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POWER BALANCING APPROACH FOR EFFICIENT ROUTE DISCOVERY BY SELECTING LINK STABILITY NEIGHBORS IN MOBILE ADHOC NETWORKS

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Abstract- *A fundamental problem arising in mobile ad hoc networks (MANETs) is the selection of the optimal path between any two nodes for longer time and broadcast storm problem due to its highly dynamic nature. We focusing on the availability and duration probability of a routing path that is subject to link failures caused by node mobility. In order to discover the efficient routing with suitable path, the neighbor information with probability values of a node and stable path values are considered to reduce the latency and overhead of routing. To obtain the neighbor information, rebroadcast delay for finding the rebroadcast order and connectivity factor with additional coverage for calculating the node density which reduces the routing overhead by reducing retransmissions are calculated. In order to find stability of a node we present an approach, routing based on stability and hop-count, where stability metric is considered for the residual lifetime of a link. The stability based routing is not as a separate routing protocol but as an enhancement to a hop-count based routing protocol (e.g. Dynamic Source Routing and Adhoc On demand Distance Vector), so that the expected residual lifetime as well as hop count of route are taken into account.*

Keywords *– Mobile Adhoc Networks; rebroadcast order; Stability metric; Routing overhead*

I. Introduction

A mobile ad-hoc network (MANET) is a self-configuring infrastructure less network of mobile devices connected by wireless links. Due to node mobility in MANETs, frequent link breakages may lead to frequent path failures and route discoveries. The main problem of mobile adhoc network is finding the effective path which is stable for longer time duration. It increases the overhead of routing protocols which reduces the packet delivery ratio and also increases the end-to-end delay. Thus, reducing the routing overhead in route discovery and stability path was an essential problem. The conventional on demand routing protocols like Dynamic Source Routing and Adhoc On demand Distance Vector uses the flooding method to discover a route. These protocols use less bandwidth for routing, because the connection is established only on the basis of requirements of a particular node.

In the Flooding method, a source node may send a Route Request (RREQ) packet to all of its neighborhood nodes, which leads to redundant RREQ packets. This problem is known as broadcast storm problem [6], which causes a considerable number of packet collisions and traffic problems. Some of the methods like Area based methods, Distance based methods, Counter based methods, Probability based methods and neighbor knowledge has been proposed for minimizing the drawbacks of broadcast storm problem which reduces the problem in minimum significant level.

We introduce the approach, neighbor information with probability [1] and path stability metrics which will reduce the broadcast storm problem while decreasing the redundant packets and improving the routing performance .Rebroadcast Delay is used to find the order of broadcasting which eliminates the duplicate RREQ packets. The value of rebroadcast order is calculated based on the area between the sender and the particular node. If the distance is smaller than the packet will reach more number of neighbors. If the distance is higher, then the probability value also be higher, which leads to discard the packet. The Probability value decides whether to forward a packet to its neighbor node or discards the packet. Connectivity value is to determine the number of neighbors may receive the RREQ packet based on the distance coverage.

For discovering the most stability path in the routing, a routing protocol called Delay Aware and Route Stability Protocol (DARSP) is used. This routing protocol applies the following three metrics for neighbor coverage selection: the estimated total energy to transmit and process a data packet; the residual energy; the path stability. Route maintenance and route discovery procedures are similar to the DSR protocol, but with the route selection based on the three metrics. We develop a technique to make reactive protocols energy-aware in order to increase the operational lifetime of an ad hoc network. The quality of service support in mobile ad hoc networks depends not only on the available resources in the network but also on the mobility rate of such resources. This is because mobility may result in link failure which in turn may result in a broken path. Furthermore, mobile ad hoc networks potentially have fewer resources than fixed networks.

Quality of service routing is a routing mechanism under which paths are generated based on some knowledge of the quality of network, and then selected according to the quality of service requirements of flows. Thus, it is evident that both the aforementioned parameters like link stability associated with the nodes mobility and energy consumption should be considered in designing routing protocols, which allow right tradeoff between route stability and minimum energy consumption to be achieved.

II. Algorithm

A. Ad hoc On-Demand Distance Vector (AODV) Routing Protocol

Ad hoc On-Demand Distance Vector (AODV) Routing is a reactive routing protocol for mobile ad hoc networks which establishes the route to the destination only on demand or based on requirements. AODV is capable of both unicast and multicast routing. It maintains these routes as long as they are needed by the sources. AODV builds routes using a route request / route reply query cycle. When a source node desires a route to a destination for which it does not already have a route, it broadcasts a route request (RREQ) packet across the network. Nodes receiving this packet update their information for the source node and set up backwards pointers to the source node in the route tables.

In addition to the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination of which the source node is aware. A node receiving the RREQ may send a route reply (RREP) if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ. If this is the case, it unicasts a RREP back to the source. Otherwise, it rebroadcasts the RREQ. Nodes keep track of the RREQ's source IP address and broadcast ID. If they receive a RREQ which they have already processed, they discard the RREQ and do not forward it. Once the source node receives the RREP, it may begin to forward data packets to the destination.

