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A Review on Reducing Routing Overhead in Mobile Ad Hoc Network using Probabilistic Rebroadcast Mechanism

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***Abstract-* In mobile ad hoc network (MANETs) the nodes are continuously moving, this mobility of nodes causes continuous link breakage due to which frequent path failure occur and route discoveries is required. The fundamental mechanism for route discoveries is broadcasting in which the receiver node blindly rebroadcast the first received route request packet unless it has route to the destination. This mechanism incur retransmission which causes overhead and decrease the packet deliverance ratio and increase the end delay, which cannot be avoided. In this paper we proposed reducing routing overhead in mobile ad hoc network using probabilistic rebroadcast mechanism. In which rebroadcast delay is introduced to determine the neighbour coverage knowledge which will help in finding accurate additional coverage ratio and rebroadcast order. We also define connectivity factor to provide node density adaptation. By combining the additional coverage ratio and connectivity factor, rebroadcast probability is determined. The approach can signify improvement in routing performance and decrease the routing overhead by decreasing the number of retransmission.**

***Keywords–* Routing overhead, Mobile ad hoc network, probabilistic rebroadcast.**

I. INTRODUCTION

The MANET is a special type of wireless mobile network in which mobile host can communicate without any aid of established infrastructure and can be deployed for many applications. MOBILE Ad hoc networks (MANETs) consist of a collection of mobile nodes which can move freely (See Fig 1). These freely moving nodes without any fix infrastructure can dynamically self-organized into arbitrary topology network. One of the fundamental challenges of MANETs is the design of dynamic routing protocols with good performance and lessoverhead. Many routing protocols, such as Ad hoc On-demand Distance Vector Routing (AODV) [1] andDynamic Source Routing (DSR) [2], have been proposed for MANETs.The Ad hoc On Demand Distance Vector (AODV) routing algorithm is a routing protocol designed for ad hoc mobile networks.AODV is capable of both unicastand multicast routing. AODV is an on demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. It maintains these routes as long as they are needed by the sources[19].The Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need for any existing network infrastructure or administration [20].

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 [3]. 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 [4]. Thus, reducing the routing overhead in route discovery is an essential problem.

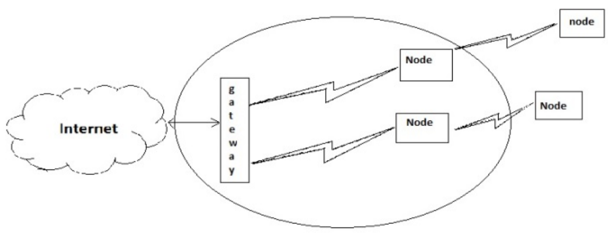

Fig 1: Simple block diagram of MANET

II. LITERATURE REVIEW AND RELATED WORK

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 [9]. Ni et al. [5] studied the broadcasting protocol analytically and experimentally, and showed that the rebroadcast is very costly and consumes too much network resource. The broadcasting incurs large routing overhead and causes many problems such as redundant retransmissions, contentions, and collisions [5]. Thus, optimizing the broadcasting in route discovery is an effective solution to improve the routing performance.

Haas et al.[10] proposed a gossip based approach, where each node forwards a packet with a probability. They showed that gossip-based approach can save 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 [9]. Kim et al. [8] proposed a probabilistic broadcasting scheme based on coverage area and neighbour confirmation. This scheme uses the coverage area to set the rebroadcast probability, and uses the neighbour confirmation to guarantee reach ability. Peng and Lu [11] proposed a neighbour knowledge scheme named Scalable Broadcast Algorithm (SBA). This scheme determines the rebroadcast of a packet according to the fact whether this rebroadcast would reach additional nodes.

