Chapter 7
User–Oriented Intercell Interference Coordination in Heterogeneous Networks (HetNets)

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ABSTRACT

HetNet is a hot research topic in the next generation broadband wireless access network and mitigating the intercell interference could improve the system throughput. Users care whether their requested data rates can be satisfied or not the most. Hence a user-centric intercell interference coordination scheme (i.e. resource allocation scheme considering user request) is necessary. In this paper, at each specific subframe, when users have data requests, the corresponding base station first selects which user to serve based on each user’s ‘instant data rate’, data rate request and capacity gained. Then given the users selected, a method is proposed to help choose which intercell interference coordination scheme to use in order to maximize the users’ data rate satisfaction ratios. Intensive simulations are conducted and the results demonstrate that the proposed scheme achieves considerable gains over competing schemes in terms of the data rate satisfaction ratio and system capacity in Config.4b scenarios defined by 3GPP.

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INTRODUCTION

Heterogeneous network (HetNet) has recently become a hot research topic of 3GPP Long Term Evolution-Advanced (LTE-A) and is one fundamental issue of the 4G and 5G cellular networks (Wang C. X., 2014) or the next generation broadband wireless access networks. HetNets are composed by deploying small cells such as picocells, femtocells, etc. besides macrocells to help offload macrocells, improve area coverage and provide high data rate transmission in ‘hotspots’ (Ghosh, 2010) (Lopez-Perez D. G., 2011) such as the sport center or shopping mall. Macrocell is the usual base station used in the cellular communication. A picocell is a small cellular base station that covers a small area such as offices, shopping center, metro station, etc. Femtocell is an even smaller, low-power cellular base station, which is mainly for use in home or small business office. Typically, the coverage of picocell is 200 meters or less and the coverage of femtocell is 10 meters or less.

Given multiple cells co-exist, how each user equipment (UE) selects the service cell is non-trivial. User association discusses how each UE selects the service cell, and the user association scheme can affect the system performance significantly. The cell selection is typically based on the measured reference signal received power (RSRP). And the cell, which provides the largest RSPR, will be the service cell for the corresponding user. While in HetNet, due to the transmission power difference between macrocell e-NB (i.e., base station) and picocell e-NB (10.3.0., 2011), users may connect to macrocell instead of picocell which has shorter path loss distance. To offload macrocell and mitigate uplink (UL) interference, range expansion is introduced (Okino, 2011) (Guvenc, 2011). The main idea is adding an offset to increase the picocell’s coverage, hence the problems caused by power differences between cells in HetNets can be solved. Figure 1 illustrates one typical HetNet with range expansion, which is also the scenario we will discuss in this paper. Abbreviations MUE, PCUE, and PEUE denote macro user equipment, picocell center user equipment, and picocell range expanded region user equipment, respectively. In the scenario shown in Figure 1, PEUE is the user in the expanded region, and this user receives stronger signal form macro-eNB but is served by the pico-eNB. According to the different requirements, more small base stations can be added in this scenario.

Figure 1. Illustration of the HetNet with one macro-eNB and pico-eNB