A route is considered active as long as there are data packets periodically travelling from the source to the destination along that path. Once the source stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node to inform it of the now unreachable destination. After receiving the RERR, if the source node still desires the route, it can reinitiate route discovery.

B. Neighbor Coverage based Probabilistic Routing Protocol

This protocol uses the rebroadcast order and probability with connectivity value for improving the routing performance while reducing the redundant transmissions in the routing.

- **Rebroadcast order:** Rebroadcast order is used to establish the transmission order from the source to the destination. When a node receives the RREQ packet from the previous nodes, it checks the neighbor list of the previous node for the redundant RREQ packet. If the current node has more common neighbors than the previous node, then the rebroadcast order value will be lower and so the packet will reaches the large number of neighbor nodes .If the current node has less common neighbors than the previous node which has highest rebroadcast order value, then it forwards the RREQ packet to next neighbor node. The main purpose of rebroadcast order is to provide the route request information to large number of neighbor nodes more quickly. After calculating the order, the node can set its own timer for further transmissions.

- **Probability with Connectivity value:** The probability contains two parts:

1)Coverage range, which is the ratio of the number of neighbor nodes that should be covered in the single broadcast which is based on the total number of neighbors

2) Connectivity value, which reflects the relationship of network connectivity factors and the number of neighbors of a given node.

The node which has higher rebroadcast order must receive the RREQ packet from the node which has lower rebroadcast order. The node with higher order checks for the duplication of the packet. If it finds the duplication in the packet which is received, it discard the packet and make changes in the neighbors list. When the timer of the rebroadcast order of the node expires, the node obtains the final Uncovered Neighbors set. The nodes belonging to the final UCN set are the nodes that need to receive and process the RREQ packet. 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. Finally calculated Coverage range is combined with the connectivity value and the probability value is set to 1.

***C.* Delay Aware and Route Stability Protocol (DARSP) Protocol:**

This Protocol is used to find out the neighbor node with and route stability by using the three metrics for neighbor coverage selection 1) the estimated total energy to transmit and process a data packet; 2) the residual energy; 3) the path stability.

A delivery probability of each node is used to select link stability path over dynamic route discovery. Delivery probabilities are synthesized locally from context information. We define context as the set of attributes that describe the aspects of the system that can be used to drive the process of message delivery. An example of context information can be the change rate of connectivity, i.e., the number of connections and disconnections that a host experienced over the last T seconds. The process of prediction and evaluation of the context information in DARSP can be summarized as follows:

1. Each host calculates its delivery probabilities for a given set of hosts.
2. This process is based on the calculation of utilities for each attribute describing the context.
3. The calculated delivery probabilities under current status are periodically sent to the route request neighbor as part of the update of routing information.
4. Each host maintains a logical forwarding table of tuples describing the next logical hop and its associated delivery probability for all known destinations.
5. Each host uses local prediction of delivery probabilities between updates of information.
6. Each host selects the best forwarding node among list of neighbor's on the basis of highest Stability value
7. Steps continue until reach the destination.

III. Protocol Implementation and Performance Evaluation

A. Protocol Implementation

The protocol is implemented in NS2 simulator by modifying the source code of AODV protocol. The protocol needs Hello packets to obtain the neighbor information, and also needs to carry the neighbor list in the RREQ packet. The techniques are used to reduce the overhead of Hello packets and neighbor list in the RREQ packet, which are described as follows, the broadcasting packets such as RREQ and route error (RERR) can play a role of Hello packets. 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.

For sending or forwarding of RREQ packets, the neighbor table of any node n has the following 3 cases:

1) The num_neighbors variable will set to a positive integer if the node adds a new neighbor.

2) The num_neighbors variable will set to a negative integer if the node deletes the neighbor in the neighbor table.

3) If the neighbor table of node n does not vary, node n does not need to list its neighbors, and set the num_neighbors to 0.

B. Simulation Environment

In order to evaluate the performance of the proposed protocol, we compare it with some other protocols using the NS-2 simulator. Broadcasting is a fundamental and effective data dissemination mechanism for many applications in MANETs. In order to compare the routing performance of the proposed protocol, we choose the

Dynamic Probabilistic Route Discovery (DPR) protocol which is an optimization scheme for reducing the overhead of RREQ packet incurred in route discovery in recent literature, and the conventional AODV protocol.

