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Reducing Routing Overhead in Mobile Ad Hoc Networks by Neighbour Coverage-Based Probabilistic Rebroadcast

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ABSTRACT: Due to high mobility of nodes in mobile ad hoc networks (MANETs), there exist frequent link breakages which lead to frequent path failures and route discoveries. The overhead of a route discovery cannot be neglected. 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.To discover the route better than broadcasting methodology rebroadcast can done with the help of neighbour knowledge methods. In order to effectively exploit the neighbour 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 neighbour coverage knowledge. We also define a connectivity factor to provide the node density adaptation. By combining the additional coverage ratio and connectivity factor, we set a reasonable rebroadcast probability. This approach can significantly decrease the number of retransmissions so as to reduce the routing overhead and also improve the routing performance.

KEYWORDS: Mobile ad hoc networks, neighbour coverage, network connectivity, probabilistic rebroadcast, routing overhead.

I. INTRODUCTION

The Mobile Ad hoc Networks (MANETS) is a special type of wireless mobile network in which mobile hosts can communicate without any aid of established infrastructure and can be deployed for many applications such as battlefield, disaster relief and rescue, etc. The nodes are free to move randomly and act as end points as well as routers to forward packets in a multi-hop environment where all nodes may not be within the transmission range of the source. The network topology may change rapidly and unpredictably in time. New nodes can join the network, and other nodes may leave the network. The

Expected size of a MANET is larger than the transmission range of the nodes, because of this fact it is necessary to route the traffic through a multi-hop path for giving the nodes the ability to communicate with each other. There exist neither fixed routers nor fixed locations for the routers nor centralized administration. The lack of any fixed infrastructure is compensated by the routing ability of every mobile node. They all act as mobile routers and for this they need the capability to discover and maintain routes to every node in the network and to route the packets accordingly.

To optimize the broadcasting, limiting the number of rebroadcasting in the routing will help. Rebroadcasting delay helps to define the neighbor coverage knowledge in network, in order to strengthen the network connectivity, broadcasting neighbors should receive the RREQ packet these reduce the redundant and number of rebroadcasts of the RREQ packet in the data transmission. Always neighbor selection has to done randomly, due to random mobility model in network. Number of collisions in re-broadcasting will occur in the physical layer. Since data packets and routing packets share the same physical channel, thecollision possibility is high when there is a large number of routing packets (request / response).

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II. LITERATURE SURVEY

Broadcasting is an effective mechanism for route discovery, but the routing overhead associated with the broadcasting can be quite large, especially in high dynamic networks [5]. Perkins [1] studied routing protocols are proposed for Ad hoc networks and their classification of these schemes according to the routing strategy (i.e., table- driven and on-demand). Table-driven routing protocols, such as DSDV and OLSR, attempt to maintain consistent and up-to-date routing information from each node to every other node in the network. Each mobile node is required to periodically discover and maintain routes to every possible destination in the network. In the on-demand routing protocols, such as AODV and DSR, routes are discovered only when they are needed. Each node maintains a route for a source-destination pair without the use of periodic routing table exchanges or full network topological view.

Johnson [2] studied conventional on-demand routing protocols, a node that needs to discover a route to a particular destination, broadcasts a Route Request control packet (RREQ) to its immediate neighbors. Each mobile node blindly rebroadcast the received RREQ packet until a route is established. This method of route discovery is referred to as blind flooding. Blind flooding is extensively use in ad hoc, where a mobile node blindly rebroadcasts RREQ packets. This leads to packet collisions in network. In this paper generic Dynamic Probabilistic Method for route discovery is introduced, which is simple to implement and can reduce the overhead with dissemination of RREQs. The main problem is how to minimize the number of rebroadcast packets while good retransmission. Kim [4] proposed a probabilistic broadcasting scheme based oncoverage area and neighbor confirmation. The scheme combines probabilistic approach with the area-based approach. A mobile host can dynamically adjust the value of the rebroadcast probability according to its additional coverage in its neighborhood. The coverage is estimated by the distance from the sender. Our scheme combines neighbor confirmation concept to prevent early die-out of rebroadcast. Abdulai [6] proposed a Dynamic Probabilistic Route Discovery (DPR) scheme based on neighbor coverage. In this approach, each node determines the forwarding probability according to the number of its neighbors and the set of neighbors which are covered by the previous broadcast. This scheme only considers the coverage ratio by the previous node, and it does not consider the neighbors receiving the duplicate RREQ packet.

