ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Energy Efficient Power Adaptation and Spectrum Handoff for Multi User Mobile Cognitive Radio Networks



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ABSTRACT:

Multiple Input and Multiple Output (MIMO) and Orthogonal Frequency Division Multiplexing (OFDM) system have the potential to achieve very high capacity depending on the propagation environment. The objective of this paper resource allocation on MOBILE -CRN using is the adaptive resource allocation in MIMOOFDM system using the water filling algorithm. Water filling solution is implemented for allocating the power in order to decrease the channel capacity for power consumption.

An MOBILE -CRN-Advanced cooperative cellular network where a Type II relay station (RS) is deployed to enhance the cell-edge throu[ghput and to extend the coverage area. To better exploit the existing resources, the RS and the eNodeB (eNB) transmit in the same channel (In-Band) with decode-and-forward relaying strategy.

For such a network, this paper proposes joint Orthogonal Frequency Division Multiplexing (OFDM) subcarrier and power allocation schemes to optimize the downlink multi-user transmission efficiency.

Keywords: ***MISO, MIMO, MOBILE-CRN, WATERFILLING.***

INTRODUCTION:

MOBILE -CRN (Cognitive Radio Networks) is the latest mobile communications technology responding to the high demand for broadband data access. Based on MIMO-OFDMA technology, MOBILE -CRN Downlink system provides 100 Mbps (SISO), 172 Mbps (2x2 MIMO) and 326 Mbps (4x4 MIMO). The performance evaluation of MIMO-OFDM systems depends on many parameters. Channel estimation plays a key role in the performance of MIMO-OFDM systems. It has attracted a lot of research interest as in [3] [4]. Most of these research works assume that the power want to be allocated equal to base station users.

So that they need to improve power allocation using bit allocation, channel estimation, block coding and pre-coding on spatial diversity functions. In this paper, we have investigated the performance of power allocation for a Cooperative Communication node which is far from near base station. The Cooperative Communication node which is far away from PU may not perform spectrum sensing with great efficiency due to severe fading in channel and may create interference to PU. In this condition, to improve the power allocation efficiency, we propose a cooperative network based on relay nodes. The performance has been investigated in terms of capacity, throughput, optimal throughput and optimal sensing time. The probability of detection can be improved by

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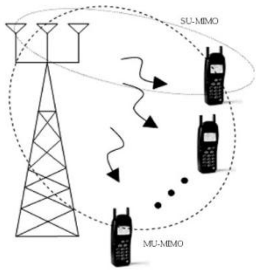
cooperative communication, which in turn reduces power allocation of the system.



If the sensing time reduces, the transmission time for Cooperative Communication increases which results in improvement of throughput of the CR user. Hence we highlight the major contributions of our paper: We have investigated the power allocation of a MIMO in the proposed model with respect to a number of users and capacity consumption on MIMO Using Water filling process.

EXISTING METHOD ANALYSIS:-

In multiuser OFDM or MIMO-OFDM systems, dynamic resource allocation always exploits multiuser diversity gain to improve the system performance and it is divided into two types of optimization problems: 1) to maximize the system throughput with the total transmission power constraint ; 2) to minimize the overall transmit power with constraints on data rates or Bit Error Rates (BER). To the best of our knowledge, most dynamic resource allocation algorithms, however, only consider unit cast multiuser OFDM systems. In wireless networks, many multimedia applications adapt to the multicast transmission from the base station (BS) to a group of users. These targeted users consist of a multicast group which receives the data packets of the same traffic flow. The simultaneously achievable transmission rates to these users were investigated. Recently scientific researches of multicast transmission in the wireless networks have been paid more attention.

