Friendships in the Air: Integrating Social Links into Wireless Network Modeling, Routing, and Analysis

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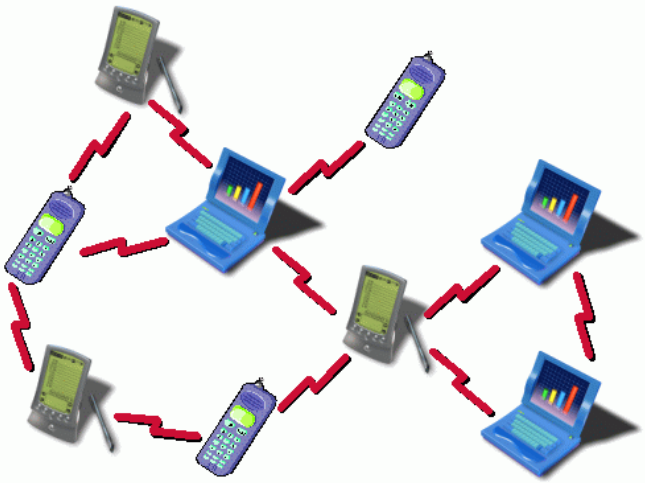
Outline

- Motivation
  - Exploratory research on combining social and wireless communication links
- Assumptions and Modeling
  - Greedy routing
  - Success delivery probability and delay
- Small-scale experiments
  - Setups
  - Results
- Conclusion and limitations

Communication networks today

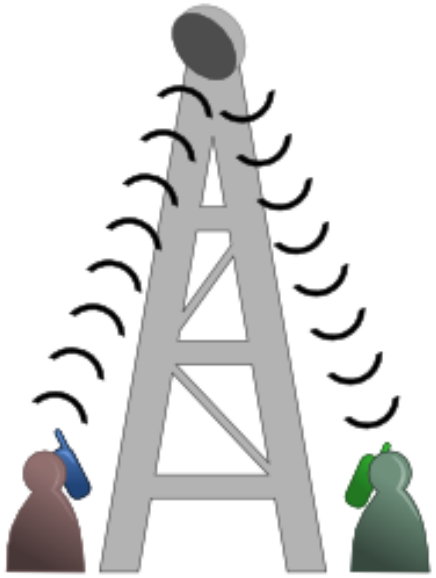
- Today's infrastructure based network
  - Cellular network
  - Satellite network

- Peer-to-peer based network, ad-hoc network
  - WiFi
  - bluetooth



Social Networks vs Physical Networks

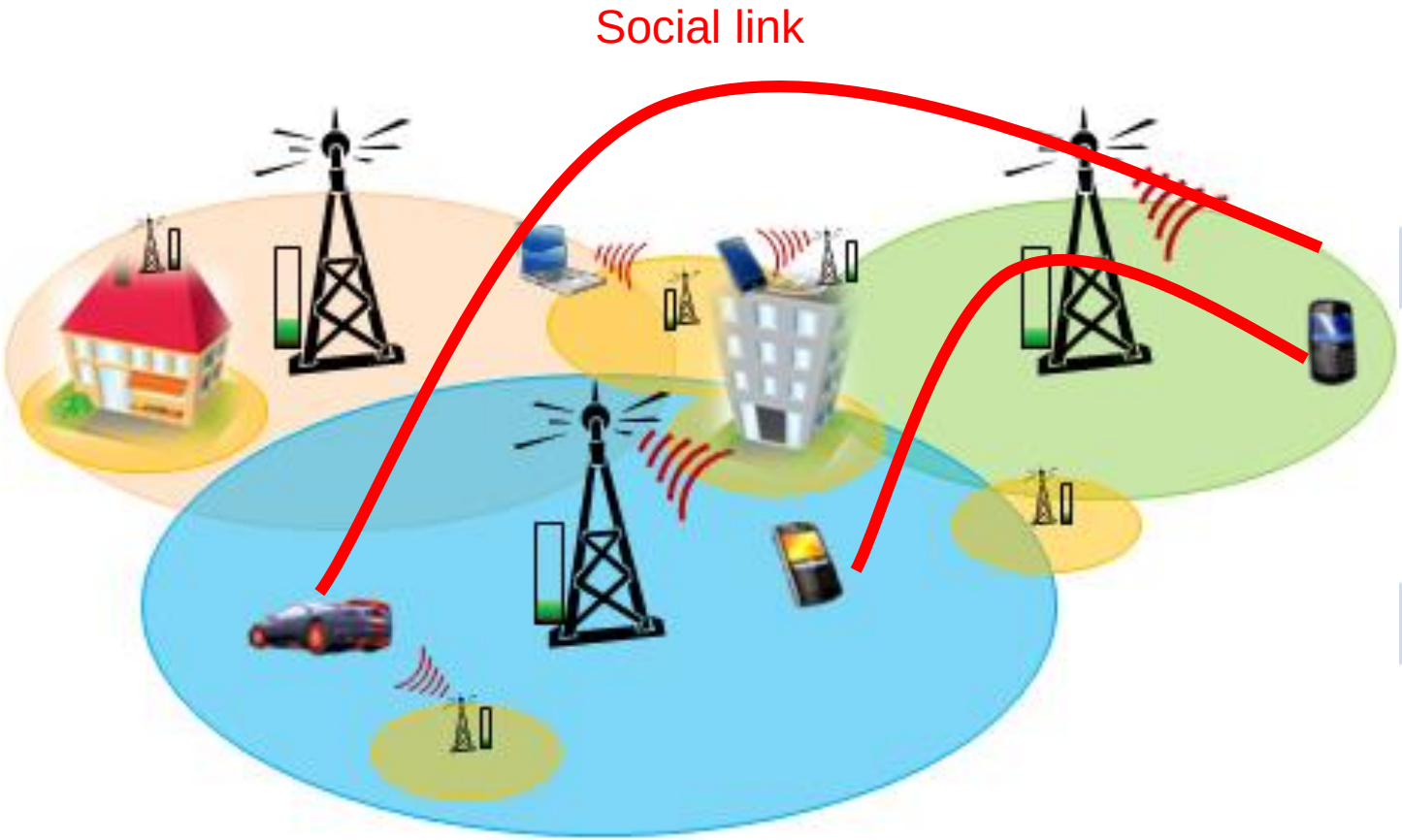
- Social link
  - Logical link, does not physically exit
- Today's communication network provide a communication medium for social connections



