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ENHANCEMENT IN DTN ROUTING WITH EFFICIENT BUFFER MANAGEMENT

Apexa Anilbhai Dabhi*[1], Prof. Reshma Dayma [2]

[1]Department of Computer Engineering, L.D. College of Engineering, Ahmedabad, India
[2]Department of Computer Engineering, L.D. College of Engineering, Ahmedabad, India

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ABSTRACT

Delay Tolerant Networks or DTNs are the results of the evolutions in the mobile ad hoc networks (MANETs). In such environments the link between the pair of nodes is frequently disrupted due to the dissemination nature, mobility of nodes, and power outages. Because of the environment nature in Delay Tolerant Networks like under water, ocean sensor networks etc., the delays may be very extensive. To obtain data delivery in such challenging and harsh networking environments, researchers have proposed a technique in which the messages is stored into the buffers of intermediary nodes until it is forwarded to the destination. The DTNs are based on the concept of store-carry-and-forward protocols. So, node have to store message for long or short period of time and when connection established replica will be sent to encountered node. A critical challenge is to determine routes through the network without even having an end-to-end connection. This combination of long term storage and message replication imposes a high storage and bandwidth overhead. Thus, efficient scheduling and dropping policies are necessary to decide which messages should be discarded when node ‘s buffers operate close to their capacity. If a relay buffer is full and needs to store a new packet, it has to decide either to keep the current message or to drop it. In this paper, we propose effective buffer management drop policy for DTN. In our schema, when buffer is full, messages with high summation of hop count and replica count will be queued first to drop. A series of simulation has been carried out and the results show that our hop count and replica count based routing schema significantly improves the number of delivered messages, reducing the overhead ratio.

KEYWORDS: DTN, Epidemic routing, Buffer management

I. INTRODUCTION

Delay Tolerance Network is popularly known as disruption tolerance network. Initially as a concept it was proposed by NASA for interplanetary communication. Delay-tolerant networks are intended to function in different and dissimilar environments that are characterized by three prime features respectively: i) there is no persistent end to- end connectivity among the nodes, ii) there are long delays in paths and iii) frequent packet drops. DTNs apply in many application instances, especially in developing regions lacking network infrastructure. The concept of delay-tolerant networks emerged when the traditional TCP/IP protocol failed to work in environments that use acoustic or optical modulation with frequent interruptions, terrestrial mobile networks with no constant end-to-end connectivity and sensor nodes with limited end-node power and CPU capability. Such networks violate the functioning of TCP/IP suite and are often termed as Challenged Networks [9].

DTN works as an overlay on top of an already existing TCP/IP stack which supports intermittent connectivity and overcomes communication disruptions as well as delays. To provide its services ‘Bundle Protocol ‘sits at application layer. DTN provide store-carry-forward mechanism to deliver message to the destination node by coping message at intermediate node in case of disconnection and forward it whenever there is connection established with another node. Bundle layer uses the custody transfer mechanism to realize the message retransmission and confirm among nodes, thus increasing the reliability of message transmission.

Substantial effort made by researchers for developing routing protocols for DTN applications, buffer management is not paid that much attention. Many of the routing protocols theoretically assume infinite buffer size and in simulator they consider finite buffer size with first in first out replacement policies. This constraint on buffer size degrades the performance of routing protocols in terms of increasing the delivery delay and decreasing the delivery

ratio which is not shown in their simulation results. E.g. Epidemic routing protocol achieves an optimal delivery ratio with infinite buffer, but with a limited buffer scenario, the routing performance is degraded.
In this paper we have discussed existing methods for buffer management and proposes a novel buffer management policy and compare it with traditional buffer management schemes.

