SHODH SANGAM -- A RKDF University Journal of Science and Engineering

Impact of Buffer Size Variation on Average Latency and Average Hop Count

Vadher Jashmita Jayantibhai[1] and Puneet Dwivedi[2]

[1]MTech Scholar, Bhabha College of Engineering, RKDF University, Bhopal, INDIA
[1]Assistant Professor, RKDF College of Technology and Research, RKDF University, Bhopal, INDIA
puneet.rkdf@gmail.com

Abstract: ***This paper presents the performance analysis of various routing protocols: Epidemic, Spray and Wait, MaxProp and Prophet, by analyzing the effect of size of buffer. To measure the performance of Epidemic, Spray and Wait, MaxProp and Prophet routing protocols,avg. latency and avg. hop count metrics are utilized.***

***Keywords*: DTN, *Epidemic, Spray and Wait, MaxProp, Prophet,* routing, ONE.**

I. INTRODUCTION

The name delay tolerant network is given by Kevin fall of Intel research group, in which they proposed a network architecture as well as application interface for asynchronous message forwarding in a partition based network which suffer from continuous topology change and extremely long delay (may be in days). In such network finding the destination node and the way to route the packet to intended destination to insure the robust communication is a major challenge. DTN with vehicular nodes called Vehicular Delay Tolerant network (VDTN).

This work investigates the performance of various routing protocols: Epidemic, Spray and Wait, MaxProp and Prophet, by analyzing the effect of size of buffer. The simulation experiment is carried out using ONE simulator with Synthetic Traces and Real Contact Traces. ***To measure the performance of Epidemic, Spray and Wait, MaxProp and Prophet routing protocols, avg. latency and avg. hop count metrics are utilized.***

The rest of the paper is sorted out as follows. Section II presents past work done in the field of mobility models in DTN environment. Section III presents the simulation set up and our research outcomes. Last section concludes the paper.

II. LITERATURE REVIEW

T. Spyropoulos et al. [1] proposed two kinds of routing schemes: single-copy routing scheme and multi-copy scheme. In single copy routing scheme single custody is used for each message throughout the network. A single custody implies that a single copy of message exist at particular time. As long as the message reaches its destination, a current message holding node forwards a copy to appropriate next node.

T. Spyropoulos et al. [2] defined a multi-copy routing scheme. In order to increase efficiency as well as robustness, this scheme spreads multiple copies of message throughout the network. Further the multi copy routing scheme may be categorized into two groups based on the restrictions imposed on the number of copies. The scenario of multi copy scheme may use flooding-based approach or restricted flooding based approach for example “Spray and Wait” Routing algorithm. First of all, this routing algorithm spreads sufficient number of message copies to reach the destination as same as epidemic routing. After that it stops and wait until each node carrying a copy perform direct transmission

J. Shen et al. [3] utility based routing algorithm defines a utility function which is maintained by each node for every other node for indicating the usefulness of message delivery as well as a hybrid routing algorithm termed as seek and focus routing algorithm which makes the use of both of the above algorithm i.e. randomized as well as utility based routing algorithm.

L. K. Choudhary et al. [4] The traditional ad-hoc network routing protocol do not fit in the opportunistic network environment because of many limitations such as high node mobility, end to end delay etc. Due to this inherent adversity of opportunistic network, most of the delay tolerant routing protocols falls under three categories, based on the number of copies of same message created throughout the network i.e. forwarding based routing protocol, quote or replication based routing protocol and flooding based routing protocol.

Y. Lin et al. [5] Under flooding scheme, Epidemic routing protocol was one of the earliest in which encountering node first exchange a summery vector in between them. Here the summary vector contains the metadata regarding the message stored at node’s buffer. By comparing a summary vector a node learns about new messages or information stored at the neighbor.

A. Lindgren et al. [6] Prophet, Max-Prop, RAPID etc. Although the flooding based routing protocols are well suited to the opportunistic network environment, it suffers from high congestion overhead because of its policy to replicate as many copies of message as resource permits. To deal with the problem of greedy use of network resources as flooding based routing protocol does, forwarding based routing scheme is introduced. Here, single copy of the message is injected into a network and is forwarded towards the destination through successive intermediate nodes.

Forwarding routing protocol though saves network resources but present low delivery probability unless frequent connectivity is present in the network. The various proposed forwarding routing protocols are MEED, SimBet etc. which makes the use of different types of knowledge oracle to forward the packet towards the destination.

J. Burgess et al. [7] Max-Prop, an effective routing protocol for DTN messages, is predicted on prioritizing each the schedule of packets transmitted to different peers. These priorities are relies on historical data and conjointly on many complementary mechanisms, as well as acknowledgments, a head-start for new packets and lists of previous intermediaries. The author's estimation proves that MaxProp shows higher than the other existing protocols found in the literature.

