

Improved AODV Routing Protocol for Manet to Enhance The Network Performance

S.Venkatasubramanian, R.Mohankumar, C.Hemalatha

Dept. of CSE, Saranathan College of Engineering, Tiruchirapalli, Tamilnadu, India

Abstract

AODV is a prominent routing protocol for MANET that uses hop count as a path selection metric. However, AODV has no means to convey traffic load on current route. This study focuses on introducing two metrics such as , Aggregate Interface Queue Length (AIQL) and link quality, in AODV to deal with load balancing issues. In this paper, the network performance is enhanced by balancing the load using queue length and link quality. Moreover through the simulation, it is shown that the modified protocol performs better than the conventional AODV in terms of the average throughput, average end to end delay and packet delivery ratio

Keywords

MANET, AODV, AIQL, Packet Delivery, Load Distribution, Load Balancing

I. Introduction

A mobile ad hoc network is defined as a collection of mobile platforms or nodes where each node is free to move about arbitrarily. Each node logically consists of a router that may have multiple hosts and that also may have multiple wireless communication devices [4]. The routing protocols in MANETs can be categorized into three different groups: Global/Proactive, on demand/ Reactive and Hybrid routing protocols. [6]

In global routing protocols, each node stores and maintains routing information to every other node in the network. In on-demand routing protocols, routes are created when required by the source node, rather than storing up-to-date routing tables. Hybrid routing protocols combine the basic properties of the two classes of protocols mentioned earlier. In practice, some routes get congested, while other routes remain underutilized. This results in poor performance of mobile ad hoc networks. Therefore, the need for balancing the load distribution among various routes becomes more important.

In this paper, an attempt to enhance the network performance is made. Moreover through the simulation, it is shown that the modified AODV can perform better than the conventional AODV. Also, the effect of interface queue length and link quality on normalized routing load, average throughput and average end to end delay are observed.

II. Problems of ADHOC Routing Protocols

A major drawback of all existing ad hoc routing protocols is that they do not have provisions for conveying the load and/or quality of a path during route setup. Hence they cannot balance the load on different routes. Also, both proactive and reactive protocols chose a route based on the metric, the smallest number of hops to the destination.

But it may not be the most significant route when there is congestion or bottleneck in the network. It may cause the packet drop rate, packet end-to-end delay, or routing overhead to be increased particularly in the cases when the traffic is concentrated on a special node like a gateway through which mobile nodes from ad hoc network can connect to Internet

There are various proposed algorithms for load balancing that consider traffic load as a route selector, but these algorithms neither reflect burst traffic nor transient congestion [2]. In order to ensure uninterrupted communication and in order to make routing protocols more efficient in presence of node movement, tow issues, Route maintenance and Bandwidth reservation need

due mention.

A very good solution to these issues is multi path routing. Due to such multi path routing, even if one path fails, data can still be routed to the destination using the other routes. Thus, the cost of rediscovering new path can be salvaged. While selecting the path set the following issues need due consideration.

The distribution of load should be even. Mobile nodes with lower traffic load should be preferred to the heavily loaded mobile nodes. The traffic load in the medium surrounding the mobile nodes on the routes should be light. The paths should comprise of nodes with high residual battery power. If a link is highly reliable, it is advantageous to allow it to be shared by more than one path.

III. Proposed System

A. Aggregate Interface Queue Length

The proposed modification extends AODV and distributes the traffic among ad hoc nodes through a simple load balancing mechanism. The protocol adopts basic AODV procedure. In this protocol each node measures the number of packets queued up in its interface.

Now when a source node initiates a route discovery procedure by flooding RREQ messages, each node receiving an RREQ will rebroadcast it adding its own interface queue length. Destination node will select the best route and replies with RREP.

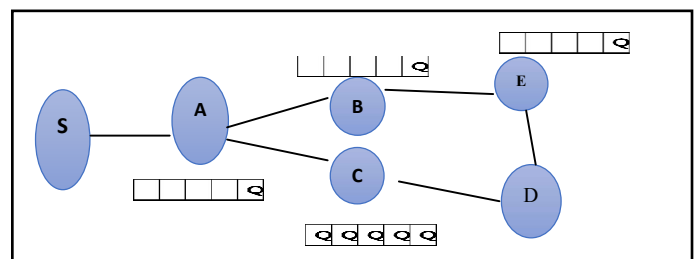


Fig. 1: Route Discovery Process

Route selection procedure: When a source node initiates a route discovery procedure by flooding RREQ messages, each node that receives the RREQ looks in its routing table to see if it has a fresh route to the destination. If it doesn't have the route it adds the number of packets in its interface queue and broadcasts it further. The process is repeated till either the destination is reached or no destination is found

