Neighbour Cell List Optimization Based on Cooperative Q-learning and Reinforced Back-Propagation Technique

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Heterogeneous Networks (HetNets) involve a mixture of radio technologies and cell types such as femtocells and macrocells working in cohesion to provide a better capacity, coverage and speed, leading to better user experience. Femtocell-to-femtocell handover is one of main concern when it comes to dense network deployment. For these handover cases, minimalistic as well as appropriate neighbor cell list (NCL) is the key element for successful handover. One of the main features of Self Organizing Network is the use of intelligent algorithms for self-optimization of NCL that enables them to adjust themselves to key radio frequency (RF) parameters (e.g. FAP RSS and hidden FAP) periodically and automatically making them adjustable to changes in traffic and radio environment.

Traditional optimization algorithms were based on a single optimization parameter (eg. Stationary RSS) and did not consider the impact of other parameters such as dynamic traffic, detection of new FAPs and surrounding radio environment. In order to address the shortcomings, we propose self-optimization of NCL using a cooperative Q-learning through reinforced back-propagation method. A central control mechanism would be used that enables cooperative learning by enabling each FAP to share its optimization experience, represented as the parameters of learning method, with surrounding FAPs. Online NCL optimization have no fixed linking function from inputs and corresponding RF parameters adjusted for femtocell NCL performance due to the complex configuration parameters. Both fuzzy inference rule base along with parameters of its membership functions are developed and adapted via reinforcement learning method that can achieve a desired efficient NCL by interacting with an unpredictable environment and using past experiences from control mechanism database. To make an efficient and appropriate NCL, we optimize the number of femtocells having maximum transmission power and suitable frequency while considering the varying and non-uniform traffic load distribution as well as hidden FAPs within a specific region.

An AI based NCL optimization can be achieved through adaptation of novel hybrid architecture. In this architecture, each femtocell optimizes its neighbour cell list in a distributed form. A central network management system (NMS) realizes the cooperative distributed optimization scheme by the collective optimization experience of femtocells and share them globally. So, in this paper, an online approach of self-optimization of NCL in femtocell networks would be presented allowing femtocells to work in a distributive and cooperative form. This facilitates optimizing NCL automatically and cooperatively, utilizing the shared experiences of optimization of all FAPs. The simulation result is expected to show that our approach will be able to obtain robust optimization policies with minimum but optimal number of femtocell list for multiple traffic scenarios maintaining a better performance compared to previous schemes with further reduced energy consumption.