Friends talking using phones

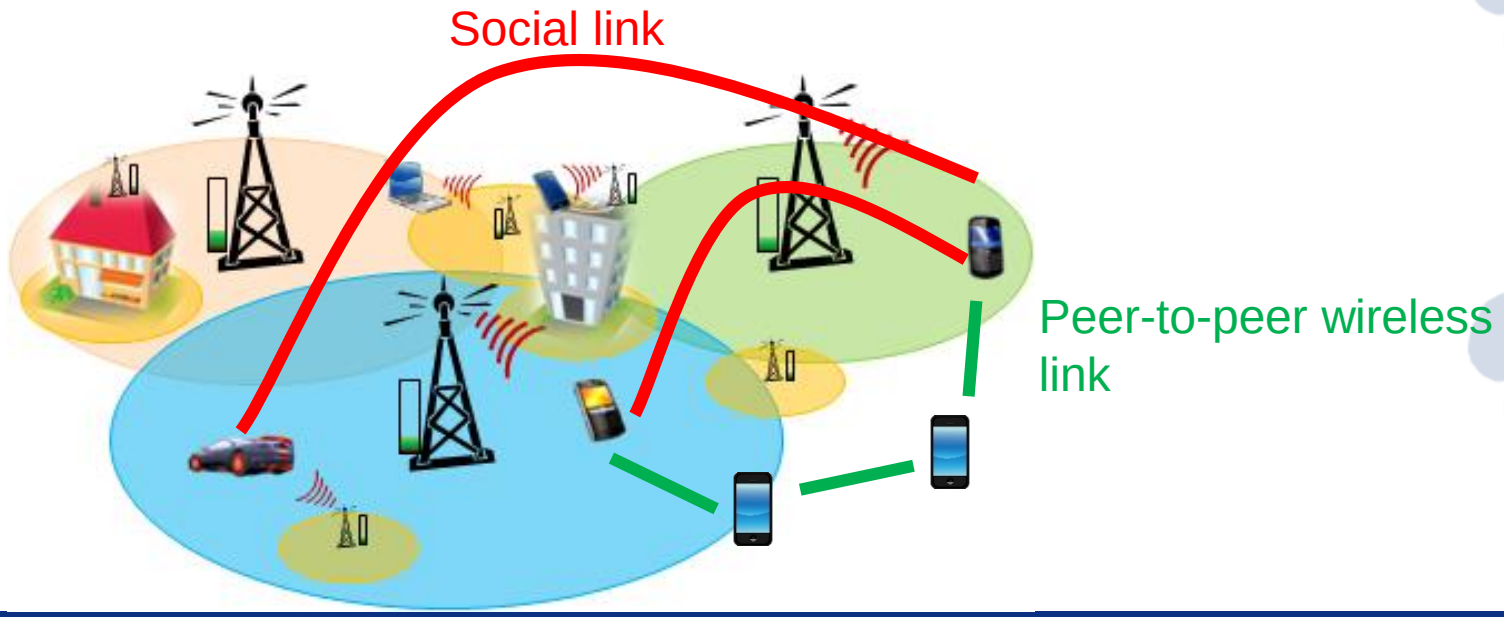
Social links overlaid over wireless networks

- On the upper layer, we can think data is delivered over social links.



A highly abstract model

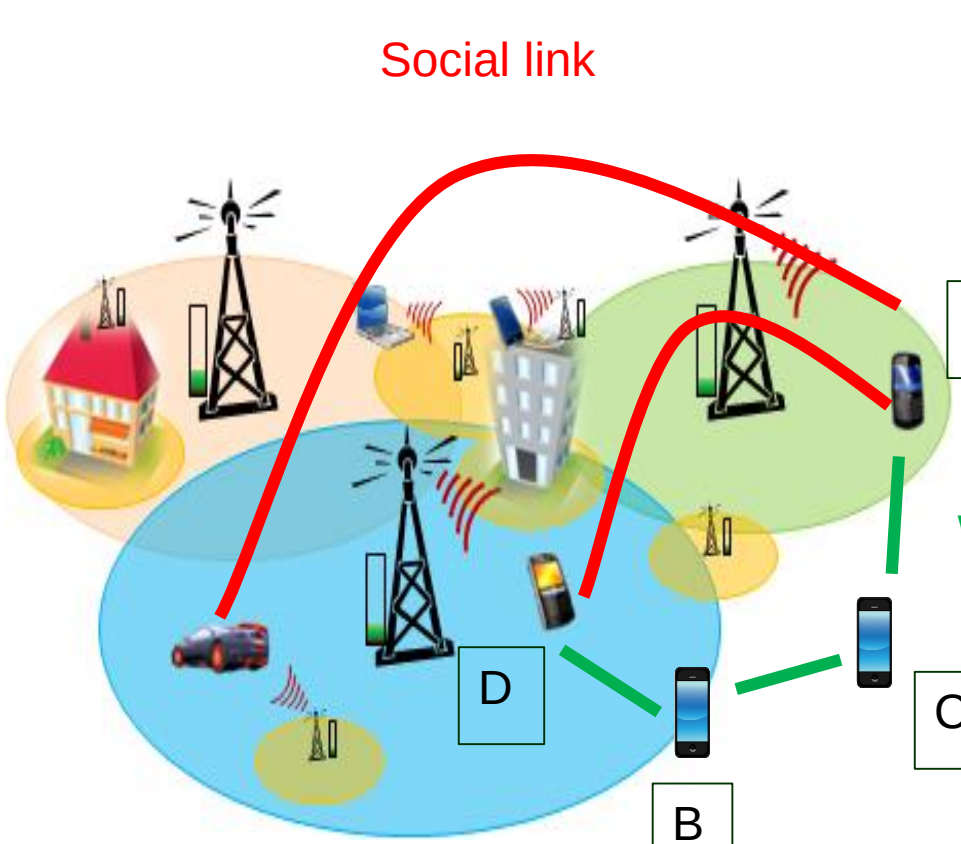
- Combined social and wireless network
  - A hybrid network consisting of
    - Social links
    - Wireless links
- Both links can be used to deliver data



