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Gregarious Characteristics Based Social Aware Routing in Mobile Ad-Hoc Network

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ABSTRACT- Mobile ad hoc Network (MANET) is a type of wireless mobile network that does not guarantee continuous network connectivity. Intermittently connected network (ICMAN) refers to the network where no end-to-end paths exist from time to time. However in normal MANET, usually end-to-end paths exist, which is not the case in ICMAN. This concept is also similar to Delay Tolerant Network, since both require a 'store-carry-forward' style of message propagation. In such a network, people move around and contact each other based on their common interests. The routing hence becomes a process to resolve the social feature differences between a source and a destination. Present social friendship avoid selfness node based Routing in which temporally differentiated friendships are used to make the forwarding decisions of messages. In a typical sensor network, where small packets generated by sensors need to be periodically reported to the base station, end-to-end delay plays a more important role. This paper presents how to achieve the minimum end-to-end delay for regular traffic through routing.

Key Words – *MANET, Routing protocol, Throughput and Delay, Social aware routing, social features*

I INTRODUCTION

An ad-hoc network is a collection of wireless mobile hosts forming a temporary network [1]without the assistance of any centralized administration or any stand-alone infrastructure. The mobile applications present additional challenges for mesh networks as changes to the network topology are swift and widespread. Such scenarios require the use of Mobile Ad hoc Networking (MANET) technology to ensure communication routes are updated quickly and accurately. Ad-hoc networks are a new paradigm of wireless [2] communication for mobile hosts where node mobility causes frequent changes in topology. The communication of nodes can only be conducted when they are in the communication range of each other. When a node has a copy of message, it will store the message and carry it until forwarding the message to a node in the communication range which is more appropriate for the message delivery. These mobile opportunistic networks could be comprised of human-operated mobile devices moving in restricted physical spaces, such as conferences, university campuses, refectories, clubs and in many other social settings. For instance, they could include networks of commuters sharing every morning and evening the same train/bus. In essence, they are characterized by nodes with heterogeneous contact rates, unpredictable mobility and limited information; communication in such settings relies on both opportunistic multi-hop forwarding and physical carrying of messages by mobile nodes. Different from wired networks, MANETs exhibit unpredictable topology and as such the adopted mobility model has a crucial role in testing the performance of routing algorithms. Designing new algorithms or choosing between existing ones depends on different factors varying from the context the software is deployed and operable to the mobility patterns of users operating the software. In a disconnected environment, data must be forwarded using node encounters in order to deliver data to a destination. The problem of message delivery in disconnected delay-tolerant networks can be modelled as the flow of information over a dynamic network graph with time-varying links. This section reviews network theory that may be applied to social networks along with social network analysis techniques. Synthetic mobility models have been largely used to measure quantitative aspects of routing protocols but these are not sufficient as they do not capture reliably the properties of movement in the real life scenarios. In a typical sensor network, where small packets generated by sensors need to be periodically reported to the base station, end-to-end delay plays a more important role. This paper aims to address how to achieve the minimum end-to-end delay for regular traffic through routing.

II RELATED WORK

J. Burgess, et al., "MaxProp: Routing for vehicle-based disruption-tolerant networking," 2006 - Disruption-tolerant networks (DTNs) attempt to route network messages via intermittently connected nodes. Routing in such environments is difficult because peers have little information about the state of the partitioned network and transfer opportunities between peers are of limited duration. In this paper, we propose MaxProp, a protocol for effective routing of DTN messages. MaxProp is based on prioritizing both the schedule of packets transmitted to other peers and the schedule of packets to be dropped.

P. Li, et. al., "Smooth trade-offs between throughput and delay in mobile ad hoc networks," 2012 - Throughput capacity in mobile ad hoc networks has been studied extensively under many different mobility models. However, most previous research assumes global mobility, and the results show that a constant per-node throughput can be achieved at the cost of very high delay. Specifically, we assume that a network of unit area with n nodes is evenly divided into cells with an area of n -2α, each of which is further evenly divided into squares with an area of $n^{-2\beta}(0\leq \alpha \leq \beta \leq 1/2)$.

