# Social Delay-Tolerant Network Routing

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## 1. Introduction

Mobile ad hoc DTNs may be useful for various scenarios including information propagation during disasters, bulk data distribution in urban areas and network connectivity in rural areas.

Since nodes may be mobile, static routing tables are inappropriate. When a source sends a message it is likely that the destination node (and even many of the intermediate nodes) is known to the source, and so researchers have explored the use of this social network information for building DTN routing tables[2].

Researchers have looked at **Detected Social Networks (DSNs)** where the users encounters are recorded in order to generate the social network. Asking users to declare contacts is another way of obtaining a social network. We are interested in comparing these **Self-Reported Social Networks (SRSNs)** with DSNs.

## 2. Data Collection and Analysis

In order to study DTN performance, we conducted an encounter-tracking experiment. 25 participants carried T-mote invent sensor motes for a total of 80 days.[1]. The SRSN and DSN of the participants can be seen in Figure 1 and Figure 2.

In order to determine whether the SRSN and DSN are similar, we employ a technique frequently used by social scientists: **role equivalence**. Role equivalence studies clustering among nodes. Two actors *i* and *j* are role equivalent if the collection of ways in which *i* relates to other actors is the same as the collection of ways in which *j* relates to other actors[3]. Role equivalence can be shown on a blockmodel, where nodes are grouped according to role and equivalence in connections from row to column actor is indicated by a black mark.

## 3. Social Network Comparison

The SRSN and DSN blockmodels show that on average, nodes in the DSN have a greater number of ties than in the SRSN. The SRSN roles seem to form more blocky structures with similar relations to each other, and with clear boundaries.

In the DSN, however, divisions seem to be distinguished by number of ties to the centre of the network. This implies that in the SRSN there are some key nodes that bridge structural holes in the social network and allow routing between members of the different roles. The DSN, with its greater number of ties, is less reliant on a small number of key nodes.

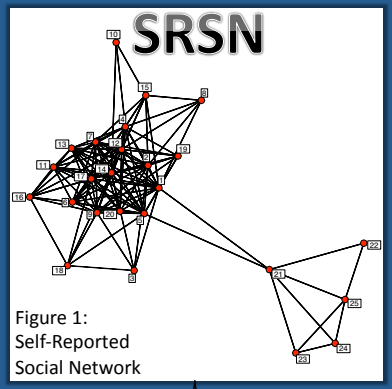



Figure 1: Self-Reported Social Network

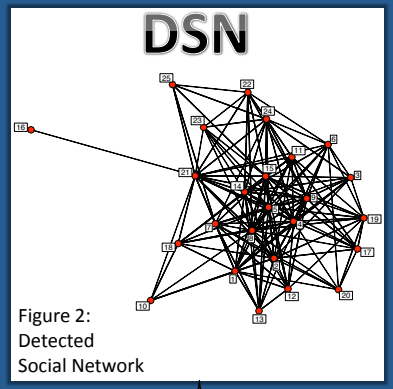



Figure 2: Detected Social Network

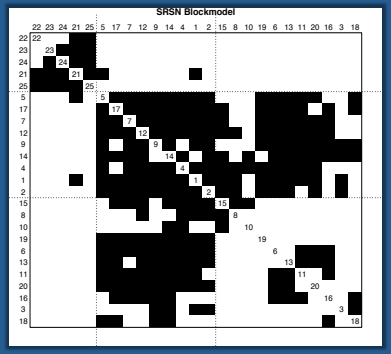
**Social Network Properties**

- Key nodes bridge structural holes
- Role structures have clear divisions based on similar relations
- Roles more well defined

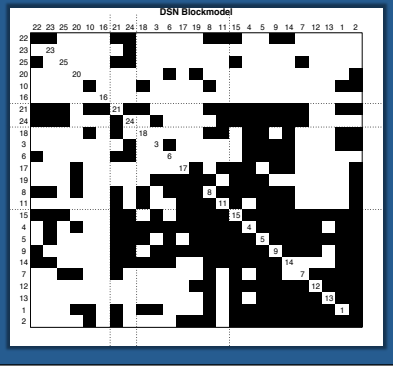
**Social Network Properties**

- Less reliant on key nodes
- Divisions distinguished by number of ties to center of network
- Roles less well defined

**Analysis of node roles**




**Analysis of node roles**




## 4. Routing Evaluation

To analyse the effects of SRSNs and DSNs on DTN routing performance, we used the two social networks as inputs to a simulated DTN. We observe similar trends for both DSN and SRSN in terms of delivery ratio, with the SRSN's delivery ratios around 6% lower. Figure 3 shows the delivery costs for the SRSN and DSN simulations. We observe that messages are sent at around a third of the cost when using the SRSN, with the largest difference for any TTL being 84.93 medium accesses per message sent.

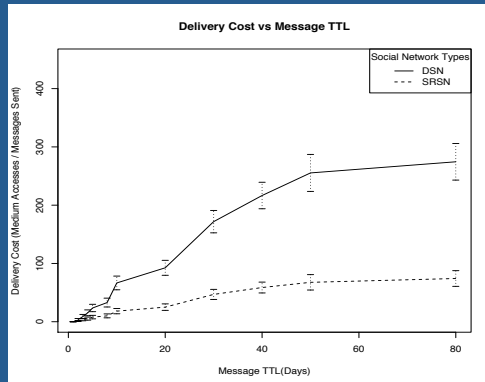



Figure 3: Comparison of SRSN and DSN delivery costs. We see that the SRSN has around a third of the cost for message sending.

## 5. Future Work

In the future we intend to: conduct larger-scale experiments using different devices and scenarios; explore how SRSNs and DSNs can be used together for routing; explore how to provide functionality to applications to tune the use of SRSNs within a DTN scenario; and explore how SRSNs can help in specific application areas.

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