Interest-based prediction routing protocol in Opportunistic Networks

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Abstract. Mobile devices are popular used in people’s life. Many applications and services through wireless technologies are provided. Opportunistic Networks are used in intermittently connected networks by use of store-carry-and-forward fashion. It is mainly based on opportunistic meet opportunities to forward messages. In this paper, we study influence of interest information and use them to predict the contact probability. We present Interest-based Routing protocol (InR) and establish experiments based on real trace data set from INFOCOM06. The simulation results show that the efficiency of InR outperforms Epidemic and PROPHET in higher delivery ratio, lower overhead.

Keywords: Opportunistic Networks; Interest; Routing Protocol.

1. Introduction

With the proliferation of portable mobile devices and wireless transmission technologies, many applications and services using wireless technologies have been developed recently. Short transmission wireless technologies such as Bluetooth and WiFi have been more and more exploited. In Opportunistic Networks [1] and DTNs [2], mobile nodes are intermittently connected. And there is large latency due to lack of end-to-end pass from source node and destination node. Mobile nodes use store-carry-and-forward manner to implement the delivery process hop by hop. It is the key problem in routing field to predict future contact probability through studying nodes' mobility property.

Many properties are exploited to utilize and predict the appropriate intermediate nodes as forwarders. Interest is a special property which is related not only with data, but also with people. People with same interest may be together a long time to share their data. They are generally sensitive to similar data.

In this paper, we utilize interest property as a main evidence to exploit routing protocol. On one hand, we collect the interest list for mobile nodes, called self-interest, and maintain their changes. On the other hand, we collect the second-interest list in order to record the successful delivery related interests.

We present a routing protocol named interest based routing protocol (InR), which is based on the self-interest and second-interest information to predict the future meet opportunities.

The rest paper is illustrated as follows. Section 2 introduces system model and implement of InR. We establish simulations for InR using real trace data in Section 3. Finally, Section 4 presents the conclusion.

2. System Model and Implement

2.1. System Model.

We assume there are K mobile nodes with short transmission wireless technologies such as Bluetooth or WiFi. Each node need to maintain their self-interest information and second-interest information. For the self-interest information, people can record their interest ID and their degree into the mobile device and maintain manually. For the second-interest information, the InR routing protocol is responsible to capture and maintain them in mobile process.

Self-interest and second-interest shares same structure which is constructed of value-pair (ID, degree). Where ID represent the interest and the degree indicate the sensitive strength of the interest.

The difference between them is that the degree of self-interest is based on input or track about the operation history.

On the contrary, the degree of second-interest is based on the successful delivery times about the interest. Thus, the degree of second-friend is based on Eq. (1) as follows.

$$\deg = \sum n \tag{1}$$

Where, n represents the successful delivery times about the interest. Finally, an evaporation process is necessary for the degree by (2). γ and k is evaporation factor.

$$\deg\_new = \deg\_old * \gamma^{\kappa} \tag{2}$$

2.2 System Implement.

In InR, mobile nodes record and maintain two parts of information: self-interest information and second-interest information. When two nodes are in transmission range, they exchange message according to InR, which consists of 4 steps. For implicitly description, we assume the transmission is happened between node NA and NB. And we give the detailed introduction from NA's aspect.

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

(2) The interest of Message is supposed as M_I. For each message in NA, NA checks whether NB is the destination. If NB is the destination, the message is delivered to NB. On the same time, NA maintains the second-interest information about M_I. Otherwise, go to (3).

(3)The message list consists of the destination information (ND) and current meet probability. For example, message in message list of NB has a meet probability between NB and ND (supposed P_{BD}), which is mainly based on degree in (ID, degree) in NB. For each message, InR 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.

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

3. Simulation

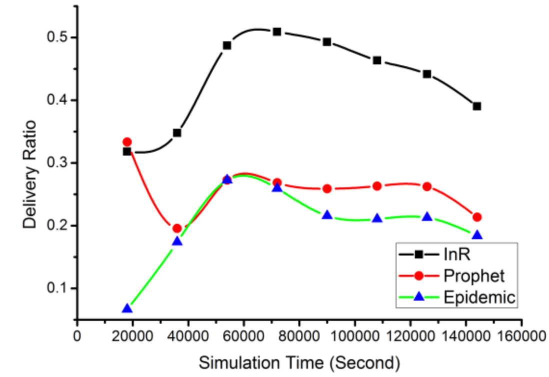
In the simulation, we use real data set collected by an opportunistic mobile social application MobiClique during INFOCOM06 conference [14] through ONE simulator [15]. The messages with 5 hours TTL are generated randomly.

