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SUBCHANNEL ALLOCATION WITH POWER CONTROL FOR BIT ERROR RATE MINIMIZATION FOR FEMTOCELLS BY USING THE UTILITY BASED TECHNIQUE

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ABSTRACT

Both femtocell as well as orthogonal frequency-division multiple access (OFDMA) gives better services for subscribers. Femtocells have ad hoc nature. So, interference may occur which leads to high bit error rate.The bit error rate minimization is essential for the femtocells to increase the coverage of the femtocells.So, Distributed Subchannel Allocation (DSA) is investigated for bit error rate minimization in the femtocells based on OFDMA technique. So, this problem is formulated as a noncooperativerate maximization game Unfortunately, uncertainty of existence of Nash equilibrium for the formulated game makes it difficult to design anefficient distributed schemes. To address the issues, a state space to reflect players' desire for new strategies is being introduced and then a utility-based learning model that requires no information exchange between different players is framed. Moreover, it is analytically shown that the proposed method achieves low bit error rate when compared with the existing strategies, which require information exchange among different femtocells.

Index Terms—OFDMA, Distributed subchannel allocation, femtocells,bit error rate minimization

I.INTRODUCTION

Femtocell is a promising technology to fulfill the explosive demand of high-data-rate services and the requirement of ubiquitous access [1]–[3].Femtocell access points (FAPs) or the so-called home BSs are lower-power, short-range, plug-and-play small BSs. They are installed and managed by customers in residential areas and small offices. By using this novel technology, more users can share the same spectrum resource by accessing different femtocells in different areas. On the other hand, users in poor-indoorcoverage regions or dead zones can achieve better performanceby employing additional FAPs. Since the Orthogonal frequency-division multiple access (OFDMA) femtocells are considered here, it divides the available spectrum into orthogonal subchannels. Moreover the bit error rate minimization is also essential for the femtocells to improve the performance.

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The number and positions of the femtocells are uncertain so the centralized scheme cannot be performed [4]. Therefore, in this paper, the Distributed Subchannel Allocation (DSA) in OFDMA femtocell networks is being considered. In this paper, motivated by the utility-based learning model, which is appropriate for studying multiagent systems [5]–[8], we have introduced an additional state space in NRMG and then Utility based Technique is formulated.

II.SYSTEM MODEL AND PROBLEM FORMULATION

Let us consider a femtocell network, where FAPs are deployed in random locations. There are in total Nfemtocellssharing the dedicated spectrum consisting of K orthogonal subchannels each of which has bandwidth B. Assume the opportunistic scheduling operation which has been assumed in previous studies [9], [12]. In this paper, the bit error rate minimization for the downlink communication. In this case, the formulated NRMG is identical to the SINRmaximization game introduced in [10]. Based on the numerical example presented in [11, Tab. I] we note that the SINRmaximization game may have no NE. Hence, there is also no guarantee that NRMG always admits an NE. On top of this conclusion, it brings us a great challenge of designing an efficient DSA scheme for the formulated problem. The issue for efficient algorithm design will be addressed in detail in the following section.

III.UTILITY BASED METHOD

In the utility based models, it is assumedthat each player can only access the history of its own actionsand utilities, and players have to make decisions based on the limited information. For this reason, such models are consideredto be more applicable for studying the multiagent systems, where the information exchange between different agents is strictly restrained. Recently, Li and Marden began to address this issue in their studies [4]–[8], and they demonstrated that it is critical to introduce an additional degree of freedom to the formulated game or to the proposed learning algorithm.

By introducing a state to reflect the player's desire for new strategies, we will devise a utility-based learning model here. Then, our algorithm will be developed based on the proposed learning model. Here, to devise the utility-based learning model, we reconstruct NRMG by introducing an additional state to each player. Then, ateach decision moment t, every player ncan be described by triplet Ln (t) = (Sn (t), Un (t)) where Sn (t), Un (t), represent its strategy, utilityrespectively. When implementing the utility-based learning model, during the decision period, each player only needs to evaluate its utility and capture the historical state and then choose a strategy. In this algorithm, players can sequentially update their strategies. Similar to [14], the stop criterion of this algorithm can be one of the following:

1) The preset maximum iteration number Tis reached; or

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2) For each player n, the variation of its utility during a period is trivial.

A.Steps In The Utility based Technique

1. At the beginning of UDSA, the related parameters and players' states should be initialized, where $(\mathbf{0})1\times M$ represents an M-dimension null vector.

2. After that, the algorithm goes into a loop. At each iteration t, player n will first update its state profile Ln (t) = (Sn (t), Un (t)) with the devised utilitybased learning model.

3. Then, it will update the strategy count **C**n.

4. When the loop is exited, individual players will make their final decisions as follows:

$S_n^D = \max C_n$ WhereS_n^D is the Final decision and C_n is the strategy count.

From the above equation for final decision, we find that the strategy recorded most frequently will be eventually adopted. Recalling the proposed method, which can be implemented in parallel, we note that each player only needs to make its own decision, and meanwhile, only basic arithmetic operations and random number generation are involved in eachiteration step. Therefore, the complexity of this algorithm is depending on both the stop criterion of the loop.

IV.SIMULATION SCENARIO

Consider a circular region of radius r m, where N femtocells are randomly deployed. Furthermore, for each FAP-FU pair, thechannel gains are independent on different subchannels. Duringthe transmission period, the uniform distributionmechanism is used to determine the power set, i.e.,

$$P = \frac{P_{n,max}}{K_n} \quad (1)$$

Unless specified otherwise, the simulation parameters are shown in Table 1[13].

Table 1 Simulation Parameters

PARAMETER	VALUE
Number of subchannels,K	5
Region radius,r	100m
Bandwidth per subchannel,B	100 kHz
Subchannel Requirement,K_n	3
AWGN power density, N_0	-174 dBm/Hz
FAP power limit,$P_{n,max}$	20dBm

A. Bit Error Rate Vs SNR

The proposed method and the existing method is compared in terms of Bit Error Rate Vs SNR

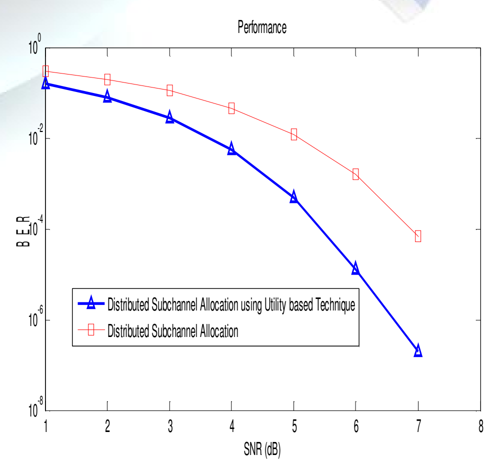

Fig 1 Performance comparison

The figure 1 compares the proposed method with the existing method i.e., Distributed Subchannel Allocation using Utility based Technique and the Distributed Subchannel Allocation From the graph it is observed that the proposed method has low error rate when it is compared with the existing method [11].

V.CONCLUSION

In this paper, the issue of DSA for bit error rate minimization in OFDMA femtocells and proposed the Utility based Technique.The developed method is appropriate for the networks that are organized in an ad hoc fashion, since there is no information interaction among the autonomous agents Simulation results verify the validity of our analysis and demonstrate the effectiveness of our proposed scheme. Compared with the available strategies requiring information exchange, the proposed approach achieves even better performance when compared with the existing method.

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