Time sensitive Interest-based routing protocol in Social Opportunistic Networks

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Abstract. With more and more portable mobile devices used in life, many applications and services with wireless technologies are explored in recent years. Due to the close relationship between mobile devices and people, the mobility of mobile devices is influenced heavily by people's social relationship. Social Opportunistic Networks utilizes store-carry-and-forward fashion in intermittently connected networks. It is mainly based on social relationship to design solutions for problem such as routing protocol. In this paper, we study social relationship about interest information among people and use them to predict the contact probability. In addition, time factor is considered. We present Time Sensitive Interest-based routing protocol (TSI) and establish experiments based on real trace data set from SIGCOMM2009. The simulation results show that the efficiency of TSI outperforms Epidemic and PROPHET.

Keywords: Social Opportunistic Networks; Interest; Routing Protocol.

1. Introduction

Recently, short transmission wireless technologies such as Bluetooth and WiFi have been exploited as a promising solution to tackle the 3G overload problem. In intermittently connected networks, it is difficult to find an end-to-end path from source node and destination node. Mobile nodes use store-carry-and-forward or store-carry-and-replicate manner to implement the delivery process hop by hop.

As the main carriers of mobile devices, the mobility of mobile nodes have close relationship with human's social relationship. Social Opportunistic Networks are mainly based on social relationship to design routing protocol. Generally, people's movement follow regular pattern from time aspects. For example, students usually have breakfast at 7:00 am and start a class at 8:00 am. Then they end classes at 12:00 am and have lunch. Based on the time regularity, the meet opportunities between them can be predicted.

In addition, interest is a special property which is related not only with data, but also with people. And people's interest in different time may be various. In this paper, we integrate time regularity and interest property and propose a time sensitive interest-based routing (TSI).

The remainder of this paper is organized as follows. Section 2 presents the system model and implementation of TSI Routing. We describe the simulation for TSI Routing in Section 4. Finally, Section 5 gives conclusion for this paper.

2. System Model and Implement

2.1 System Model.

We assume there are N mobile devices using wireless transmission technology such as Bluetooth or WiFi. Every node needs to maintain their interest information according to time. Interest information involves first-interest information and second-interest information. For the first-interest information, people can record the interest ID and its degree in different time peirods into the mobile device. For the second-interest information, the TSI is responsible to store and maintain according to the contact information, which is illustrated as Eq. (1) as follows. And the evaporation process is necessary for the degree by Eq. (2).

$$\deg ree = \sum n \quad (1)$$

$$\deg ree\_new = \deg ree\_old * \gamma^{\kappa} \quad (2)$$

2.2 System Implement.

In TSI, mobile nodes record and maintain the first-interest information and second-interest information according to contact times in a time window and successful delivery record. When two nodes such as NA and NB are in transmission range, they exchange interest information and message list firstly, then compute the prediction function. And TSI consists of 5 steps. For implicitly description, we give the detailed introduction from NA's aspect. NB does the same process as NA.

(1) Firstly, NA and NB exchange their related interest information and message list for each other.

(2) According to the interest information, two nodes update their second-interest information in current time periods.

(3) For each message in NA, NA checks whether NB is the destination. If NB is the destination, the message is delivered to NB.

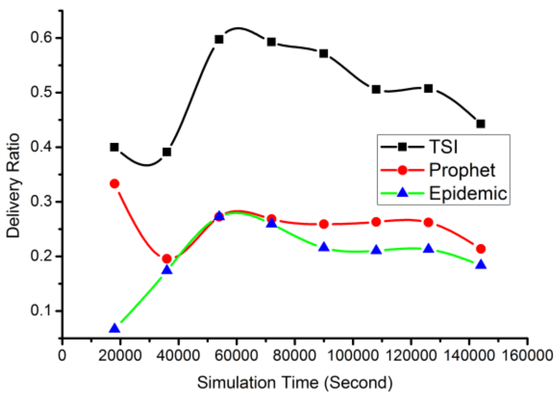
(4)The message list consists of the destination information (ND). For each message, TSI compare the similarity between current node and destination node through comparing their interest information in next several time periods in order to compute the meet probability. We assume that message in message list of NB has recorded the meet probability between NB and ND (supposed P_{BD}). For each message, TSI computes the meet probability between NA and ND, supposed P_{AD}. If $P_{AD} > P_{BD}$, the message is decided to deliver from NB to NA. The meet probability is decided by the corresponding degree.