Potential Application

- Exploratory research
  - Combining social and communication networks
  - Analyzing information dissemination over joint network structures.
- Potential applications:
  - Emergency broadcasting
  - Optimized message delivery

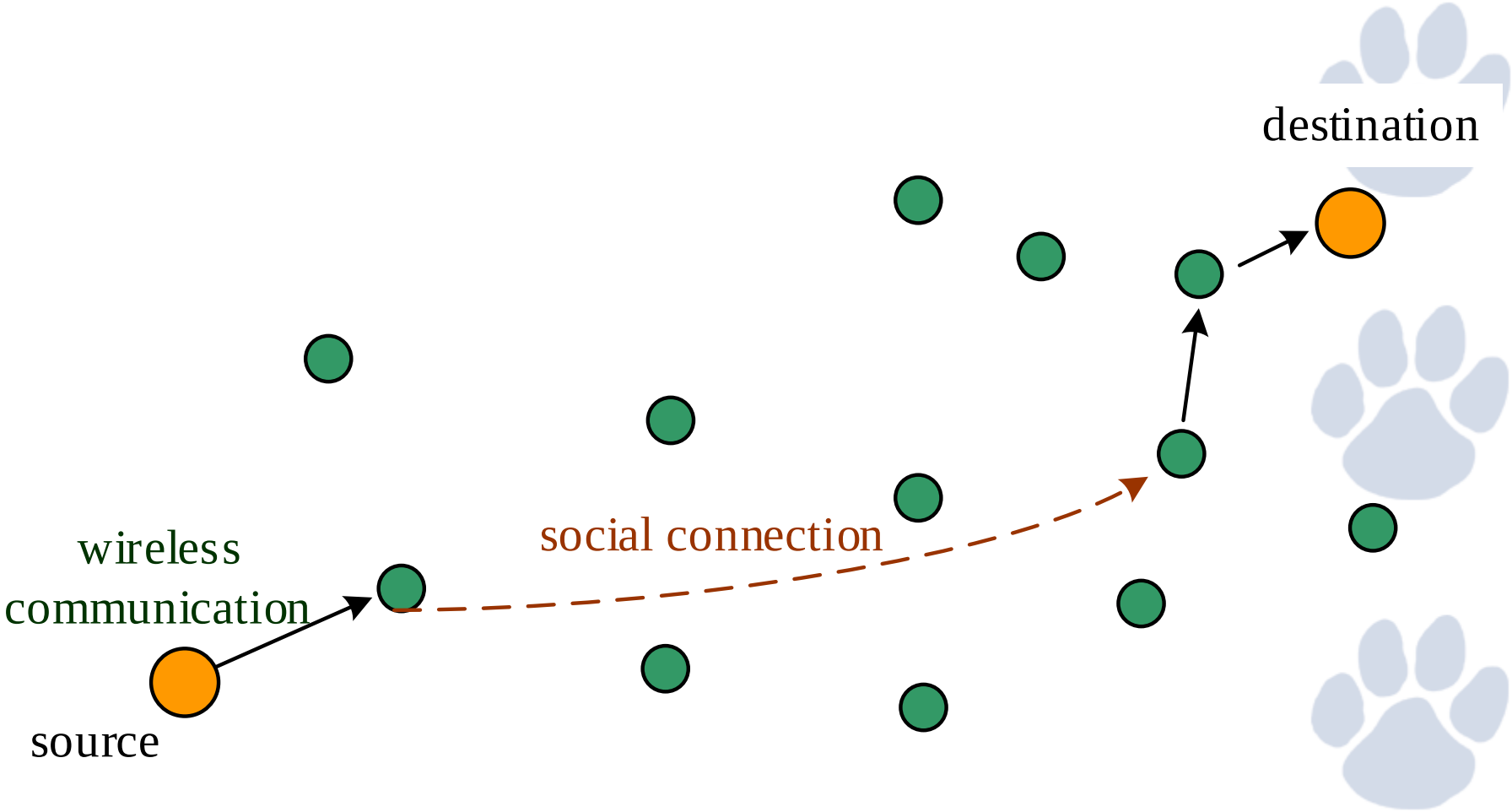
Example: Emergency broadcasting



Emergency!

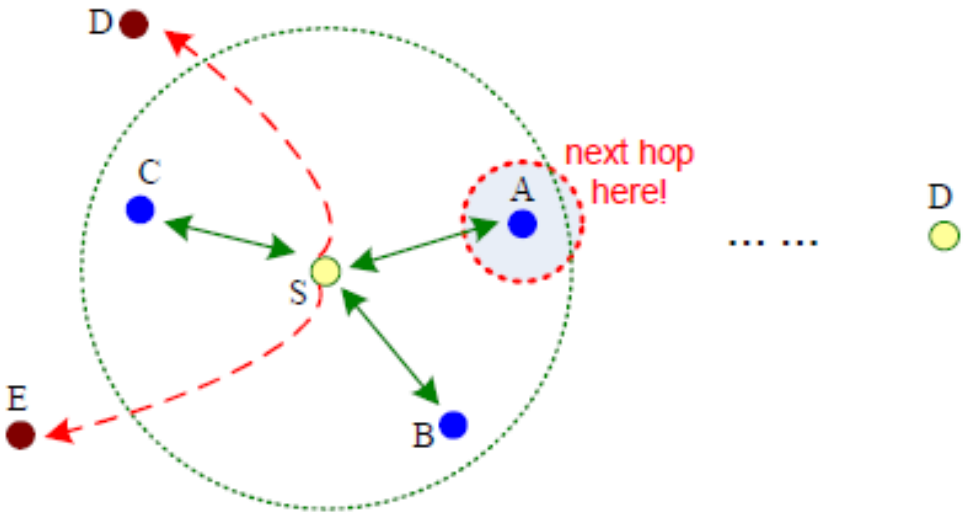
When B can get the message?