In the simulations, four performance metrics are evaluated including delivery ratio, overhead, average latency and average hop count.

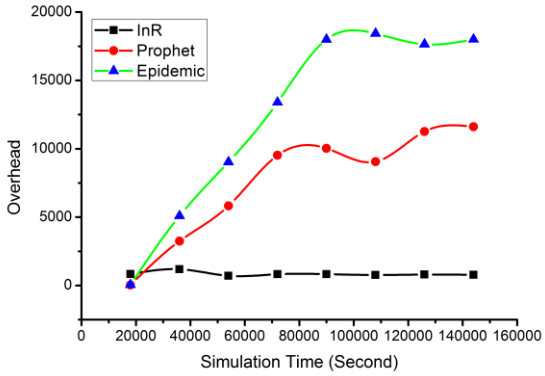
We compare the efficiency of our InR with two 'non-oblivious' routing protocols: Epidemic and PROPHET.

In Fig 1, we show comparison of all algorithms in terms of delivery ratio, overhead ratio, average latency and average hop count under different simulation times respectively.

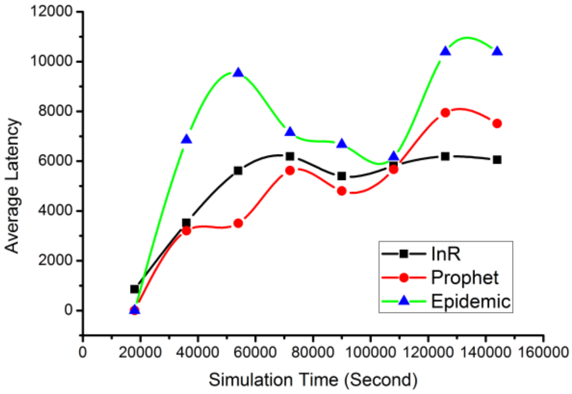
As shown, the performance of InR outperforms Epidemic and PROPHET. In Fig 1 (a), the delivery ratio of InR is far higher than Epidemic and PEOPHET. For example, in 20 hours, InR forwards 50.9% , which is much higher than Epidemic with 25.93% and PROPHET 26.85%. In Fig 1 (b), the overhead of InR is 823.7, which is much lower than Epidemic with 13394 and PROPHET 9521. In Fig 1 (c), the average latency of InR is 6190, which is close to Epidemic with 7147 and PROPHET 5623. In Fig 1 (d), the average hop count of InR is 14, which is more than Epidemic with 6 and PROPHET with 1.



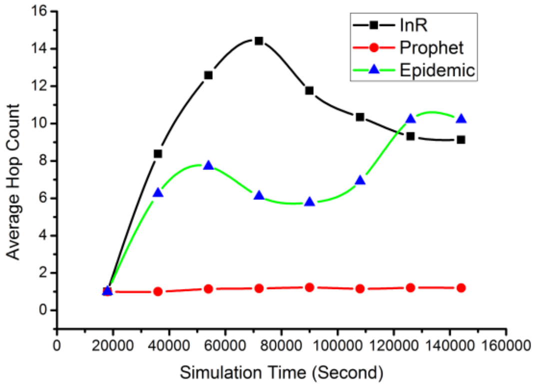
(a) Delivery Ratio



(b)Overhead



(c) Average Latency



(d) Average Hop Count

Fig. 1 Efficiency Comparison

4. Conclusion

In this paper, we present a routing protocol in Opportunistic Networks, named interest based routing protocol (InR). In InR, each mobile node records and maintains self-interest and second-interest for successful delivery. Based this information, InR chooses the higher meet probability to destination node as the better forwarder in order to improve the efficiency. The simulation shows that InR obtains the higher efficiency than Epidemic and PROPHET in higher delivery ratio, lower overhead.

Acknowledgements

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