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Improving Efficiency of Routing Protocol in Delay Tolerant Network

Mayur S. Padia[1]

[1]*Computer Engineering, Atmiya Institute of Technology & Science - Rajkot, mayur.mece@gmail.com*

Abstract: Delay tolerant networks (DTNs) have recently drawn much attention from networking researchers due to the wide applications of these networks in challenging environments, such as space communications, military operations, and mobile sensor networks. Intermittent connectivity in DTNs results in the lack of instantaneous end-to-end paths, large transmission delay and unbalanced network topology. These features make the classical ad hoc routing protocols not being applicable for DTNs, since these protocols rely on formation of a complete end-to-end route from the source to the destination.A number of routing protocols have been proposed in DTNs. Nevertheless, most of them only achieve either good performance in terms of delivery ratio or delivery cost. For instance, flooding-based routing protocols attain the good performance of delivery ratio at the cost of huge resource consumption. Whereas forwarding-based routing protocols consume the smallest resources, however, they sacrifice the delivery ratio.The goal of my protocol is to achieve a good trade-off between the routing performance and the resource consumption.

Keywords-routing protocols; delay tolerant network; flooding protocol; replication based protocol; intermittent connectivity

I. INTRODUCTION

A Delay Tolerant Network (DTN) is a highly partitioned mobile ad hoc network which allows frequent disturbance of connection and long duration of disconnection. In a DTN, most of the times sources send packets to destinations without establishing complete end-to-end paths or connectivity between them. These paths, exist by chance, are very unsteady and can break or change soon after being discovered. When the network is fairly sparse this partitioning nature causes the network to be viewed as set of disconnected, timevarying clusters of nodes [1]. 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 CommunitiesNetworks etc, the concept of DTN is applied [1].

In this paper, I propose to adapt the spray phase of Binary Spray and Wait routing. The idea of my spray phase is as follows: first I derive a switch value for each message residing in a node using the initial time to live (TTL) value of the message, number of hops traveled by the message, initial number of copies and remaining number of copies of that message, area of the network topology. I then propose each node to make use of the switch value of a message to enter into the wait phase for that particular message. Simulation results show that my proposed scheme, maintains good delivery and latency performance while maintaining lowoverhead in various scenarios.

II. RELATED WORK

Despite of the challenges of routing in DTN many routing schemes have been proposed by the researchers. Among these routing schemes replication based routing schemes achieve higher delivery ratio and lower delay by injecting multiple copies of a message into the network. However, the redundant copies of a message consume network resources like buffer space, bandwidth and energy [3]. Replication based schemes like PROPHET [4], MaxProp

[5], etc. replicate as many copies of a message as the network permits and this genre of routing schemes fall into the category of flooding based schemes. This approach is vulnerable to high network contention and could lead to huge overhead and latency. Quota based schemes like Spray and Wait [1], Spray and Focus [6] save the network resources by relaying a limited number of copies of a message in the network. Nevertheless, existing quota based routing schemes experience comparatively lower delivery ratios even though they are the better steward of network resources.

Binary Spray and Wait [1] improves Spray and Wait. The difference is in the Spray phase. A node forwards half the copies of a message, till it has more than one copy of that particular message, to a node that does not possess a copy of the message. When a node is left with only a single copy of a message, it switches to the Wait phase and performs direct transmission when it meets the destination. However, Spray and Wait and Binary Spray and Wait both have the blind flooding problem because they forward message copies to nodes without considering their performance. Furthermore, Binary Spray and Wait suffers from high communication overhead due to its message forwarding nature. In Spray and Wait routing, only the sources take the responsibility to forward a message to a node met during the spray phase. Therefore, the communication overhead is less in Spray and Wait. In contrast, Binary Spray and Wait routingallows source nodes to forward half the copies of a message to a node which (the node) in turn follows the same criteria to forward the message to newly seen nodes. As a result, the scheme suffers from high communication overhead and the problem becomes severe with higher number of copies of a message. My scheme uses the switch value of a message to allow a node to enter the wait phase for that message. Thus, I start the wait phase after an appropriate number of forwarding of a message instead of allowing the number of copies of the message to reach one. This saves my scheme suffering from high communication overhead.

III. PROPOSED ALGORITHM

I propose to employ a new clause during the spray phase of Binary Spray and Wait routing to toggle to the wait phase. Instead of using the number of copies of a message reaching one as the toggle condition to enter the wait phase, I propose a new scheme. I impose a clause on the TTL value of a message to permit a node to enter the wait phase for that message. I permit a node to forward a message to other nodes for a certain value of its TTL. Once the TTL falls behind the value I propose the node to start the wait phase. I term the certain value as the switch value of a message. I formulate an equation to obtain the switch value of a message using the initial TTL value of the message, number of hops traveled by the message, initial number of copies and remaining number of copies of that message, and area of the network topology. As long as the TTL value of a message is higher than the switch value of that message, I permit nodes to forward half the copies of that message to other nodes met. Once the TTL drops below that margin I permit the wait phase to begin. This way I can achieve much better delivery and latency performance while reducing the communication overhead.

3.1.1. Spraying

When a node n (source or intermediate), carrying a message m with c number of copies encounters another node, I allow it to compute the S for that message. I then compare the $S_{(n, m)}$ value with the TTL value of the message m. If the TTL value of the message m is greater than the S value and the value of c is greater than one, I permit node n to transmit half the copies of the message to the newly encountered node. I permit node n to use the following criteria to transmit message m to other nodes.

A sender (source or relay node) having more than one copies of message m will repeatedly do the same thing until each node is left with only one copy of m or the TTL value of message m falls below the switch value for that message in that node. Then, we allow the nodes to toggle to the Wait phase.

3.1.2. Wait Phase

In the Wait phase, I permit nodes to deliver the messages to the destinations using direct transmission only or drop the message when the TTL expires.

IV. PROPOSED ALGORITHM

I implement my scheme in ONE (Opportunistic Network Environment) simulator developed by Helsinki University of Technology. To validate my scheme I compare the performance of my scheme with that of Spray and Wait routing and Binary Spray and Wait Routing. I use a typical scenario consists of a 4500X3400 m^2 area of Helsinkicity. I considered 126 nodes divided into 6 groups..

V. CONCLUSION

In this paper, I propose a new routing scheme for Delay Tolerant Networks. I first define a switch value for a message in a node using the initial TTL value of the message, number of hops traveled by the message, initial number of copies and remaining number of copies of that message, and area of the network topology. I let a node to compare to switch value of a message to the TTL of the message to enter the wait phase. Nodes toggle to the wait phase for a message if the TTL of the message falls behind switch value for that message. My main contribution is that I propose to reduce the communication overhead by permitting the nodes to enter the wait phase much earlier than waiting for the number of copies of the message to reach one. Thus, I allow nodes to relay only necessary number of copies of a message into the network to lessen the overhead.

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