ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 1, January 2016

A Proposal on Neighbor Coverage-Based Probabilistic Rebroadcast for Increasing Efficiency of Routing in MANETs

Shivani Suresh Yadao, Prof.R.K.Krishna

M. Tech, Dept. of Computer Science and Engineering, Rajiv Gandhi College of Engineering ,Research &Technology, Chandrapur, India

Professor, Dept. of Electronics, Rajiv Gandhi College of Engineering, Research &Technology, Chandrapur, India

ABSTRACT: For increasing efficiency in mobile ad-hoc networks (MANETs) containing high mobility of node, it is necessary to avoid frequent link breakages which lead to frequent path failures and route discoveries. In a route discovery, broadcasting is a fundamental and effective data dissemination mechanism, where a mobile node blindly rebroadcasts the first received route request packets unless it has a route to the destination, and thus it causes the broadcast storm problem. In this paper, we propose a neighbor coverage-based probabilistic rebroadcast protocol for reducing routing overhead in MANETs. In order to effectively exploit the neighbor coverage knowledge, we propose a novel rebroadcast delay to determine the rebroadcast order, and then we can obtain the more accurate additional coverage ratio by sensing neighbor coverage knowledge. We also define a connectivity factor to provide the node density adaptation.

KEYWORDS: Mobile ad hoc networks, neighbor coverage, broadcast storm, probabilistic rebroadcast, routing overhead.

I. INTRODUCTION

A mobile ad hoc network (MANET) is a continuously self-configuring, infrastructure-less network of mobile devices connected without wires. Mobile ad hoc networks (MANETs) consist of a collection of mobile nodes which can move freely. These nodes can be dynamically self-organized into arbitrary topology networks without a fixed infrastructure. One of the fundamental challenges of MANETs is the design of dynamic routing protocols with good performance and less overhead. Many routing protocols, such as Ad hoc On-demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR) have been proposed for MANETs. The above two protocols are ondemand routing protocols, and they could improve the scalability of MANETs by limiting the routing overhead when a new route is requested. However, due to node mobility in MANETs, frequent link breakages may lead to frequent path failures and route discoveries, which could increase the overhead of routing protocols and reduce the packet delivery ratio and increasing the end-to-end delay. Thus, reducing the routing overhead in route discovery is an essential problem.

The conventional on-demand routing protocols use flooding to discover a route. They broadcast a Route REQuest (RREQ) packet to the networks, and the broadcasting induces excessive redundant retransmissions of RREQ packet and causes the broadcast storm problem, which leads to a considerable number of packet collisions, especially in dense networks. Therefore, it is indispensable to optimize this broadcasting mechanism. Some methods have been proposed to optimize the broadcast problem in MANETs in the past few years.

Performance of neighbor knowledge methods is better than that of area-based ones, and the performance of area-based methods is better than that of probability-based ones. We now obtain the initial motivation of our protocol: Since limiting the number of rebroadcasts can effectively optimize the broadcasting, and the neighbor knowledge methods perform better than the area based ones and the probability-based ones, then we propose a neighbor coverage-based probabilistic rebroadcast (NCPR) protocol. Therefore, 1) in order to effectively exploit the neighbor coverage

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 1, January 2016

knowledge, we need a novel rebroadcast delay to determine the rebroadcast order, and then we can obtain a more accurate additional coverage ratio; 2) in order to keep the network connectivity and reduce the redundant retransmissions, we need a metric named connectivity factor to determine how many neighbors should receive the RREQ packet. After that, by combining the additional coverage ratio and the connectivity factor, we introduce a rebroadcast probability, which can be used to reduce the number of rebroadcasts of the RREQ packet, to improve the routing performance and thus increase efficiency.

