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Q-LEARNING BASED VERTICAL HANDOVER DECISION ALGORITHM IN LTE-A TWO-TIER MACROCELL-FEMTOCELL SYSTEMS

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ABSTRACT

Next generation mobile systems require improved capacity and proper quality assurance for services. To achieve these requirements, small cells have been deployed intensively by Long Term Evolution (LTE) networks operators beside conventional base station structure to provide customers with better service and capacity coverage. Accomplishment of seamless handover between macrocell layer (first tier) and femtocell layer (second tier) is one of the key challenges to attain the Quality of Service (QoS) requirements. Handover related information gathering becomes very hard in high dense femtocell networks. Effective handover decision designs are important to minimize unnecessary handovers from occurring and avoiding the ping-pong effect. In this work, we have classified and reviewed current works for the two-tier macrocell-femtocell LTE-A systems, based on the main decision scheme applied. Key features and drawbacks of the most representative approaches have been studied. Modeling issues and the key performance evaluation for HeNB-specific mobility management are discussed and studied as well. The main objective of this work is to propose and implement an efficient handover decision procedure based on users' profiles using Q-learning technique in a LTE-A macrocell-femtocell networks. New multi-criterion handover decision parameters are proposed in typical/dense femtocells in macrocells environment to estimate the target cell for handover. The proposed handover algorithms are validated using the LTE-Sim simulator under an urban environment. The simulation results are encouraging. A reduction in the average number of handovers, the average number of control signaling measurements and packet loss and delay is observed. At the same time, the system throughput was increased. The proposed algorithms reduced the handover number, packet delay and packet loss by 48%, 89% and 85% respectively, whereas the system throughput increased by 13% compared to reference algorithms.

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CHAPTER ONE
INTRODUCTION

1.1 Research Background

The portion of indoor voice and data communication is increasing day by day. Nowadays 60% of voice and 70% of data traffic is generated indoors [1]. Everywhere multimedia services necessitate adequate throughput and low latency maintained by the system. Thus, the majority of the literature works in next-generation wireless systems are spotlighting on development of throughput and spectral effectiveness. To develop obtainable capacity and enlarge the indoor coverage (where the signal strength from outdoor base stations is generally unsatisfactory), 4th generation telecommunication networks, such as 3rd Generation Partnership Project Long Term Evolution 3GPP LTE and LTE Advanced (LTE-A), install small cells (i.e. femto-, pico- or microcells) to support the macrocell base station structure [2– 4] as shown in Figure 1.1. This arrangement is known as multi-tier network. The first tier (Tier 1) is the macrocells covering area. A few km2 areas can be covered by a typical macrocell in an urban environment. To fill in the coverage gaps created by path loss (e.g. wall penetration loss), telecommunication operators usually deploy smaller cells under this tier. These small cells are called the second tier (Tier 2). In this work, we refer to these small cells as Home evolved Node-B (HeNB) or femtocell.

Femtocells or HeNBs are a promising cost efficient solution for enhancing indoor coverage and accomplishing Quality of Service (QoS) necessities. Basically, femtocells are small base stations, which are generally installed in an office or a flat in order to improve indoor coverage and offer enhanced Quality of Experience (QoE) to local users, by making the base station nearer to the user. Femtocell model is not like the formerly used pico- or microcell model since the data composed by a femtocell is transferred to the wireless providers through public Internet. However, femtocells are recommended as main access points in LTE/LTE-A networks. That means these femtocells have preference over the traditional access points like macro-, micro- and