ABSTRACT

The fifth telecommunication generation (5G) is planned to use C-band of 3.4–4.2 GHz, where spectrum sharing between 5G and Fixed Satellite Services (FSS) is, therefore, required. This thesis aims to protect the FSS and proposes new scheme of Coded Random Access (CRA) with extension to frequency domain, called Frequency Domain-Extended Coded Random Access (FDE-CRA) to make the coexistence between 5G and FSS possible. Original CRA uses time-slots to serve users, while FDE-CRA uses both time-slots and frequencies to serve larger number of users. The proposed FDE-CRA is highly motivated by the necessity of spectrum sharing between 5G and FSS in bands of 3.4–4.2 GHz such that many interfering frequencies to the FSS can be reduced.

FDE-CRA makes spectrum sharing possible by the use of multiuser detection (MUD) based on the available frequencies. We optimize degree distribution by maximizing the bandwidth efficiency and minimizing loss of random access using extrinsic information transfer (EXIT) chart. We also validate the results using practical simulations of packet-loss-rate (PLR) and throughput performances based on computer simulations. We found that the delay in decoding is lower when the number of frequencies (K), used in MUD, is large. This is because the decoding process is faster when many signals received at the same time slot can be decoded. In this thesis, we optimizes the best K for spectrum sharing between 5G and FSS.

To decrease the packets loss, shielding technique is employed in this thesis. This thesis evaluates five types of material shielding, (i) zinc, (ii) aluminium, (iii) aluminium mesh wire, (iv) copper, and (v) copper mesh wire in urban area, and natural shielding in sub-urban and rural areas to suppress the interference from 5G cellular to the FSS. We found that zinc material is optimal to prevent 5G signals harmful to the FSS systems. In addition, zinc material have lifespan longer than aluminium and copper. The results obtained for the separation distance caused by zinc decreased around 94.4% for urban area, natural shielding with $W = 5$ for sub-urban and rural area up to 90.4% and 90.2%, respectively.

Keywords: Coded Random Access, 5G, Fixed Satellite Services, Non-Orthogonal Multiple Access