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Contact Time Oriented Spray Phase In Delay Tolerant Networks

Trupesh S. Patel[1], Viren G. Patel[2]

[1]Computer Science and Engineering, S.P.B .Patel Engineering College
[2]Computer Science and Engineering, S.P.B. Patel Engineering College

Abstract —*In Delay Tolerant networks, Network is intermittently connected that makes a message delivery a challenging task. Frequent disconnection issues reduce message delivery ratio in the network. We have proposed a routing scheme known as a contact time oriented spray phase in delay tolerant networks which concentrate on effective contact time between two nodes and then decides to forward the message copies. We called wait phase early with reference to TTL so buffer management can be achieved.*

Keywords- *store carry and forward, routing, contact time, spray and wait, ONE simulator*

I. INTRODUCTION

Delay Tolerant Networks (DTNs) is a disruption tolerant network where source to destination connection does not be present. They have frequent disconnection issues and very small contact time. In many real scenarios like interplanetary internet, Deep Space Networks, Military Networks, Inhabitant or Wildlife Tracking System, Terrestrial Wireless Networks, Satellite Networks, Underwater Acoustic Networks, Nomadic Communities Networks , the concept of DTN is applied[1].

The purpose of a DTN is to deliver reliable communication in situation where frequent disconnection and long delay [2] in transmission occurs. The researchers worked in different issues like increasing the delivery ratio [3], optimizing resource usage, providing scalability.

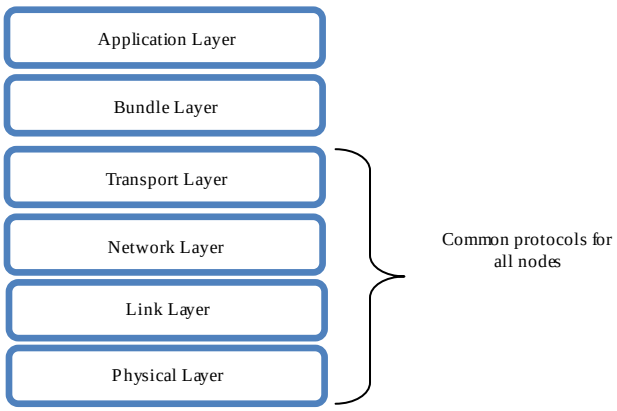

Fig 1. Bundle Layer

A Delay Tolerant Network is overlying on the existing provincial networks. This overlie is known as bundle layer [4]. The bundle layer works above provincial protocols and its purpose is to provide entrance when two nodes encounter each other. Bundle layer protocol is very flexible in nature. We can join more than one network together with the help of Bundle layer. Bundle layer can be explained well according to fig 1.

As shown in fig 1, there are four basic layers below Bundle layer. This four layer namely Physical layer, Link layer, Network layer, Transport layer are always present in any type of network so Bundle layer can be easily embedded in any type of networks.

Bundles are also known as collection of packet data. We can achieve reliability by transmitting data from one node to another by store carry and forward mechanism. The Bundles contains a bundle header, control data and source node's user data.

DTN implements store-carry and forward mechanism in which intermittent nodes contain data packets and store it. When link to destination or next intermittent node is established then it sends that stored packets. This store carry and forward mechanism is exactly same as postal services in real life. Every document must have to pass through all the post offices

which come into route. We can overcome common issues like message lost, link lost, low delivery ratio, interrupted connectivity etc. store carry and forward mechanism is explain well in fig 2.

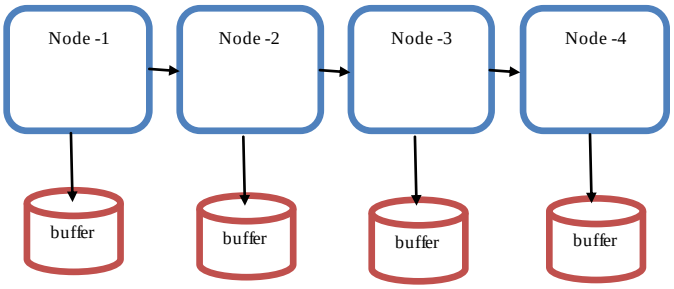

Fig 2. Store carry and forward mechanism

Many DTN routing protocols have been proposed. Three main different categories of DTN routing protocols are: message-ferry-based, opportunity-based, and prediction-based [4].