A. Chaintreau et al. [8] finds the impact of human mobility on the class of existing proposed forwarding algorithms. The authors utilize a simplified model supported the renewal theory in order to review the impact of parameters of the distribution on the delay performance of these algorithms.

T. Spyropoulos et al. [9] proposed Spray and Wait routing protocol which has two basic phases. In the first phase also known as spray phase identical message copies are disseminated throughout the network and in second phase i.e. wait phase, nodes with single copy of message directly transmit it to the destination when encounters.

T. Spyropoulos et al. [10] A very slight modification in spray and wait routing protocol was done by (Spyropoulos et. al. 2007) named spray and focus routing protocol. Here the spray phase uses same binary quota allocation function and in focus phase, a node with only single copy of message performs utility based forwarding. With this modification in second phase overhead ratio decreases up to 20 times and the delivery probability increases up to two times.

S. C. Nelson et al. [11] Another flavor of Replication based routing protocol is also proposed such as Encounter-Based Routing (EBR). It relies on mobility property observed like nodes that face a good number of times encounters are more likely to successfully go by the message all along to the final destination than those nodes who only infrequently encounter others.

Shou Chih Lo and Chuan-Lung Lu [12] Dynamic congestion control based routing, they not only change the message quota accordingly but also change quota-replication routing to forwarding routing if the network is seriously congested. Based on network condition, a node would modify the message quota associated with each message in its buffer or move some messages from the buffer to other nodes, prior to performing any message routing.

J. M. Pujol et al. [13] Since accepting to forward a message has a cost, nodes will only accept forward request from those nodes of equal or higher status. The replication function should aware of the network conditions such as traffic load distribution, resource constraints.

Sushant Jain et al. [14] has classified these knowledge oracle into four categories that is contact summery oracle which provide average waiting time until the next contact for an edge, contact oracle which specifies contact between two nodes at any point of time, queuing oracle which makes the use of knowledge regarding buffer occupancy of a node and at last traffic demand oracle which can answer any question regarding present or future traffic demands and inject message according to the network traffic.

Z. Zhang and Q. Zhanget [15] (On the basis of decision type used) As DTN suffer from intermittent connectivity where the nodes are sparsely distributed; the source node can utilize the source routing in order to resolve the entire pathway of a message. It then encodes this information in the messages. Thus the route is determined once and does not change during the traversal of the message throughout out the network.

W. Zhao et al. [16] On the other hand in per hop routing the next hop of a message is determined at each intermediate hop. Here the message uses the local information regarding available contacts and queuing status of each node. The network performance can be enhanced by per hop routing. However, if nodes have different topological views, it leads to loops.

A. Keranen et al. [17] They use historical information such as, location and moving speed of the destination, to calculate movement range. This scheme consists of two phases namely Approach and Roam. In the Approach phase, the objective is to make faster transmission of message towards the estimated movement range, and in the Roam phase, guaranteed message replication occurs within this range. But the scheme suffers from local maximum problem. The same group of researchers solves the above-described local maximum problem based on the idea proposed in Delegation Geographic Routing (DGR).

III. Performance Analysis Using ONE Simulator

There are two notable simulators broadly utilized in DTN environment, the Network Simulator 2 (NS-2) and the Opportunistic Network Environment simulator (ONE). NS-2 is an event driven test system, created through extensive coordinated effort between numerous firms. It is an open source venture which incorporates an assortment of user-developed extensions, protocols, and customizations. On the other hand, the ONE Simulator is additionally an event based simulator created at the Helsinki University of Technology explicitly for simulating DTN routing protocols. The detail of different simulation boundaries is recorded in Table I given beneath.

IV. Conclusion

This work investigates the performance of various routing protocols: Epidemic, Spray and Wait, MaxProp and Prophet, by analyzing the effect of size of buffer. ***To measure the performance of Epidemic, Spray and Wait, MaxProp and Prophet routing protocols,avg. latency and avg. hop count metrics are utilized.*** Buffer occupancy means how many bytes are available in the each node's buffer. The messages transferred during each contact should not exceed the receiver buffer capacity. It is clear from the outcomes shown by our research work that no one model is adequate for all the circumstances and diverse situation.

