Energy Harvesting-Based D2D-Assisted Machine-Type Communications

Abstract:

Supporting massive numbers of machine-type communication (MTC) devices poses several challenges for future 5G networks, including network control, scheduling, and powering these devices. A potential solution is to offload MTC traffic onto device-to-device (D2D) communication links to better manage radio resources and reduce MTC devices' energy consumption. However, this approach requires D2D users to use their own limited energy to relay MTC traffic, which may be undesirable. This motivates us to exploit recent advancements in RF energy harvesting for powering D2D relay transmissions. In this paper, we consider a D2D communication as an underlay to the cellular network, where D2D users access a fraction of the spectrum occupied by cellular users. This underlay model presents a fundamental trade-off: to protect cellular users, the spectrum available to D2D users needs to be reduced, which limits the number of D2D transmissions, but increases the amount of time that D2D users can spend harvesting energy to support MTC traffic. We study this trade-off by characterizing the spectral efficiency of MTC, D2D, and cellular users using stochastic geometry. The optimal spectrum partition factor is characterized to achieve fairness and balance in the network, while increasing the average MTC spectral efficiency.