Abdulai et al. [12] proposed a Dynamic Probabilistic Route Discovery (DPR) scheme based on neighbour coverage. In this approach, each node determines the forwarding probability according to the number of its neighbours and the set of neighbours which are covered by the previous broadcast. This scheme only considers the coverage ratio by the previous node, and it does not consider the neighbours receiving the duplicate RREQ packet. Thus, there is a room of further optimization and extension for the DPR protocol. Several robust protocols have been proposed in recent years besides the above optimization issues for broadcasting. Chen et al. [13] proposed an AODV protocol with Directional Forward Routing (AODV-DFR) which takes the directional forwarding used in geographic routing into AODV protocol. While a route breaks, this protocol can automatically find the next-hop node for packet forwarding.

Keshavarz-Haddad et al. [14] proposed two deterministic timer-based broadcast schemes: Dynamic Reflector Broadcast (DRB) and Dynamic Connector-Connector Broadcast (DCCB). They pointed out that their schemes can achieve full reach ability over an idealistic lossless MAC layer, and for the situation of node failure and mobility, their schemes are robustness. Stann et al. [15] proposed a Robust Broadcast Propagation (RBP) protocol to provide near-perfect reliability for flooding in wireless networks, and this protocol also has a good efficiency. They presented a new perspective for broadcasting: not to make a single broadcast more efficient but to make a single broadcast more reliable, which means by reducing the frequency of upper layer invoking flooding to improve the overall performance of flooding. The proposed protocol set a deterministic rebroadcast delay, but the goal is to make the dissemination of neighbour knowledge much quicker. One of the earliest broadcast mechanisms is flooding, where every node in the network retransmits a message to its neighbours upon receiving it for the first time. Although flooding is extremely simple and easy to implement, it can be very costly and can lead to serious problem, named as broadcast storm problem, which is characterized by redundant packet retransmissions, network bandwidth contention and collision. Ni et al. [5] studied the flooding protocol analytically and experimentally and showed that a rebroadcast can provide only 61% additional coverage at most and only 41% additional coverage in average over that already covered by the previous transmission. So, rebroadcasts are very costly and should be used with caution.

III. Analysis Of Problem

In Mobile Ad Hoc Network nodes are moving continuously 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 [4]. 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 [5], which leads to a considerable number of packet collisions, especially in dense networks.

The Broadcast Storm Problem:

A straight-forward approach to perform broadcast is by flooding. A host, on receiving a broadcast packet for the first time, has the obligation to rebroadcast the packet. Clearly, this costs n transmissions in a MANET of n hosts. In a CSMA/CA network, drawbacks of flooding include:

1. *Redundancy:* When a mobile host decides to rebroadcast a broadcast packet to its neighbours, all of its neighbours might already have heard the packet
2. *Contention:* After a mobile host broadcasts a packet, if many of its neighbours decide to rebroadcast the packet, these transmissions (which are all from nearby hosts) may severely contend with each other.

Broadcasting is a special routing process of transmitting a packet so that each node in a network receives a copy of this packet. Flooding is a simple approach to broadcasting with no use of global information; in flooding, a broadcast packet is forwarded by every node in the network exactly once. Simple flooding ensures the coverage; the broadcast packet is guaranteed to be received by every node in the network providing there is no packet loss caused by collision in the MAC layer and there is no high speed movement of nodes during the broadcast process. (Fig. 2) shows a network with six nodes. When node v broadcasts a packet as shown in Fig. 1b, all neighbouring nodes, u, w, x, and y, receive the packet due to the broadcast nature of wireless communication media. All neighbours will then forward the packet to each other. Apparently, the two transmissions from nodes u and x are unnecessary. Redundant transmissions may cause the broadcast storm problem [18] in which redundant packets cause contention and collision.

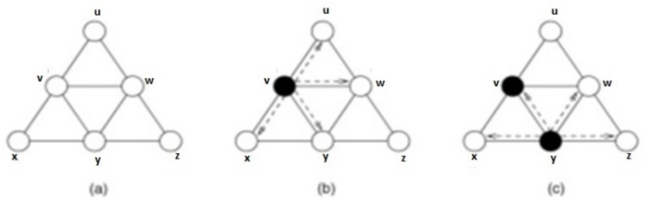

Fig. 2. Representing Broadcast storm problem

IV. Proposed Work

In MANET the network topology frequently changes causing routing overhead due to dissemination of routing control packet such as RREQ. During route discovery traditional on-demand routing protocols produce a large amount of routing traffic by blindly flooding the entire network with RREQ packet. Recently, the issue of reducing the routing overhead associated with route discovery and maintenance in on demand routing protocols has attracted increasing attention.

