Social Aspects to Support Opportunistic Networks in an Academic Environment

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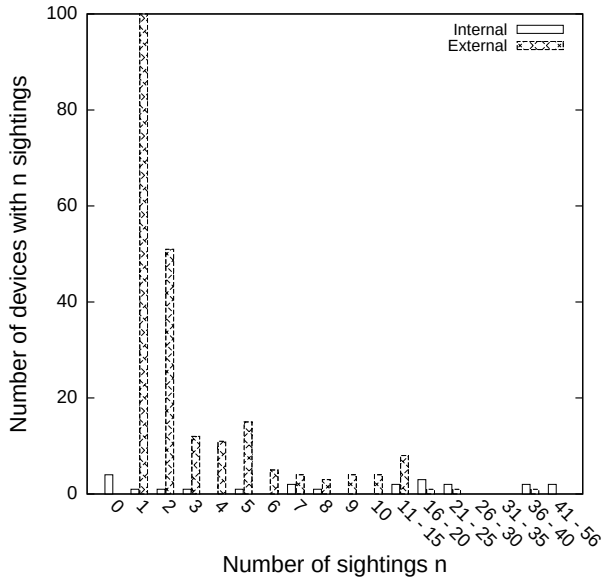
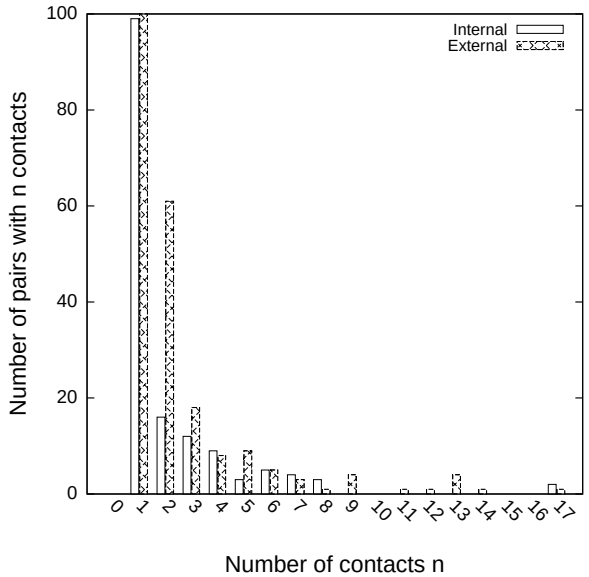
Introduction

- **Opportunistic networks**
  - human-carried mobile devices that communicate with each other in a store-carry-and-forward fashion
  - members are people that carry mobile devices, organized into communities (according to common professions, workplaces, interests, etc.)
  - generally, members of the same community interact with each other more often than with members of outside communities
- **Solution**
  - add knowledge about social links between opportunistic network nodes to routing and dissemination algorithms in order to improve hit rate
  - analyze results on real-life mobility traces

Social Tracing (1)

- Collected a mobility trace (UPB 2011)
  - social tracing experiment performed for 35 days with 22 participants (chosen from all study years) at the University Politehnica of Bucharest
  - Social Tracer application for Android phones[1]
  - academic environment → small enclosed space with lots of contact opportunities
  - Facebook social information collected





[1] *http://code.google.com/p/social-tracer/*

Social Tracing (2)

- Similarity value
  - k-CLIQUE $\leftrightarrow$ logical distribution of participants into year groups: **79.95%**
  - k-CLIQUE $\leftrightarrow$ social network organization: **83.06%**