N. Lu, T. H. Luan, et al., "Capacity and delay analysis for social-proximity urban vehicular networks," 2012 - In this paper, the asymptotic capacity and delay performance of social-proximity urban vehicular networks with inhomogeneous vehicle density are analyzed. Specifically, we investigate the case of N vehicles in a grid-like street layout while the number of road segments increases linearly with the population of vehicles.

J. Zhang, X. Wang, et al., "Optimal multicast capacity and delay tradeoffs in MANETs," 2014 In this paper, we give a global perspective of multicast capacity and delay analysis in Mobile Ad Hoc Networks (MANETs). Specifically, consider four node mobility models: two-dimensional mobility, two-dimensional hybrid random walk, one-dimensional mobility, and one-dimensional hybrid random walk. Two mobility time-scales are investigated in this paper fast mobility where node mobility is at the same time-scale as data transmissions and slow mobility where node mobility is assumed to occur at a much slower time-scale than data transmissions. In this paper, the asymptotic capacity and delay performance of social-proximity [11] urban vehicular networks with inhomogeneous vehicle density are analyzed. Specifically, we investigate the case of N vehicles in a grid-like street layout while the number of road segments increases linearly with the population of vehicles. Each vehicle moves in a localized mobility region centered at a fixed social spot and communicates to a destination vehicle in the same mobility region via a unicast flow. With a variant of the two-hop relay scheme applied, we show that social-proximity urban networks are scalable: a constant average per-vehicle throughput can be achieved with high probability. A method is developed for deriving lower bounds on the convergence time by merging nodes according to their mobility pattern.

III IMPLEMENTATION

A. Mobility

Node movement capabilities are implemented through mobility models. Mobility models define the algorithms and rules that generate the node movement paths. Three types of synthetic movement models are included

- Random movement
- map-constrained random movement
- Human behavior based movement.

The simulator includes a framework for creating movement models as well as interfaces for loading external movement data. Implementations of popular Random Walk (RW) and Random Waypoint (RWP) are included. While these models are popular due to their simplicity, they have various known shortcomings. It is also possible to completely omit mobility modelling and construct topologies based on static nodes. To better model real-world mobility, map-based mobility constrains node movement to predefined paths and routes derived from real map data. Further realism is added by the Working Day Movement (WDM) model that attempts to model typical human movement patters during working weeks.

B. *Social Metrics Calculation*

The links in the social graph we consider may be known a priori or inferred from the frequency of observed contacts. To evaluate the similarity of two nodes in a more accurate way, we look at the nodes' past meeting ratios. Each individual node X has a vector of length $m: \langle x_1, x_2, \ldots \ldots x_m \rangle$, where $x_i = \frac{M_i}{M_{total}}$ that is,

$$< x_1, x_2 \ldots\ldots x_m > = \langle \frac{M_1}{M_{total}}, \frac{M_2}{M_{total}}, \frac{M_3}{M_{total}} \ldots\ldots\ldots \frac{M_m}{M_{total}} \rangle \quad \text{Eq (1)}$$

Where M_i is the number of meetings of X with nodes whose social feature F_i is the same as the destination's feature Fi, and M_{total} is the total number of meetings of X with any other node in the history we observe. Thus $0 \leq xi \leq 1$ for all $1 \leq i \leq m$. With the node's vector defined, the next task is to use similarity metrics to compare the similarity of two vectors An ideal forwarder R is a theoretical node who meets people like destination D all the time.

C.Selfishness Avoid

Selfishness has been well-studied in sociology and economics, and has recently been considered in design of computer networks. In MANETs, selfishness can describe the selfish behaviours of MANET nodes controlled by rational entities. Selfish nodes can behave selfishly at individual level and aim to[3] only maximize their own utilities without considering system-wide criteria. They can also behave selfishly in a social sense and are willing to forward packets for nodes with which they have social ties but not the others. A selfish MANET node may drop others' messages and excessively replicate its own messages to increase its own delivery rate while significantly degrading other users' performance or even cause starvation.

