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Survey on Backhaul Rate Allocation in Uplink SC-FDMA Systems with Multicell Processing

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Abstract: *Our goal is to improve the energy-efficiency of the amplify-and-forward relay assisted carrier frequency-division multiple-access uplink, where the relay considered may support a single user or may be shared by multiple users communicating over dispersive channels subject to large-scale fading. Based on the proposed amalgam of single-tap frequency-domain equalisation and a diversity combining aided receiver relying on the minimum mean-square error criterion, three different relay selection schemes designed for either singleuser or multi-user relaying scenarios are investigated, when combined with source/relay power sharing, which employ imperfect power control. Using a closed-form expression of the achievable throughput in the presence of quantization noise, an iterative greedy algorithm for the backhaul rate allocation is developed, where at each iteration we select the signal to be exchanged as the one providing the maximum network throughput increase per backhaul bit.*
Keywords: *MIMO systems; Power Allocation, SC-FDMA, Cooperative Communications,*

I. Introduction

Cooperative communication [1] systems have attracted the attention of both academia and industry in recent years, since they are capable of achieving a diversity gain in large-scale fading environments by sharing the resources of the cooperating user terminals. This allows us to jointly exploit the benefits of both time- and frequency diversity for the sake of mitigating the deleterious effects of wireless propagation and/or for increasing the attainable system throughput and energy-efficiency [2]–[5]. Recently, the family of cooperative diversity oriented Multiple-Access (MA) and distributed Multiple-Input Multiple-Output (MIMO) follow. Aided multiplexing techniques has been invoked in order to design the uplink of advanced cooperative cellular networks [6]–[8]. Furthermore, the cooperative concepts have been extended to broadband systems by designing techniques for mitigating the effects of frequency-selective fading with the aid of Multi-Carrier (MC) techniques associated with appropriate source/relay power sharing [9], [10]. From a Multi-User (MU) network point of view, the cooperative link sharing from the source Mobile Terminals (MT) to the Base Station (BS) can be determined by choosing the single or multiple relays [11] from a cluster of idle MTs. Generally, the Random Relay Selection (RRS) philosophy allows the BS to appoint a relay randomly without any channel knowledge, but in this case simultaneous gains from relaying path and selection diversity are limited. By contrast, the socalled Distance-Dependent Relay Selection (DD-RS) [8] policy is based on the distance from the relay to the source MT or BS, hence the Relay Candidates (RCs) which benefits from a high path gain may experience deep shadowing and fast fading. However, the Channel-Dependent Relay Selection (CD-RS) regime benefits from a certain degree-of-freedom in terms of selecting the cooperating MT, by monitoring the instantaneous channel conditions in a distributed scenario, including the associated path-loss, shadowing and multi-path fading effects. Therefore, it is also known as Opportunistic Relaying (OR) [12], which is capable of exploiting the selection diversity that we refer to as multi-user diversity arising from appropriate relay selection [13]–[16].

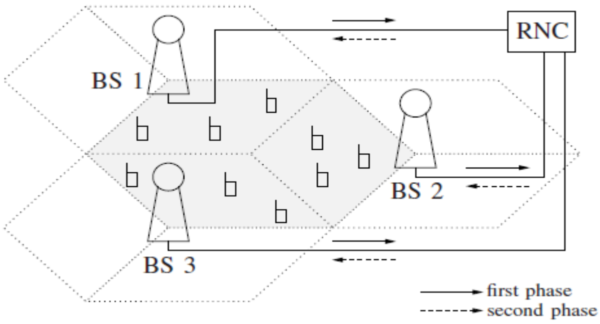

Fig: Cellular setup with 3 BSs, where each BS is directly connected to the RNC.

II. Literature Review

Paolo Baracca et. al. "Backhaul Rate Allocation in Uplink SC-FDMA Systems with Multi cell Processing" In this paper author have considered CoMP for the uplink of a cellular system where MTs transmit by using SC-FDMA. By assuming that detection and decoding are distributed at each BSs, and considering a constraint on the number of bits exchanged on the backhaul, we have developed a resource allocation algorithm for the scheduling of backhaul transmissions. By considering an efficient composite bit representation of different quantized versions of received signals, the proposed algorithm iteratively schedules the subcarrier signal providing the maximum network throughput increase per backhaul bit. We have compared two criteria: static bit allocation (SBA), where the number of quantization bits is fixed and dynamic bit allocation (DBA), where the number of bits is chosen by imposing a fixed percentage through put loss with respect to sharing the unquantized subcarrier signal. Numerical results in a LTE scenario show that the two methods provide similar performance, hence SBA is preferred due to its lower complexity [1].

Philipp Frank et. al. Cooperative Interference-Aware Joint Scheduling for the 3GPP LTE Uplink author have presented a novel approach for jointly perform in the resource allocation of various UEs associated to different cooperating BSs based on proportional fairness. By means of periodically exchanged multi-cell CS between the cooperating BSs and a central scheduling unit via a fast high-capacity backhaul network it is possible to accurately predict the cause dinter-cell interference level if a certain UE would be scheduled on certain PRBs, leading to an interference-aware scheduling. We have investigated the performance of our scheme by means of extensive system-level simulations for a 3GPP LTE system and it turned out that the system performance and in particular the cell-edge throughput can be significantly improved this way. Moreover, it is shown that our interference-aware joint scheduling scheme outperforms a state-of-the-art dynamic interference coordination scheme based on HII signaling [4].

