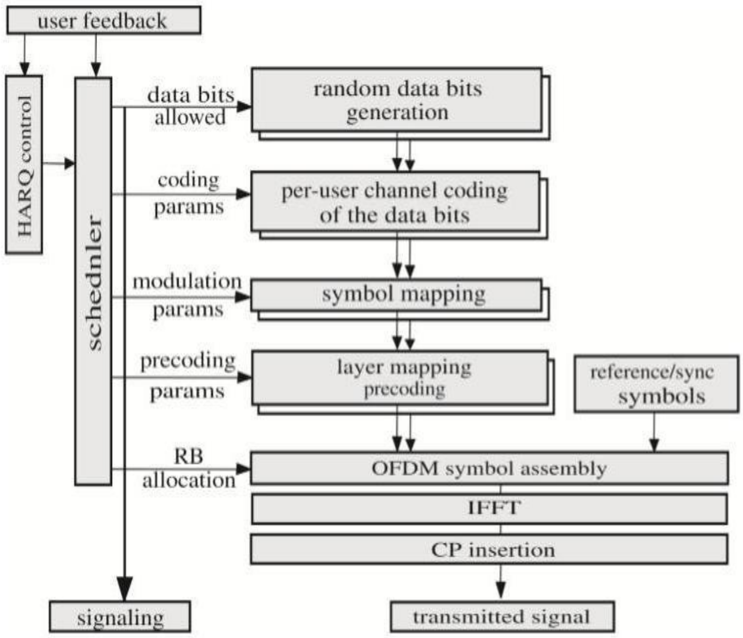


Figure 4: LTE downlink transmitter structure

Within the first step of the transmitter processing, the consumer facts is generated relying on the preceding Acknowledgement (ACK) signal. If the preceding consumer records delivery Block (TB) changed into now not mentioned, the stored TB is retransmitted the usage of a Hybrid computerized Repeat request (HARQ) scheme. Then a Cyclic Redundancy check (CRC) is calculated and appended to every user's TB. The records of every consumer is independently encoded the usage of a faster encoder. Every block of code bits is then interleaved and rate matched with a target rate depending on the obtained Channel pleasant Indicator (CQI) person comments. In addition to HSDPA, the fee-matching method in LTE already consists of the HARQ technique.

V.CONCLUSION

We have observed the energy-efficient resource allocation in an OFDM-based CR network is an important function for green communication method. The proposed design is broad also it covers many possible restraints, focusing an intractable mixed integer programming problem. In this design, we accomplish a set of identical conversions by evaluating the define complication thoroughly, redesigning it into a convex optimization problem that can be determined by standard optimization procedure. Moreover, we evolve a dynamic algorithm to work out the (near) optimal result by employing its certain structure to update Newton step in an innovative approach, minimizing the computation complexity dramatically and making its applications possible. The numerical results show that our resource allocation proposal can achieve near optimal energy efficiency, hence the algorithm developed in this paper converges quickly and stably. Imperfect channel state information case can be considered as a future extension. By adopting MIMO we are enhancing the energy efficiency by which the durability of device increases and power consumption is decreases which are very important in the field of Telecommunication Industry.

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