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Downlink Resource Management Scheme for Next Generation Wireless Networks with Rank Scheduling

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Abstract

Next generation wireless networks aim to meet the rising demands on cellular networks by supporting higher throughput data applications and efficient usage of the spectrum. In wireless communications, radio spectrum is becoming a limited resource since it is shared by all nodes in the range of its transmitters. Orthogonal frequency division multiple access (OFDMA) technique is the chosen channel accessing in next generation wireless cellular networks for attaining high spectrum efficiency and to reduce frequency-selective fading. Compared to present generation wireless networks, there is a denser cellular deployment in next generation wireless networks. In the multi-cell scenario, Inter Cell Interference (ICI) has become a major issue of concern since it leads to performance degradation. This paper presents a radio resource management (RRM) scheme which includes resource allocation involving ICI reduction, power control based on optimal power allocation solutions which emphasize energy consumption and scheduling which enhances cell edge user's performance in future wireless networks.
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*Keywords:*Inter cell interference; cellular network; resource allocation; power allocation; rank scheduling

1. Introduction

Wireless systems comprise of wireless wide-area networks (WWAN), wireless local area networks (WLAN) and wireless personal area networks (WPAN).A cellular network or mobile network which is a category of WWAN, is distributed over land areas called cells and are served by at least one fixed-location transceiver, known as base

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station (BS). Major aspects to the rapid growth in wireless communications, is due to the large expansion in cellular systems. The wireless industry is on a path that promises some great innovation in the future. 1G, 2G, 3G, 4G, and by the year 2020 5G, refers to the various generations of mobile phone communication technology standards.

In wireless communications, radio spectrum is becoming a limited resource since it is shared by all nodes in the range of its transmitters. Though frequency reuse strategies exist to solve this problem, in future generation of cellular networks there is a denser deployment of cellular users. So the need arises to accommodate a large number of users within a limited frequency spectrum which leads to interference among users by frequency band overlapping, within a cell referred to as intra-cell interference and among adjacent cell users referred to as inter-cell interference (ICI). ICI is reflected as a main issue in cellular systems since it can lead to severe performance degradation for users at the cell edge which will affect the entire system performance. In 2G and 3G networks, by choosing a high reuse factor among adjacent cells, interference problem is solved to a certain limit [1]. But in future cellular systems like 4G, these methods may not work due to the shortage of radio resources [2]. The leading framework for 4G systems is the Long Term Evolution (LTE) defined by the 3rd Generation Partnership Project (3GPP) [3]. The aim of LTE is to attain the frequency reuse one or near to one by letting each cell to access the whole frequency band assigned to the system [4] instead of using a partial frequency reuse pattern [5]. In LTE, the orthogonal frequency division multiple access (OFMDA) is used as the channel accessing technique, due to its promising features such as effectiveness and flexibility in radio resource allocation, which increases the effort of ICI avoidance [6]. Therefore, the need arises for a careful planning of coverage and signal levels for the best and worst cases for serving cells as well as adjacent cells from both a coverage and interference stand point. In LTE networks, mitigating ICI and thereby improving network throughput, soft frequency reuse (SFR) is regarded as an effective frequency planning strategy [7]. The traffic loads in each cell can be asymmetric and time varying. So resource allocation for cellular users in a real time scenario having varying time and different cell load conditions is performed with the help of a graph approach which is translated to a graph coloring problem[8]. For achieving high data rate multi-media services, availability of interference reduced orthogonal channels and selecting suitable power for transmission are the two major concerns. To design an anti-fading transmission scheme for cellular users, along with an optimal resource allocation scheme, the energy factor for transmission should also be taken into account. Significant research on improving network throughput with the help of power control is proposed in [9,10,11].In order to maximize network capacity and to incorporate a larger number of cellular connections while maintaining the quality of ongoing cellular connections, next generation wireless systems needs efficient radio resource management (RRM) schemes which will include resource allocation, power control and scheduling schemes. In [12] a RRM scheme which emphasize interference reduction in a multi-cell scenario and which focuses on using power allocation to optimize the performance of cell-edge users without affecting the performance of cell-center users are proposed. In [13], a centralized downlink packet scheduling scheme which could satisfy the conflicting requirements of mobile users (fairness, throughput etc.) and service providers (revenues) is proposed. A scheduling scheme for an uncoordinated LTE-A system which works on the basis of the user report of a recommended rank for interfering cells is proposed in [14] which could improve edge user performance and thereby network performance.

In this work, we develop an efficient RRM scheme for next generation wireless networks, which can improve the edge user's performance and thereby improve network performance in terms of throughput by unifying the radio resource and power allocation concepts which is proposed in [12] and enhance it with the rank scheduling concepts as proposed in [14].

2. System Model and Description

2.1. System Model

In this paper, a multi-cell OFDMA based downlink is considered as presented in [12]. A seven cell hexagonal layout, where a BS equipped with omni-directional antenna, represented as 'Δ' is placed at the center of each cell in order to serve randomly distributed mobile users represented as '$\circ$' within each cell and the reference cell is presented with a thick border as shown in Fig 2.(a). Out of seven cells, any cell can be chosen as the reference cell and its performance can be analyzed. Here in ourpaper, the center cell is considered as the reference cell and it suffers from maximum inter-cell interference in the considered network since it is surrounded by neighboring six

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