Effects of Location Awareness on Concurrent Transmissions for Cognitive Ad Hoc Networks Overlaying Infrastructure-Based Systems

Through wide-band spectrum sensing, cognitive radio (CR) can identify the opportunity of reusing the frequency spectrum of other wireless systems. However, wide-band spectrum sensing requires energy consumption processes. In this paper, we aim to relieve the burden of spectrum scanning in a CR system by means of location awareness. We investigate to what extent a CR system with location awareness capability can establish a scanning-free region where a peer-to-peer connection of the secondary CR users can coexist with an infrastructure-based connection of the primary user. We compute the concurrent transmission probability of a peer-to-peer connection and an infrastructure-based connection in a system based on the carrier sense multiple access with collision avoidance (CSMA/CA) medium access control (MAC) protocol. It has been shown that the frequency band of the legacy system can be reused up to 45% by the overlaying cognitive ad hoc network if certain location techniques help CR users locate primary and other secondary users. In summary, a CR system equipped with location awareness techniques can dramatically reduce the need of spectrum sensing thanks to the capability of identifying the concurrent transmission region in a hybrid infrastructure-based and ad hoc overlaying systems. Hence, from another aspect, the issue of wide-band spectrum sensing in CR systems is resolved fundamentally.

Proactive Spectrum Handoff in Cognitive Radio Ad Hoc Networks Based on Common Hopping Coordination

Cognitive radio (CR) is a promising solution to improve the spectrum utilization by enabling unlicensed users to exploit the spectrum in an opportunistic manner. However, because unlicensed users are considered as temporary visitors to the licensed spectrum, they are required to vacate the spectrum when a licensed user reuses the current spectrum. Due to the randomness of the reappearance of licensed users, disruptions to both licensed and unlicensed communications are difficult to prevent, which leads to high spectrum switching overhead. In

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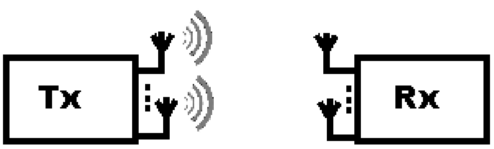
this work, a proactive spectrum handoff framework in a CR ad hoc network scenario is proposed. Based on channel usage statistics, proactive spectrum handoff criteria and policies are devised. CR users proactively predict the future spectrum availability status and perform spectrum switching before a licensed user reuses the spectrum. In addition, a channel coordination scheme is investigated and incorporated into the spectrum handoff protocol design. To eliminate collisions among CR users, a novel distributed channel selection scheme in a multi-user scenario is proposed. Simulation results show that the proposed proactive spectrum handoff protocol outperforms the conventional sensing-based reactive spectrum handoff approach in terms of higher throughput and fewer collisions to licensed users. It is also shown that the proposed channel selection scheme outperforms the purely random channel selection scheme in terms of shorter average service time and higher packet delivery rate.

PROPOSED SYSTEM MODEL:-

In this section, we elaborate on the system model of the multiuser fixed relay system. First we describe the system block diagram and main assumptions of the system, and then we present the downlink signal model.

MIMO System:- Where there is more than one antenna at either end of the radio link, this is termed MIMO - Multiple Input Multiple Output. MIMO can be used to provide improvements in both channel robustness as well as channel throughput.

Cmimo (M) = Cmimo (M)+log2 (real(det(eye(M))+SNR/M*Hmimo* Hmimo')))



In order to be able to benefit from MIMO fully it is necessary to be able to utilise coding on the channels to separate the data from the different paths. This requires processing, but provides additional channel robustness / data throughput capacity.

Power Allocation on MIMO Using Water filling Process:

Considering a multiuser MIMO-OFDM system with downlink beam forming, it is assumed that the base station can acquire perfect CSI, employed the SUS (Semi-orthogonal User Selection) algorithm proposed in to minimize the total transmit power satisfying the QoS of users. But in the size of OFDM group was fixed, therefore, the orthogonality of channels of users in a group was not well guaranteed. In order to guarantee the orthogonality of channels of users in a group. The OFDM communication model is of the form

Y_n = H_n*X_n+N_n(n=0,1,2….N-1)

Where $x_n[m]$ is the input, $y_n[m]$ is the output, $w[m]$ is AWGN and h_n is the channel gain. The normal water filling problem consist of optimizing capacity in the by allocating the power such that

$$C_n = \max_{P_0,\ldots P_{N-1}} \sum_{n=0}^{N-1} \log(1 + \frac{P_n|h_n|^2}{N_0})$$

