Review on Reducing Routing Overhead in Mobile Ad-hoc Network Using DSDV, DSR, AODV & NCPR

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Abstract - In mobile ad hoc network (MANET), each device is continuously move independently in any direction, and will therefore change its links to other devices continuously. Due to high mobility of nodes in the mobile ad-hoc network there will be the frequent link breakage which gives the frequent path failure and route discovery. The overhead of route discovery cannot be ignored in the Mobile ad-hoc network. Basically Broadcasting is the fundamental mechanism in route discovery, in which the receiving node blindly rebroadcast the Route Request packet until it does not get the destination. Due to this rebroadcasting cause the overhead and decreases the packet delivery ration and increase the end to end delay. That means it's occurred the broadcast Strom Problem. In this paper, we proposed reducing the routing overhead in the Mobile ad-hoc Network using DSDV, DSR, AODV & NCPR probabilistic rebroadcast mechanism. In which rebroadcast delay is determined by the neighbor 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, we can determine rebroadcast probability. This approach can show improvement in routing performance and diminish the routing overhead by decreasing the number of retransmission.

Keywords - *Mobile ad hoc network, DSDV, DSR, AODV, NCRP.*

1. Introduction

Mobile ad-hoc network consisting with the collection of node which are move freely, and the nodes are not depending on other nodes. These Mobile node forming a temporary network without any infrastructure, In the mobile Ad-hoc Network (MANET) each node act as a router, source or destination and forward the packet to the net node/hop. The Mobile Ad-hoc network has a basic challenge to design the dynamic routing protocol having good performance with minimum Overhead. Routing protocol plays an important role in the designing of MANET. Many routing protocols, are proposed for the Mobile ad-hoc Network such as Ad hoc On-demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR) and Destination – Sequence Distance Vector (DSDV). The routing protocols in MANET are classified in two ways:
1. Proactive Routing Protocols 2.Reactive routing protocols.

The Proactive Routing Protocols continuously try to establish the network connectivity so that root is already decided when the packet required forwarding. The Destination Sequence Distance vector protocol (DSDV) is one of the examples of Proactive Routing Protocol.

Now second is the On Demand protocols i.e. Reactive Protocols. In this type route are creates only when the source node is demanded for that. The Dynamic Source Routing Protocols and Ad-Hoc On demand Distance Routing Protocols (AODV) are the examples of the Reactive Protocols. 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 .The traditional on-demand routing protocols use flooding for route discovery. They broadcast a Route REQuest (RREQ) packet to the networks, and the broadcasting induces too much redundant retransmissions of RREQ packet and causes the broadcast storm problem, which causes the packet collision, so it is important to optimize the broadcast problem. Many techniques are in used to optimize the broadcast problem.

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. Thus, reducing the routing overhead in route discovery is an essential problem.

2. Literature Review

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. proposed a 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 reach ability. Peng and Lu [11] proposed a neighbor 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 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. 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. [12] 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 neighbor knowledge much quicker. One of the earliest broadcast mechanisms is flooding, where every node in the network retransmits a message to its neighbors 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 transmissions, 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.

2.1 AODV

In the Ad Hoc On-Demand Distance Vector protocol (AODV), when a source requires a path to the destination, a *route request* message is flooded in the network. Upon receiving such a message, a node examines its local route-cache to check if a fresh route to the required destination is available. If so, the node unicasts a *route reply* message to the source with information about the route. Otherwise, the *route request* is retransmitted using a pure flooding mechanism with local duplicate elimination. As an optimization, AODV employs an "expanding ring" flooding, where a *route request* is issued with a limited TTL. If no *route reply* message is received within a certain time, the message is issued again with a larger TTL. If still no reply, the TTL is increased in steps, until a certain maximum value.

While this route discovery is performed, any IP-packets to the destination are buffered in the source node. When a route is established, the packets are transmitted. If no route can be established, the packets are dropped. When a link is detected to be broken (either through a neighbor discovery protocol, as in OLSR, or through a link-layer notification), the detecting node issues a *route error* message to those neighbors who have been using a route over the now broken link. These nodes will then have to issue new *route requests* to repair the broken routes.

2.2. DSR

The Dynamic Source Routing protocol employs the same basic mechanism of on-demand flooding a *route request* and awaiting that the destination node, or an intermediate node with verified valid information, replies with a *route reply*.

DSR employs source routing, both as a way of obtaining loop freedom and as a way of "sharing" a nodes route cache with other nodes in the network: since each data packet contain routing information, nodes along its path, as well as nodes which overhear the transmissions, may collect and cache the route information for later use. Route maintenance is based on each hop receiving an acknowledgment for a packet being forwarded (either through link-layer notification, through overhearing the next-hops forwarding of the packet or through requesting a DSR-specific acknowledgment). If a node thus detects a broken route, a *route error* is returned to the source. Upon receiving a *route error*, the source removes the broken route from its routing cache. If an alternative route is available, it may be used for remaining data to the destination - alternatively, a new route discovery is initiated. Like AODV, DSR buffers IP packets in the source node while route discovery is performed.

