Modeling and Analysis of SCMA Enhanced D2D and Cellular Hybrid Network

Abstract:

Sparse code multiple access (SCMA) has been recently proposed for the future wireless networks, which allows nonorthogonal spectrum resource sharing and enables system overloading. In this paper, we apply SCMA into device-to-device (D2D) communication and cellular hybrid network, targeted at using the overload feature of SCMA to support massive device connectivity and expand network capacity. Particularly, we develop a stochastic geometry-based framework to model and analyze SCMA, considering underlaid and overlaid modes. Based on the results, we analytically compare SCMA with orthogonal frequency-division multiple access (OFDMA) using area spectral efficiency (ASE) and quantify closed-form ASE gain of SCMA over OFDMA. Notably, it is shown that system ASE can be significantly improved using SCMA and the ASE gain scales linearly with the SCMA codeword dimension. Besides, we endow D2D users with an activated probability to balance cross-tier interference in the underlaid mode and derive the optimal activated probability. Meanwhile, we study resource allocation in the overlaid mode and obtain the optimal codebook allocation rule. It is interestingly found that the optimal SCMA codebook allocation rule is independent of cellular network parameters when cellular users are densely deployed. The results are helpful in the implementation of SCMA in the hybrid system.