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DISTRIBUTED RESOURCE ALLOCATION AND SCHEDULING FOR BROADBAND WIRELESS NETWORK BY CONSIDERING INTERFERENCE

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Abstract**—**Multiuser orthogonal frequency division multiplexing (MU-OFDM) is a potential method for attaining high downlink capacities in future cellular Network. The sum capacity of MU-OFDM is increased when each sub channel is allocated to the user with the best channel-to-noise ratio for that sub channel, with power successively distributed by water-filling. However, fairness among the users cannot generally be achieved with such a scheme a further problem in cellular network is data rate maximization.one more problem in cellular system is Inter Cell Interference(neighboring base stations use the same frequency range) .In this paper, One possible approach to solve the conflict such as inter cell interference by the implementation of greedy algorithm. Inter-cell interference coordination (ICIC) schemes can be viewed as a scheduling strategy used to limit the inter-cell interference such that cell-edge users in different cells preferably are scheduled on complementary parts of the spectrum when needed. The common theme of ICIC avoidance schemes is to apply restrictions to the usage of downlink resources such time/frequency and/or transmit power resources. Such coordination of restrictions will provide an opportunity to limit the interference generation in the area of the cellular network. Accordingly, Signal to Interference and Noise Ratio (SINR) can be improved at the receivers in the coverage area, which will provide capability for increased (cell-edge) data-rates over the coverage area, or increased coverage for given data-rates.

Index Terms**—OFDMA, inter cell interference, resource allocation.**

I. INTRODUCTION

NEXT generation wireless networks target pervasive high data rates, effective resource (e.g., spectrum and power) usage and cost-effective network deployment. Given the fact that radio spectrum is becoming a occasional resource in wireless communications, the orthogonal frequency division multiple access (OFDMA) has been planned as a state-of-the-art air interface technology to qualify high spectrum proficiency and meritoriously combat frequency-selective fading. Due to its capable features, OFDMA is agreed in many initial cellular systems such as the Long Term Evolution (LTE) [1] and IEEE 802.16m [2] for achieving those aspiring objectives of next generation networks.

The multiuser Orthogonal Frequency Division Multiplexing (OFDM) is a very capable transmission procedure for broadband wireless networks. The orthogonality characteristic among the subcarriers is one more very important feature of OFDM technique, since it combats intra-cell interference inside a cell. Inter-cell interference exists and plays ansignificant role for the outcome performance of the network. To be more specific, interference in OFDM-based systems arises when the same frequency resources are used in near another cell. For example, when two users in different cells, use the same frequency block instantaneous, then the Signal to Interference and Noise Ratio (SINR) associated with these blocks can drop to a very low value, resulting in a bad resource consumption and lesserperformance.Three methods are currently being considered, ICI randomization, ICI cancellation and ICIC.The first method aims at randomizing the interfering signal and thus allowing interference suppression at the mobile terminal either by applying (pseudo) random scrambling after channel coding/interleaving or using different kinds of frequency hopping.

The second method based on interference clampdown which can be achieved by spatial destruction using multiple antennas at the mobile terminal.

The last method aims at applying conditions to the downlink resource management in a matched way between cells. These conditions can be either on the available resources of the resource manager or can be in the form of boundaries on the transmit power that can be applied to certain radio resources. Such conditions in a cell will offer the possibility for enhancement in SINR, and constantly to the cell edge throughput and coverage. Inter-cell Interference Co-ordination (ICIC) requires also communication between different network nodes in order to set and reconfigure these conditions. Two cases are considered, the fixed one where reconfiguration of the conditions is done on a time scale corresponding to days and the semi-static where the time scale is much smaller and corresponds to seconds.

The effect of inter-cell interference is more obvious for the cell-edge users, which are more complex due to the already bad channel gains with their serving base stations. This results in poor receptions at the cell edge in the downlink direction. Limited reception at the cell edge is anproblem of great importance for the wireless operators who want to provide full coverage inside their service area and promise a certain Quality of Service (QoS) to their subscribers independently of their positions inside a cell. The scope of this paper is to examine how users can share the available radio resources, in terms of bandwidth and power allocation, in order to conquer intercell interference and increase cell-edge throughput and spectrum efficiency.

The performance of the proposed schemes is evaluated comprehensively in a multi-cell network. The schemes are also estimated under different circumstances with respect to uneven user distribution and various traffic loads. Extensive simulations demonstrate that the proposed schemes can provide significant performance improvement for both celledge and cell-center users compared with existing schemes. It is also shown that generous fairness can be further addressed by the proposed schemes in terms of achieving balanced performance between cell-edge and cell-center users in the network.