II. MATERIALS AND METHODS

There are a number of buffer management schemes that can be adopted by various DTN applications. These can be broadly classified into two categories: schemes that do not require global knowledge or network-wide information and select the message to drop/schedule using local information like arrival time, TTL and size, etc. and schemes that require partial or complete network information like number of copies of the message in the network, contact rates between nodes and shortest path knowledge between various nodes etc. But this requires global network information for optimizing routing metric which is impractical in case of DTN. So, our first proposed solution is to use replica count with local information.
We are introducing one parameter which is a vector to store replica id with replica count. Whenever message is relayed, this replica count value is incremented first and then transferred to encountered node if encountered node has space to store that message. To achieve better performance, routing schemes in DTNs have to also effectively utilize the limited encounter opportunity. what if encountered node has no free space to store new message? Therefore, message prioritization in a node's buffer is required. so that messages which optimize the performance must be scheduled to be transferred first. Thus, there is a requirement of a routing scheme which can be applied in real life situations. Considering the constraints, a DTN has and utilizing the available information to effectively manage buffer and schedule messages. So, our solution is proposed scheduling and dropping policy which sort encountered node's buffer messages with summation of hop count and replica count of replica vector. Here we are not using only hop count or only replica count because there may be chance that message with low hop count but it's so many replicas are present in network. Also, message with high hop count has a only path from with it was pass through so there are not so many replicas of that message. To avoid this ambiguity, we are using summation of both hop count and replica count to sort messages. Low sum value means it has high priority to transfer first and High sum value means it has high priority to be dropped first. This dropping process is done until buffer has enough free space to store new in coming message.

III. RESULTS AND DISCUSSION

We have simulated our algorithm on the ONE (Opportunistic Network Environment) Simulator, which is a well-known DTN simulator. Epidemic routing is one of the first schemes for routing in DTN environment, and is a flooding-based approach. This scheme is based on the idea that the message will eventually find its destination through transitive exchanges between nodes, if it is spread in the connected portion of the network. The epidemic routing protocol can achieve a delivery rate of 100% in partitioned networks where ad hoc routing protocols fail entirely. But flooding results in high resource consumption in terms of both power and storage. We did an analysis on the performance of Epidemic routing by applying traditional approach and proposed approach [4].
We have simulated these routing methods under two different scenarios. In the first scenario, the network consisted of cars and pedestrians moving around a city. We set the mobility model to Map-based movement, where cars and pedestrians are restricted to move in predefined paths and routes derived from real map data. We used the map data of the Helsinki downtown area (roads and pedestrian walkways) provided with the simulator. Nodes choose a random point on the map and then follow the shortest route to that point from their current location. Messages are generated using a uniform random distribution from within a predefined interval, and assigned a random source and destination [4].
With this model we conducted experiment with different buffer size form 5MB to 50MB to see the effect of delivery ratio and the message overhead. This scenario is simulated for 12 hours, with similar network parameters.

Formulas:

Suppose that N be the set of all messages created in the network and M_d be the set of all messages delivered.
Then,

delivery Probability = M_d / N (1)[15]

Overhead ratio is defined as how many replica packets are forwarded to deliver one packet.
Then,

Overhead ratio is defined as: (Number of total forwarded message – M_d) / M_d (2)[15]

Let the i^{th} delivered message was created at time C_i and delivered at time d_i. Then,

average message delivery latency = $(\sum_{i=1}^{n}(di - Ci))\ /\ M_d$ (3)[15]

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Tables:

Table 1. Simulation settings

PARAMETERS	VALUES
Router	EpidemicRouter
Hosts	40
Speed	2Mbps
Buffer capacity	5-50MB
Message size	500KB-1MB
Message TTL	300 minutes (5 hours)
Message generation rate	25-35 seconds
Simulation time	12 hours

The delivery probability increases with increase in buffer size (as in Fig 1) there is high delivery probability in proposed method as compare to traditional epidemic routing with lower buffer size. while the associated overhead decreases(Fig.2). This is because as the buffer size increases, more free space become available to store and carry more messages, thereby enhancing the performance. There is some calculation require to sort the messages in buffer therefore average latency of proposed method is higher than traditional routing (as in Fig 3).