II. RELATED WORKS

In DTN, routing generally classified into two main categories: *Forwarding strategies [5]*, where single copy of message routed through network and *flooding strategies* where multiple copies of message routed through network. Forwarding strategy required complete knowledge of network topology and node mobility [6].

Epidemic [7] is one of the flooding based routing protocol which distribute many replica of message into the network [8]. It assigns message copy to its entire neighbor node thus it required infinite resources. PROPHET [9] routing protocol provides message to its neighbor node only if it is highly predictable to deliver message to destination. Spray and wait [10] protocol controls huge number of message injection into network by spraying L number of message copies in its spray phase.

III. PROPOSED CONTACT TIME ORIENTED ROUTING SCHEME

Our new strategy improves the performance of basic spray and wait protocol by utilizing minimum network resources.

3.1. Frequent disconnection issues

As we know in DTN, there isn't end to end connectivity between source and destination. Nodes must have to deliver message when they meet with each other. Such meeting time is very small so sometimes nodes move away before completion of message transmission. So we can improve this issue by considering those nodes that has sufficient contact time. Contact time Ct is calculated from range and speed of node. Then Transmission capacity will be calculated based on contact time. Only those nodes considered with higher transmission capacity value than the message size. So the frequent disconnection issue resolved.

3.2. Forwarding strategy specification

3.2.1 Spray phase

In contingency based spray and wait, every source node calculates the contact time of the node it encounters then only allocates copies of message. We have formulated an equation to calculate contact time of two nodes as shown in equation 3.1.

$$Ct = (2R1)/(s1 + s2) \quad (3.1)$$

$$Tc = ct * Transmission\_speed\_of\_node \quad (3.2)$$

In above equation (3.1) Ct, R1, s1, s2 represent contact time, range of node 1, speed of node 1, speed of node 2 respectively. From equation (3.1), it is clear that node believes only those relay nodes as a promising one who have enough contact time. Equation (3.2) calculates transmission capacity of the node .This calculation of transmission capacity reduces disconnection issue because it only selects those intermittent nodes that are looking most promising as per equation (3.1). As shown in Flowchart, when two nodes encounter with each other, first encountered node is checked if it is destination. Message copies are delivered if it is destination. When encountered node is not destination and no. of copies is more than one then available transmission capacity (Tc) and required transmission capacity (S_G) is calculated. How many no. of messages should be forwarded is selected based on comparison of these two factors as shown in flowchart. When No. of copies source node carry becomes one then it switch into wait phase which described in next paragraph. Due to such contingency based spraying, only selected node will get the copies of the message so total

number of copies into the network reduces and thus network overhead can be effectively reduced which was one of the major challenges in DTN.

3.2.2 Wait phase

When nodes have only one copy of the message then it moves into wait phase. We introduce implicit and explicit concept in wait phase. Node moving in the network compares rank of community with node it meets. If rank of community is higher of next node than itself then it assigns copies when TTL becomes less than 200.of the message to that node. Here rank of community defined as the speed of node. If node in pedestrian meets node on the bus then it allocate message copy to that node as it has higher chances to delivery to destination.