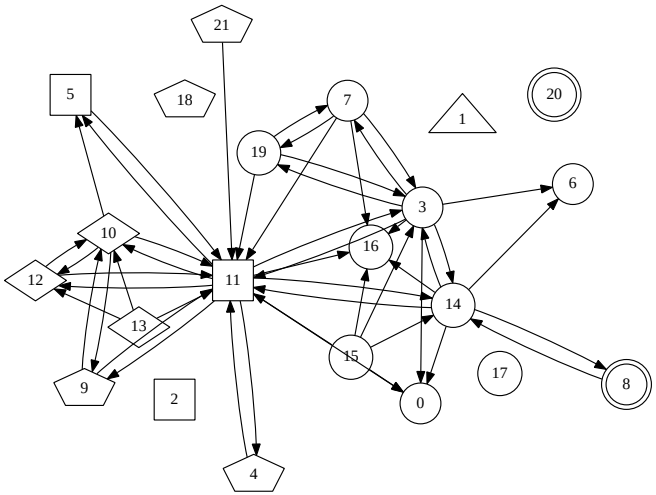


Figure: k-CLIQUE graph

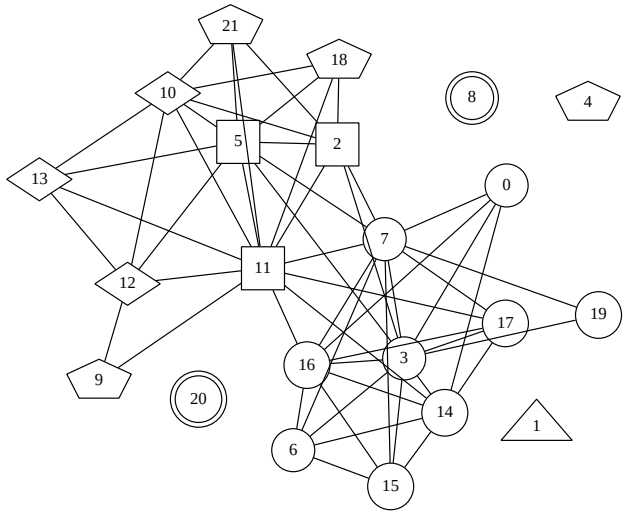


Figure: Social graph

Opportunistic Routing (1)

- **BUBBLE Rap**
  - routing algorithm for opportunistic networks that uses knowledge about nodes' communities to deliver messages
  - global popularity level used until a message reaches the destination community
  - local ranking used in the community
  - popularity given by betweenness centrality (number of times a node is on the shortest path between two other nodes in the network)
  - community detection done by *k*-CLIQUE
- **DiBuBB**
  - distributed version of BUBBLE Rap
  - uses distributed *k*-CLIQUE for community detection
  - cumulative/single-window algorithm for distributed centrality computation

Opportunistic Routing (2)

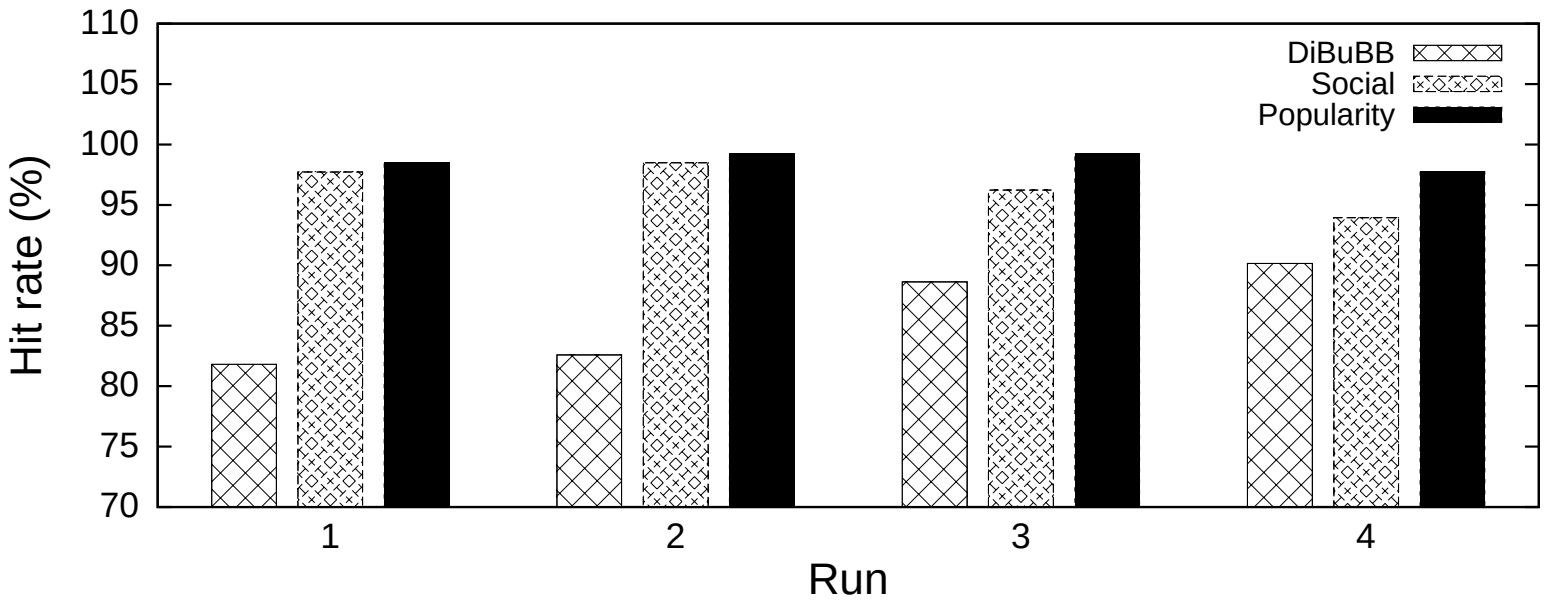
- Use social relationships information to increase routing effectiveness
- We propose two modified versions of DiBuBB
  - **Social** $\rightarrow$ use Facebook communities instead of k-CLIQUE to decide what centrality value to use
  - **Popularity** $\rightarrow$ $centrality = w_1 * C_{window} + w_2 * popularity$
- Details
  - C_{window} $\rightarrow$ normalized value computed by cumulative-window algorithm
  - $popularity$ $\rightarrow$ normalized number of Facebook social relationships a node has with other nodes in the network
  - $w_1 + w_2 = 1$