- **Routing overhead comparison with number of nodes**

Fig.1. Normalized routing overhead with varied number of nodes

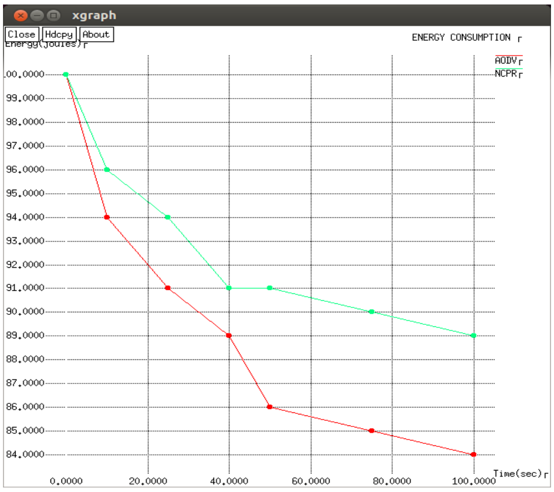

Fig. 1 shows the normalized routing overhead with different network density. The proposed protocol can significantly reduce the routing overhead incurred during the route discovery, especially in dense network. Then, the RREQ traffic is reduced. In addition, for fairness, the statistics of normalized routing overhead includes Hello traffic. Even so, the NCPR protocol still yields the best performance, so that the improvement of normalized routing overhead is considerable. On average, the overhead is reduced by about 45.9% in the NCPR protocol compared with the conventional AODV protocol. Under the same network conditions, the overhead is reduced by about 30.8% when the proposed protocol is compared with the DPR protocol. When network is dense, the proposed protocol reduces overhead by about 74.9% and 49.1% when compared with the AODV and DPR protocols, respectively.

- **Energy Consumption Comparison**

Fig2 Energy Consumption Comparison

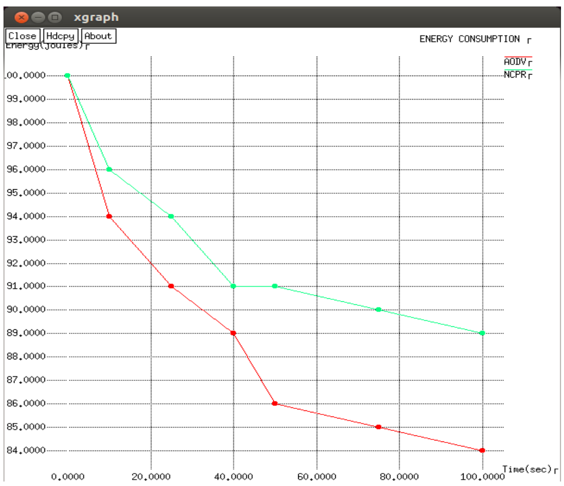

Fig 2 shows the comparison of Energy consumption of Neighbor Coverage with Probability Routing protocol and Adhoc On-demand distance vector routing protocol. The simulation results shows that our proposed protocol consumes less energy than the AODV protocol which indicates the less resource utilization.

- **Packet delivery ratio with varied random packet loss rate**

Fig 3 Packet delivery ratio with varied random packet loss rate.

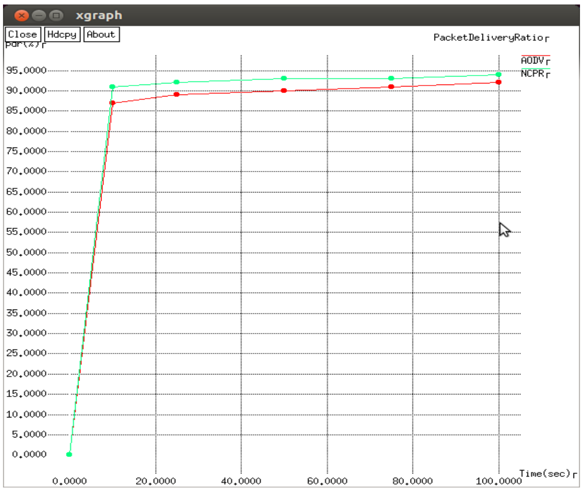

Fig 3 shows the packet delivery ratio with increasing packet loss rate. As the packet loss rate increases, the packet drops of all the three routing protocols will increase. Therefore, all the packet delivery ratios of the three protocols increase as packet loss rate increases. Both the DPR and proposed protocol do not exploit any robustness mechanism for packet loss, but both of them can reduce the redundant rebroadcast, so as to reduce the packet drops caused by collision. Therefore, both the DPR and neighbor information protocols have a higher packet delivery ratio than the conventional AODV protocol. On average, the packet both of them significantly reduce the number of collisions and then reduce the number of packet drops caused by collisions. On average, the packet delivery ratio is improved by about 11.5 percent in the neighbor information protocol when compared with the conventional AODV protocol. And in the same situation, the neighbor information protocol improves the packet delivery ratio by about 1.1 percent when compared with the DPR protocol.

IV. Conclusion

In this paper we proposed a probabilistic rebroadcast protocol based on neighbor information and delay aware and route stability protocol to reduce the routing overhead and maintain the path stability in MANETs. This neighbor information includes coverage range and connectivity value. We proposed a new scheme to dynamically calculate the rebroadcast order which is used to determine the forwarding order of the packets. Delay aware and Route Stability Protocol is used to select the path which is stable for longer time duration. Simulation results show that the proposed protocol generates less rebroadcast traffic than the flooding and other schemes. 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. The simulation results also show that the delay aware and route stability protocol improves the routing performance with highest stable nodes while reduces the energy consumption.

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