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Geo-Social: Location and Social Metrics Enabled MoNs Routing Algorithms

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***Abstract*—Mobile opportunistic networks (MONs) are intermittently connected networks in which a multitude of mobile devices are carried by people and packets are delivered among devices via opportunistic communications. In opportunistic networks (OppNets), messages are transmitted between nodes in an opportunistic fashion following a store , carry-and-forward approach and a routing protocol, with the hope to reach their destinations. Routing in MONs is very challenging as it must handle network partitioning, long delays, and dynamic topology. In existing routing protocols for OppNets, different parameters such as node's delivery predictability, node's mobility, distance with respect to destination, node's energy consumption, contact duration between nodes etc.. are considered in the selection of the best suitable next hop to carry the message toward the destination. In this paper we have presented a routing protocol which considers the location history, access patterns of mobile user as its feature and infer the location and social relationship between the mobile users. We have a large dataset of mobile users which is simulated and simulation results show the effectiveness of geo social methods.**

***Index Terms*— Delay tolerant network, Geo social metrics, Routing.**

I. INTRODUCTION

Mobile opportunistic network (MON) has begun late drawn a great deal of thought from structures association analysts because of its wide applications, for example, adaptable, easygoing systems, smaller information sharing, and participatory perceiving. A metric is proposed, which aims to quantify the importance of a node based on frequency, utility and network topology (R.B. Geeta et al. 2011). Deft organizing (Lilien et al. 2006) is an organizing point of view for remote couple-skip networks (Perkins et al. 2003) that mishandling the striking idea of remote (Johnson and Maltz 1996) correspondence to course store in a message to pass on forward structure toward its goal. Organizing tries is MON astoundingly trying a consequence of the nonattendance of brief as far as possible ways, tremendous transmission deferral and wobbly structure geography. There is an innate need to look at this distributed information that leverages the past, monitors the present and predicts the future with accuracy (Shashikumar et al. 2018).

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The lead and social characteristics of profitable customers pick the flexibility of the clients. To improve controlling execution the social traits typically critical because they prop up for extended length, and are logically dependable in MONs condition, in like manner utilizing them to pick progressively vigilant sending choices may significantly lessen the control overhead. Meanwhile, with the accessibility of improved region data, district-based strategies have been utilized for masterminding correspondence appears in changed adaptable structures. The most remarkable outcome is position based controlling in versatile phenomenally named structures or sensor systems, where organizing choices are totally made dependent on the position data. We run in excess of two distinct kinds of procedures to utilize zone data in MON or DTN organizing. A pinch of the DTN sorting out checks induces the going with ricochet hand-top survey point using the current space information as the standard position-based controlling does. For instance, GeoDTN+Nav strategy consolidates the GPSR methodology with DTN controlling for a vehicular DTN. Managing of packs to the neighbors is done on the smallest fragment to the objective and if the current network point doesn't have any neighbor starting at now; it changes to DTN mode by techniques for passing on the social event. The other game-plan of the territory based strategies play out the adaptability need through transportability course of action showing up over veritable region information of center core interests.

II. Location based Routing

In this section of the paper we introduce two simple location-based routing methods.

A. Location Based Routing

An area profile of every client is collected from client's history which incorporates the visit recurrence and span of a spot in the past may suggest the chance of this client to visit this spot later on. Along these lines by recording the authentic visiting recurrence and length of every area, the client will meet the specific spot.

B. Top-Location Based Routing

In Top-Location Based Routing every hub followed to register and track its own area the source profile while hub followed to get a goal's area the outline and state immersion in the information lead. On an off chance that the system traverses countless spots, the size of area profile could be immense lead which to enormous lot of overhead. Along these lines, we have attempted to rearrange the count of area profile and area closeness among hubs.

III. GEO-Social based Routing

In this section, we propose some new geo-social routing methods which consider the location information and social properties of mobile users.

A. Geo-Social Metrics: Home and Work Places

The social relationships of users can be known by their location information. If two users' location information is very close, we can infer that they are neighbors. If their living place is same then they might be family members. If two users' location information is very close during only the day we can infer that they are colleagues. If we consider a mobile user rests for eight hours every day and spends almost ten hours in the office we can infer from the information whether they are family members or colleagues depending upon their location during the day and night time. These are the social features by which we can infer the opportunities of the communication between the users.

B. Geo-Social Based Routing

1. Geo-Social Based Routing Based on Work or Home: The first two methods use the numbers of common home and work places. The more common home or work places between two users, the more likely they live or work in the same place.

Thus the relay node is selected by comparing ComW(vj,vd) and ComH(vj,vd) of the neighbor vj with ComW(vi,vd) and ComH(vi,vd) of the current node vi.

- Work: a message is only forwarded from vi to vj if and only if (iff) vj has more common work places with vd than vi has, i.e. ComW(vj,vd) > ComW(vi,vd).
- Work/Home: a message is only forwarded from vi to vj iff ComW(vj,vd)+ComH(vj,vd) > ComW(vi,vd)+ ComH(vi,vd) or ComW(vj,vd) > ComW(vi,vd)

2. Geo-Social Based Routing with Multiple Metrics: Using multiply metrics as relay selection criterion may benefit by taking advantage of varies information resources. We now explore the combination of

social- and location-based metrics in the following three geo-social based routing methods