3. Scenarios

We conduct our simulations using the network simulator ns2 [1]. We use a physical layer, simulating the behavior of IEEE 802.11[2] as included with ns2: each node has a radio range of 250 meter, when no obstacles are present, and a nominal bandwidth of 2 Mbit/s. The MAC scheme is an implementation of that specified by IEEE 802.11. The purpose of our simulations is to uncover in which situations the individual protocols have their strengths and weaknesses, rather than to promote one protocol as generally "better" than the others. Thus, in order to avoid getting results which favor either of the protocols, we apply a strategy of specifying a set of parameters (number of nodes, node mobility, traffic characteristics etc), from which a large number of scenarios are randomly generated. These scenarios will be different, yet have the same overall characteristics. We base all our scenarios on the following basic parameters: 50 nodes, 1000 x 1000 field , 250 seconds simulation times 1-5 , 0-5s rest time, 1000 m. distance, random waypoint model. 25 CBR streams, 0.1 sec. packet interval, 64 bytes/packet, 10 sec stream duration Unless otherwise stated when describing the simulation results, the simulations are conducted with scenarios conforming to the above parameters. Each sample point, represented in the simulation results in section V is the mean taken over 30 different scenarios, conforming to the same parameter set. We emphasize, that the set of 30 scenarios per sample point are the same for all the three tested protocols. I.e. for a given sample point, the each of the protocols are tested with the same 30 scenarios.

4. Simulation Results

Simulations have been conducted with varying mobility and varying number of traffic streams to examine protocols in different contents. Comparisons have been done on the following: packet delivery rate, control traffic overhead, route length, and performance under TCP traffic.

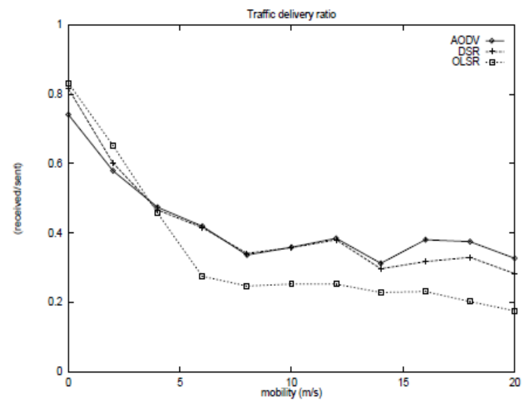

Fig. 1 Traffic delivery ratio with varying mobility

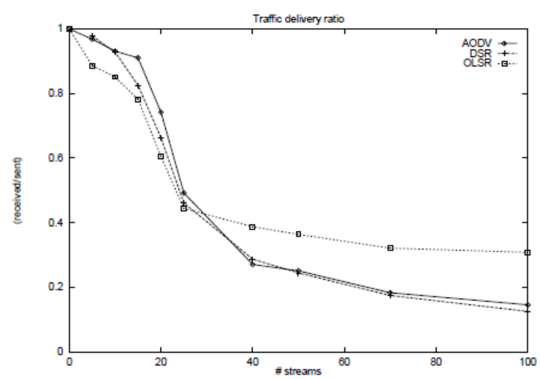

Fig. 2 Traffic delivery ratio with varying number of traffic streams.

4.1 Packet Delivery Rate and Packet Delay

The prime property for a routing protocol is to provide routes between sources and destinations. Thus one measure of success for a routing protocol is the fraction of data packets being successfully delivered to the destinations. In figure 1 and figure 2, we present the traffic delivery ratio (i.e. number of received/number of sent using the three protocols under various mobility scenarios and traffic scenarios, respectively). Figure 1 shows that the two reactive protocols perform roughly equivalent and manage to deliver about the same amount of data packets. A slight advantage to DSR is noticed in static networks, while AODV has a slight advantage in largely mobile networks.

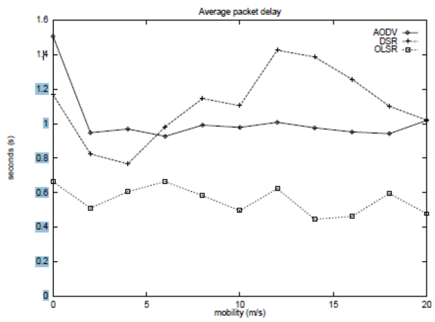

Fig 3. Packet delay with varying mobility

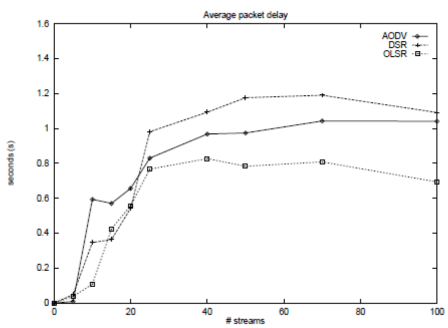

Fig 4. Packet delay with varying number of traffic streams.

5. 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 neighbor coverage and probabilistic methods.

5.1 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 neighbors uncovered by the RREQ packet from previous node, which means that if node rebroadcasts the RREQ packet, the RREQ packet can reach more additional neighbor nodes. To quantify this, we define the Uncovered Neighbors' (UCN) set of node. 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 enables the information that the nodes have transmitted the packet spread to more neighbors, which is the key to success for the proposed scheme.

5.2 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 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'*. 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.

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 neighbors of node *'ni'*. The nodes that are additionally covered need to receive and process the RREQ packet. Xue and Kumar [14] derived that 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 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

$$F_c = Nc / |N(ni)|$$

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.

6. Applications

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.

7. Conclusion and Future Scope

In this review paper we proposed to reduce the routing overhead in MANET by introducing probabilistic rebroadcast mechanism based on neighbor 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. In future this method can be used to check the suitability in VANETS and the same has to be implemented.

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