Social-Aware Data Dissemination in Mobile Networks

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Data Dissemination in Wireless Networks

- Data dissemination aims at delivering information to a group of target users in a geographical region.
- Data dissemination in wireless networks has been paid much attention by academia and industry because of its application value in a wide range of applications.

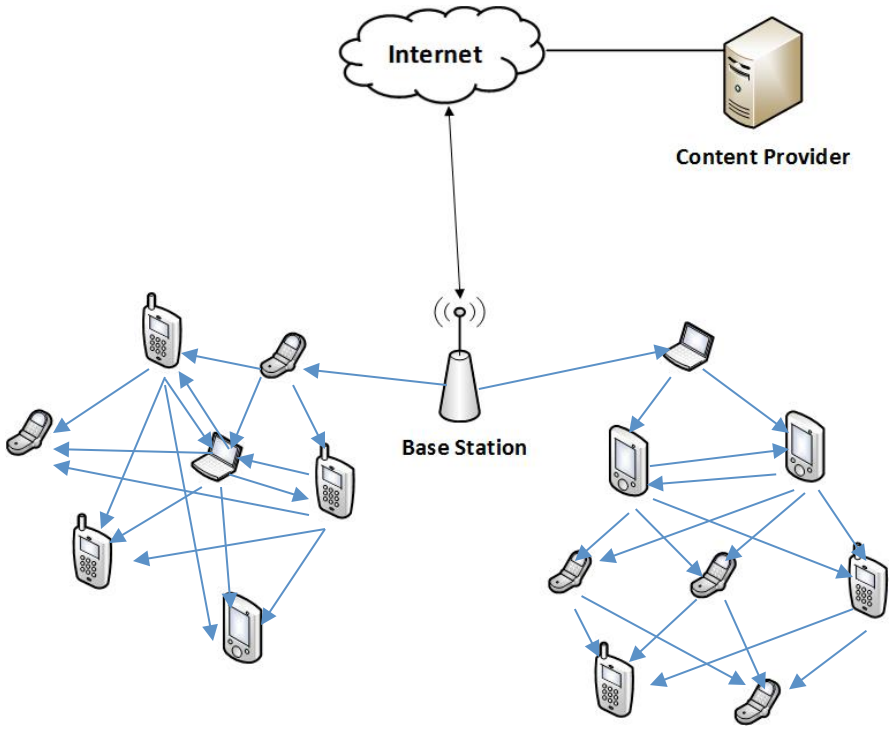
Disaster alert

Event notification

Ad distribution

A Straightforward Approach

- A straightforward approach of data dissemination in wireless networks is flooding

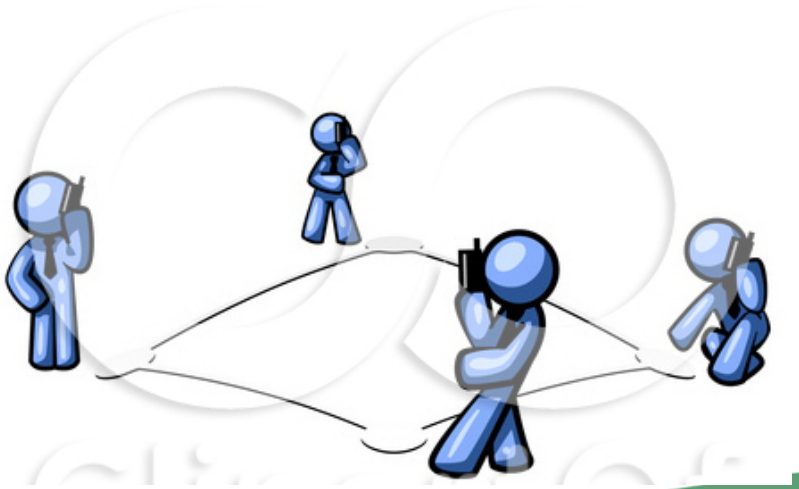


Disadvantages:

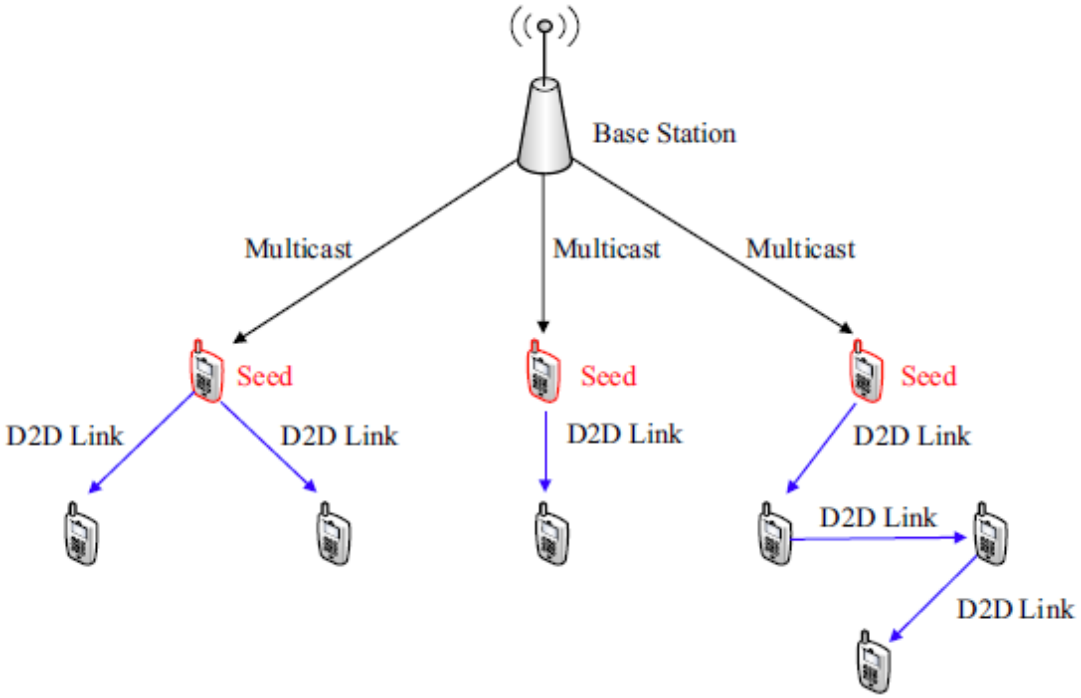
- Consume much energy of network nodes
- Generate a large number of replicate packets in the network
- Result in network congestion

Social-Aware Data Dissemination

- Considering that portable wireless devices are carried by people, people's social features and properties can be exploited to disseminate data more effectively.
- Thereby, social-aware data dissemination becomes a promising approach.



Data Dissemination Model



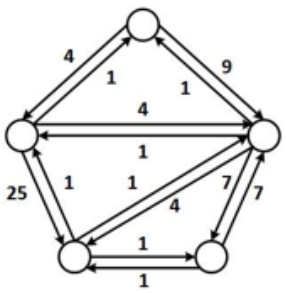
- A D2D link is established between two users if they are socially connected and their distance is within the requirement of D2D transmission.

Research Problems and Objectives

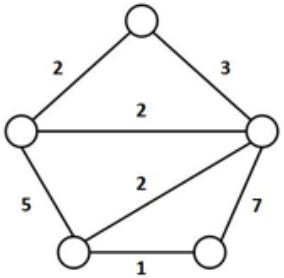
- We aim to design a data dissemination solution to properly select seeds and schedule the D2D transmission among users.
  - Seed selection
  - Transmission scheduling
- Reduce total energy consumption of D2D transmission and the final finishing time of data dissemination.