- Location+Centrality : a message is only forwarded from vi to vj if and only if Sim(vj,vd) > Sim(vi,vd) or c(vj) > c(vi). Here c(vi) is the degree centrality from the contact graph G where two nodes share an edge if they have met before.
- Work/Home+Centrality : a message is only forwarded from vi to vj iff ComW(vj,vd) > ComW(vi,vd) or ComW(vj,vd) + ComH(vj,vd) > ComW(vi,vd) + ComH(vi,vd) or c(vj) > c(vi).
- Work/Home+Bubble : we jointly consider both common home/work places with the destination (ComH(vi,vd) and ComW(vi,vd)) and the home/work centrality (ch(vi) and cw(vi)) in home/work social graphs. When the current node doesn't have any common home/work places with the destination, it chooses the relay node with higher home/work centrality or with common home/work places with vd since it is not close to either home or work places of the destination. Until the current node meets with a node, which has common home/work places with the destination, it then only relays the message to the node, with more common home/work places with the destination (same as Work/Home)

Algorithm Work/Home+Bubble Routing (W/H+Bubb)

When node vi with a message M destined to vd encounters a node vj.

1: if vj = vd then
2: vi forwards M to vj
3: else if ComW(vi,vd) + ComH(vi,vd) = 0 then
4: if ch(vj) > ch(vi) or cw(vj) > cw(vi) or ComW(vj,vd) > 1 or ComH(vj,vd) > 1
then
5: vi forwards M to vj
6: else
7: vi holds on M
8: else
9: if ComW(vj,vd)+ComH(vj,vd) > ComW(vi,vd)+ ComH(vi,vd) or ComW(vj,vd) > ComW(vi,vd)
then
10: vi forwards M to vj 11: else 12: vi holds on

IV. RESULTS

To test our proposed geo-social based routing methods, we also implement four representative MON routing algorithms.

- Naive: this message is always sent to the node during any encounter. It can be treated as a single-copy version of Spray and Wait
- Fresh: the message is only forwarded from the current node vi to the encountered node vj if vj has met the destination more recently than vi does.
- Destination Frequency (Dest-Freq): the message is only forwarded from vi to vj if vj has met the destination more often than vi does.
- Centrality (Centr): the message is only forwarded from vi to vj if vj has higher centrality than vi does. Here, we use the degree centrality as the centrality metric, similar to many existing social-based methods

We measure the following parameters in our proposed work.

- Average delivery ratio, the average percentage of successfully delivered messages from source to destination. Fig 1.
- Average hop count: the average number of hops during each successful delivery from source to destination. Fig 2
- Average number of forwarding: the average number of messages forwarding in the network. Fig 3
- Average delay (in secs), the average time duration of successfully delivered messages from source to destination. Fig 4

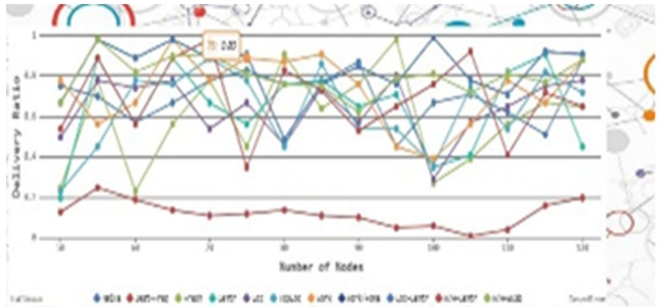

Figure 1. Average delivery ratio

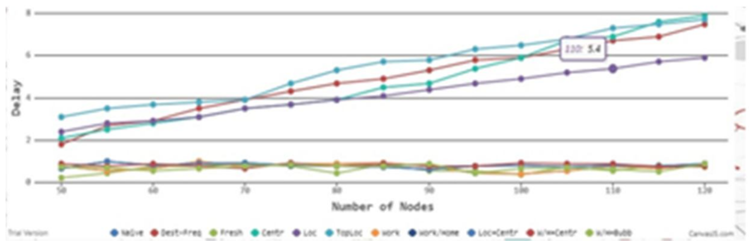

Figure 2. Average number of Hop Count

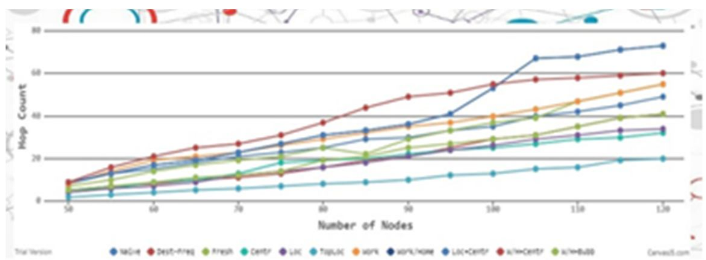

Figure 3. Average number of forwarding

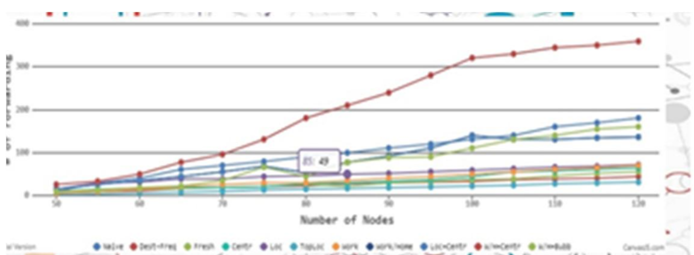

Figure 4. Average delay

V. Conclusion

In this paper, we have designed and implemented the geo-social based MON routing methods which consider both social and Location information of mobile users as geo-social metrics. These algorithms help to identify relay nodes using these geo-social metrics. The efficiency of geo-social based approaches in MON routing via extensive simulations over a real-life large-scale wireless tracing data is shown.

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