D. Routing

All of the social based routing methods discussed above are unicast routing protocols for MANETs. Social based approaches can be applied to multicast routing protocols for MANETs as well. The integration of two distinct communication and social layers is shown [4,5]to increase routing robustness at the expense of added delay due to the higher cost assigned to social links. Fig. 3.1 illustrates the interaction of MANET links and the underlying social connections of the users carrying devices. If links at the device level do not exist, an alternate route can be traced through the social Underlying social component of wireless links shown in Figure1.

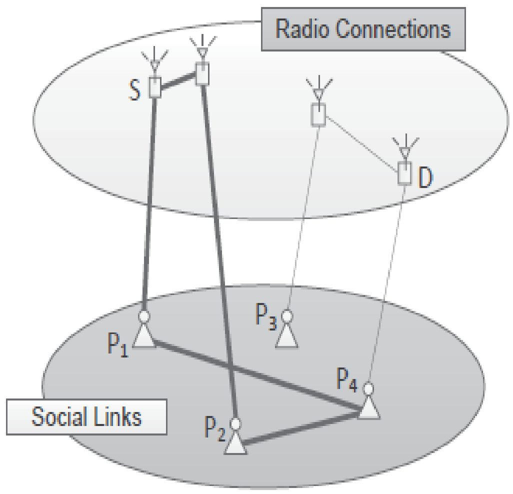

Fig1: Underlying social component of wireless links

S can transmit the message to the device of user P2 and then P2 can carry the message to P4; or P1 can deliver the message directly to P4 through social interaction. The investigated QOS routing approach leverages these social interactions by including the social links as feasible paths and assigning them heavier weights for the routing decision. When using only the contact graph, routes exploiting virtual social links may have never been considered as valid despite the improvement to overall robustness, at the expense of added delay.

IV METHODOLOGY

A. Social network based Routing

Social proximity and content knowledge to augment the efficiency of data delivery in urban, dense scenarios. it show the advantages That brings to the operation of opportunistic networks (in terms of delivery, cost and latency) through simulations based on synthetic mobility and trace-based scenarios. First, nodes with similar daily habits have higher probability of having similar (content) interest; second, social proximity metrics allow a faster dissemination of data. If a node A has n contacts with another node having an interest contact k having a certain duration (Contact Duration – CD (a,x)k), at the end of ΔTi the Total Connected Time to Interest x (TCT I (a, x)i) is given by Eq. 2.

$$TCTI(a,x)_i = \sum_{k=1}^{n} CD(a,x)_k \qquad \text{Eq (2)}$$

The Total Connected Time to Interest x in the same daily sample over consecutive days is used to estimate the average duration of contacts towards the data interest x for that specific daily sample. The ATCT I during the same daily sample ΔTi in the previous day (ATCT I(a, x)(j−1)i) as illustrated in Eq. 3.

$$ATCTI(a,x)_{ji} = \frac{TCTI(a,x)_{ji} + (j-1)ATCTI(a,x)_{(j-1)i}}{j} \qquad \text{Eq (3)}$$

Then, node A computes the Time-Evolving Contact to Interest x (TECI) (cf. Eq. 4) to determine its social[6,7] strength (w(a, x)i) towards consecutive t − 1 samples, where t is the total number of samples can be Represent the Eq.4

$$TECIw(a,x)_i = \sum_{k=i}^{i+t-1} \frac{t}{t+k-i} ATCTI(a,x)_k \qquad \text{Eq(4)}$$

In order to compare the routing strategies, here define three important metrics to evaluate their performance:

1) *Delivery ratio*: The fraction of generated messages that are correctly delivered to the final destination since the beginning of the simulation.

2) *Delivery latency*: The time between when a message is generated and when it is received.

3) *Packet duplication*: The number of duplications needed to deliver a message to its destination.

