Resource Allocation for Network-Integrated Device-to-Device Communications Using Smart Relays

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Device-to-device (D2D) communication underlaying cellular network has recently been intensively discussed in standardization committee and academia. Reusing the LTE-A cellular resources, D2D communication enables wireless peer-to-peer services directly between user equipments (UEs) which enhances spectrum utilization and improves cellular coverage. Possible usage cases for D2D communication are local voice and data services including content sharing (i.e., exchanging photos, videos or documents through smart phones) and multiplayer gaming [1]. In the context of D2D communication, it becomes a crucial issue to set up reliable direct links between the UEs while satisfying quality-of-service (QoS) of traditional cellular UEs (CUEs) and D2D UEs in the network. Besides, interference to and from CUEs and poor propagation channel may limit the advantages of D2D communication in practical scenarios. In such cases, network assisted transmission through relays could efficiently enhance the performance of D2D communication when D2D-pairs are too far away from each other or the quality of D2D channel is not good enough for direct communication.

We consider relay-assisted D2D communication in LTE-A cellular networks where D2D-pairs are served by the relay node. We concentrate on the scenario in which potential D2D UEs are located near to each other (i.e, office blocks or university areas, concert sites etc.); however, the proximity and link condition may not be favorable for direct communication. We formulate the resource allocation problem with an objective to maximizing the end-to-end rate (i.e., minimum achievable rate over two hops) for the UEs while maintaining the QoS (i.e., rate) requirements for cellular and D2D UEs under total power constraint at the relay node. The resource allocation problem turns out to be a mixed-integer non-linear programming (MINLP) problem and to make it tractable we relax it using the time-sharing strategy. The contribution of this work is the analysis of network performance under relay-assisted D2D communication. We compare the performance of proposed method with an underlaying D2D communication scheme [2] and the numerical results show that there is a distance threshold beyond which relay-assisted D2D communication significantly improves network performance when compared to direct communication between D2D peers.

REFERENCES

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