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The Improvement of Epidemic Routing Algorithm Using Nodes Movement Direction Data in Delay Tolerant Networks

Behrooz Noraeinejad[1], Sana Moradi[2], Mohammad Shiri[3] , MohammadJavad Sayadi[4]
[1&4]Technical and Vocational University, Technical College of Ilam
[2&3]Ilam University
BehNor.info@gmail.com
moradi.sana@gmail.com

Abstract— Today, Delay Tolerant Network has become more widespread and has drawn many researchers' attention due to its features and applications. Due to the mobile nodes in Delay Tolerant Networks, the connection among some nodes in a specific moment is scarcely resistant [1]. Beating this in mind, the routing issue in these networks has attracted many researchers' attention. Routing in these networks performed based on STORE-CARRY-FORWARD paradigm [1]. One of the routing methods in these networks is Epidemic Routing that is flooding-based [3]. So that each node sends the packets to all the nodes it meets and has not received the packet yet [4]. Accordingly, an attempt made to add nodes movement direction factor and the destination situation to the epidemic routing as well as to improve buffer atmosphere through optimizing the number of copies.

Keywords— Delay Tolerant Networks; routing of Delay Tolerant Networks; Epidemic routing; Nodes movement direction in routing.

I. Introduction

Delay and disruption are two major problems in communication networks. To solve these problems, many methods have been proposed by researchers; as a result, the "STORE-CARRY-FORWARD" System has been suggested instead of "STORE-FORWARD" in Delay Tolerant Networks [5]. In this method, each node stores the received message in its own buffer and when there is no transmission route from the node to the destination node, the node carries the message; and as soon as it finds a transmission route with the other nodes, it attempts to send the message to those nodes [6]. According to "when" and "how" of sending a message by intermediate nodes and also taking into account the characteristics of Delay Tolerant Networks such as high delay, low transmission rate, and limited resources [7], different routing protocols are provided to achieve an efficient and secure communication network for Delay Tolerant Networks. There are numerous factors for routing algorithms classification in Delay Tolerant Networks; however, they all concentrated on the copies number of the messages that are sent in the network [8].

A message may have many copies in the network since each intermediate node plays the role of message sender, flooding-based to the destination, as a router. Some of the routing algorithms employ the node knowledge about its own communication history with other nodes [9]. In the present research, it is tried to reduce the copy number of messages using nodes movement direction factor, in epidemic algorithm as one of the main algorithms of Delay Tolerant Networks. Besides, the epidemic algorithm is briefly introduced, the effect of nodes movement direction factor on routing in the proposed algorithm is discussed, and finally, the simulation results and conclusion are presented.

II. Epidemic Routing Algorithm

Epidemic Routing Algorithm functions based on the flooding pattern (Figure 1). In this algorithm, when a node meets other nodes, it sends its messages to the nodes that have not received the messages yet [4]. The epidemic routing purposes include: 1) to maximize message delivery rate, 2) to minimize message latency, and 3) to minimize the total resources consumed in message delivery.

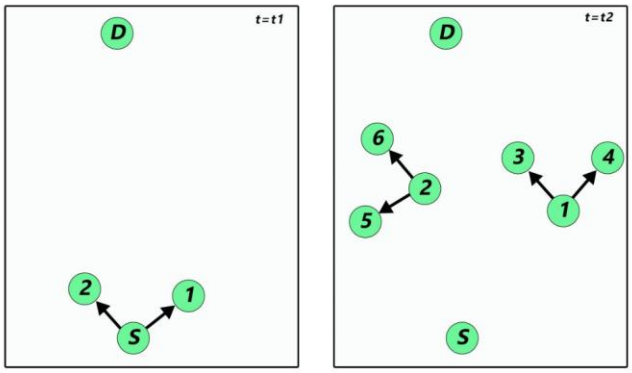

Fig. 1. Epidemic Routing

In this algorithm, each node stores messages with specific destination in its buffer and sends it to the other nodes. Each node, with the stored messages in its buffer, keeps a Summary Vector. The Summary Vector of each node represents the messages in the buffer of that node.

In this algorithm, two nodes lying in their transmission range, first; start to exchange their own Summary Vector. Then; based on the data resulting from these vectors, each node requests the messages in the buffer of the other node that are not present in its own one. Finally; the nodes send the requested messages to each other [10].

III. The effect of node movement direction on epidemic routing algorithm

Epidemic routing algorithm is a flooding-based algorithm. In this algorithm, each node tries to forward the received message to all encountered nodes. Researchers attempt to control and minimize the copy number of sent messages in

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the network to decrease the resulting overhead from these copies. On this basis, different routing algorithms are presented. For instance, in PRoPHET Algorithm, a node sends the message merely to the nodes having appropriate probability to meet the destination; therefore, the copies number are reduced [13] or in [11] an improvement in the inter-automobiles networks has been achieved by eliminating unused packets applying nodes movement direction. In the Ad-hoc wireless networks, the movement direction and the location data (information) are two critical factors in routing algorithms. In the present paper, an attempt is made to employ these factors in the epidemic algorithm to present a novel algorithm. In this novel algorithm, through the comparison of its own movement direction with the destination location data (information), each node can easily decide whether or not to send the message (Figure 2).