How to send a message: example



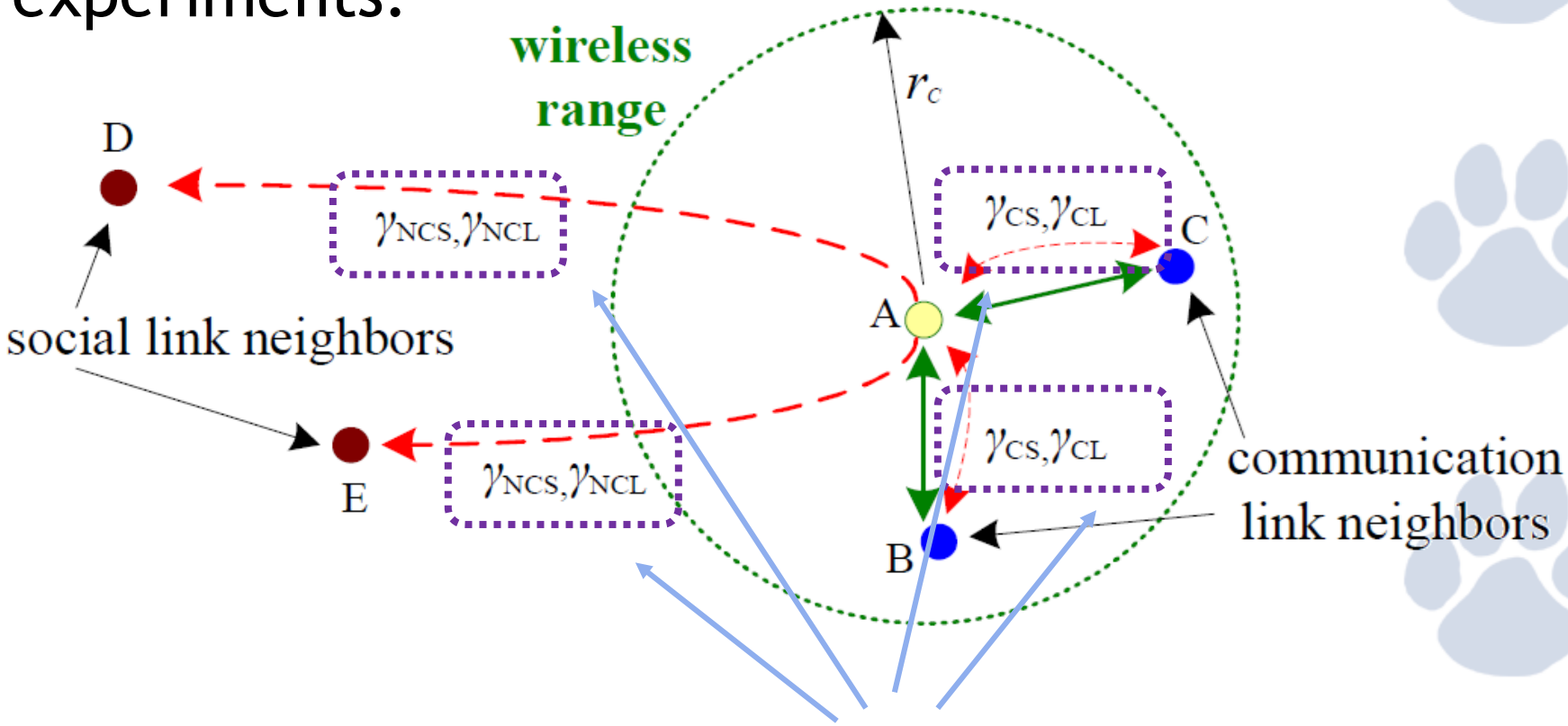
Greedy Routing

- In all of social link and communication link neighbors, attempt to find the next-hop node in neighbors, whose distance to the destination is the shortest.



