Are You moved by Your Social Network Application?

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Evolution in socializing techniques

- **Before the Internet:** socialize by physical meeting
  - People communicate only if they know each others AND if they are together

- **Today:** Internet allows “virtual” socializing
  - Chat, e-mail, Online Social Network
  - No need for locality

- **Tomorrow:** MobiClique
  - Meet your virtual community using opportunistic contacts and locality
Motivation

- Explore the relation between virtual social interactions and human physical meetings.
- Understand complex temporal properties based on simple social properties.
- Forwarding based on social network properties.
Structure of this talk

- Overview of the MobiClique experiment
- Topological comparison
  - Properties of nodes, contacts and paths
  - Is there any similarities?
- Exploring social rules on opportunistic forwarding
  - Overview of the opportunistic forwarding problem
  - Proposed social forwarding rules
- Discussions
Mobiclique experiment

- Distribute smartphones to 28 participants
- 3 days experiment at CoNext 2007
- Initially, each participant identifies its friends among the 150 CoNext participants
- Three applications:
  - Opportunistic socializing: make new friends based on friends and interests
  - Epidemic newsgroup
  - Asynchronous messaging
Mobiclique experiment: Social Graph

<table>
<thead>
<tr>
<th></th>
<th>Initial Graph</th>
<th>Final Graph</th>
</tr>
</thead>
<tbody>
<tr>
<td># connected nodes</td>
<td>26</td>
<td>27</td>
</tr>
<tr>
<td># edges</td>
<td>56</td>
<td>115</td>
</tr>
<tr>
<td>average degree</td>
<td>5.2</td>
<td>9.5</td>
</tr>
<tr>
<td>clustering coefficient</td>
<td>0.2</td>
<td>0.36</td>
</tr>
<tr>
<td>diameter</td>
<td>7</td>
<td>4</td>
</tr>
</tbody>
</table>
Node properties

- **Characterize Node** *heterogeneity*
  - High/low activity,
  - Popularity,
  - Contact rate

- **We measure two metrics**
  - **Node degree:**
    - Social Graph: number of friends
    - Contact Graph: average number of device seen per scan (every 2mn)
  - **Centrality of nodes**
    - Social Graph: measure the occurrence of the node inside all shortest paths
    - Contact Graph: measure the occurrence of the node at each time \( t \) inside all shortest paths
Node similarities

Ordering error 10.8%

Ordering error 3.97%

Avg. device seen per scan

Degree

Centrality in contact graph

Centrality in social graph
Contact properties

- Compare contacts according to:
  - **social** distance (friends have distance 1, friends of friends have distance 2, etc.).
  - **contact** duration, and time between two successive contacts.
Path properties

Delay-optimal paths as a function of the social distance between the source and the destination
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● Conclusion and Discussions
Social forwarding paths

Path construction rules:

- **neighbor(k):**
  - $(u \rightarrow v)$ is allowed if and only if $u$ and $v$ are within distance $k$ in the social graph.

- **non-decreasing-centrality:**
  - $(u \rightarrow v)$ is allowed if and only if $C(u) < C(v)$.

- **non-decreasing-degree:**
  - $(u \rightarrow v)$ is allowed if and only if $d(u) < d(v)$.

- **non-increasing-distance:**
  - $(u \rightarrow v)$ is allowed if and only if the social distance from $v$ to $d$ is no more than the one from $u$ to $d$. 
Comparison of rules

- The neighbor rule performs reasonably well.
- The rule based on centrality outperforms all the rules we have tested.
- The combination of neighbor and centrality rules reduces the cost (best trade-off).
Summary of results

- Beyond local divergence, nodes have heavy relation in the two graphs.
  - Similarities in the properties of nodes, contacts, and paths.
  - Nodes may be ranked according to their centrality
- Use **central nodes and social neighbors to communicate can be effective**
  - improves selectivity
  - offers more flexibility
  - best trade-off
  - Difficult to compute in real-time
- **Limitations and future work:**
  - single event inside a community
  - more traces, more social graphs
Thank You

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