Effective Resource Allocation for Cooperative Communication using Water Filling Algorithm in LTE Advanced Network

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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 is to adaptively allocate resources in MIMO-OFDM 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 LTE-Advanced cooperative cellular network where a Type II relay station (RS) is deployed to enhance the cell-edge throughput 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: MIMO, OFDM, LTE, RS, eNB, Relaying Strategy.

I. INTRODUCTION

LTE (Long Term Evolution) is the latest mobile communications technology responding to the high demand for broadband data access. Based on MIMO-OFDMA technology, LTE 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 cooperative communication, which in turn reduces power allocation of the system.

Fig.1.

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.

II. 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.

A. Amplify Forward Method for Co-Operative MIMO OFDM Communication

In Phase 1, the source node transmits the signals by way of broadcasting, while the destination node and the relay node receive the signals. In Phase 2, the relay node amplifies the powers of the signals received from the source node and forwards them to the destination node. In Phase 3, the destination node combines and decodes the signals received from the source node in Phase 1 and the relay node in Phase 2 so as to restore the original information. AF is also called non-regenerative relaying scheme and it is basically a processing method for analog signals. Compared with other schemes, AF is the simplest. Besides, as the destination node can receive independent fading signals from the source and relay nodes, full diversity gain and good performance can be achieved with this scheme. However, AF scheme is prone to noise propagation effect because the relay node amplifies the noise on the source-relay channel when the retransmitted signals are amplified.

B. Delay Forward Method for Co-Operative MIMO OFDM Communication:

In Phase 1 and Phase 3, DF scheme processes the signals the same way as AF. In Phase 2, the relay node decodes and detects the signals received from the source node before it forwards the signals to the destination node. Hence, DF is also called regenerative relaying scheme. Obviously, DF is essentially a digital signal processing scheme. Although noise propagation problem will not take place, the signal processing in DF largely depends on transmission performance of source-relay channel. If Cyclic Redundancy Check (CRC) is not implemented in coding, full diversity orders cannot be obtained. Moreover, the errors brought by the relay node during signal demodulation and decoding will accumulate with the increase of hops, thus affecting diversity advantage and relay performance. All these demonstrate that the transmission characteristics of source-relay channel have great impact on the performance of DF communication systems.

III. 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.

A. 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.\[ C_{\text{mimo}}(M) = C_{\text{mimo}}(M) + \log_2 (\det(\text{eye}(M) + \text{SNR/M} \cdot \text{Hmimo}^\dagger \cdot \text{Hmimo})); \] (1)
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D. Asynchronous Communication

Asynchronous systems are the most common standard for serial communications and include your classic internet dial up modem systems. Asynchronous systems are character oriented. There is no global not (no other communication) involved in this case. Internally generated events/signals are going to take care of the ordering of the system functions. Once the sender (source signal) has sampled the input data, it sends a request to the next stage and waits for the acknowledgement. On receiving the acknowledgement, sender sends the data and it reaches the receiver register via the through increase channel.
Fig.5. Comparison of Overall Throughput when RS Operates in Synchronous and Asynchronous Mode.

B. Time Duration Analysis

In order to evaluate the performance of our proposed suboptimal subchannel and power allocation algorithm in time duration, the rest of the network parameters are unchanged. We only take the synchronous relay case as an example and similar results can be obtained in the asynchronous case.

Fig.6. Comparison of Time Duration When RS Operates in Synchronous and Asynchronous Mode with Multi Relays.

VI. CONCLUSION

Although the performance of RS 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 Market Game and Shapley’s theory, 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.

VII. REFERENCES