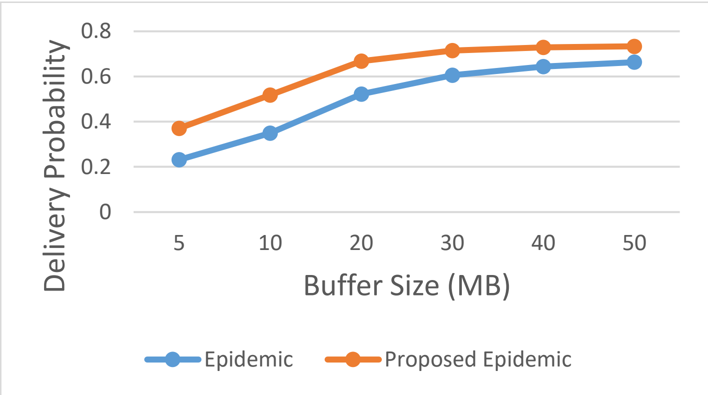

Figure 1. Delivery probability of epidemic routing

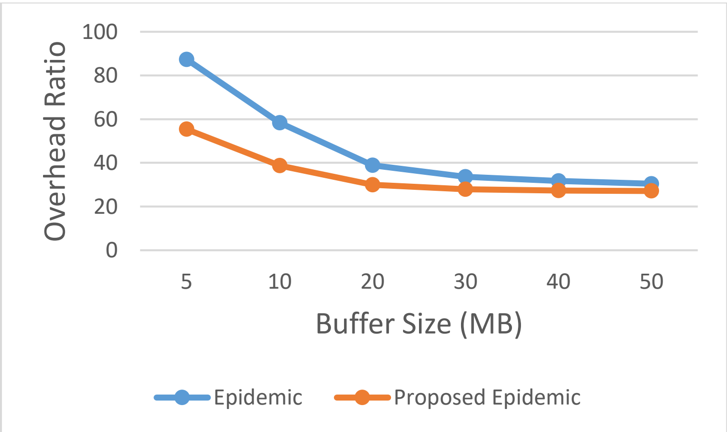

Figure 2. Overhead ratio of epidemic routing

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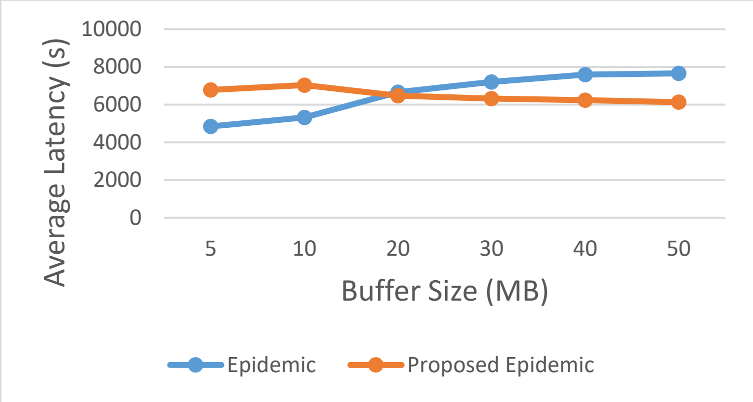

Figure 3. Average latency of epidemic routing

IV. CONCLUSION

We have proposed an efficient buffer management policy which take local information like hop count and replica count to sort messages, this strategy take intelligent decision on message transfer and drop messages for efficient buffer management. With this strategy, comparison shows improvement in delivery probability and overhead ratio from traditional routing. In this strategy we are introducing one vector parameter and also there is some time require for calculation in queuing buffer messages to drop. Therefore, average latency is increased. Here we are analyzing performance for epidemic routing with different buffer size only. Our future work is to use this strategy in all routing protocols like PROPHET, MAXPROP, Spray and wait etc. and analyze the result with different parameters like time to live, message generation rate, message size etc.

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