Efficient routing entails a high delivery rate and low latency with an acceptable number of duplications.

B. Social aware multipath routing

Assume that there are N individuals in the system. Each individual can be represented by a Social feature profile, a representation of her/his social features [8] within a *feature space*, also called the F-space. The following algorithm Represent the Node-Disjoint-based Routing in Source node Shown in the following figure2.

Algorithm1: Node-Disjoint-based social aware Routing (Source node)

1: if B and D are the same group then
2: Forward the packet to D.
3: else
4: case i ∈d: d = d−{i} and send Ci,0 to B.
5: case i ∈d': d' = d' −{i} and send (C||i,1) to B.
6: case i / ∈d∪d': do nothing.
7: end if

Fig 2: Node-Disjoint-based social aware Routing (Source node)

In ,Figure 2 for the source node, the source sends (seq, mode) to a matching neighbour, where mode is 0 for a shortest path or 1 for a non-shortest path. Seq is the result of a circular left shift of C0 for mode=0. D is the destination. The source also maintains two vectors, d and d'. [9]d is initialized as{1,2,...,k}, which are different features between the source and destination. d' is {k,k + 1,...,m}.The following algorithm Represent the Node-Disjoint-based Routing in Source node Shown in the following figure3.

Algorithm2: Node-Disjoint-based social aware Routing (Non-Source node)
1: if B and D are in the same group then
2: Forward the packet to D
3: else
4: case $m = 0 \wedge i = first(C')$*: send* $(C' - \{i\}, 0)$ *to B*
5: case $m = 1 \wedge i \in C'$*: send* $(C' - \{i\}, 1)$ *to B*
6: end if

Fig 3: Node-Disjoint-based social aware Routing (Non-Source node)

In Figure3 , for a non-source node, source routing is used when the routing path is determined by the packet header seq. **Step 4** represents short-path routing, where a strict coordinate sequence order is followed through extracting the first dimension in C′. **Step 5** corresponds [10]to non-shortest path routing, where any permutation of dimension differences can be used.

V. RESULTS AND DISCUSSIONS

In our simulation, used the real world connectivity and traffic traces, collected during a N4C deployment in 2010. The total number of MANET nodes was 18 and the number of bundles sent 1407. The lifetime of these bundles was set to three days.

In the second evaluation we used the Working Day Model (WDM) with the default settings for WDM in the SWANS simulator. [11,12]The simulation time was set to one week and the expiry time for the bundles was set to 1430 minutes. The number of nodes was 500, and a total of 17000 bundles were sent. In this set up, the buffer space was limited to 100MB per node and the available bandwidth was 100 Kbit/s.

Our simulations produced three sets of results using the traces of the buses for determining when transfer opportunities occur and for how much bandwidth is transferred at each.

1. Delivery rate and latency when offered load varies from 2 to 18 pkts/hour on each bus (with fixed buffer size and packet size). These values represent the means of exponentially [13,14] distributed packet loads.
2. Delivery rate and latency when buffer size varies from 500KB to 5MB on each bus (with fixed offered load and packet size).
3. Delivery rate and latency when packet size increases from 10KB to 100KB (with fixed buffer size and offered load).

A. PERFORMANCE COMPARISON

This experiment is done on SWAN 1.6 by simulated and using synthetic traces, analyzed how the protocols performed In order to compare the routing strategies, here define three important metrics to evaluate their performance.