II. RELATED WORK

In [1] Authors uses On-demand routing protocols to construct a path to a given destination only when it is required. They do not maintain topological information about the whole network, and thus there is no periodic exchange of routing information. They broadcast a Route REQuest (RREQ) packet to the networks, and the broadcasting induces excessive redundant retransmissions of RREQ packet and causes the broadcast storm problem, which leads to a considerable number of packet collisions, especially in dense networks. Therefore, it is indispensable to optimize this broadcasting mechanism. In [2] Authors used DSR which stands for Dynamic Source Routing; it is a reactive link state protocol. It can accumulate source route during discovery of route. DSR routing appends the full route to all data packets. The hop-by-hop forwarding state in nodes is not applicable for DSR which is available in our paper. It is disorderly composition of cache routing information and automatic route shorting. Some packet salvaging can be happen in DSR. In [3] authors presents a new routing protocol for Ad hoc networks, called On-demand Tree-based Routing Protocol (OTRP). This protocol combines the idea of hop-by-hop routing such as AODV with an efficient route discovery algorithm called Tree-based Optimized Flooding (TOF.).Route discovery overheads are minimized by selectively flooding the network through a limited set of nodes, referred to as branching-nodes. However flooding gives out broadcasting storm problem when mobility of nodes and heterogeneity of networks is high which is overcome by our research paper. In [4] authors presents the paper on a mathematical framework for quantifying the overhead of proactive routing protocols in mobile ad hoc networks (MANETs). It focus on situations where the nodes are randomly moving around but the wireless transmissions can be decoded reliablely, when nodes are within communication range of each other. It explicitly presents a framework to model the overhead as a function of stability of topology and analytically characterize the statistical distribution of topology evolutions. However topology evaluation might be an overhead our paper focuses on neighbour knowledge for this. In [5] Authors presented Conventional on-demand route discovery methods in mobile ad hoc networks (MANET) employ blind flooding, where a mobile node blindly rebroadcasts received Route Request (RREQ) packets until a route to a particular destination is established. This can potentially lead to high channel contention, causing redundant retransmissions and thus excessive packet collisions in the network. Such a phenomenon induces what is known as broadcast storm problem, which has been shown to greatly increase the network communication overhead and end-to-end delay. This paper shows that the deleterious impact of such a problem can be reduced if measures are taken during the dissemination of RREQ packets. The Protocol used in our paper determines ReBroadcast order using ReBroadcast delay by using neighbour coverage knowledge. Approach is to overcome collisions and channel contentions by reducing the number of retransmission and improve the Quality of Service (QoS) routing in MANETS. In [6] it is proposed that many ad hoc routing protocols are based on some variant of flooding. Despite various optimizations of flooding, many routing messages are propagated unnecessarily. A gossiping-based approach is proposed, where each node forwards a message with some probability, to reduce the overhead of the routing protocols. Haas et al proposed a gossip based approach, where each node forwards a packet with a probability. They showed that gossip-based approach can save up to 35 percent overhead compared to the flooding. However, when the network density is high or the traffic load is heavy, the improvement of the gossip-based approach is limited. In our probabilistic broadcasting scheme based on coverage area and neighbor confirmation, this scheme uses the coverage area to set the rebroadcast probability, and uses the neighbor confirmation to guarantee reachability.

III. PROPOSED ALGORITHM

The main calculations of this paper are as follows:

A. We propose a novel scheme to calculate the rebroadcast delay. The rebroadcast delay is to determine the forwarding order. The node which has more common neighbors with the previous node has the lower delay. If this node rebroadcasts a packet, then more common neighbors will know this fact. Therefore, this rebroadcast delay

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 1, January 2016

enables the information that the nodes have transmitted the packet spread to more neighbors, which is the key to success for the proposed scheme.

B. We also propose a novel scheme to calculate the rebroadcast probability. The scheme considers the information about the uncovered neighbors (UCN), connectivity metric and local node density to calculate the rebroadcast probability. The rebroadcast probability is composed of two parts:

1) Additional coverage ratio, which is the ratio of the number of nodes that should be covered by a single broadcast to the total number of neighbors; and
2) Connectivity factor, which reflects the relationship of network connectivity and the number of neighbors of a given node.