I. SYSTEMMODEL

A multi-cell OFDMA-based downlink network is considered in this paper. One example of the network layout with seven hexagonal cells is displayed in Fig: 1, where a BS fortified with an omnidirectional antenna is located at the center of each cell to serve users who are randomly dispersed within the cell. In OFDMA systems, the frequency resource is divided into subcarriers while the time resource is divided into time slots. The smallest radio resource unit that can be allocated to transport data in each transmission time is termed as traffic bearer in general. The PRB is a group of subcarriers that can be coherently allocated to users in a given time. For reliability, thus from now on we will use the term PRB to as specified in the LTE standard, the traffic bearer is defined as a physical resource block (PRB), which consists of twelve consecutive subcarriers in the frequency domain and one slot duration (0.5 msec) in the time domain represent the single unit of radio resource for allocation in the OFDMA-based network. In addition, the following fundamental assumptions are made throughout the remainder of this paper.

1. In each cell, users are classified as either cell center or cell-edge users subject on their current geographic places and straight-line expanses to the serving BS. The border that separates the cell center and cell edge region, as shown in Fig: 1 can be attuned as a design parameter. The geographic position information can be conveyed to the BS by users periodically via the uplink control channels.

2. In every transmission time interval (TTI), each BS has to make a resolution on PRB assignment to its served users. The interval of TTI is equal to one time slot of the PRB. We also assume that BSs can have perfect understanding of channelstate information updated periodically via feedback channels for every TTI.

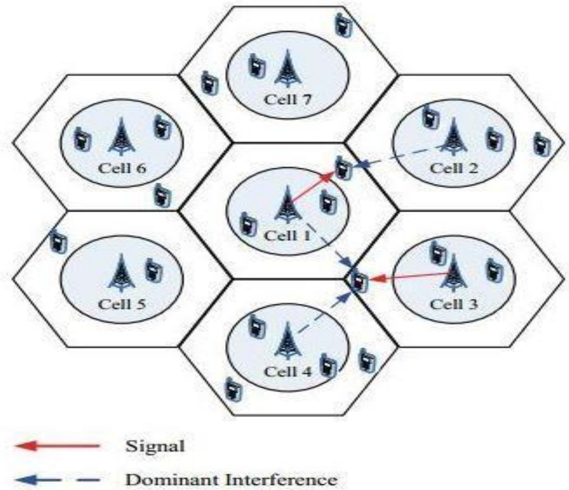

Fig: 1 An Example of LTE Network with inter cell interference

3. The transmission power is permitted to be individuallyallotted on each active PRB that has been allocated to users in the network. Hence, dynamic or fixed power allocation can be performed depending on different given schemes. The sum of the overall assigned power in each cell cannot surpass the maximum transmission power of the BS. We assume that all BSs in the network are given the same maximum transmission power.

4. To any cell, only interference from its adjacent cells are considered as the effective ICI. In certain, to any cell-edge user there is a dominate interference that usually comes from its closest adjacent cell (i.e., in Fig: 1 cell 2is considered as the dominant interfering cell to the cell-edge user in cell 1). In addition, cell-edge users may have at most two dominant interfering cells when they are placed at the corner of serving cells and thus have nearly equal distances with both neighboring cells (i.e., in Fig:1 both cell1and cell4 are dominant interfering cells for the cell-edge user in cell 3). Note that this assumption has been appealed by many prior authors in literature and particularly verified.

II. PROBLEM FORMULATION

Optimization goal is to increase the overall throughput of cell-edge users while keeping the essential throughput for cell-center users. As a result, a balanced performance enhancement between cell edge and cell-center users is expected to be achieved in the multi-cell systems. The reason behind this is that cell-center users usually do not suffer from heavy ICI and relatively high performance is easy to be attained for these users even in a network without optimization, whereas cell-edge users' performance is muchmore susceptible to ICI and their performance enhancement has to strongly depend on optimization schemes.

Cell-edge users suffer from several interference due to the shorter distances to the adjacent BSs.

1. Users within the same cell are mutually associated.
2. For any cell-edge user, the connection is only pair wise recognized with other cell-edge users of its leading interfering cells.

III. POWER ALLOCATION APPROACH

The radio resource allocation, the power allocation is decided individually in each cell and subsequently performed by BSs in a distributed manner. Therefore, a distributed power allocation approach is proposed in this section with an emphasis on performance optimization for cell-edge users

a. Total Power Distribution

The total transmission power of each cell into two parts: total power for cell-edge users and cell-center users. Let $P_E^j$and P_C^jdenote the total power allotted to cell edge users and cell-center users in cell j, correspondinglyand $+P_C^j=P_{Max}$. Note that Pmax is supposed to be the same for all BSs in the network.

$$P_E^j+P_C^j=P_{Max}$$

$$\frac{P_C^j}{P_E^j}=\alpha\frac{|B_C^j|}{|B_E^j|}$$

Where $B_C^j$and B_E^j denote sets of total PRBs employed by cellcenter and cell-edge users in cell j, respectively, and α (0<α<1) is a proportional factor indicating that a higher weight is given to cell-edge users for power allocation.

