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Society Dissemination Based Propagation For Data Spreading In Mobiles Social Networks

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Abstract: - In mobile ad hoc networks, nodes are dynamically changing their locations. MOBILE ad hoc networks (MANETs) consist of a collection of mobile nodes which can move freely. These nodes can be dynamically self-organized into arbitrary topology networks without a fixed infrastructure. A mobile ad hoc network consists of wireless hosts that may move often. Movement of hosts results in a change in routes, requiring some mechanism for determining new routes. Several routing protocols have already been proposed for ad hoc networks. MSNets can be viewed as a kind of socially aware Delay/ Disruption Tolerant Networks (DTNs). Thanks to the popularization of smart phones (e.g., iPhone, Nokia N95,and Blackberry), MSNets have begun to attract more attention. However, intermittent and uncertain network connectivity make data dissemination in MSNets a challenging problem. *Broadcasting* is the operation of sending data from a source user to all other users in the network. Most of the envisioned services (ranging from safety applications to traffic management) rely on broadcasting data to the users inside a certain area of interest. For example, location-based services (product prices, tourist points of interest, etc.) can be advertised from salesmen to near-by users. In this paper The objective is to broadcast data from a superuser to other users in the network. There are two main challenges under this paradigm, namely 1) how to represent and characterize user mobility in realistic MSNets; 2) given the knowledge of regular users' movements, how to design an efficient superuser route to broadcast data actively. We first explore several realistic data sets to reveal both geographic and social regularities of human mobility, and further propose the concepts of geocommunity and geocentrality into MSNet analysis.

Key Terms: -Mobile social networks, data dissemination, broadcasting, geography, community, acknowledgement.

I.INTRODUCTION

Our primary goal is to design flexible superuser routes for data broadcasting in MSNets, without any constraints on the movements of regular users. Hence, the main challenge is how to characterize and represent user mobility in MSNets. From a social network perspective, people sharing interesting properties (e.g., common hobbies, social functions, and occupations) tend to form a *community*. Through tracebased study, we detect an

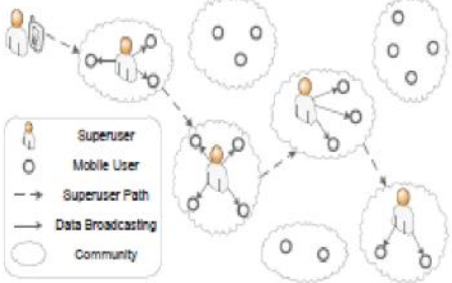

Diagram demonstrating our geo-community-based data broadcast scheme in MSNets

- Through trace-based study, we detect that

interesting phenomenon: *in MSNets, community always strongly relates to geography*. For example, graduate students working in the same office form a community, and they always contact each other in the office. Therefore, we propose *geo-community*, which represents a geography-related community, with MSNetsas undamentalstructure. By means of geocommunity, we characterize user mobility and further design superuser route to actively broadcast data to mobile social users in the network.

The novelty and contributions of this paper are as follows:

• We use three datasets collected from realistic MSNet environments to study the characteristics of user mobility. The experiment results show that people in a human society also express geographic regularity, as a supplementary social attribute. Therefore, we propose *geocommunitiesinto* MSNets to characterize both geographic and social regularities of user mobility.

a user's sojourn time at a geo-community does not follow the exponential, but instead a power-law distribution. Hence, we formulate user mobility over geocommunities in MSNets as a semi-Markov model.

• With a semi-Markov model, we compute each user's steady-state probability distribution over geo communities, and further propose *geo-centrality* to measure the user density of each geo-community. • Considering geo-centrality, we propose *Static Route Algorithms (SRA)* from a statistic perspective to the superuser that wants to either minimize total duration of the route (*min-T-SRA*), or maximize dessemination ratio (*max-p- SRA*). Furthermore, we also propose a *Greedy adaptive Route Algorithm (GARA)* excluding the overlap of contact user sets among the geo-communities.