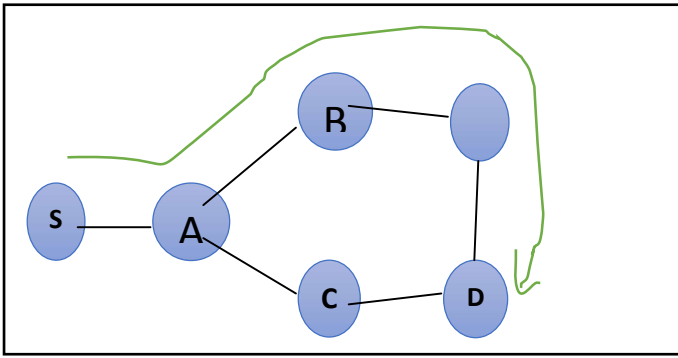


Fig. 2: Route Selection Process

If an intermediate node has a fresh route to the destination or for the same sequence number the intermediate node has a shorter route or the Aggregate Interface Queue Length (AIQL) is smaller, the intermediate node replies with the route. Here the metric AIQL is the sum of interface queue lengths of all the intermediate nodes from the source node to the current node.

The AIQL metric has been used in order to find out the heavily loaded route. Because if the aggregate queue length for the path is higher, then it obviously means that either all the nodes on the route are loaded or there is at least one node lying on the route that is overloaded. Hence by considering a route with lesser value of aggregate queue length for selecting the path we are diverging the packets from heavily loaded route to comparatively lighter route.

B. Estimating Link Quality

Each node in the network estimates its quality of links with its one-hop neighbors. If P is the number of HELLO packets received during a time window T_{win} and Q is the percentage of HELLO packets received in the last seconds, then the link quality is measured as

$$Lq = \delta \cdot Pq + (1 - \delta) \cdot Nq \quad (1)$$

The estimated link quality is maintained by each node in its NT. The average link quality of all the links across the path P , gives the route quality Rq of the path. RREQ packets of the reverse path and RREP packets of the forward path accumulate the estimated Lq values

C. Calculating Link Weight

Each node then calculates the weight of the link as

$$W = AIQLn + Lq \quad (2)$$

D. Route Request

During the route discovery phase of the protocol, each intermediate node uses an admission control scheme to check whether the flow can be accepted or not. If accepted, a Flow Table (FT) entry for that particular flow is created. The FT contains the fields Source (Src), Destination (Dst), Reserved Bandwidth (BWres), Minimum bandwidth (BWmin). Each node collects the bandwidth reserved at its one hop neighbors (piggybacked on periodic HELLO packets) and stores it in its Neighbor Table (NT). The Neighbor Table contains fields Destination (Dst), Reserved Bandwidth (BWres), No. of Hello Packets (No Hello)[8].

Consider the scenario

Let us consider the route

$$W = Lq + C_{occ} + D_{avg}$$

To initiate QoS-aware routing discovery, the source host S sends a RREQ. When the intermediate host R1 receives the RREQ packet, it first estimates all the metrics as described in the previous section.

The host $R1$ then calculates its weight W_{R1} using (3).

$$RREQ_{R1} \xrightarrow{W_{R1}} R2$$

$R2$ then calculates its weight W_{R2} in the same way and adds it to the weight of $R1$. $R2$ then forward the RREQ packet with this added weight.

$$RREQ_{R2} \xrightarrow{W_{R1}+W_{R2}} R3$$

Finally the RREQ reaches the destination node D with the sum of node weights

$$RREQ_{R3} \xrightarrow{W_{R1}+W_{R2}+W_{R3}} D$$

E. Route Reply

The Destination node D send the route reply packet RREP along with the total node weight to the immediate upstream node $R3$.

$$RREP \xrightarrow{W_{R1}+W_{R2}+W_{R3}} R3$$

Now $R3$ calculates its cost C based on the information from RREP as

$$C_{R3} = (W_{R1} + W_{R2} + W_{R3}) - (W_{R1} + W_{R2}) \quad (4)$$

By proceeding in the same way, all the intermediate hosts calculate its cost.

On receiving the RREP from all the routes, the source selects the route with minimum cost value.

We will show that these calculations will not increase the overhead significantly, by simulation results in the next section.

Performance metrics: The following performance metrics are used to evaluate the effect of routing algorithm:

Average end-to-end delay: This is the average overall delay for a packet to traverse from a source node to a destination node. This includes the route discovery time, the queuing delay at a node, the transmission delay at the MAC layer and the propagation and transfer time in the wireless channel.

Average throughput: It is defined as the ratio of total packets received to the simulation time.

Packet delivery ratio: The ratio of packets that are successfully delivered to a destination compared to the number of packets that have been sent out by the sender

IV. Simulation Results

The network performance has been calculated for various scenario and traffic patterns. Mobility models are created for the simulations for various number of nodes, with pause time of 0 seconds, maximum speed of 10m/s, topology boundary of 500x500 and simulation time of 100 milli seconds.

