A Hybrid Energy Sharing Framework for Green Cellular Networks

Abstract:

Cellular operators are increasingly turning toward renewable energy (RE) as an alternative to using traditional electricity in order to reduce operational expenditure and carbon footprint. Due to the randomness in both RE generation and mobile traffic at each base station (BS), a surplus or shortfall of energy may occur at any given time. To increase energy self-reliance and minimize the network's energy cost, the operator needs to efficiently exploit the RE generated across all BSs. In this paper, a hybrid energy sharing framework for cellular network is proposed, where a combination of physical power lines and energy trading with other BSs using smart grid is used. Algorithms for physical power lines deployment between BSs, based on average and complete statistics of the net RE available, are developed. Afterward, an energy management framework is formulated to optimally determine the quantities of electricity and RE to be procured and exchanged among BSs, respectively, while considering battery capacities and real-time energy pricing. Three cases are investigated, where RE generation is unknown, perfectly known, and partially known ahead of time. Results investigate the time varying energy management of BSs and demonstrate considerable reduction in average energy cost thanks to the hybrid energy sharing scheme.