Device-to-Device (D2D) technology underlying the cellular network is an attractive solution for future generation network to increase cellular traffic offloading. In order to reduce the interference caused to cellular network, D2D users can opportunistically access the cellular spectrum using cognitive radio capabilities. They can either avoid interference by transmitting on the spectrum wholes or merely control their power while transmitting simultaneously with the cellular users. In this paper, cognitive D2D users, referred to as Secondary Users (SUs), communicate at the same time as uplink cellular users. A new power control approach is proposed based on bargaining game theoretic solutions to better control SUs' transmit power and thus reduce the interference level at the cellular base station referred to as the Primary User (PU). First, the SUs utility functions are defined and take into account the achieved data rate, the power consumption and the impact of the interference. Then, the optimal power allocation is analyzed through the application of the Nash bargaining, Kalai-Smorodinsky and other bargaining solutions. A comparison between the performance of these solutions in terms of energy efficiency and fairness is derived. Simulation results show that a tradeoff between
fairness and energy efficiency should be taken into account. The performance of cooperative solutions is also compared with non-cooperative games both analytically and through simulations.

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