Table 1: Simulation Parameters

No. of Nodes	25,50,75 and 100
Area Size	1000 X 1000
Mac	802.11
Radio Range	250m
Simulation Time	100 sec
Traffic Source	CBR
Packet Size	512
Mobility Model	Random Way Point
Speed	5m/s to 20m/s
Pause time	5 s
No. of Nodes	25,50,75 and 100

Traffic models were generated for various number of nodes with CBR traffic [7] sources, with maximum connections of 10 at a rate of 8kbps. (-rate 2.0: in one second, 2 packets are generated. The packet size is 512 byte. Therefore the rate is $2 \times 512 \times 8 = 8\text{kbps}$).

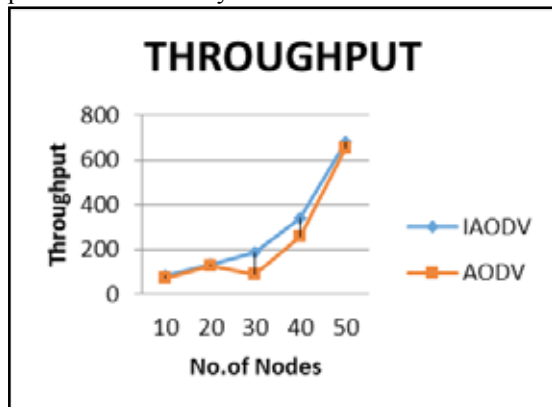


Fig. 3: Throughput Vs. Nodes

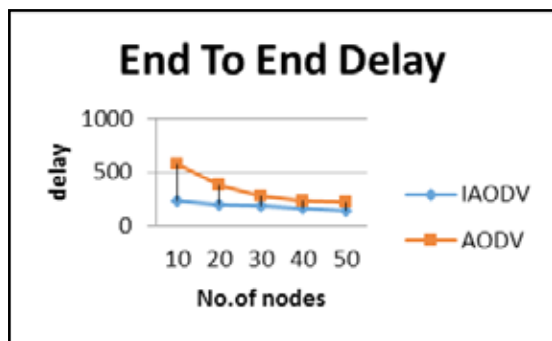


Fig. 4: Delay Vs. Nodes

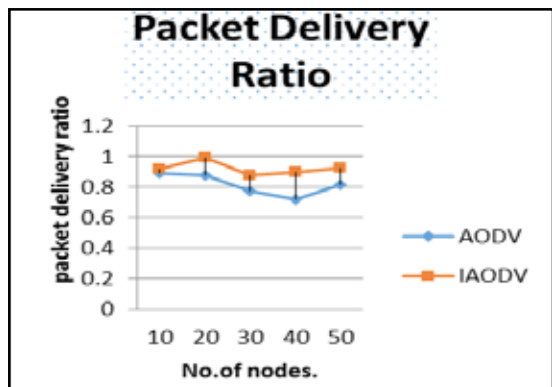


Fig. 5: Packet Delivery Ratio Vs. Nodes

V. Conclusion

Thus the improved AODV(IAODV) has the better performance than the existing AODV routing protocol by an average of 11 % in their network performance

References

[1] Lee, Y.J and G.F. Riley, 2005. *A Workload-Based Adaptive Load Balancing Technique for mobile Adhoc Networks*: IEEE Communication Society, WCNC 2005, pp:2002-2007.

[2] Nisar Hundewale, Sunsook Jung and Alex Zelikovsky “Energy Efficient Node Caching and Load Balancing Enhancement of Reactive Ad Hoc Routing Protocols” Georgia State University, Atlanta, GA 30303.

[3] P atil V.P “ Efficient AODV Routing Protocol for MANET with enhanced packet delivery ratio and minimized end to end delay “ *International Journal of Scientific and Research Publications, Volume 2, Issue 8, August 2012* 1 ISSN 2250-3153

[4] Perkins, C.E., 2001. *Ad Hoc Networking: Addison Wesley, USA.*

[5] Srdjan Krco and Marina Dupcinov, “Improved Neighbor Detection Algorithm for AODV Routing Protocol”, *IEEE Communications Letters, vol. 7, No.12, December 2003.*

[6] Sunil Taneja and Ashwani Kush, “A Survey Of Routing Protocols in Mobile Ad Hoc Networks” *International Journal Of Innovation, Management and Technology, Vol. 1, No. 3, August 2010* ISSN:2010-0248.

[7] “Network Simulator, ns-2,” available online at <http://www.isi.edu/nsnam/ns/>.

[8] S.Venkatasubramanian and N.P.Gopalan “ A QOS Robust multipath routing protocol for mobile Adhoc networks” *IACSIT International Journal of Engineering and Technology Vol.1, No.5, December, 2009* ISSN: 1793-8236, pp 391-396