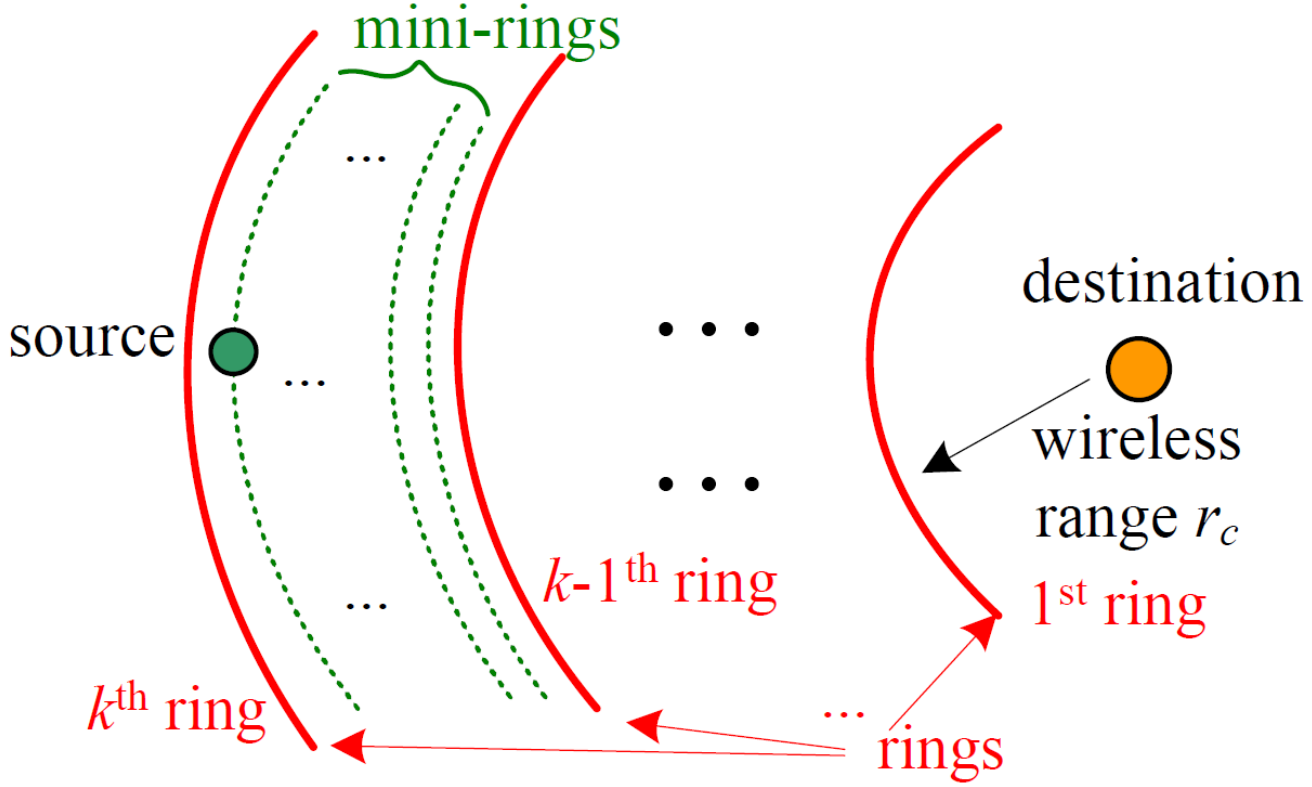
Coupling between social & comm. links

- We capture correlation between social and communication links in modeling, analysis and experiments.



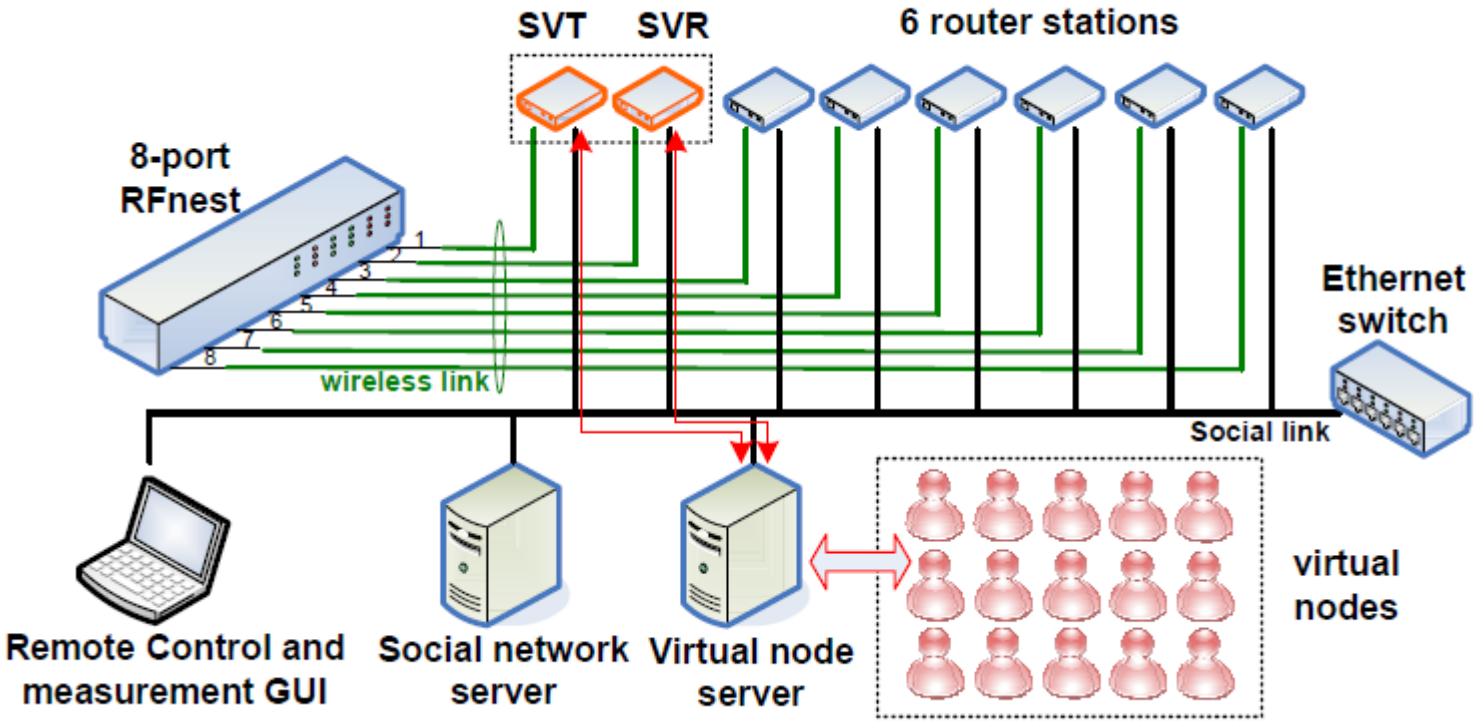
Approximation

- **Distance discretization**
  - get iterative solutions of delivery success probability and delay

