ABSTRACT

The advancement of 5G network technology has driven a significant increase in capacity and connectivity among devices. One promising approach is Device-to-Device (D2D) communication, particularly within the inband scheme. However, the simultaneous use of frequency spectrum by Cellular Users (CU) and D2D users poses the risk of interference and overloading, which can degrade service quality.

This thesis proposes the implementation of a combined multiple access technique, namely Orthogonal Frequency Division Multiple Access (OFDMA) for CU and Sparse Code Multiple Access (SCMA) for D2D communication. The resource allocation process is carried out in two stages: first, Resource Block allocation for CU; and second, codebook allocation for D2D users. Three main allocation algorithms are used: Greedy, Hungarian, and RB Greedy, along with several combinations such as Greedy-Hungarian, Hungarian-RB Greedy, and RB Greedy-Greedy. System performance is evaluated based on five key parameters: data rate, sum rate, spectral efficiency, power efficiency, and fairness. Testing is conducted under two Scenarios: varying the number of users and varying the maximum distance between D2D pairs.

In Scenario 1 (user count variation), the Hungarian algorithm increases the sum rate by 1.5% compared to Greedy and 13.3% compared to RB Greedy; spectral efficiency rises by 1.4% over Greedy and 13.6% over RB Greedy; and power efficiency improves by 1.3% over Greedy and 9.5% over RB Greedy. For CU fairness, the Hungarian-RB Greedy and RB Greedy-Hungarian combinations outperform Greedy-RB Greedy by 1.7% and Hungarian-Greedy by 5.5%. D2D fairness achieves the highest values in almost all algorithm combinations. In Scenario 2 (D2D distance variation), the Hungarian algorithm increases the sum rate by 1.3% over Greedy and 7.8% over RB Greedy; spectral efficiency rises by 1.6% over Greedy and 7.6% over RB Greedy; and power efficiency improves slightly over Greedy and 5.6% over RB Greedy. The highest CU fairness is achieved by Hungarian-RB Greedy and RB Greedy-Hungarian, while the best D2D fairness is obtained from Greedy-RB Greedy and RB Greedy-Greedy combinations. Overall, the Hungarian algorithm and its variants consistently deliver superior performance in spectral efficiency, power efficiency, and fair resource distribution in D2D communication systems based on OFDMA–SCMA in 5G networks.

Keywords: *RB Greedy, Greedy, Hungarian,* OFDMA, SCMA