Under the constraint

$$\sum_{k=0}^{N-1} P_n = P_{total} \qquad P_n \geq 0, n = 0,1,\ldots,N-1$$

The above conditions are solved using Lagrangian multipliers using the Kuhn- tucker condition to get the optimum solution such that

The model is modified to suit an OFDM based cognitive radio system described above by adding a following constraint of maximum power i.e.$\sum_{i\epsilon I_i} P_i = F_j \leq G_j$where P_i is the power allocated to that subcarrier and G_j is the maximum power transmission capacity of that particular sub channel.

$$P_n = \begin{cases} 0 & if\ \frac{1}{\lambda} < \frac{N_0}{(|h_n|)^2} \\ \frac{1}{\lambda} - \frac{N_0}{(|h_n|)^2} & otherwise \end{cases}$$

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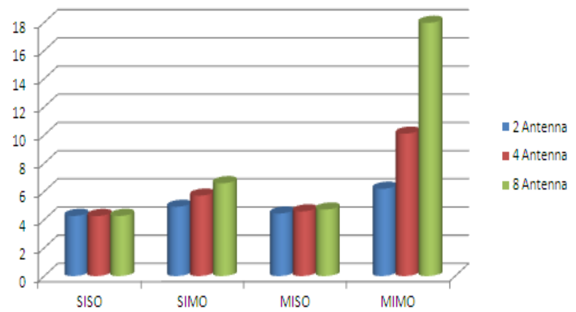
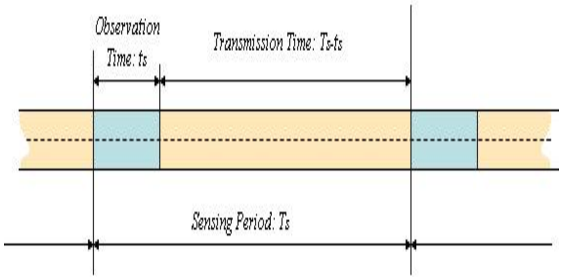
We derive bounds of achievable sum rates of the MIMO fixed relay system using coding, which has been shown to be sum capacity optimal. The sum rate using dirty paper coding can be expressed as a function of the pre-coding matrix F and the relay processing matrix approach is to directly optimize the sum rate with respect to the matrices F and W, however, this approach optimizes large number of parameters and has very high computational cost. Further, in this formulation, the optimizers may not be unique. Thus finding a globally optimum solution is difficult. To resolve this problem, we introduce several design structures for the parameters F and W. This leads to sum rate lower bounds that can be computed using low complexity algorithms. The concept of water filling can be extended to multiple users, where one resource is allocated to one user.

Unfortunately,the computational complexity of the ideal solution explodes, because the two problems of allocating users to resources and distributing a user's transmit power budget are coupled. While the ideal solution is of interest for theoretical research, it has important flaws that prevent its use in a real-world application Users are handled in a Round-Robin fashion, and the best free resource is tentatively allocated to the current user. Since the best resource is picked first, the signal-to-noise ratio reduces for each additional resource. The process stops, when the signal-to-noise ratio drops below a user-defined threshold. The number of resources for any user can be limited to improve the performance of cell-edge users at the expense of sum throughput. The algorithm takes the power budget of each user as a parameter (again, for example one may allocate more power to cell-edge users). The mode parameter switches between fixed-power allocation as shown in Figure 2 part 2) and water filling as in Figure 2 part 4). The code can be further optimized for fixed power allocation by replacing the iterative "water fill ()" subroutine with another one that splits a user's power evenly between resources allocated to the user.

	2 Antenna	4 Antenna	8 Antenna
SISO	4.2674	4.2565	4.2681
SIMO	4.915	5.7067	6.5878
MISO	4.4347	4.5919	4.7181
MIMO	6.1909	10.1027	17.9687



Spectrum Mobility: As CR networks have capability to support flexible usage of wireless radio spectrum, cognitive radio (CR) techniques have attracted increasing attention in recent years. In CR networks, secondary users may dynamically access underutilized spectrum without interfering with primary users, which is called spectrum handoff. Spectrum handoff refers to the procedure invoked by the cognitive radio users when they users wish to transfer their connections to an unused spectrum band. Spectrum handoff occurs when:1.When primary user is detected or 2. current spectrum condition becomes worse.