3.3 Flowchart Of Proposed Method

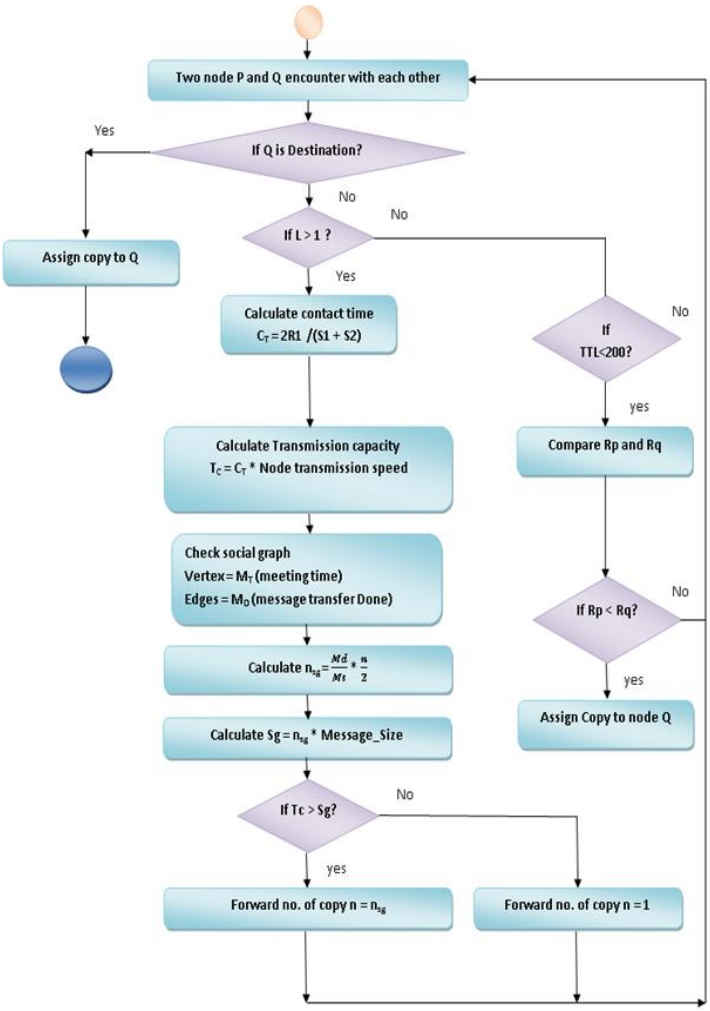

FIG 3. FLOWCHART OF PROPOSED METHOD

IV. Simulation Results

In this section, we will provide the comparison of simulation results of existing routing scheme and our proposed routing scheme under ONE simulator.

1. Delivery Ratio (TTL 270): In following fig 4, Delivery ratio of basic spray and wait, adaptation of spray and wait routing and contact time oriented spray phase. We can easily notice that delivery ratio of proposed scheme is almost higher around 10% than spray and wait.

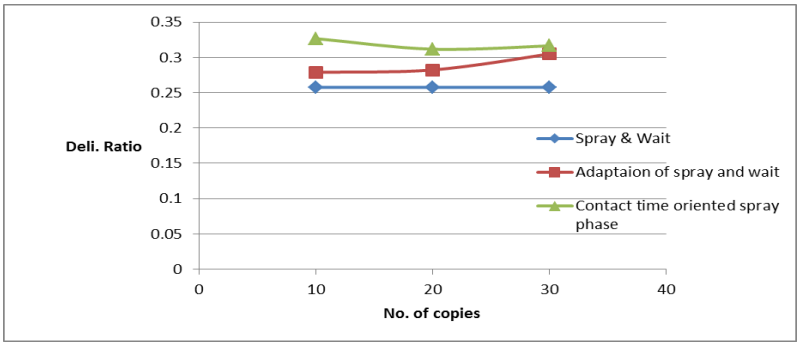

FIG 4. DELIVERY RATIO (TTL 270)

2. Delivery Ratio (TTL 300): Delivery Ratio of proposed method at TTL 300 is varied from 0.32 to 0.34 which is just 0.25 in case of spray and wait.

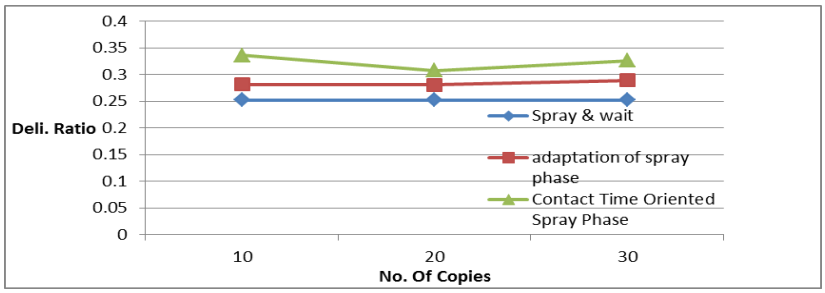

FIG 5 DELIVERY RATIO (TTL 300)

3. Delivery Ratio (TTL 330): Delivery Ratio of proposed method at TTL 330 is varied from 0.30 to 0.35 which is just 0.25 and 0.30 for spray & wait and adaptation of spray phase respectively.