IV. FORMULATIONS IN ALGORITHM

In this section, we calculate the rebroadcast delay and rebroadcast probability of the proposed protocol. We use the upstream coverage ratio of an RREQ packet received from the previous node to calculate the rebroadcast delay, and use the additional coverage ratio of the RREQ packet and the connectivity factor to calculate the rebroadcast probability in our protocol, which requires that each node needs its 1-hop neighborhood information.

Uncovered Neighbors Set and Rebroadcast Delay

When node ni receives an RREQ packet from its previous node s, it can use the neighbor list in the RREQ packet to estimate how many its neighbors have not been covered by the RREQ packet from s. If node ni has more neighbors uncovered by the RREQ packet from s, which means that if node ni rebroadcasts the RREQ packet, the RREQ packet can reach more additional neighbor nodes.
To quantify this, we define the UnCovered Neighbors set U (ni) of node ni as follows:

$$U(ni) = N(ni) - [N(ni) \cap N(s)] - \{s\}, \quad (1)$$

Where $\cap$ denotes intersection of two sets, N(s) and N (ni) are the neighbors sets of node s and ni, respectively. s is the node which sends an RREQ packet to node ni.
In order to sufficiently exploit the neighbor knowledge and avoid channel collisions, each node should set a rebroadcast delay. When a neighbor receives an RREQ packet, it could calculate the rebroadcast delay according to the neighbor list in the RREQ packet and its own neighbor list. The rebroadcast delay Td (ni) of node ni is defined as follows:

$$Tp(ni) = 1 - [(|N(s) \cap N(ni)|) / (|N(s)|)], \quad (2)$$

$$Td(ni) = MaxDelay \times Tp(ni)$$

Where Tp (ni) is the delay ratio of node ni, and MaxDelay is a small constant delay. | . | is the number of elements in a set and / is for indicating division.
The above rebroadcast delay is defined with the following reasons: First, the delay time is used to determine the node transmission order. When node s sends an RREQ packet, all its neighbors ni, i = 1, 2 . . . | N(s)| receive and process the RREQ packet. We assume that node nk has the largest number of common neighbors with node s, according to the above formula; node nk has the lowest delay. The objective of this rebroadcast delay is not to rebroadcast the RREQ packet to more nodes, but to disseminate the neighbor coverage knowledge more quickly.
If node ni receives a duplicate RREQ packet from its neighbor nj, it knows that how many its neighbors have been covered by the RREQ packet from nj. Thus, UCN set according to the neighbor list in the RREQ packet from nj.
Then, the U (ni) can be adjusted as follows:

$$U(ni) = U(ni) - [U(ni) \cap N(nj)], \quad (3)$$

After adjusting the U (ni), the RREQ packet received from nj is discarded. When the timer of the rebroadcast delay of node ni expires, the node obtains the final UCN set. Note that, if a node does not sense any duplicate RREQ packets

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 1, January 2016

from its neighborhood, its UCN set is not changed, which is the initial UCN set. We define the additional coverage ratio (Ra (ni)) of node ni as:

Ra (ni) = | U (ni) | / | N (ni) | (4)

This metric indicates the ratio of the number of nodes that are additionally covered by this rebroadcast to the total number of neighbors of node ni. Ra becomes bigger, more nodes will be covered by this rebroadcast, and more nodes need to receive and process the RREQ packet, and, thus, the rebroadcast probability should be set to be higher. If each node connects to more than 5:1774 log n of its nearest neighbors, then the probability of the network being connected is approaching 1 as n increases, where n is the number of nodes in the network. Then, we can use 5.1774 log n as the connectivity metric of the network. We assume the ratio of the number of nodes that need to receive the RREQ packet to the total number of neighbors of node ni is Fc (ni). In order to keep the probability of network connectivity approaching 1, we have a heuristic formula: |N (ni)| . Fc (ni) ≥ 5.1774 log n. Then, we define the minimum Fc (ni) as a connectivity factor, which is:

Fc (ni) = Nc / | (N(ni)) | (5)

Where Nc = 5.1774 log n, and n is the number of nodes in the network. From (5), we can observe that when |N (ni)| is greater than Nc, Fc (ni) is less than 1. That means node ni is in the dense area of the network, then only part of neighbors of node ni forwarded the RREQ packet could keep the network connectivity. And when |N (ni)| is less than Nc, Fc (ni) is greater than 1. That means node ni is in the sparse area of the network, then node ni should forward the RREQ packet in order to approach network connectivity. Combining the additional coverage ratio and connectivity factor, we obtain the rebroadcast probability Pre (ni) of node ni:

Pre (ni) = Fc (ni) . Ra (ni) (6)

Where, if the Pre (ni) is greater than 1, we set the Pre (ni) to 1. Note that the calculated rebroadcast probability Pre (ni) may be greater than 1, but it does not impact the behaviour of the protocol. It just shows that the local density of the node is so low that the node must forward the RREQ packet. Then, node ni need to rebroadcast the RREQ packet received from s with probability Pre (ni).

V. SYSTEM MODULES

1. Network formation with different mobile nodes
2. Rebroadcasting Delay calculation
3. Rebroadcast Probability
4. A neighbor coverage-based probabilistic rebroadcast.

Module Description:

1. Network formation with different mobile nodes:-

In this module we form the mobile network. The network contains number of nodes and one base station. We can construct a topology to provide communication paths for wireless network. Here the node will give the own details such as Node ID and port number through which the transmission is done and similarly give the known nodes details such as Node ID, IP address and port number which are neighbors to given node.

2. Rebroadcasting Delay calculation:-

Node mobility available in MANETs, frequent link breakages may lead to frequent path failures and route discoveries, which could increase the overhead of routing protocols and reduce the packet delivery ratio and increasing the end-to-end delay. Thus, the conventional on-demand routing protocols use flooding to discover a route. They broadcast a Route REQuest (RREQ) packet to the networks, and the broadcasting induces excessive redundant retransmissions of

ISSN(Online): 2320-9801
ISSN (Print): 2320-9798

International Journal of Innovative Research in Computer and Communication Engineering

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Issue 1, January 2016

RREQ packet and causes the broadcast storm problem, which leads to a considerable number of packet collisions, especially in dense networks.

3. Rebroadcast Probability:-

We now obtain the initial motivation of our protocol: Since limiting the number of rebroadcasts can effectively optimize the broadcasting, and the neighbor knowledge methods perform better than the area-based ones and the probability-based ones, then we propose a neighbor coverage-based probabilistic rebroadcast (NCPR) protocol. Therefore, 1) in order to effectively exploit the neighbor coverage knowledge, we need a novel rebroadcast delay to determine the rebroadcast order, and then we can obtain a more accurate additional coverage ratio; 2) in order to keep the network connectivity and reduce the redundant retransmissions.

4. A neighbor coverage-based probabilistic rebroadcast:-

The proposed NCPR protocol needs Hello packets to obtain the neighbor information, and also needs to carry the neighbor list in the RREQ packet. Therefore, in our implementation, some techniques are used to reduce the overhead of Hello packets and neighbor list in the RREQ packet. In order to reduce the overhead of Hello packets, we do not use periodical Hello mechanism. Since a node sending any broadcasting packets can inform its neighbors of its existence, the broadcasting packets such as RREQ and route error (RERR) can play a role of Hello packets. Only when the time elapsed from the last broadcasting packet (RREQ, RERR, or some other broadcasting packets) is greater than the value of HelloInterval, the node needs to send a Hello packet. The value of HelloInterval is equal to that of the original AODV. In order to reduce the overhead of neighbor list in the RREQ packet, each node needs to monitor the variation of its neighbor table and maintain a cache of the neighbor list in the received RREQ packet. We modify the RREQ header of AODV, and add a fixed field num_neighbors which represents the size of neighbor list in the RREQ packet and following the num_neighbors is the dynamic neighbor list.

