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Reducing Routing Overhead In MANET Using NCPR

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Abstract: ***Mobile ad hoc network consists of a group of mobile nodes which can be dynamically self-organized into arbitrary topology networks without any fixed infrastructure. In MANET mobile nodes will not stay in a same position, due to this large mobility of nodes in MANET, frequent link breakages will occur which will lead to path failure and route discovery problems. To overcome this type of routing overhead we are proposing the new technique using NCPR. The proposed NCPR method is used to determine the rebroadcast delay in the rebroadcast order and obtain the more exact additional coverage ratio by sensing neighbor coverage knowledge.***

Keywords: *Mobile ad hoc networks, neighbor coverage, network connectivity, probabilistic rebroadcast, routing overhead* **.**

1. Introduction

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) [2], have been proposed for MANETs. The above two protocols are on demand 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. Williams and Camp categorized broadcasting protocols into four classes: “simple flooding, probability-based methods, area based methods, and neighbor knowledge methods.” For the above four classes of broadcasting protocols, they showed that an increase in the number of nodes in a static network will degrade the performance of the probability-based and area-based methods. Kim et al. indicated that the 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.

1.1 Statement Of The Problem

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.

1.2 Scope Of The Study

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, 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.

2. Literature Survey

Xin Ming Zhang et al [1] show that the probabilistic rebroadcast protocol based on neighbor coverage to reduce the routing overhead in MANETs. C. Perkins et al [2] Shows that the Ad hoc On-Demand Distance Vector (AODV) routing protocol is intended for use by mobile nodes in an ad hoc network. H AlAmri et al [3] shows that new routing protocol for Ad hoc networks, called on demand Tree-based Routing Protocol (OTRP). Z. J. Haas et al [4] many ad hoc routing protocols are based on some variant of flooding. Despite various optimizations of flooding, many routing messages are propagated unnecessarily. B Williams & T Camp [5] had discussed the Network wide broadcasting in Mobile Ad Hoc Networks provides important control and route establishment functionality for a number of unicast and multicast protocols.

3. Neighbor Coverage Based Probabilistic Rebroadcast (NCPR) Protocol

To calculate the rebroadcast delay and rebroadcast probability of the proposed protocol. Using 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.

3.1 Rebroadcast Delay and Uncovered Neighbors Set

The node receives the RREQ packet from its earlier node s, to use the neighbor list in the RREQ packet to estimate how many its neighbors have been not covered by the RREQ packet from s. The node ni has more neighbors not covered by the RREQ packet from source, and the RREQ packet can
reach more additional neighbor nodes when node ni rebroadcasts the RREQ packet,. To quantify of the Uncovered Neighbors (UCN) set U(ni) of node ni as follows:

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

The N(s) and N(ni) are the neighbors sets of node. s is sends an RREQ packet to node ni. According to Eq.(1), The broadcast characteristics of an RREQ packet, node ni can receive the duplicate RREQ packets from its neighbors. Node ni could further adjust the U(ni) through the neighbor knowledge. In order to sufficiently exploit the neighbor knowledge and avoid channel collisions, each node should set a rebroadcast delay. The choice of a proper delay is the key to success for the proposed protocol because the scheme used to determine the delay time affects the dissemination of neighbor coverage knowledge. 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**:**

$$Tp(ni) = 1 - \frac{|N(s) \cap N(ni)|}{|N(s)|}$$

$$Td\ (ni) = MaxDelay \times Tp(ni)\ , \qquad (2)$$

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. The above rebroadcast delay is defined reasons: First, the delay time is used to determine the node transmission order. To sufficiently exploit the neighbor coverage knowledge. The
Eq. (2) is, node nk has the lowest delay. Once node nk rebroadcasts the RREQ packet, here more nodes to receive it, because node nk has the largest number of common neighbors. Then there are more nodes which can exploit the neighbor knowledge to adjust their UCN sets. Of course, whether node nk rebroadcasts the RREQ packet based on its rebroadcast possibility calculated in the subsequent section. The aim of this rebroadcast hold-up is not to rebroadcast the RREQ packet to more nodes, but to disseminate the neighbor coverage knowledge more quickly. After determining the rebroadcast delay, the node can set its own timer.