Congzheng Han, et. al. Green Radio: Radio Techniques to Enable Energy-Efficient Wireless Networks. This article has described the approach being taken in the Mobile VCE project to study novel approaches introducing the energy consumption of wireless links, particularly in improving the design and operation of wireless base stations. Analysis has shown that when accounting for manufacturing or embodied energy costs, base stations have a much higher operational energy budget than mobile terminals. Proper modeling of the energy consumption of base stations has been shown to be an important issue when try into obtain a clear view of how different radio technologies can reduce energy consumption. Three case studies of current research in resource allocation, interference suppression, and multi hop routing have also been discussed. The means by which these methods can lead to energy savings have been described, and initial results that estimate the performance benefits of these techniques have been presented. The Green Radio project is a three-year program, which started in January 2009 and is starting to deliver initial results, some of which are described and discussed here. The project is being led by industry with the expectation at the most promising research outcomes can feed into future energy-efficient wireless standard sand products [3].

Jiayi Zhang, et. al. Energy-Efficient Channel-Dependent Cooperative Relaying for the Multi-User SC-FDMA Uplink. In this paper we evaluated the performance benefits of the energy-efficient opportunistic AF cooperation aided multiuser SC-FDMA uplink, which was designed to be free from any MUI at the relays, when communicating over frequency selective fading channels in shadow fading scenarios. The channel-dependent relay selection schemes were investigated considering source/relay power sharing based on the proposed JFDEC-MMSE solution, in order to exploit the multi-user selective diversity combined with cooperative diversity in the presence of both pass-loss and shadowing, while subjected ACCEPTED FOR IEEE TVT 2010-00423 11to imperfect power control. Our results demonstrate that at a BER of 10^{-4}, the proposed receiver is capable of saving2dB power by achieving a higher cooperative diversity gain than the conventional receiver. For instance, when the channel exhibits a shadowing variance of 8dB at $E_b/N_0 = -10$dB,an ECG of 2.5»4.5 is attainable by invoking the proposed SU-RS, MU-RS and MA-RS schemes compared to the non cooperative scenario. Most importantly, the ECG gleaned from our MU-RS and MA-RS schemes may increase to 4»8 when the shadowing variance is increased from 4to8dB compared to the direct transmission in the absence of shadowing at $E_b/N_0 = -10$dB [4].

III. Theory

Uplink Coordinated Multipoint

Theoretical work has shown that uplink (UL) coordinated multipoint (COMP) offers the potential to increase throughput significantly [1, 2], in particular at the cell edge, which leads to enhanced fairness overall. Modeling some practical aspects such as a reasonably constrained backhaul infrastructure and imperfect channel knowledge, UL COMP promises average cell throughput gains on the order of 80 percent, and roughly a threefold cell edge throughput improvement [6]. The channel information is available in the network without resource-consuming feedback transmissions in the uplink. Also, the terminals need no modifications in order to support UL COMP. Therefore, base station cooperation may be easier to implement than in the downlink (DL). Only the interface between base station sites (X2) needs to be defined. In case of joint detection in the UL, higher X2 capacity is needed than for joint transmission in the DL. Although the UL capacity is not the bottleneck in today's networks, guaranteeing a minimum data rate, especially for cell edge users, is improving user experience, and UL COMP may be used to carry control traffic necessary to implement DL COMP. unavoidable.

Dynamic Interference Coordination

In order to facilitate a dynamic interference coordination between different BSs, we make use of the standardized proactive LTE HII. This HII consists of a bitmap with one bit per PRB and provides information about upcoming uplink transmissions of cell-edge UEs, which thus may cause high interference to adjacent BSs [6]. Hence, this information can be taken into account for improving the system performance, particularly at the cell-edge. For realizing a fast adaptation to the current interference situation, each BS periodically sends a dedicated HII report to its corresponding set of cooperating BSs via a high-capacity backhaul network, which may be realized by means of the X2 interface.

IV. Problem Formulation

It is that the RNC has got CSI from the BSs. However, to reduce the scheduler complexity and by assuming that the coherence bandwidth of the channel is larger than the FSB bandwidth, and not maintain throughput

V. Proposed Technique

In review of [1-4] all author try to maintain throughput and proposed following algorithms(Backhaul rate allocation, Greedy bit allocation,JFDEC-Joint frequency domain equalization and combining) but these algorithms are not maintain the performance parameters like (throughput,BER,SNR). In this paper proposed to maintain throughput, bit error rate, signal to noise ratio and channel estimation by MIMO SC-OFDM system and optimized system by dynamic bit allocation.

In dynamic bit allocation subcarrier allocation techniques improve the average throughput of an OFDMA system. In most of the works of resource allocation for joint conditions, a utility function is described and attempts to minimize the divergence in the utility function is performed so that the throughput is maximized.

In this proposed channel estimation for 16 and 256 QAM and we are working long channel estimation for high order. Mainly most of the systems have suffer from performance loss especially under severely fading channels for uplink and throughput and has difficulty supporting high-order modulations like 256 QAM, to maintain high throughput we are work MIMO OFDM systems and optimized channel with the help of SP(Subspace Pursuit) algorithm using MATLAB implementation .

This algorithm has two important characteristics: Low computational complexity, comparable to that of orthogonal matching pursuit techniques when applied to very sparse signals, and reconstruction accuracy of the same order as that of LP(linear programming) optimization methods.

VI. Conclusion

After review multiple paper periodically exchanged multi-cell CSI between the cooperating BSs and a central scheduling unit via a fast high-capacity backhaul network it is possible to accurately predict the caused inter-cell interference level if a certain UE would be scheduled on certain PRBs, leading to an interference-aware scheduling. We have investigated the performance of different scheme by means of extensive system-level simulations for a LTE system and it turned out that the system performance and in particular the cell-edge throughput can be significantly improved this way. We proposed MIMO with backhaul network for best output.

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