Lifetime Maximization Energy Efficient Routing Protocol for Ad Hoc Wireless Networks

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Abstract—Ad hoc networks are wireless mobile networks that can operate without infrastructure and without centralized network management. Traditional techniques of routing are not well adapted. Indeed, their lack of reactivity with respect to the variability of network changes makes them difficult to use. Moreover, conserving energy is a critical concern in the design of routing protocols for ad hoc networks because most mobile nodes operate with limited battery capacity, and the energy depletion of a node affects not only the node itself but also the overall network lifetime. We propose an energy-efficient routing protocol, called AODV, which uses the RSSI based routing method to increase the network lifetime. Path selection mechanism uses receiver signal strength. This protocol improves the performance of ad hoc networks by prolonging the lifetime of the network. The protocol performance has been evaluated in terms of Throughput, Packet delivery ratio, and end-to-end delay.

Key words: AODV, RSSI

I. INTRODUCTION

An ad hoc network is characterized by frequent changes in the network topology, limited bandwidth availability, and limited power of nodes. The ad hoc network topology changes frequently as nodes are able to move collectively or individually and often in an unpredictable way. When one node moves out of or into the transmission range of another node, the wireless link between the two becomes down or up. Another cause of the topological changes is the instability of the wireless link quality, which might become high or low due to the signal fading (obstacles between the two wireless nodes), interference from other signals, or the change in the node transmission power level. In the following, we refer to the disappearance of the wireless link for any reason as link failure. Mobile nodes are battery-powered; when they run out of battery power, they fail. All these types of failures increase the intensity of changes in the network topology. As the nodes have a limited communication range, the path from source to destination usually has multiple hops (the data packets are retransmitted by some intermediate nodes); hence, these characteristics make route discovery complex.

The routing problem in mobile wireless networks has attracted considerable interest in the research community.

Several research studies have focused on routing protocols of ad hoc networks. Basically two types of routing are used in Ad hoc networks first one is Reactive and second one is proactive. Proactive routing (such as DSDV) create routing table which contains an entry of every node in the network. They update the route table periodically and recalculate the distance to all nodes. In reactive method (such as DSR and AODV), whenever route is required it calculate the route between source and destination. A stable route in Ad hoc network is defined as routes which gives flexibility in highly mobile network and not fail for an acceptable period of data transfer. Similarly an intermediate node is stable when it does not break the route due to mobility.

II. RELATED WORK

Finding a stable route between source and destination has always been a challenging issue in highly mobile networks. Various methods have been proposed to deal with node mobility.

A. Signal Strength-Based Routing Protocol for Mobile Ad hoc network

In node measure the signal strength of the link and send Route Request to other node, after that intermediate node accept that packet compare the signal strength value of the link with Route Request packet, if it is less than packet value then its modified the packet value with minimum value and forwarded to other node until it reach to the destination, with the help of this approach weak link of the route is calculated after receiving Route Request by the destination node ,its send the Route Reply with minimum of the route to source then source node first select earliest established path to forward packets, then changes to the strongest signal strength path for long transmissions.

B. SINR based Multipath routing

In SINR based method protocol maintains multiple path and calculate maximum signal strength of each route when the source node got the reply from destination then it select the route which have maximum signal strength among the multiple route. If the primary path is unavailable, the next one of the alternate path is immediately used for data transmission.

III. AODV OVERVIEW

AODV has the merits of DSR and DSDV protocol. DSDV maintains routes to all destinations with periodical route information flooding and uses sequence numbers to avoid loops. AODV inherits the sequence numbers of DSDV and minimizes the amount of route information flooding by creating routes on-demand, and improves the routing scalability and efficiency of DSR, which carries the source route in the data packet.

In AODV protocol, to find a route to the destination, the source broadcasts a route request packet (RREQ). Its neighbors relay the RREQ to their neighbors until the RREQ reaches the destination or an intermediate node that has fresh route information. Then the destination or this intermediate node will send a route reply packet...
(RREP) to the source node along the path from which the first copy of the RREQ is received. AODV uses sequence numbers to determine whether route information is fresh enough and to ensure that the routes are loop free.

