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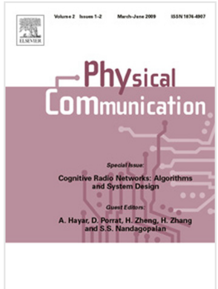

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A Fractional Path-loss Compensation based Power Control Technique for Interference Mitigation in LTE-A Femtocell Networks

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***Abstract*— Introduction of Femtocells in heterogeneous network enhances the capacity, indoor coverage of the existing macrocell based network. It also allows high-speed data services for the multi-media application and software. However, in dense co-channel deployment scenarios femtocells cause severe interference to the neighbouring cells users. In this paper, a downlink-power-control scheme is presented for femtocell with no overhead signalling exchange with the macrocell. The femtocell adjusts the transmit power subject to home user equipment (HUE) measurements. The minimum level of transmit power is determined by the target Signal to Interference and Noise Ratio (SINR) of femtocell user that is set according to the required Quality of Service (QoS) of the femtocell users. The system level simulations confirm that, the proposed scheme reduces the outage probability of the nearby macrocell user equipment (MUE) up to 16.7% compared to fixed power setting, while maintaining the spectral efficiency of femtocell users. Furthermore, the transmit power can be reduced by 52.6% which leads to power effective solution of the interference scenario.**

Keywords—co/cross-tier interference, femtocells, macrocells, power control, heterogenous network.

1. INTRODUCTION

Recent studies on wireless usage show that the major growth in data traffic originates in indoors environment [1], where the majority of the mobile users suffer from inadequate indoor coverage. That limits the users to enjoy the high data speed and enhanced capacity of the LTE-A marketed by the mobile operators. Femtocell is an alternative of the existing outdoor macrocell and works as an extension of the macrocell to increase the indoor cellular coverage. It also provides a cost effective solution for the mobile operators [2]. Femtocell which is also known as Home enhanced NodeB (HeNB) in the 3rd Generation Partnership Project (3GPP) Long Term Evolution-Advanced (LTE-A) standard is a small size, low power (≤ 20 dBm) base station with short service range (<30 m) and can support under ten users simultaneously. It has dragged huge attention in the wireless communication industry [3]. HeNB is considered as plug-and-play consumer device, which is easily installed by the user. Femtocell utilizes the user existing broadband internet access, e.g. Digital Subscriber Line (DSL), cable modem or optical fiber connection as a backhaul to communicate with the mobile operator core network [4]. Femtocell has many attractive features of low deployment cost and traffic offload from macrocell [5]. Femtocell reduces the capital expenditure (CAPEXs) and operational expenditure (OPEXs), while providing enhanced indoor coverage and high data rates [6].

Femtocells are operated in three types of access control modes: (i) closed access, (ii) open access and (iii) hybrid access mode [7]. For the closed access, only closed subscriber group (CSG) is allowed to connect to the femtocell. Open access mode allows all the users to get access. In hybrid access mode, all the users get a limited service and the CGS enjoys the full privilege. The conditions of access can be defined by each operator based on the owners' preference. However, femtocell are categorized by different algorithm that modifies the capability to select the number of outside users to be allowed to access by keeping in view the performance of authorized users in a particular femtocell [8].

In a dense femtocell network, the transmit power level of a femtocell is responsible for the interference created in the network [9]. Although high femtocell transmit power provides wider coverage and better signal quality, but at the same time it causes tremendous interference to other surrounding users of the adjacent macrocell networks [10]. Proper tuning of the femtocell transmit power varies the interference scenarios [11]. Femtocell has extensive self-organization capabilities that enable simple plug-and-play deployment. It is also designed to integrate automatically into an existing macrocell network. These self-capabilities are implemented using several algorithms that automatically change certain network configuration parameters (radiated power, channels, neighbor list, and handover parameters) in response to any change in the environment it is operating in [12]. For successfully deployment of the process of self-organization, there are three main functions need to be performed: (i) Self-configuration in pre-operational state, (ii) Self-optimization in an operational state, and (iii) Self-healing in case of failure of a network element. One example of self-organizing capabilities in femtocell deployments is power optimization. Self-configuration function can transmit power based on the measurement of interference from neighbouring base stations in a manner that achieves roughly constant cell coverage. The HeNB then performs a self-optimization function that