II.RELATED WORK

In the context of intermittently connected networks, e.g. DTNs, Pocket Switched Networks (PSNs), and Opportunistic Networks, a number of routing schemes have been proposed for data forwarding and content dissemination. These routing schemes exploit the fact that end-to end paths do exist over time in intermittently connected networks, which depend on a store-carry-and-forward pattern. Most recent work focuses on proposing routing schemes to achieve comparable performance as Epidemic routing, but with a lower cost measured by the number of relays needed for forwarding. Spray&wait and its extended scheme Spray&focus both select a fixed number of data relays, while some other schemes make relay selection decisions based on the nodes' data forwarding metrics. In, a relay forwards data to another node, whose forwarding metric is higher than itself. Delegation forwarding is a single copy forwarding scheme, which reduces the cost, by only forwarding data to the node with the highest metric. However, all of these schemes use the intrinsic mobility of the nodes in the network.

Another set of work considers the possibility of controlled mobility for network routing. They have proposed communication models where special mobile nodes facilitate the network connectivity. However, these models always assume the special nodes move with fixed routes. SCFR studies a multiple ferry scenario, and the ferry trajectory is adaptive to the actual traffic and location of destinations. Moreover multiple relays are allowed in SCFR, but with control. However, only ferries are mobile and all other nodes are static. Tariq *et al*. aim towards designing a customized ferry route without disturbing nodes' movements in mobile DTNs. However, they laid many constraints on node mobility, and did not consider the social nature of the network. On the contrary, our data dissemination scheme exploits the social characteristics of mobile networks without any online collaboration between the superuser and regular users in the network. Though we focus on a different application (data broadcasting from the superuser to regular users), our superuser also can extend to work as a "data carrier" between regular users. As such, it strengthens the research of both mobility assisted routing schemes, and even the foundations in the area of intermittently connected networks.

EXISTING METHOD:

MOBILE Social Networks (MSNets) are networks in which mobile social users physically interact with each other and further reach network service, even in the absence of network infrastructure or end-toend connectivity. MSNets can be viewed as a kind of socially aware Delay/Disruption Tolerant Networks (DTNs). However, intermittent and uncertain network connectivity make data dissemination in MSNets a challenging problem.

PROPOSED METHOD:

The main idea behinds this is exploring both geographic and social properties of users mobility to facilitate data dissemination on purpose. We explore the geographic and social regularities of users mobility from both theoretical and experimental perspectives. Based on the exploited characterization, we introduce a semi-Markov process for modelingusers mobility. The proposed superuser route comprises several geo-communities and the according waiting times, which are both calculated carefully based on the semiMarkov model. Extensive trace-driven simulation results show that our data broadcast schemes perform significantly better than other existing schemes.

III.GREEDY ADAPTIVE ROUTE ALGORITHM

In this algorithm, we also choose geocentrality as the community's utility, but instead, it computes geo-centrality of *noncontacted users* for each community repeatedly. Throughout the rest of this section we use the following notation. Given a collection of geo-communities $S = \{1, 2, \ldots, J\}$ over a domain of users $M = \{1, 2, \ldots, N\}$. LetG be a collection of *contacted* users (i.e., the users who have already received the data from the superuser). Assume $Ci(ti)$ as the geocentrality function of geo-Community *i*during waiting time *ti*, we further propose *C_i*(*ti*) to denote such centrality of *noncontacted*users covered by geo Community *i*(i.e., facing users not covered by set G).Algorithm shows the details of *GARA* for *time-sensitive superuser*(i.e., *min-T-GARA*), where *T* represents the time constraint for the superuser route, and the subscript *cur* indicates the current community where the superuser stays. *tsoj*is the waiting time at the current community, and *tcur;* indicates the traveling time from the current community to Community *j*, which is a constant and is known by the superuser as described before. *C_i*(0) stands for the

gradient of *C_i*(*ti*) at *ti*= 0. Note that *min-TGARA* can be easily changed to *max-pGARA*by modifying *Step. 4* to the constraint of dissemination ratio.