Experimental Setup and Results (1)

- **Setup**
  - implemented an emulator (MobEmu) that parses the traces and applies DiBuBB and the two modified versions
  - each node sends 11 messages
  - all messages are sent at the beginning to random destinations
  - nodes have a limited storage amount of 20 messages (assuming all messages have the same size)
  - unlimited network bandwidth
  - tested four different runs
- **Metrics**
  - *hit rate* $\rightarrow$ ratio between successfully delivered and total messages
  - *latency* $\rightarrow$ time passed between generating a message and delivering it

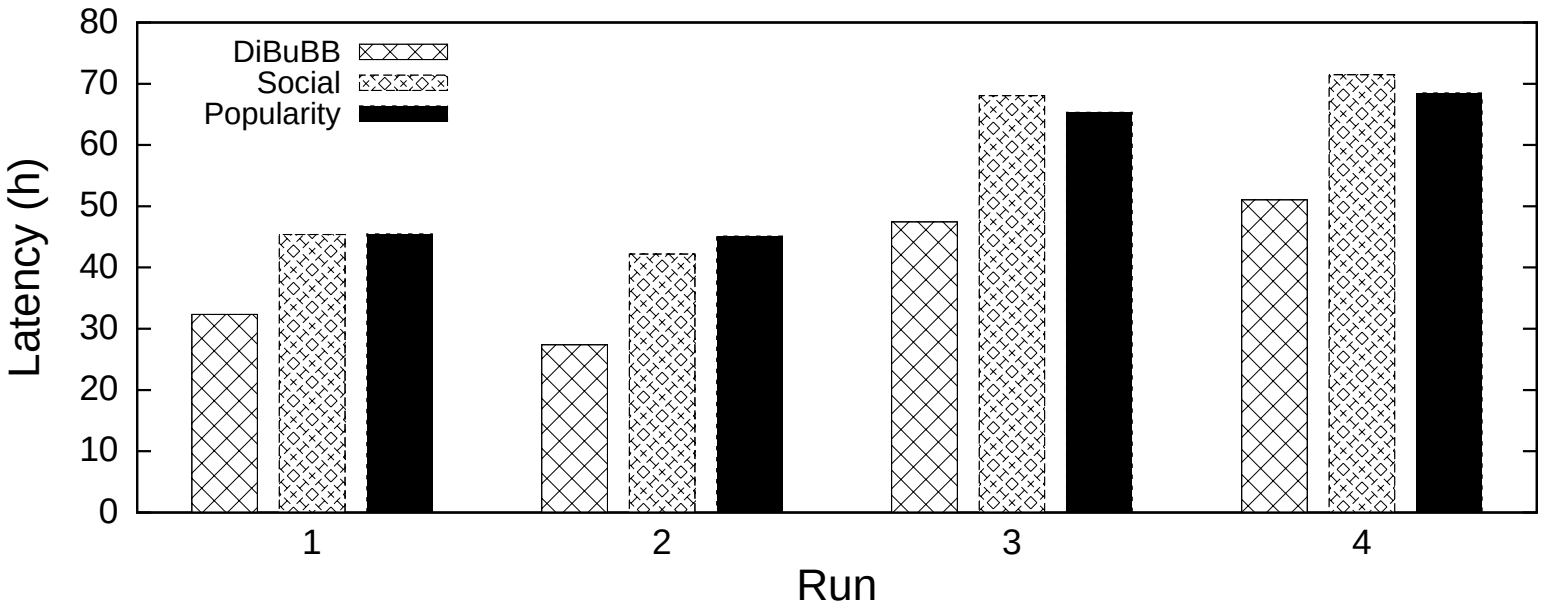
Experimental Setup and Results (2)

- Both modified versions of DiBuBB perform better than the base version in terms of hit rate
- Popularity performs best



Experimental Setup and Results (3)

- Latencies are higher (because some participants did not provide information about their Facebook relationships and centrality is only computed using C_{window})
- Opportunistic networks are Delay-Tolerant Networks (DTNs), so latency is not such an important metric



Conclusions

- We performed a social trace in an academic environment
- We proposed and investigated the addition of social data to improve the performance of communication algorithms and data transmission schema
- We showed that social information improves hit rate
- We analyzed our approach using the collected trace

Thank You!