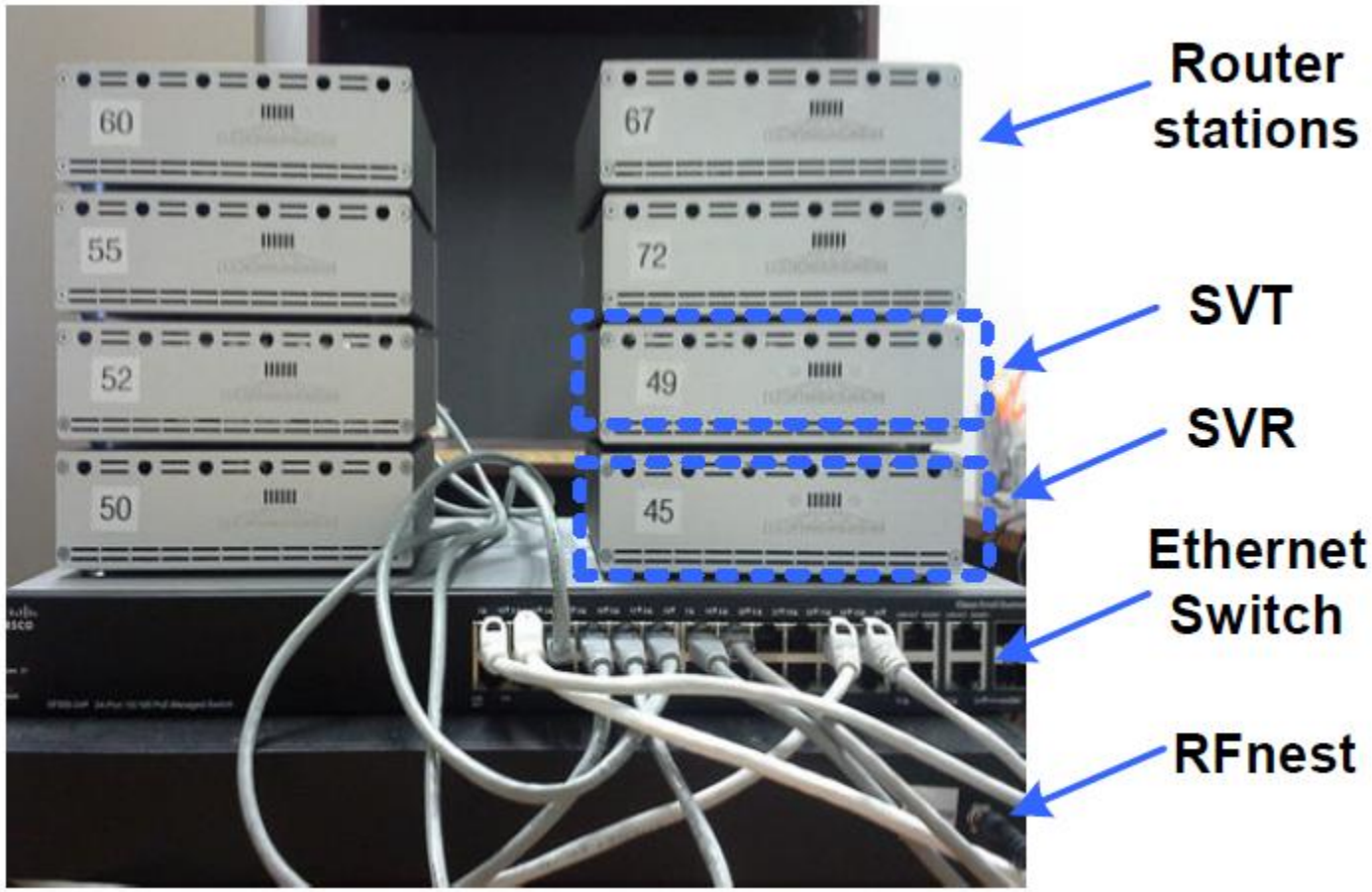


Emulation Testbed Setups

- SVT: Surrogate Virtual Transmitter
- SVR: Surrogate Virtual Receiver



Emulation Testbed Picture



Components

- RouterStation Pro:
  - WiFi, Ethernet interfaces
  - Running as a node
- WiFi
  - Wireless links
- Ethernet
  - Emulated social link controlled by social network server

RFnest: Multi-hop wireless channel emulator

Using RF cables connected to stations, RFnest accepts real RF signals and applies digitally controlled channel effects to RF signals