Huang [7] proposed a methodology of dynamically adjusting the Hello timer and the Timeout timer according to the conditions of the network. For example, in a high mobility network (with frequent topology changes) it is desirable to use small values for the timers to quickly detect the changes in the network. On the other hand, in a low mobility network where the topology remains stable and with few changes, a large value for the timers is more effective to reduce the overhead. In order to decide whether the mobility of the network is high or low, we use a simple way to approximate in real time of the link change rate. The reduction of the overhead is greatly achieved with the minimal cost of slightly increasing the drop rate in data traffic. While the packet loss increases around 1%, the overhead reduction reaches 40%.

Ni [3] studied the broadcasting protocol and simple packet flooding without a careful decision of a controlled rebroadcasting may produce an excessive redundancy of incoming packets, a greater channel contention, and a higher collision rate. Hybrid approaches is combining the advantages of distance-based and area-based schemes in terms of reachability and saving of rebroadcasting without the overhead and also satisfy two goals, namely high reachability and low redundancy. In our protocol, we also set a deterministic rebroadcast delay, but the goal is to make the dissemination of neighbor knowledge much quicker.

Aminu[9] proposed a rebroadcast probability function which takes in to account about the value of the packet counter together with some key simulation parameters(i.e. network topology size, transmission range and number of nodes) to determine the appropriate rebroadcast probability for a given node. The rebroadcast probability of a node is computed based on these parameters. Compared to the other schemes, simulation results have revealed that counter Function achieved superior saved rebroadcast (about 20% better than its closest competitor i.e., counter-based scheme, in dense network) and end-to-end delay (around 26% better than counter-based scheme in dense network) without sacrificing reach ability in medium and dense networks.

III. NEIGHBOR COVERAGE-BASED PROBABILISTIC REBROADCAST PROTOCOL

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 neighbourhood information.

A. UNCOVERED NEIGHBOURS SET AND REBROADCAST DELAY

When node ni receives RREQ packet from its neighbor node s, it can use the neighbor list available in the RREQ packet to calculate how many its neighbors have not been covered by the RREQ packet which has been delivered from node s. If node ni has more neighbors uncovered by the RREQ packet from node s, which means that if node ni rebroadcasts the RREQ packet, this RREQ packet could reach more extra neighbor nodes. We calculate the Uncovered Neighbors set U (ni) of node ni as follows:

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

We obtain the initial UCN set. Due to broadcast characteristics of RREQ packet, node ni can receive the redundant RREQ packets from its neighbors. Node ni could further adjust the U (ni) with the neighbor knowledge. Where N(s) and N (ni) are the neighbors sets of node s and ni respectively. S is the node which sends the RREQ packet to node ni .The Rebroadcast delay Td (ni) of node ni is calculated as follows: T p (ni) = 1−| [N (ni) ∩ N(s)] ||N(s)| Td (ni) = MaxDelay × 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.

B. CALCULATION OF NEIGHBOR KNOWLEDGE AND REBROADCAST PROBABILITY.

If node ni receives a redundant RREQ packet from its neighbornj then node ni can further adjust its UCN set according to the neighbor list in the RREQ packet from nj. Then U(ni)can be adjusted as follows: U(ni)= U(ni) - [U(ni) ∩ N(nj)] After adjusting the U(ni), the RREQ packet received from nj is discarded. The rebroadcast probability is composed of additional coverage ratio and connectivity factor. Additional coverage ratio Ra (ni) of node ni is defined as follows:

$$R a (ni) = |U(ni)||N(ni)|$$

This formula indicates the ratio between the number of nodes that are additionally covered by this rebroadcast to the total number of neighbors of node ni . Fc (ni) is defined as a connectivity factor as follows:

$$Fc (ni) = Nc|N(ni)|$$

Where Nc=5.1774 log n, and n is the number of nodes in the network. The rebroadcast probability Pre (ni) of node ni as follows:

$$Pre (ni) = Fc (ni) \times Ra (ni)$$

Where, if the Pre (ni) is greater than 1, we set the Pre (ni) to 1. The calculated rebroadcast probability Pre (ni) may be greater than 1, but it does not impact the behaviour of the protocol [1]. Then, with probability Pre (ni), node ni need to rebroadcast the RREQ packet received from s.

C. ROUTE RECOVERY BY RREQ AND RREP

In this section the signal handoff is done with the knowledge of route plan (RREP).The route manager inform the channel fading.

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IV. CONCLUSIONS

In this paper we did survey on probabilistic rebroadcast protocol based on neighbor coverage to reduce the routing overhead in MANETs.This neighbor coverage knowledge includes additional coverage ratio and connectivity factor. This protocol has good performance when the network is in high-density or the traffic is in heavy load. Because of less redundant rebroadcast, the proposed protocol mitigates the network collision and contention, so as to increase the packet delivery ratio and decrease the average end-to-end delay.

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