3.1 Neighbor Knowledge And Rebroadcast Probability

The node which has a more rebroadcast delay might listen to RREQ packets from the nodes, which have lesser one. For example, 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, node ni could further adjust its UCN set according to the neighbor list in the RREQ packet from nj . Then the U(ni) can be adjusted as follows:

$$U(ni) = U(ni) - [U(ni) \cap N(nj\ )]. \qquad (3)$$

After adjusting the U(ni), the RREQ packet received from nj is discarded. Do not need to adjust the rebroadcast delay because the rebroadcast delay is used to determine the order of disseminating neighbor coverage knowledge to the nodes which receive the same RREQ packet from the upstream node. Thus, it is determined by the neighbors of upstream nodes and its own. When the timer of the rebroadcast delay of node ni expires, the node obtains the final UCN set. The nodes belonging to the final UCN set are the nodes that need to receive and process the RREQ packet. Note that, if a node does not sense any duplicate RREQ packets from its neighborhood, its UCN set is not changed, which is the initial UCN set. Now we study how to use the final UCN set to set the rebroadcast probability.

The additional coverage ratio Ra(ni):

$$Ra(ni) = \frac{|U(ni)|}{|N(ni)|} \quad (4)$$

$$Fc(ni) = \frac{Nc}{|N(ni)|} \quad (5)$$

Nc = 5.1774 log n, the n is the number of nodes in the network. The Eq. (5), observe that when |N(ni)| >Nc, Fc(ni) < 1. The 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 |N(ni)| < Nc, Fc(ni) > 1. The means of 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, to obtain the rebroadcast probability Pre (ni) of node ni:

$$Pre\ (ni) = Fc(ni) \cdot Ra(ni) \quad (6)$$

Where, if the Pre (ni) is > 1, to set the Pre (ni) to 1.

3.2 Algorithm Description

The formal description of the Neighbor Coverage based Probabilistic Rebroadcast (NCPR) for reducing routing overhead in route discovery is shown in algorithm .

Definitions:
RREQv: RREQ packet received from node v.
Rv.id: the unique identifier (id) of RREQv.
N(u): Neighbor set of node u.
U(u, x): Uncovered neighbors set of node u for RREQ whose id is x.
Timer(u, x): Timer of node u for RREQ packet whose id is x.
{Note that, in the actual implementation of NCPR protocol, every different RREQ needs a UCN set and a Timer.}
1: if ni receives a new RREQs from s then
2: {Compute initial uncovered neighbors set U(ni,Rs.id) for RREQs:}
3: U(ni,Rs.id) = N(ni) − [N(ni) ∩ N(s)] − {s}
4: {Compute the rebroadcast delay Td(ni):}
5: Tp(ni) = 1 −[|N(s)∩N(ni)|/ |N(s)|]
6: Td(ni) = MaxDelay × Tp(ni)
7: Set a Timer(ni,Rs.id) according to Td(ni)
8: end if
9:
10: while ni receives a duplicate RREQj from nj before Timer(ni,Rs.id) expires do
11: {Adjust U(ni,Rs.id):}
12:U(ni,Rs.id)=(ni,Rs.id)−[U(ni,Rs.id)∩N(nj)]
13: discard(RREQj);
14: end while
15:
16: if Timer(ni,Rs.id) expires then
17: {Compute the rebroadcast probability Pre(ni):}
18: Ra(ni) = |U(ni,Rs.id)|/ |N(ni)|
19: Fc(ni) = Nc/ |N(ni)|
20: Pre(ni) = Fc(ni) · Ra(ni)
21: if Random(0,1) ≤ Pre(ni) then
22: broadcast(RREQs)
23: else
24: discard(RREQs)
25: end if
26: end if

