Impact Analysis on Delivery Ratio and Overhead Ratio by varying Buffer Size

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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, delivery probability and overhead ratio metrics are utilized.

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

I. INTRODUCTION

Opportunistic Network is possessing a very different approach as compared to traditional network architectures. Opportunistic Network was first used for Interplanetary Networks (IPN) to communicate between earth and mars. In the Opportunistic Network, end-to-end path between the starting and end node may not be available all the time, but the transfer of data takes place using store-carry-forward technique in which node can depot the data, hold it until another node comes in contact and then deliver it to the destination.

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, delivery probability and overhead ratio 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 Opportunistic Network 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 Opportunistic Network 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 Opportunistic Network 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 Opportunistic Network routing protocols. The detail of differentsimulation boundaries is recorded in Table 1 given beneath.

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

Table 2: Analysis in terms of Delivery Probability by varying Buffer size

Routing Protocols/Buffer Size	Epidemic	MaxProp	Prophet	Spray and Wait
5MB	0.2417	0.4167	0.2667	0.2583
15MB	0.3667	0.5167	0.3583	0.2583
25MB	0.375	0.5167	0.3583	0.2583
35MB	0.4	0.5167	0.3583	0.2583
45MB	0.4	0.5167	0.3583	0.2583

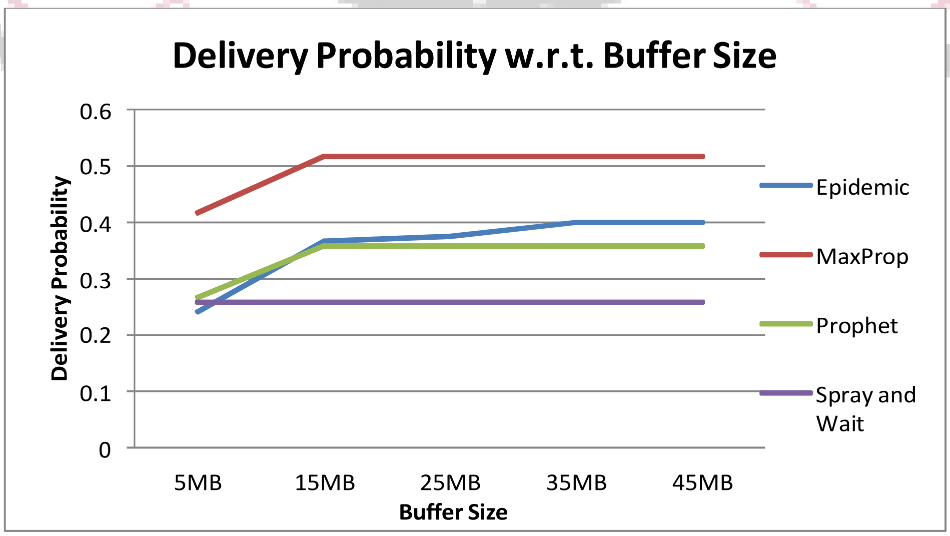

Figure 1: Analysis in terms of delivery probability by varying Buffer size

Table 3: Analysis in terms of Overhead Ratio by varying Buffer size

Routing Protocols/Buffer Size	Epidemic	MaxProp	Prophet	Spray and Wait
5MB	357.3448	182.32	182.3125	17.2903
15MB	234.5455	139.9194	127.5349	17.2903
25MB	223.2889	139.9194	122.093	17.2903
35MB	200.1667	139.9032	122.0233	17.2903
45MB	199.7083	140.3548	121.8605	17.2903

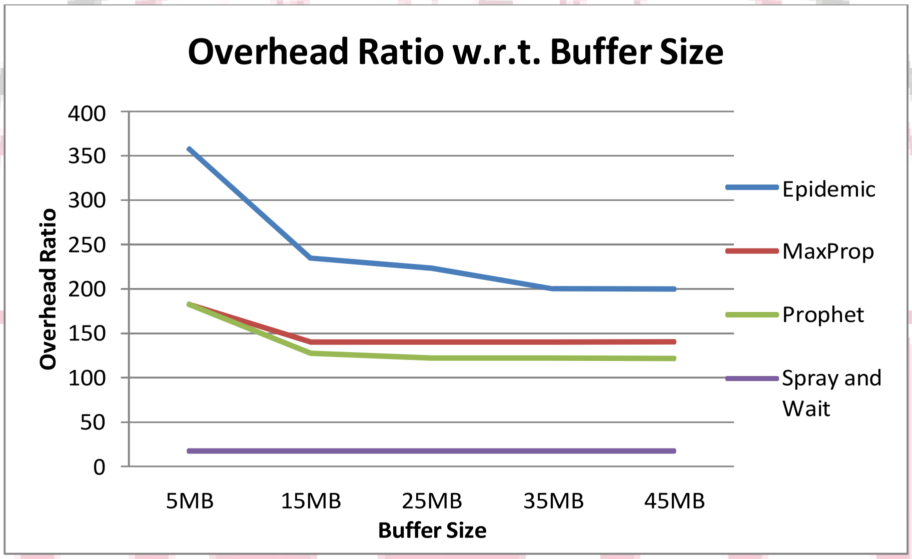

Figure 2: Analysis in terms of overhead ratio by varying Buffer size

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. 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.

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