SVT SVR

6 router stations

wireless link

Ethernet switch

Social link

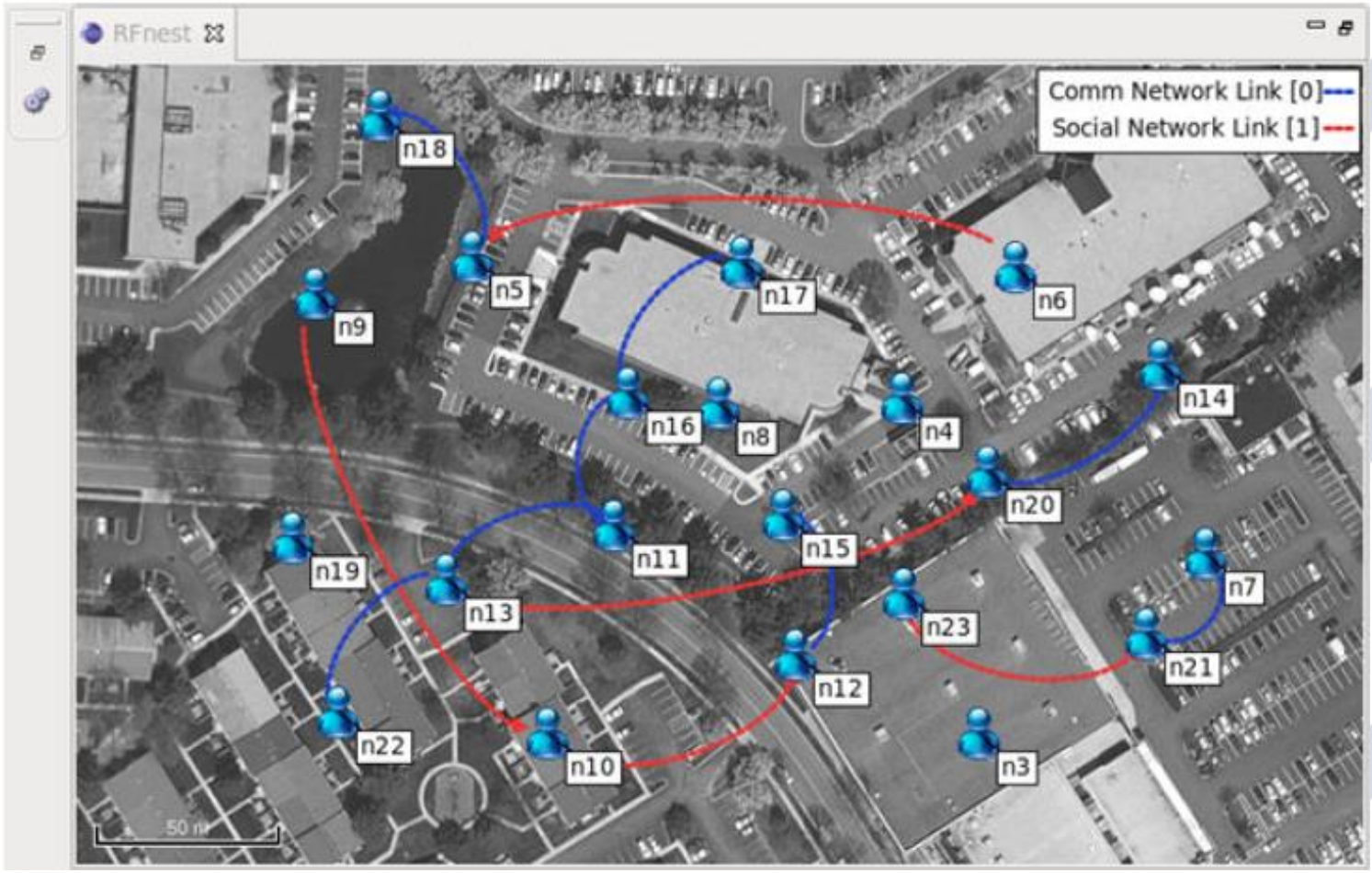
Remote Control and measurement GUI

Social network server

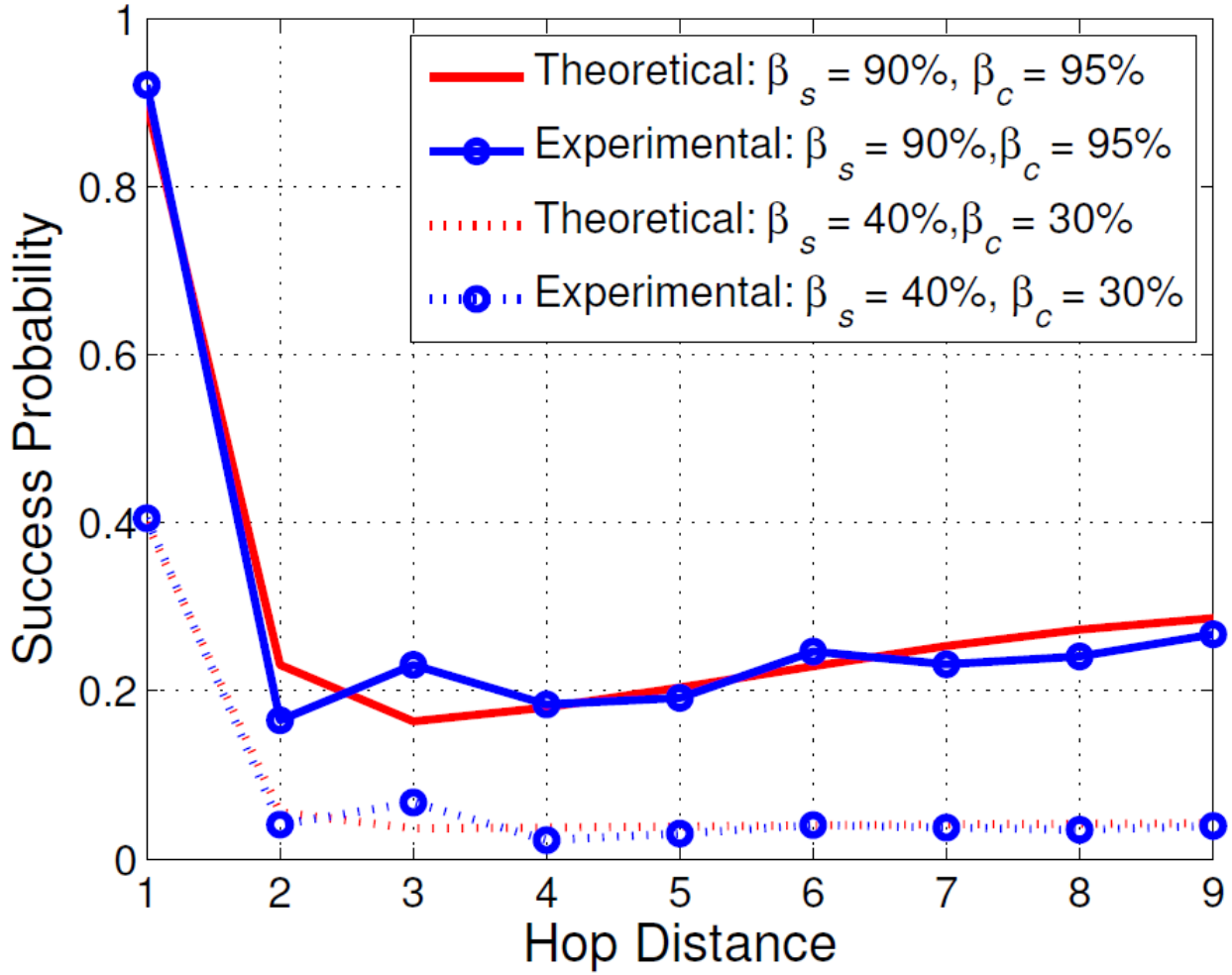
Virtual node server

virtual nodes

Visualization

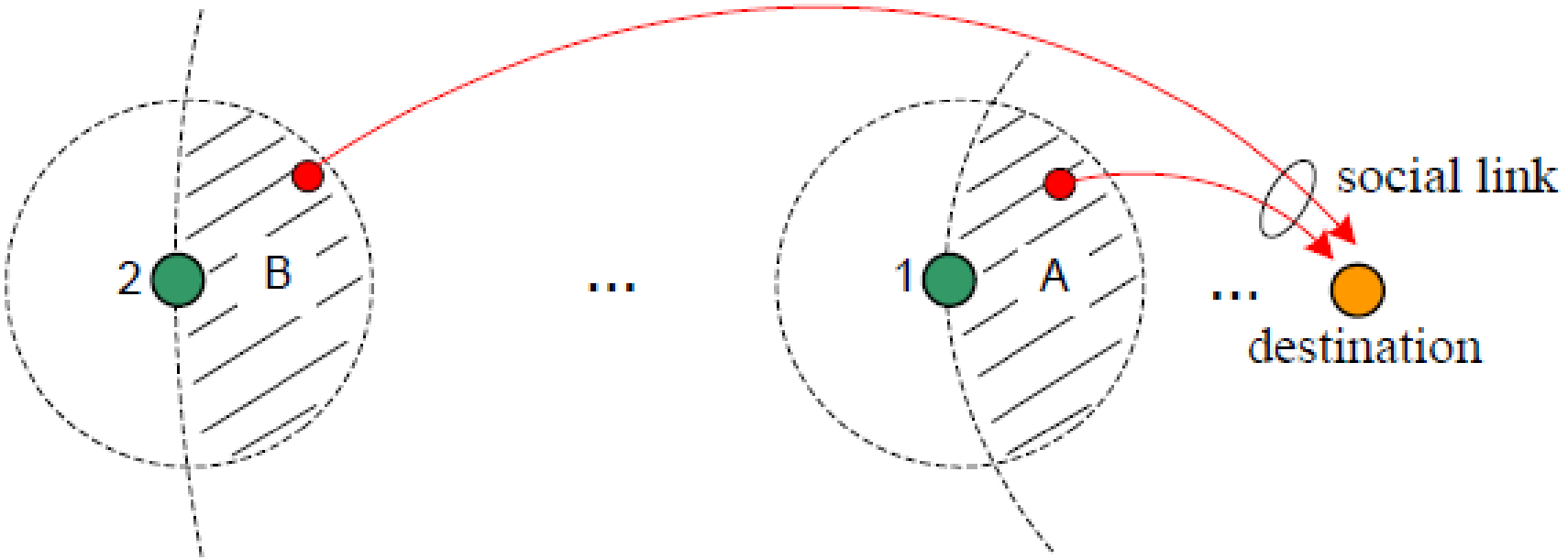


Experiments: Success Probability

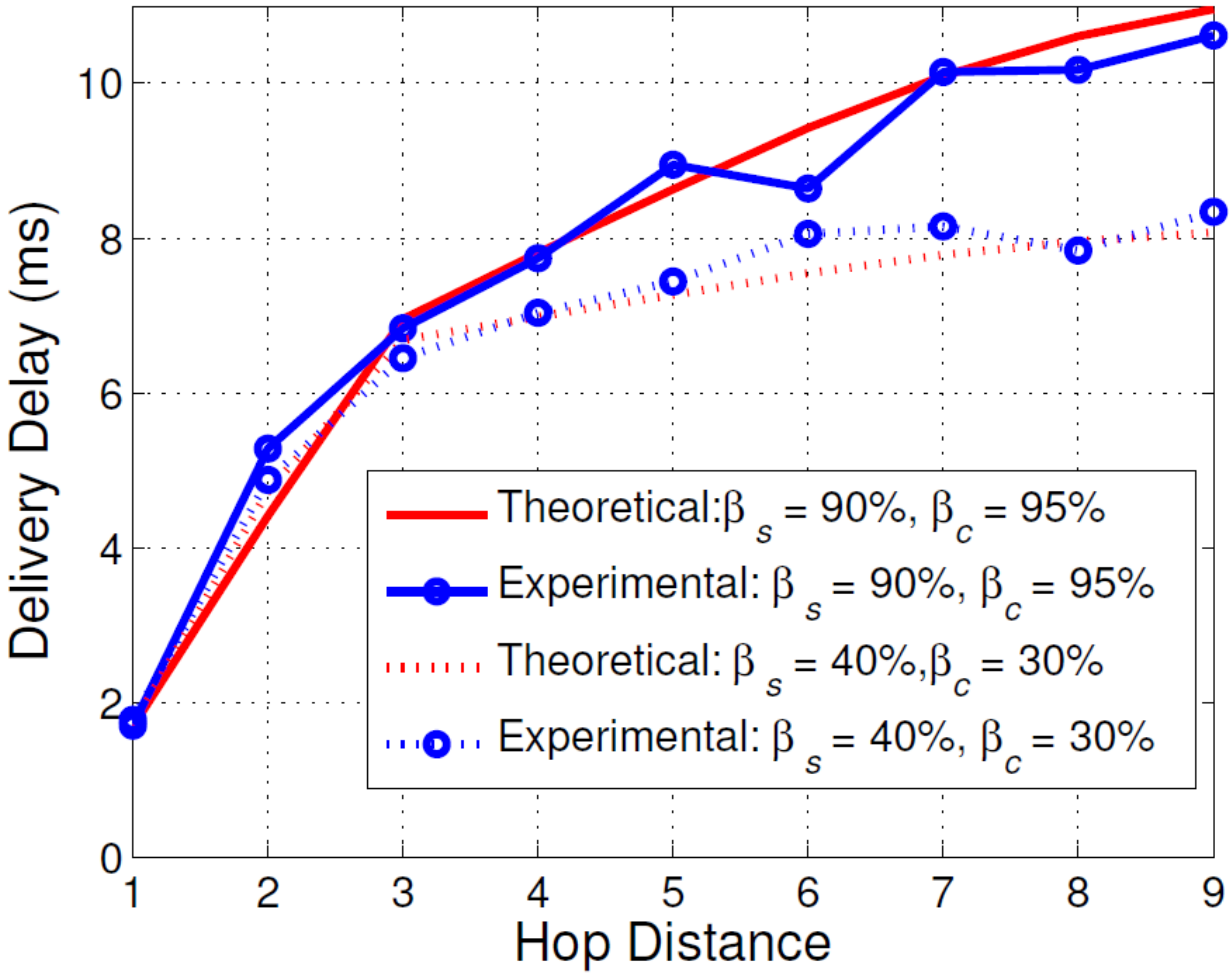


Greedy Routing

- Greedy routing: always move a message closer to the destination.
- Longer distance ➔ more likely to find a next-hop node with social link directly connected to the



Experiments: Delivery Delay



Conclusions

- Investigated the design of combining the social and wireless network.
- Small-scale experiments
  - Success probability is always bounded from below, as distance goes to infinity.
  - Average delivery delay is always bounded from above, as distance goes to infinity.
- Limitations:
  - How this model should work in practice.
  - Knowledge in routing, mobility, …