Table1: Packet Delivery Ratio

Protocols	**Buffer size**				
	2	**4**	**6**	**8**	**10**
Epidemic	0.34	0.43	0.5	0.6	0.73
Prophet	0.43	0.45	0.58	0.73	0.79
Location Popularity	0.51	0.57	0.61	0.85	0.84
Social based selfness avoid	0.64	0.7	0.84	0.95	1.0

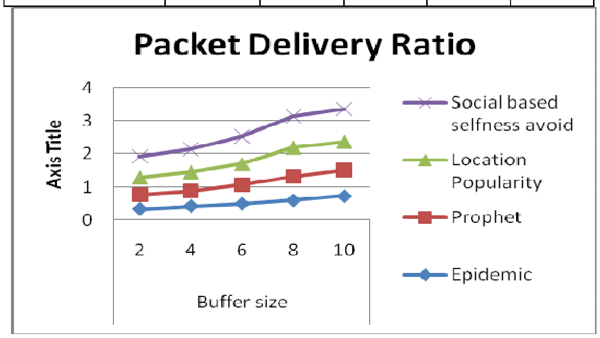

Fig4:Packet Delivery Ratio

Fig 4 shows packet delivery ratio against Buffer size. It shows that the Proposed Social based selfness avoid protocol has a better throughput in the different size of buffer.

Table 2: Average latency

Protocols	**Buffer size**				
	2	**2**	**2**	**2**	**2**
Epidemic	77	66	55	52	48
Prophet	68	61	48	45	41
Location Popularity	59	52	43	39	36
Social based selfness avoid	51	46	38	35	31

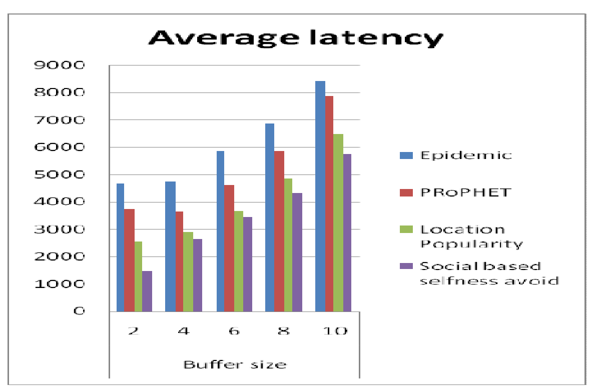

Fig 5 Average latency

Fig.5 shows the average delay of a message as the buffer size varies. Similar to the delivery ratio, the result shows that the performance of Social based selfness avoids is better than those of existing protocols.

Table 3: Overhead Ratio

Protocols	**Buffer size**				
	2	**4**	**6**	**8**	**10**
Epidemic	4673	4765	5873	6894	8435
Prophet	3745	3646	4638	5873	7874
Location Popularity	2547	2896	3689	4876	6474
Social based selfness avoid	1457	2643	3457	4328	5757

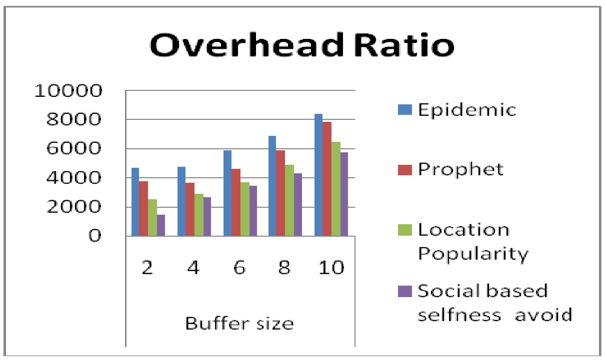

Fig 6: Overhead Ratio

Fig6 overhead ratios as function of buffer size Similar to the delivery ratio, the result shows that the performance of [15] Social based selfness avoid is better than those of existing protocols.

VI CONCLUSION

An Improved general approach for adaptively updating modules in dynamic networks which is the key in social-aware routing strategies. With the coming of information era, our lives have been filled with varied mobile devices. Due to the popularity of mobile devices, Mobile Ad Hoc Network (MANET) has been widespread more than ever. However, "how to obtain trustworthy information from trusty nodes through social network" is a significant issue. This research gears toward social aware assisted transmission in MANET. The proposed routing scheme utilizes the social relationships between people to select relays in a reliable and effective way. The simulation results show that our routing scheme achieves a much better performance in terms of packet loss rate and overhead ratio than the existing routing schemes such as Direct Delivery, First Contact, MaxProp, and Prophet.

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