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Algorithm 1 Greedy Adaptive Route Algorithm for Time-sensitive Superuser (***min-T-GARA***)

1: $\mathbb{G} \leftarrow \varnothing; \mathbb{U} \leftarrow \mathbb{S}; T$
2: Compute $C_i'(0)$ for every $i \in \mathbb{S}$
3: Stop at the geo-community with maximal $C_i'(0)$
4: **for** $(t = 1; t < T; t++)$ **do**
5:   **if** $User_k \in Community_{cur}$ **then**
6:     $\mathbb{G} \leftarrow \mathbb{G} \bigcup User_k$
7:   **end if**
8:   $\mathbf{a}[i] = \bar{C}_i'(0), 1 \le i \le J, i \ne cur$
9:   $temp = \mathbf{a}[j] = \max \mathbf{a}$
10:   **if** $(\bar{C}_{cur}'(t_{soj}) \le temp) \wedge (\bar{C}_j(T - t - t_{cur,j}) \ge (\bar{C}_{cur}(T) - \bar{C}_{cur}(t_{soj})))$ **then**
11:     Move to Community j
12:   **else**
13:     Stay at the current community
14:   **end if**
15: **end for**

We elaborately illustrate *Step* 8.−11. in Algorithm 1. Intuitively, *GARA* aims to maximize the sum of centrality within the total duration of superuser route. Obviously, the superuser
will choose the geo-community with maximal *C*′ *i*(*t*)|*t*=0 as the first stop. What matters is *if* and *when* the superuser should move to other geo-communities. Without loss of generality, we consider the condition of two geo-communities in the network. As shown in Figure 8, suppose there are two geocommunities with *C*′
1(*t*)|*t*=0 > *C*′ 2(*t*)|*t*=0, and the traveling time *t*1;2 between two geo-communities is a constant, given a superuser speed. Assumptions on *when* and *if* the superuser should move to the other geo-communities are:

*C*1: The waiting time *t*1 for the superuser staying at geo- Community *1* before leaving for geo-Community *2* is

$$C_1'(t)|_{t=t_1} = C_2'(t)|_{t=0}$$

*C*2: *C*2(*t*2) ≥ *C*1(*T*) − *C*1(*t*1)

Theorem 1: Suppose assumptions C1-C2 hold, then the total centrality will achieve maximum within time constraint T.

*C*2 is obvious, since if the travel cost of moving to the other geo-community is less than the total utility gain, the superuser should move; otherwise, the superuser would be better to stay at the current geo-community. However, we prove the optimal transition time instant (Eq. (5)) in the Appendix. Note that the prerequisite of Theorem 1 is that the two geo communities have unchanged centrality functions, whereas
GARA faces the dynamic centrality of geocommunities. However, the algorithm can guarantee the maximal total utility for the whole system at the transition time instant
(i.e., *ti*).

In contrast to *SRA*, *GARA* can overcome the overlap among geo-communities in the network by facing non-contacted users each step, but the trade-off is introducing more computational overhead.

IV. EVALUTION REPORTS

Our evaluations are conducted with Matlab on a realistic dataset, *Infocom 06*, with AP locations on the map. We extract the distance between any two APs from the map of conference site4, and treat it as the moving distance of the superuser between the two corresponding geo-communities. We compare our schemes (*SRA* and *GARA*) with the following two Message-Ferry based routing schemes for *timesensitive*(*min-T*) and *dissemination-ratio-sensitive* (*max-p*) superusers, respectively.

- **Message Ferry moves with Restricted Random Waypoint model (*MF-RRWP*):** The ferry moves according to the random way-point mobility model, with the restriction that the way-points are only chosen from the center of each geocommunity. At each way-point, the ferry pauses for exponentially distributed time with a mean of 15 minutes.
- **Message Ferry moves along ordered set of waypoints (*MF-ORWP*):** The ferry orders the center of each geo-community (way-points) to form a shortestpossible tour using the Concorde Traveling Salesman (TSP) solver. The ferry traverses the ordered set of way-points repeatedly.

In our simulation, we focus on the following two metrics, which are key characteristics in data dissemination of MSNets:

- Dissemination ratio: the ratio of the number of delivered users to the total number of users in the network.
- Average cost: the traveling distance of the superuser. Note that although the superuser is not limited in power supply, we still aim to maximize the energy efficiency.

V. CONCLUSION

In this paper, we have studied one-hop data broadcasting from a single superuser to other users in MSNets. The main idea behinds this is exploring both geographic and social properties of users mobility to facilitate data dissemination on purpose. We explore the geographic and social regularities of users mobility from both theoretical and experimental perspectives. The proposed super user route comprises several geo-communities and the according waiting times, which are both calculated carefully based on the semi-Markov model.

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