(5) Start the transmission process until beyond the transmission range.

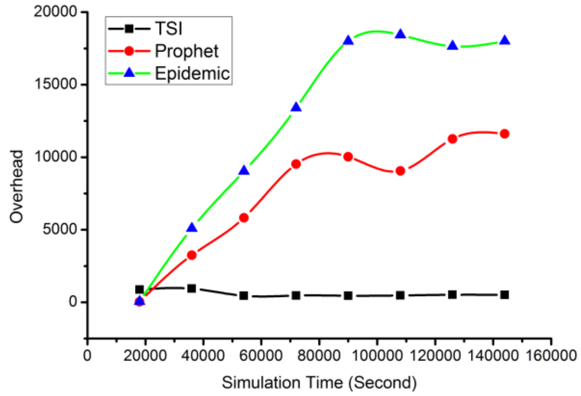
3. Simulation

In this paper, we establish experiment to evaluate the routing performance of TSI by using real data set SIGCOMM2009 [14] in ONE simulator [15]. The messages with 8 hours TTL are generated randomly. In the simulations, four performance metrics are evaluated including delivery ratio, overhead, average latency and average hop count. We compare the effectiveness of our TSI with two 'non-oblivious' routing protocols: Epidemic and PROPHET.

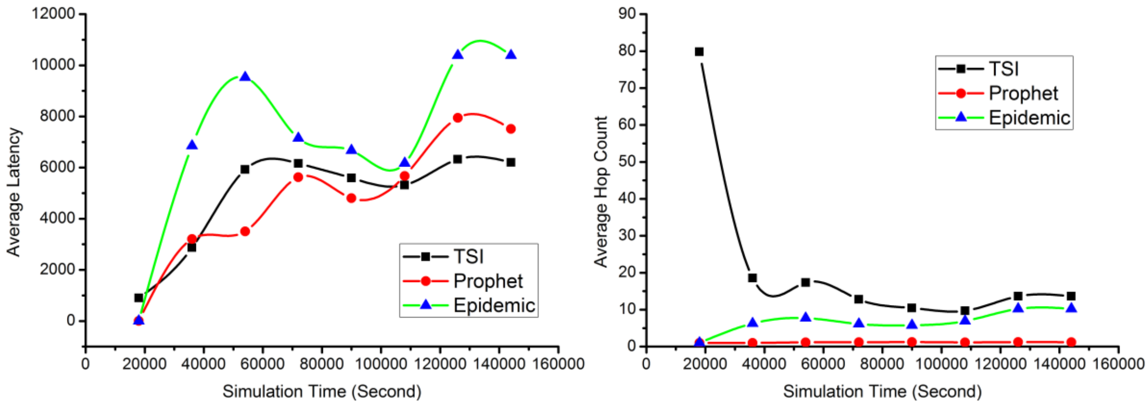
In Fig 1, we show comparison of three algorithms in terms of delivery ratio, overhead ratio, average latency and average hop count. The simulation times are designed at 5 hour interval. As shown, the performance of TSI outperforms Epidemic and PROPHET. In Fig 1 (a), the delivery ratio of TSI is far higher than Epidemic and PEOPHET. For example, in 15 hours, TSI forwards 59.74% , which is much higher than Epidemic with 27.27% and PROPHET 27.27%. In Fig 1 (b), the overhead of TSI is 445, which is much lower than Epidemic with 9030 and PROPHET with 5826. In Fig 1 (c), the average latency of TSI is 5922, which is close to Epidemic with 9524 and PROPHET 3506. In Fig 1 (d), the average hop count of TSI is 17, which is close to Epidemic with 7 and PROPHET 1.



(a) Delivery Ratio



(b)Overhead



(c) Average Latency (d) Average Hop Count

Fig. 1 Efficiency Comparison

4. Conclusion

In this paper, we present a routing protocol in social Opportunistic Networks, named Time Sensitive Interest based routing protocol (TSI). In TSI, each mobile node records and maintains first-interest and second-interest information according to different time periods. And based this information, TSI predicts higher meet probability to the destination device as better forwarder. The simulation shows that TSI obtains the higher efficiency than Epidemic and PROPHET in higher delivery ratio, lower overhead and shorter average latency.

Acknowledgements

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