IV.PERFORMANCE ANALYSIS

TABLE I
MAIN SIMULATION PARAMETERS

Parameter	Value
Number of cells	7
Cell radius	500m
Bandwidth	
Carrier frequency	
Cell-edge area ratio	5 MHz
Total number of PRBs	2 GHz
Frequency spacing of a PRB	1/3of the total cell area
Total transmission power per cell	24
LOS path loss model	180 kHz
NLOS path loss model	43 dBm
Channel model	103.4+24.2log10(d)dB,d in km
Thermal noise	131.1+42.8log10(d)dB,din km
	Rayleigh multipath model -174 dBm/Hz

Fig: 2(a) the average throughput attained by the proposed scheme for both cell-edge and cell-center users in the reference cell. Here the standards of modulator are chosen as [64-QAM] and the number of the users in each cell is 10.

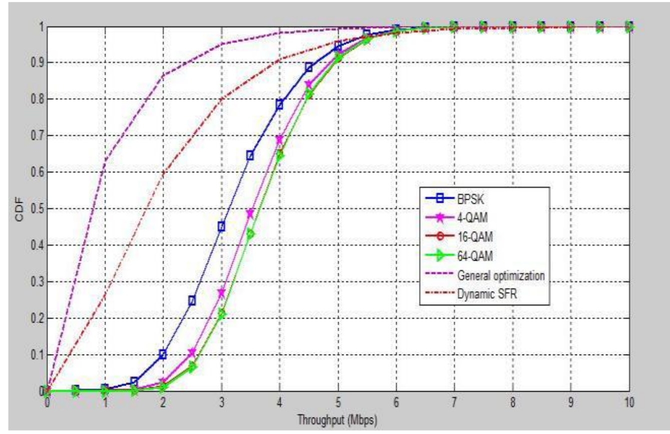

Fig: 2(a)-Performance in cell edge user

Theperformance of the proposed scheme with different values ofthe modulator and various numbers of users per cell are evaluated. Therefore, fixthe SINR threshold value as 16 dB in the following proposed schemes, though it may not result in the exact performance balance when other modulators are used.
The cumulative distribution functions (CDF) of throughputs achieved by the different schemes for cell-edge and cellcenter users of the reference cell in the network with 10 users per cell, respectively.

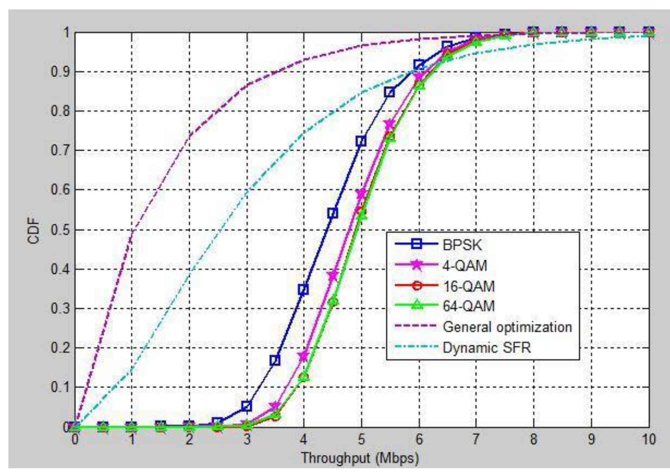

Fig: 2(b)-Performance in cell center user

In addition totheabovementionedscaleoutlinesfor comparison, weexamineperformanceof theproposed schemewith variousvalues ofthe modulator. Fig: 2(b)shows thatour proposed schemes can achievesubstantialenhancementfor cell-edge usersover the reference schemes,
where the general optimization scheme surprisinglyperforms worst. On the other hand, the general optimizationscheme maximizes the performance of cell-center users andgreatly outperforms otherschemes. It is because that thegeneral optimization scheme aims overall performance enlargement and thereby allocates resources (PRBs andpower) dominantly

to users with good channel conditionse.g., cell-center users. But, Fig: 2(b) alsomake knownthat our schemescan effectivelymaintain highperformance for cell-center users, i.e., 50% cell-center userscan achieve throughput over 3 Mbps and nearly all of themcan achievethroughput over 2 Mbps compared to 80% bythe general optimization scheme and 60% by the dynamicSFR scheme reaching the target of 2 Mbps, respectively.

Amongthe proposed schemes,in addition, [64-QAM] indicateshighmodulatorgiven to cell-edge users for resource allocation and thereby produces the bestperformanceto cell-edge users while lowest for cell center users. Incontrast, [16-QAM] achieves the best performance for cellcenterusersandlowestfor cell edge users.However, it is noticed that the performanceachieved by allthe schemes for the overall network superior that of thereference cell. This is because, with the exclusion of thereference cell, each cell of the considered 7-cell network isonly partially surrounded by neighboring cells and thussuffers from less ICI than the reference cell does.Therefore,theperformance improvement of our proposedschemeshas been expansivelyestimatedby the singlecell and 7-cellnetwork scenarios, where full and partial ICIare experienced respectively.

V. SUMMARY AND CONCLUSION

The optimal solution is obtained by the proposed scheme can achievesignificant performance improvement for cell-edge usersand desirable performance for cellcenter userscompared with the reference schemes. Also the constant improvement is verified by performance calculationonvarious userdensities inthe network. Thereforetheproposed resource allocation scheme can yield balancedperformance between cell-edge and cell-center users, whichallows for future wireless networksto deliver consistent highperformance to any user from anywhere.

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