VI. CONCLUSION

Thus we have studied various previous routing methods and protocols and have also proposed the protocol used to improve efficiency of broadcasting in routing in MANETS.

Therefore our approach combines the advantages of the neighbor coverage knowledge and the probabilistic Mechanism, which can significantly decrease the number of retransmissions so as to reduce the routing overhead, and can also improve the routing performance.

ACKNOWLEDGMENT

We would like to thank Department of Computer Science & Engineering, RCERT Chandrapur for providing infrastructure and guidance to understand routing in MANETS.

REFERENCES

[1] Bhadauria et al., “Performance Analysis of Ad hoc On-Demand Distance Vector Protocol for MANET” , International Journal of Advanced Research in Computer Science and Software Engineering , Volume 3, pp. 1-6, 2013.

[2] D. Johnson, Y. Hu, and D. Maltz, “The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR) for IPv4”, IETF RFC 4728, vol. 15, pp. 153-181, 2007.

[3]H. AlAamri, M. Abolhasan, and T. Wysocki, “On Optimising Route Discovery in Absence of Previous Route Information in MANETs,” Proc. IEEE Vehicular Technology Conf. (VTC), pp. 1-5, 2009.

[4] X. Wu, H.R. Sadjadpour, and J.J. Garcia-Luna-Aceves, “Routing Overhead as a Function of Node Mobility: Modelling Framework and Implications on Proactive Routing,” Proc. IEEE Int'l Conf. Mobile Ad Hoc and Sensor Systems (MASS '07), pp. 1- 9, 2007.

[5] J.D. Abdulai, M. Ould-Khaoua, and L.M. Mackenzie, “Improving Probabilistic Route Discovery in Mobile Ad Hoc Networks,” Proc. IEEE Conf. Local Computer Networks, pp. 739-746, 2007.

[6] Z. Haas, J.Y. Halpern, and L. Li, “Gossip-Based Ad Hoc Routing,” Proc. IEEE INFOCOM, vol. 21, pp. 1707-1716, 2002.

[7] S.Y. Ni, Y.C. Tseng, Y.S. Chen, and J.P. Sheu, “The Broadcast Storm Problem in a Mobile Ad Hoc Network,” Proc. ACM/IEEE MobiCom, pp. 151-162, 1999.

[8] A. Mohammed, M. Ould-Khaoua, L.M. Mackenzie, C. Perkins, and J.D. Abdulai, "Probabilistic Counter-Based Route Discovery for Mobile Ad Hoc Networks," Proc. Int'l Conf. Wireless Comm. And Mobile Computing: Connecting the World Wirelessly (IWCMC '09), pp. 1335-1339, 2009.
[9] B. Williams and T. Camp, "Comparison of Broadcasting Techniques for Mobile Ad Hoc Networks," Proc. ACM MobiHoc, pp. 194- 205, 2002.
[10] W. Peng and X. Lu, "On the Reduction of Broadcast Redundancy in Mobile Ad Hoc Networks," Proc. ACM MobiHoc, pp. 129-130, 2000.

BIOGRAPHY

Shivani Suresh Yadao is a student in the Computer Science and Engineering Department from RCERT College. She is pursuing Masters of Technology (MTech) degree from Gondwana University, Chandrapur, India. Her research interests are Computer Networks (wireless Networks), Cloud Computing, Algorithms etc.

Prof.R.K.Krishna is a Professor in the Electronics Department, Rajiv Gandhi College of Engineering, Research &Technology, Chandrapur, India. His research interests are Computer Networks (wireless Networks), HCI, Algorithms, etc.