

ABSTRACT

In the face of rapid traffic growth, small cells have become an important solution in cellular networks due to their ability to increase capacity, user density, and network coverage, especially in indoor areas. However, limitations such as hardware availability, installation costs, and traffic fluctuations have led to the emergence of an alternative solution in the form of Virtual Small Cells (VSC). VSC offers advantages such as scalability, cost reduction, deployment flexibility, and support for network slicing. VSC based on user equipment (UE) selects one UE as the Cell Head (CH), which acts as a relay and serves cluster members through Device-to-Device (D2D) communication. This Cell Head Virtual Small Cell (CH-VSC) approach is a potential solution to improve the efficiency of 5G networks. This study uses MATLAB simulation with a Poisson Cluster Process to generate UE distributions that represent real-world conditions. CH selection is performed using the Modified Affinity Propagation Clustering (MAPC) algorithm, which considers channel quality to the Base Station (BS). Resource block (RB) allocation uses the Proportional Fair (PF) algorithm to maximize RB efficiency on the BS-CH and CH-UE paths. Simulation results show an average SINR of 52.37 dB for BS-CH and 12.05 dB for CH-UE. The average SINR on the CH reaches 57.04 dB. The obtained data rate and spectral efficiency support the feasibility of the CH-VSC approach for mmWave D2D communication. The Jain's Fairness Index value of 0.8258 indicates that the PF algorithm can distribute RB fairly.

Keywords: Clustering Algorithm, Device-to-Device, Proportional Fair, User Equipment, Virtual Small Cell