RELAY COMMUNICATION:-

No Co-operastive communication:-

One Input One Output. This is effectively a standard radio channel or Mobile communication- this transmitter operates with one antenna as does the receiver. There is no diversity and no additional processing required

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Equal Power Allocation:

We derive bounds of achievable sum rates of the MIMO fixed relay system using coding, which has been shown to be sum power optimal. The sum rate using dirty paper coding can be expressed as a function of the pre-coding matrix F and the relay processing matrix approach is to directly optimize the sum rate with respect to the matrices S and R, however, this approach optimizes large number of parameters and has very low cost.

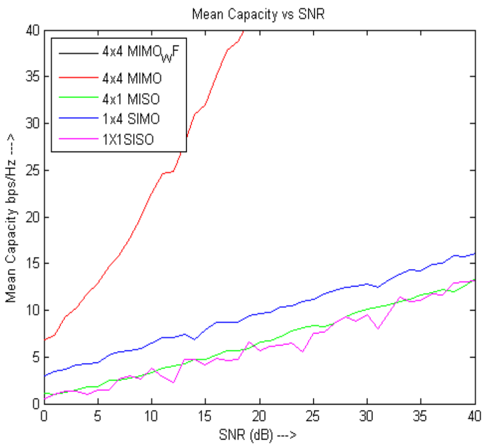

Fig:- Comparison of Multi-user achievable rates with SISO SIMO MISO in Rayleigh fading environments.

EXPERIMENTAL RESULTS:-

To evaluate the performance of our scheme, numerical results are generated using a MATLAB simulation. Relay selection is performed per SU since SU is the smallest resource unit for the MOBILE -CRN networks. The relay locations are varied to show the effect of relay locations on the performance. Here, we only consider random variations of the relay distance from the eNodeB as the first step. However, relay placement can be modelled as another optimization problem which is not studied in this paper. Then the effective channel gain over an SU is deduced from the subcarrier granularity.

The 3GPP MOBILE -CRN path loss models with log-normal shadowing of an 8dB standard deviation are assumed.

Throughput Calculation:-

To illustrate the superiority of our resource allocation scheme in terms of the cell overall throughput improvement, we compare the throughput achieved by the optimal resource allocation of MIMO 4X4 and MIMO 8X8 with the MIMO Water filling are operated in multi SNR.

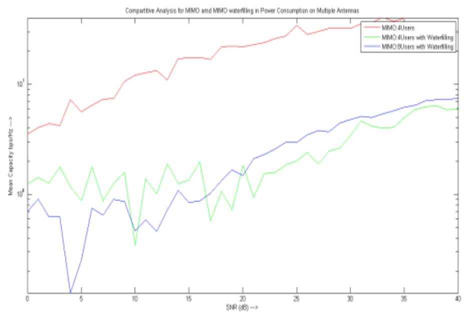

Fig:- Comparison of overall throughput when MIMO-4x4 and MIMO 8x8 with MIMO water filling.

In order to evaluate the performance of our proposed suboptimal sub channel and power allocation algorithm in time duration, the rest of the network parameters are unchanged.

CONCLUSION:

Although the performance of MISO-WF has been studied in existing literature, its analysis in this paper shows the great impact it has on data transmission. The results show that by using Waterfilling an improvement is made in radio resource allocation. By analyzing the results of our proposed algorithm, we show here through our model that upon implementation, this algorithm would be efficient and also achieve its objectives of optimizing the data rate of both cell edge users and those close to the cell center that are however starved of resources.

Our approach provides user satisfaction by sacrificing some amount of total system throughput. It supports heterogeneous traffic. The computational complexity of our algorithm is higher, but the base station can easily perform the optimization.

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