TABLE I. Simulation Setup

Parameters	Their Values

Routing Protocol	Epidemic, Spray and Wait, MaxProp, Prophet
Simulation Run	3600 s
Node Transmission Speed	2 – 10 Mbps
Node Transmission Range	10 m
Node Buffer Size	5 – 45 MB
Wait Time	0 – 120 s
Node Speed	0.5 – 13.9 m/s
Message TTL	300 minutes
No. of Nodes	100
World Size	4500 m*3400 m
Warm Up	1000 s
Message Size	500 KB – 1 MB
Message Creation Interval	25 – 35 s
Mobility Model	Shortest Path Map Based Movement

A. Latency

$$Average\ Latency = \frac{Sum\ of\ delivered\ message's\ delay}{Number\ of\ delivered\ messages}$$

Table II: Analysis in terms of Avg. Latency by varying Buffer size

Routing Protocols/Buffer Size	Epidemic	MaxProp	Prophet	Spray and Wait
5MB	1234.4655	1308.572	1509.0531	1293.2258
15MB	1392.3682	1222.8484	1548.0953	1293.2258
25MB	1355.1467	1222.8484	1540.1558	1293.2258
35MB	1330.9646	1222.8484	1540.1558	1293.2258
45MB	1330.9646	1241.6726	1547.5837	1293.2258

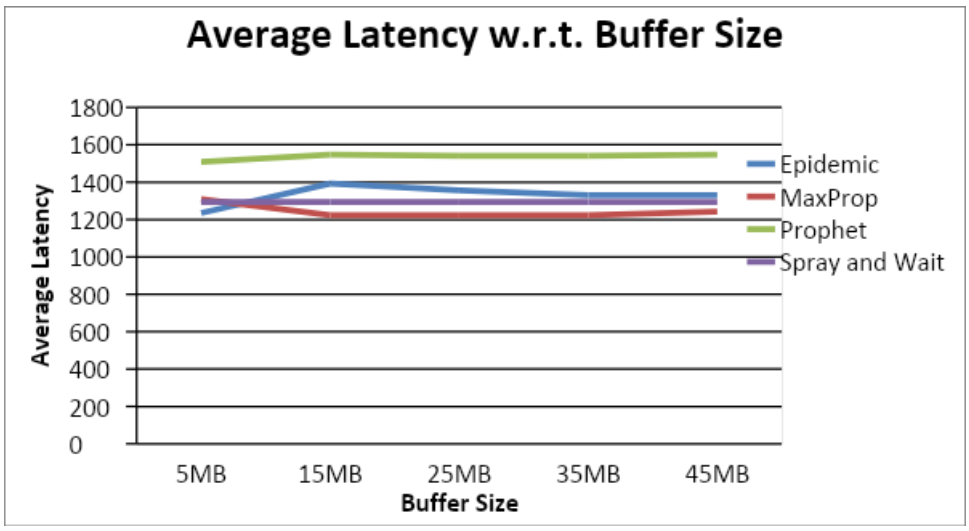

Figure 1: Analysis in terms of avg. latency by varying Buffer size

B. *Avg. Hop Count*

$$Average\ Hop\ Count = Average\ number\ of\ hops\ between\ source\ \&\ destination\ nodes$$

Table III: Analysis in terms of Avg. Hop Count by varying Buffer size

Routing Protocols/Buffer Size	Epidemic	MaxProp	Prophet	Spray and Wait
5MB	5.5862	3.64	3.4375	2.5161
15MB	4.6818	4.0645	3.2093	2.5161
25MB	4.5778	4.0645	3.1395	2.5161
35MB	4.4583	4.0645	3.1395	2.5161
45MB	4.4583	3.9677	3.093	2.5161

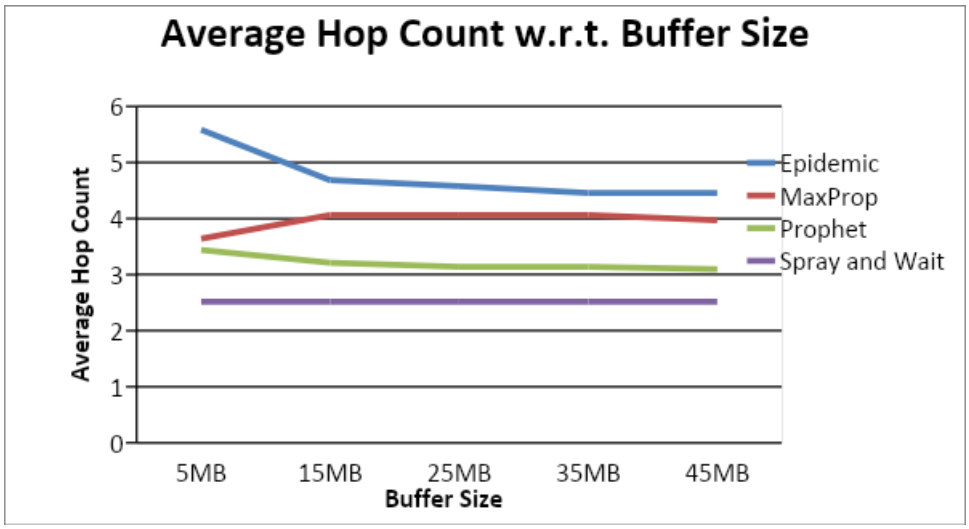

Figure 2: Analysis in terms of avg. hop count by varying Buffer size

V. CONCLUSION

This work investigates the performance of various routing protocols: Epidemic, Spray and Wait, MaxProp and Prophet, by analyzing the effect of size of buffer. ***To measure the performance of Epidemic, Spray and Wait, MaxProp and Prophet routing protocols,avg. latency and avg. hop count metrics are utilized.*** Buffer occupancy means how many bytes are available in the each node's buffer. The messages transferred during each contact should not exceed the receiver buffer capacity. It is clear from the outcomes shown by our

