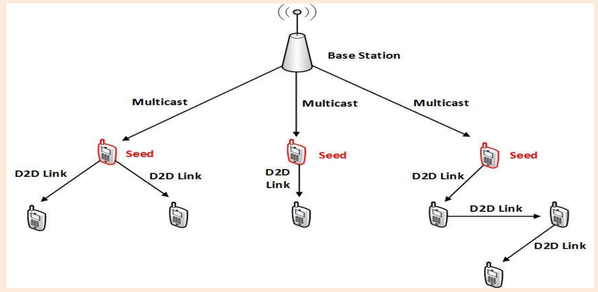
Device-to-Device (D2D) Data Dissemination with Power Budget Constraints

Yiming Zhao and Wei Song
University of New Brunswick, Fredericton, Canada

Abstract

D2D communications have been envisioned as an effective means for data dissemination, *e.g.*, in disaster alerts and event notifications. As mobile devices are battery-powered, it is essential to save power during data dissemination. Also, users are generally more willing to forward data to others with social connections. In this work, we take into account two important aspects, *i.e.*, D2D users' social incentive constraint and power budget constraint, to enable more practical data dissemination. We propose a coalitional graph game based approach, which iteratively derives a transmission graph to reach every interested user. The simulation results demonstrate the high performance of our approach in various scenarios with different network scales and social connections.

System Model



Motivation

Design a data dissemination scheme which can properly schedule the data transmission of the base station and D2D users to achieve the following goals:

- Minimize the total power consumption of data dissemination.
- Satisfy each user's power budget constraint for data dissemination.
- Accommodate user social incentive constraint, that is, D2D transmission should occur between two users with social relationships.

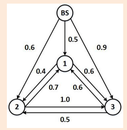
Our Solution: Coalitional Graph Game Approach

We propose a coalitional graph game based approach to form a transmission graph to coordinate the data transmission of the base station and D2D users.

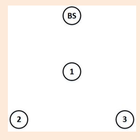
Key idea:

- Model the data dissemination as a directed graph G(V, E, w), where V is the set of the base station and D2D users, E denotes the links from the BS to D2D users and the available D2D links between D2D users, and w gives the transmit power of the corresponding transmission link.
- The algorithm uses an iterated approach:
  - *In each iteration, a node is selected randomly. That node calculates the set of feasible strategies and chooses its local best response. The graph is then updated correspondingly.*
  - *The algorithm keeps iterating until the graph converges to a local Nash network.*
- The edges of the finally restored graph are the corresponding data dissemination paths.

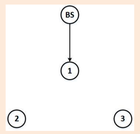
A Walk-Through Example



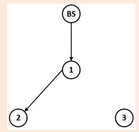
Nodes' power budget constraint
- Node 1 : 0.6
- Node 2 : 1.0
- Node 3 : 0.8



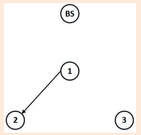
Iteration 1



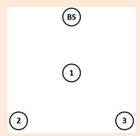
Iteration 2



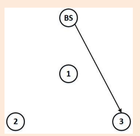
Iteration 3



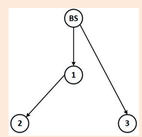
Iteration 4



Iteration 5

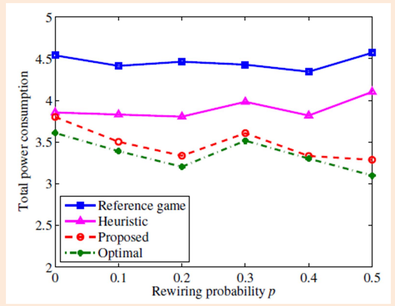


Iteration 6

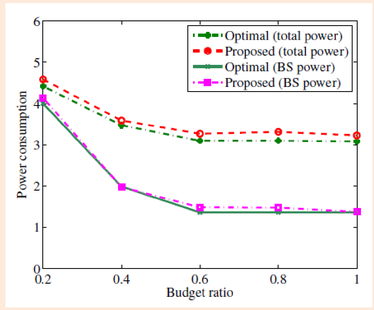


Finally restored transmission graph

Simulation Results



Reduce total power consumption



Scalability to different power budget constraints

Summary and Future Work

- In this work, we investigate how to explore D2D communications and social connections for energy-efficient data dissemination.
- We propose a coalitional graph game approach to coordinate the transmission between nodes in the network.
- The simulation results demonstrate the good performance of our proposed approach.
- In the future, we plan to extend this work to a mobile scenario where users' mobility is considered.

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