4. Results

4.1 Performance with respect to Time

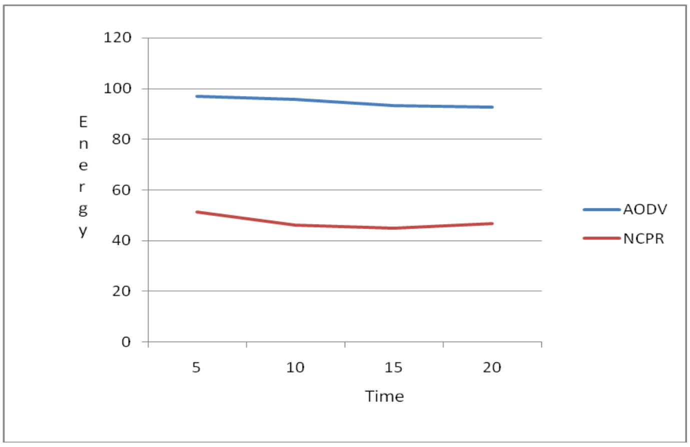

Fig1: Time vs. Energy consumption

Fig1 shows the time Vs energy Consumption .Ggraph shows that the energy consumed by the AODV protocol is greater than the energy consumed by the NCPR protocol hence we conclude that NCPR is better than the AODV Protocol.

4.2 Performance with Respect to Time

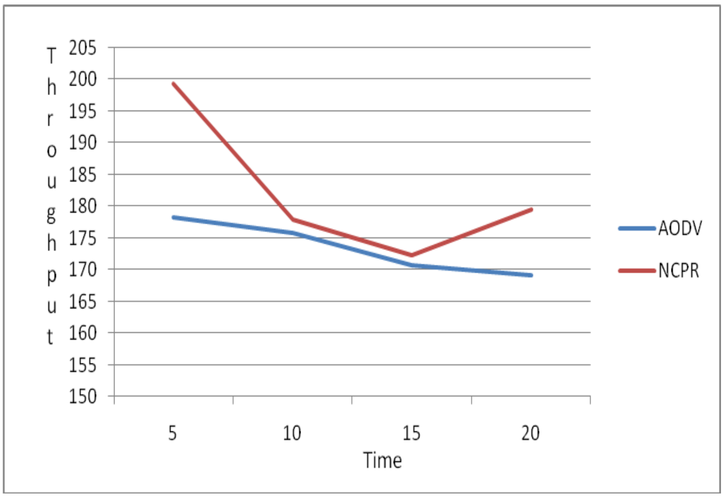

Fig2: Time Vs Throughput

Fig2 shows that the Throughput of NCPR protocol is greater than the Throughput of AODV protocol ,hence this point also helps us to show that our protocol is better .

4.3 Performance with Respect to Node Mobility

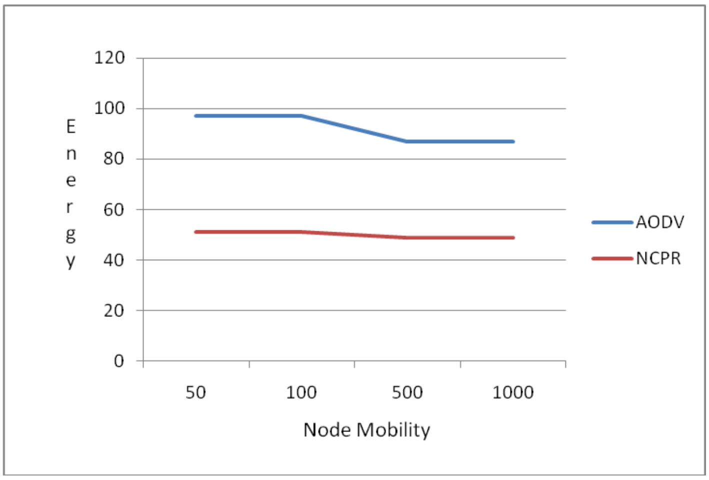

Fig3: Node Mobility Vs Energy Consumption

Fig3 shows that if we change the speed of the mobile nodes than how much energy is consumed by both protocols. Graph shows that the energy consumed by the AODV protocol with respect to the mobility of the node is greater than the energy consumed by the NCPR protocol.

Conclusion

In this paper a probabilistic rebroadcast protocol based on neighbor coverage to reduce the routing overhead in MANETs is discussed. This neighbor coverage knowledge includes additional coverage ratio and connectivity factor. We proposed a new scheme to dynamically calculate the rebroadcast delay, which is used to determine the forwarding order and more effectively exploit the neighbor coverage knowledge. Because of less redundant rebroadcast, the proposed protocol mitigates the network collision and contention, so as to increase the packet delivery ratio and throughput and decreases the average end-to-end delay.

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