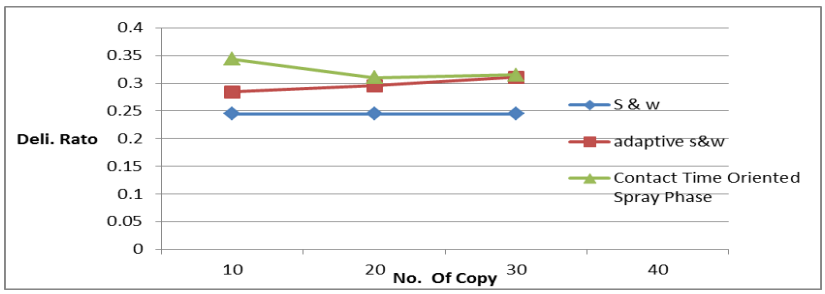

FIG 6. DELIVERY RATIO (TTL 330)

4. Overhead Ratio (TTL 270): Overhead ratio of proposed method at TTL 270 reduced greatly as shown in fig 7. It varied from 42 to 50 as no. of copies increases.

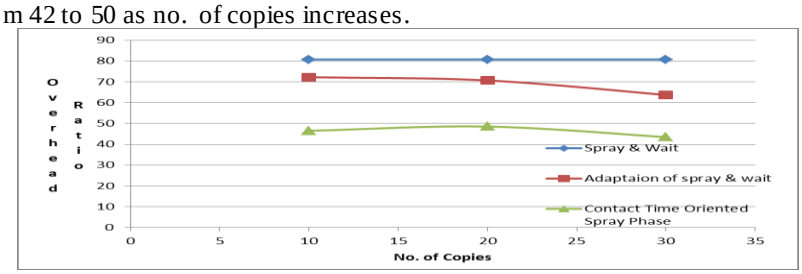

Fig7. Overhead Ratio (TTL 270)

5. Overhead Ratio (TTL 300): Overhead Ratio at TTL 300 varied from 41 to 50 of proposed method which is around 82 in case of spray & wait.

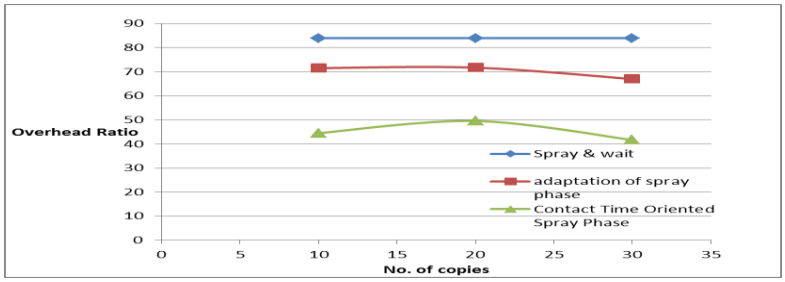

Fig 8.Overhead Ratio (TTL 300)

6. Overhead Ratio (TTL 330): Overhead Ratio at TTL 330 varied from 40 to 43 of proposed method which is around 83 in case of spray & wait.

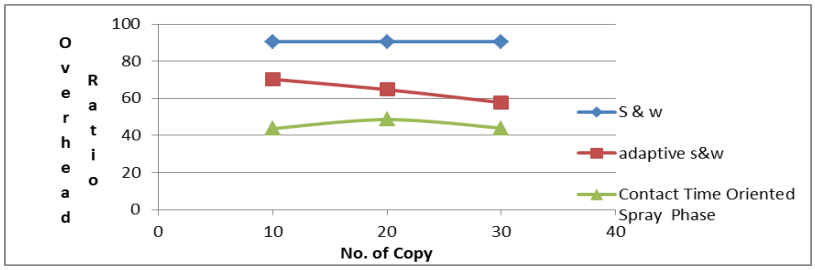

Fig 9. Overhead Ratio (TTL 330)

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