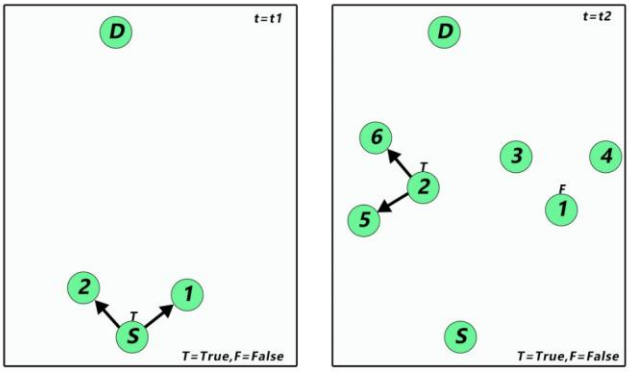

Fig. 2. The proposed method (T means that the node movement route and destination are in the same direction; F means that the node movement route and destination are in different direction)

If a node moves toward the destination, it can operate much more effective than the other nodes in the packet delivery. Hence, in the proposed method, this node can send the packet. Otherwise, it should not send the packet because it only results in a waste of network resources.

IV. Performance evaluation and simulation results

To assess the efficiency, the presented algorithm compared with the epidemic algorithm, and the results of the comparison have provided for Started, Delivery-Prob, and Overhead-Ratio factors. For the simulation, the ONE Simulation Software was used [12]. Simulation parameters are presented in Table 1.

Table 1. Simulation parameters

Simulation parameters	
Simulation time (S)	43200
The number of groups	6
The number of nodes	126
Mobility model	ShortestPathMapBasedMovement (Groups 1, 2, and 3) MapRouteMovement (Groups 4, 5, and 6)
Message size	500KB to 1MB
Time interval of packet production (S)	5, 10, 15, and 20

V. Simulation results

In this section, the simulation results as well as the epidemic algorithm comparison with the proposed method are investigated.

Figure 3 demonstrates a comparison of the packets number that was sent to the output node in both epidemic and the proposed methods. It is obvious that part of the nodes will not attempt to resend the message applying movement direction factor in the epidemic algorithm; as a result, the message transmission number is greatly reduced helping the network load be reduced as well.

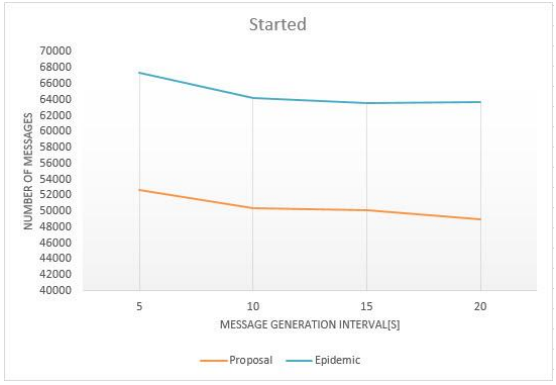

Fig. 3. Started Factor

Figure 4 displays the packets delivery probability to the destination. The comparison shows that the sent method has somewhat improved compared to the epidemic method. Nevertheless, according to Figure 3, it can be said that as the sent packet number is much smaller, the packet delivery ratio is better; signifying the network efficiency increase.

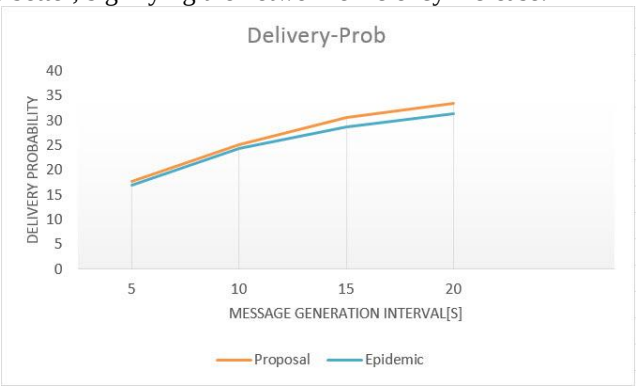

Fig. 4. Delivery-Prob Factor

Figure 5 divulges that the overhead-ratio resulting from packets transmitting (sending) within network in the proposed algorithm is less than that in the epidemic algorithm. This quality factor is attained through the proportion (ratio) of the packets number in the network that is not delivered to the destination to the packets number that is delivered to the destination. Consequently, one of the important achievements of the proposed algorithm is reaching a less overhead network.

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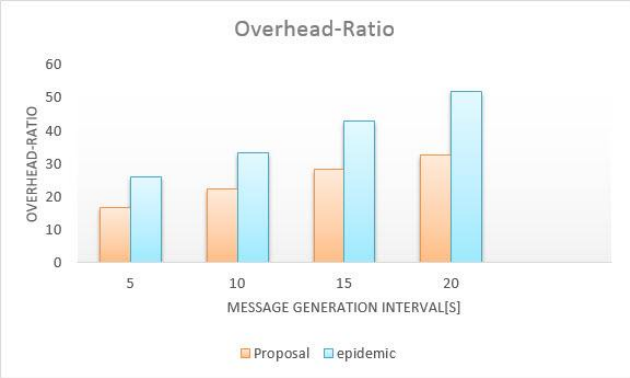

Fig. 5. Overhead-Ratio Factor

VI. Conclusion

Since the epidemic routing sends the packets based on the flooding pattern, the network overhead is high; and as the buffer size in the nodes is lower, the packet delivery ratio to the destination is reduced [13]. In the presented method, not only the network overhead is greatly reduced due to the reduced number of messages, but also the probability of receiving a message at the destination is somewhat improved.

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