Seed Selection

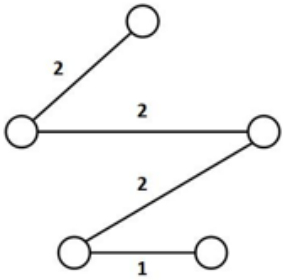
- D2D communications among users with social connections can be modeled as a bidirectional graph.
- We perform a series of operations to the original bidirectional graph G(V, E, w) to choose the seed.



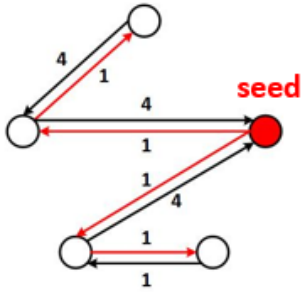
G(V, E, w)



$G'(V, E', w')$



Minimum Spanning tree T of G'



$G^*(V, E^*, w^*)$

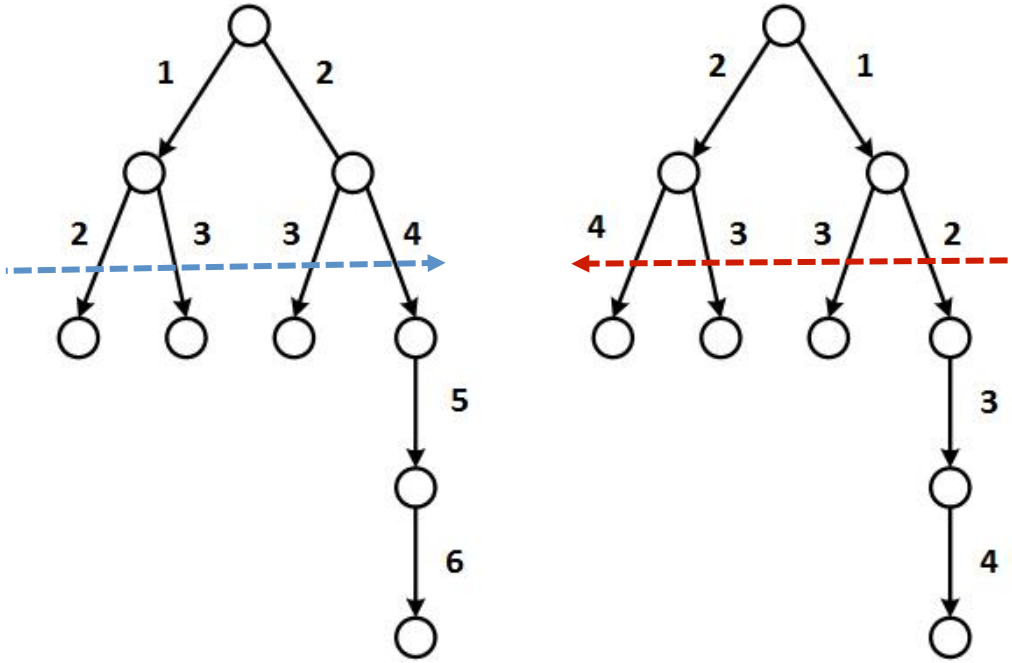
- V denotes the set of D2D users.
- $e_{ij} \in E$ denotes available D2D links between users.
- $w(e_{ij})$ denotes transmit power of D2D communication from user i to j.

- $w'(e'_{ij}) = \sqrt{w(e_{ij}) \cdot w(e_{ji})}$

- Seed is the node with minimum total energy consumption in G'.

Transmission Scheduling

- Transmission order can influence the finishing time of data dissemination. For example,



(a) Finishing time = 6 (b) Finishing time = 4

* The value on the edge is the time slot in which the transmission occurs.