research work that no one model is adequate for all the circumstances and diverse situation.

REFERENCES

[1] T. Spyropoulos, K. Psounis, and C.S. Raghavendra, "Single-Copy Routing in Intermittently Connected Mobile Networks," in Proc. IEEE Intl. Conf. Sensor and Ad Hoc Communications and Networks, pp. 235-244, Oct. 2004.

[2] T. Spyropoulos, T. Turletti and K. Obraczka, "Routing in Delay Tolerant Networks Comprising Heterogeneous Node Populations," IEEE Trans. Mobile Computing, Volume 8, Issue 8, pp. 1132-1147, August 2009.

[3] J. Shen, S. Moh, and I. Chung, "Routing Protocols in Delay Tolerant Networks: A Comparative Survey," in Proc. Intl. Conf. Circuits/Systems,Computers and Communications, pp. 1577-1580, Jul. 2008.

[4] L. K. Choudhary, M. K. Ahirwar and U. Chaurasia, "Practical Routing Strategy in Delay-Tolerant Networks: A survey," IJCSIS, pp- 25-30,July 2013.

[5] Y. Lin, B. Liang and B. Li, "Performance Modeling of Network Coding in Epidemic Routing," Proc. ACM MobiOpp, San Juan, Puerto Rico,United States, June 2007.

[6] A. Lindgren, A. Doria and O. Schelen, "Probabilistic Routing in Intermittently Connected Networks," ACM SIGMOBILE Mobile Computing and Communications Review, Vol. 7, Issue No. 3, July 2003.

[7] J. Burgess, B. Gallagher, D. Jensen, and B. N. Levine, "MaxProp:Routing for Vehicle-Based Disruption-Tolerant Networks," in Proc.IEEE INFOCOM Conf., pp. 1-11, Apr. 2006.

[8] A. Chaintreau, P. Hui, J. Crowcroft, C. Diot, R. Gass and J. Scott, "Impact of Human Mobility on The Design of Opportunistic Forwarding Algorithms," Proc. IEEE INFOCOM, 2006.

[9] T. Spyropoulos, K. Psounis and C. Raghavendra, "Spray and Wait: An Efficient Routing Scheme for Intermittently connected Mobile Networks," Proc. ACM SIGCOMM Workshop on Delay Tolerant Networks, Philadelphia, Pennsylvania, United States, August 2005.

[10] T. Spyropoulos, K. Psounis, and C. S. Raghavendra, "Spray and Focus: Efficient Mobility-Assisted Routing for Heterogeneous and Correlated Mobility," in Proc. IEEE Pervasive Computing and Communications Workshops, pp. 79-85, Mar. 2007.

[11] S. C. Nelson, M. Bakht and R. Kravets, "Encounter-Based Routing in DTNs," Proc. IEEE INFOCOM, Rio De Janeiro, Brazil, April 2009.

[12] ShouChih Lo andChuan-Lung Lu," A Dynamic Congestion Control Based Routing for Delay-Tolerant Networks" in ieee,FSKD 2012.

[13] J. M. Pujol, A. L. Toledo and P. Rodriguez, "Fair Routing in Delay Tolerant Networks," Proc. IEEE INFOCOM, Rio De Janeiro, Brazil, April 2009.

[14] S. Jain, K. Fall and R. Patra, "Routing in a Delay Tolerant Network," Proc. ACM SIGCOMM, pp. 1–13, January 2004.

[15] Z. Zhang and Q. Zhang, "Delay/Disruption Tolerant Mobile Ad Hoc Networks: Latest Developments," Wiley InterScience, Wireless Communications and Mobile Computing, pp. 1219-1232, 2007.

[16] W. Zhao, M. H. Ammar and E. Zegura, "Controlling the Mobility of Multiple Data Transport Ferries in a Delay-Tolerant Network," INFOCOM, 2005.

[17] A. Keränen, J. Ott, and T. Kärkkäinen, "The ONE Simulator for DTN Protocol Evaluation," in Proc. Intl. Conf. Simulation Tools and Techniques, Mar. 2009.