In this paper we propose probabilistic rebroadcast mechanism which combines both neighbour coverage and probabilistic methods.

1. *Uncovered Neighbours Set and Rebroadcast Delay*Rebroadcast delay: when node receives an RREQ packet from its previous node, it can use the neighbour list in the RREQ packet to estimate how many its neighbours have not been covered by the RREQ packet from previous node. If node has more neighbours uncovered by the RREQ packet from previous node, which means that if node rebroadcasts the RREQ packet, the RREQ packet can reach more additional neighbour nodes. To quantify this, we define the UnCovered Neighbours (UCN) set of node. The rebroadcast delay is to determine the forwarding order. The node which has more common neighbours with the previous node has the lower delay. If this node rebroadcasts a packet, then more common neighbours will know this fact. Therefore, this rebroadcast delay enables the information that the nodes have transmitted the packet spread to more neighbours, which is the key to success for the proposed scheme.
2. *Neighbour Knowledge and Rebroadcast Probability* the node which has a larger rebroadcast delay may listen to RREQ packets from the nodes which have lower one. For example, if node *'ni'* receives a duplicate RREQ packet from its neighbour *'nj'*, it knows that how many its neighbours have been covered by the RREQ packet from *'nj'*. Thus, node *'ni'* could further adjust its UCN set according to the neighbour list in the RREQ packet from *'nj'*. 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 neighbourhood, its UCN set is not changed, which is the initial UCN set.

We define the *additional coverage ratio* of node *'ni'* this metric indicates the ratio of the number of nodes that are additionally covered by this rebroadcast to the total number of neighbours of node *'ni'*. The nodes that are additionally covered need to receive and process the RREQ packet.

Xue and Kumar [16] derived that if each node connects to more than 5.1774*log n* of its nearest neighbours, 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 neighbours of node is *Fc(ni)*. In order to keep the probability of network connectivity approaching 1, we have a heuristic formula: $|N(ni)|.Fc(ni) \geq 5.1774 \log n$. Then, we define minimum *fc(ni)* as a connectivity factor, which is

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

Where *Nc*=5.1774*log n,* and n is the number of nodes in the network. 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 neighbours 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 of node.

V. APPLICATION

1. The Mobile Ad Hoc network can be used where the operation are often spontaneous with little or no fixed infrastructure, such operation requires a communication which are spontaneous and network can be establish when and where required.
2. The Mobile Ad Hoc network can be used in an unknown territory where an infrastructure network is almost impossible. In such situation, the ad hoc network having self-organizing capability can be effectively used.
3. The mobile Ad Hoc network can be used as an crises management application these arise, for example, as a result of natural disaster where the entire communication infrastructure is disarray. Restoring communication quickly is essential. By using Mobile Ad Hoc network, an infrastructure can be setup in hours instead of days/week required for wire line communication.
4. The Mobile Ad Hoc network is used in Army where the message is need to be transmitted to remote node away from the base station, with the help of intermediate nodes.

VI. CONCLUSION

In this review paper we proposed to reduce the routing overhead in MANET by introducing probabilistic rebroadcast mechanism based on neighbour coverage knowledge which includes additional coverage ratio and connective factor. The paper focus on mechanism that will have good performance when the network is in high density or the traffic load is high. The proposed system will generate less rebroadcast traffic that used to occur in flooding. Because of less redundant rebroadcast, the proposed work will mitigate the network collision and contention; this will increase the packet delivery ratio and reduce the average end to end delay. Although the network is in high density or the traffic is heavily loaded, the proposed work will have good performance.

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