Transmission Scheduling

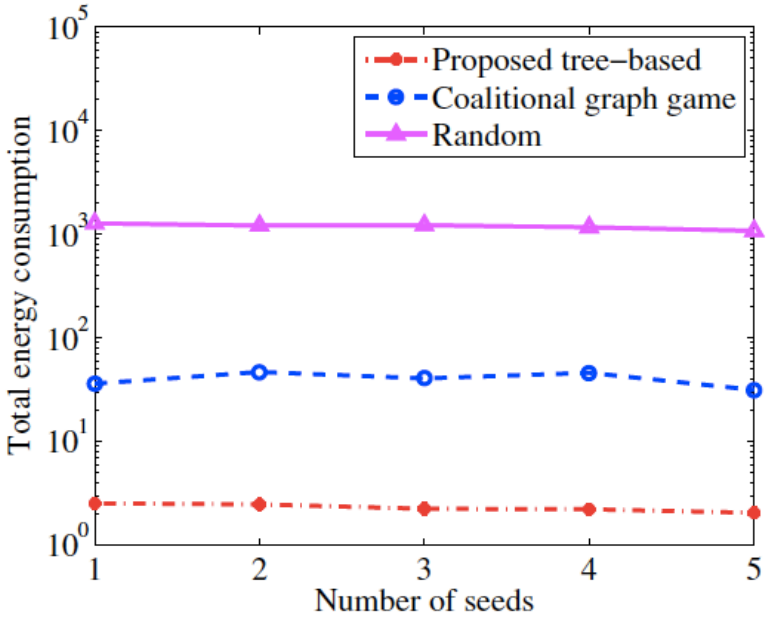
- We consider two important factors in determining the transmission order
  - Number of descendants of node i
  - Depth of the subtree rooted at node i
- We define an influence score for each node i

$$infScore_i = \beta \cdot descentant(i)_{norm} + (1-\beta) \cdot depth(i)_{norm}$$

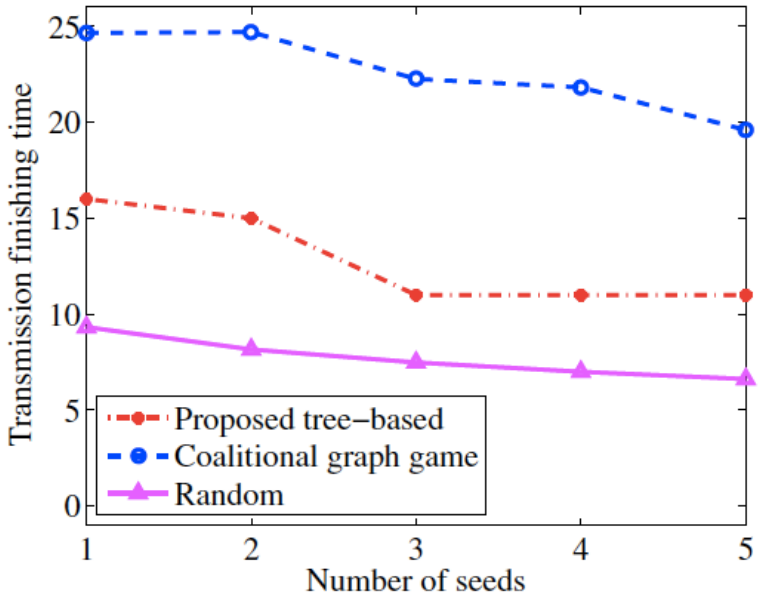
- Each node transmits data to its descendant nodes according to the ranking of the influence scores

Simulation Results

- Social relationships are modeled by the caveman model with two caves and a rewiring probability p=0.3. The size of each cave is adapted with the number of D2D users.



(a) $n = 20$.



(b) $n = 20$.

FloodNet
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Project 3-3 Future Plans

- We will develop a joint MAC and routing protocol for a multi-hop network with an increasing number of nodes so as to improve the spatial reuse of the network resources.
- We will develop a cross-layer routing protocol supporting differentiated services (esp. multimedia) in a multi-hop environment so as to meet end-to-end delay bound for delay-sensitive services and heterogeneous QoS guarantee.
- We will take into account power constraints of users' mobile devices in data dissemination. We will refine our approach based on a coalitional graph game for more realistic scenarios.
- We will extend our work for individual message dissemination, and investigate multi-message dissemination exploiting the message availability and spatial distribution of mobile users.