In AODV protocol, the route is built on demand and is not updated until the route breaks or times out. The route can’t adapt to topology changes and breaks frequently in the case of high mobility. AODV uses local repair to restrict the route discovery zone so as to reduce overhead. If the source moves away and causes the route to break, it can re-initiate route discovery to the destination. In case an intermediate link breaks and the broken link is near the destination, the upstream node of this broken link may choose to repair the route. It initiates a route request with a fresh destination sequence and the RREQ will be flooded in a zone with a radius no less than the original hop count between this node and the destination. If the upstream node of the broken link decides not to repair the broken route, it will send a route error packet (RERR) upwards to the source node. The source node will re-initiate route discovery in an even bigger zone than that of the local repair if the route is still needed.

IV. PROPOSED WORK

In the WANET, one of the major concerns is how to reduce the link failure due to the mobile node in the network, for this stable route is required which is more flexible in mobile networks. Stable route in WANETs is a route that is established for an acceptable period for transmission. For this purpose in this paper, we propose a new method for routing in WANETs that created routes have more stability. In this method we use signal strength metric to route the data to the destination. The following cases are used to forward the data over the network.

A. Route Discovery

When the route is needed, the source sends the RREQ packet to his entire neighbor after that intermediate node does following steps:

First it checks the signal strength of the packet if it is greater than SIGNAL THRESHOLD value then it process the request otherwise it discard this RREQ packet then intermediate node checks its routing table for the desired destination. If it found then send a reply to the source otherwise it forwards the RREQ to his neighbor.

B. Route Selection by source node

When several RREPs receive to the source node, it can select the best RREP based on minimum hop count and start sending data.

Fig. 1: Processing of Route Requesting IAODV-LM

V. PERFORMANCE EVALUATION

In this section, the performance of IAODV is evaluated using NS2.34 and compared with AODV. First we describe how the RSSI value is calculated then the simulation environment is described and the simulation results are discussed with comparison.

A. Calculation of RSSI value

The RSSI value is calculated with the help of two ray ground model

\[ P_r(d) = \frac{P_t \times G_t \times G_r \times h_i^2 \times h_r^2}{d^4 L} \]

- \( P_r \): Receiving power
- \( P_t \): Transmitting Power
- \( h_i \): Transmitting antenna height
- \( h_r \): Receiver antenna height
- \( G_t \): Gain of a transmitting antenna
- \( G_r \): Gain of receiving antenna
- \( d \): Distance from the transmitter
- \( L \): Path loss

B. Simulation parameters

The simulation parameter has shown in Table 1. Here, we designed and implemented our test bed using Network Simulator (NS-2.34) to test the performance of both Routing algorithms.

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulation Duration</td>
<td>100s</td>
</tr>
<tr>
<td>Topology Area</td>
<td>500m x 500m</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>20 to 200</td>
</tr>
<tr>
<td>Mobility speed</td>
<td>10m/s</td>
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C. Simulation Results

We simulated IAODV-LM (along with AODV) using NS2. In this section, we present the simulation results and compare IAODV-LM with AODV. In this scenario we change the number of nodes.

Fig. 3 shows that as the number of node increases end to end delay in AODV increases rapidly as compared with IAODV-LM. Reason behind the reduction in end to end delay is because of the selective processing of signals. Weaker signals are discarded at the routing layer after comparing the RSSI with Signal threshold. This makes only selected signals entering into further processing phase thus reducing the end to end delay.

Fig. 4 IAODV-LM select the most reliable path so number of packet drop is also low as compare to AODV. So the packet delivery ratio is also better than AODV in denser network.

VI. CONCLUSION

IAODV-LM is more beneficial at large network. As the number of nodes increases IAODV take lesser end-to-end delay than AODV due to lesser retransmissions compare to AODV.

IAODV-LM always seems to offer better performance in terms of Packet Delivery ratio and throughput when compared to AODV. It not only enhance the network performance but also more reliable in data transmission as it reduces the network partition and packet loss in the networks. Achieving all this parameters we observed that network lifetime also increased.

VII. REFERENCES


