An Improved Quality of Service Using R-AODV Protocol in MANETs

Siddalingappagouda Biradar
 Dept. of Electronic and Communication Engineering
 Don Bosco Institute of Technology,
 Bangalore - 560074, Karnataka, INDIA
 siddubiradarr@gmail.com

Prahlad Kulkarni
 Dept. of Electronics and Telecommunication Engineering
 Principal, Pune Institute of Computer Technology,
 Pune - 411043, Maharashtra, INDIA
 ptkul1@gmail.com

Abstract - Mobile ad hoc Networks (MANETs) is a type of wireless ad hoc network which is a self-arranging network of mobile nodes connected by wireless links that create a discretionary topology. The mobile nodes are free to move randomly and to arrange themselves in a random manner. Thus, the wireless ad hoc network topology may expand rapidly and unpredictably. In Mobile ad hoc networks, the routing protocol plays an important role for improving Quality of Service (QoS). There are many different types of routing protocols such as reactive, proactive, and hybrid. In reactive routing protocol, AODV is a one which establishes routes on-demand, as they are needed. In this paper, we proposed a new routing protocol called Reverse Ad hoc On-Demand Distance Vector (R-AODV) routing which reduces route path fail correction messages and gives better performance than the original AODV routing protocol with respect to set of performance metric such as packet delivery ratio, throughput, energy consumption, and overhead under different pause time. We designed the R-AODV routing protocol and implemented with certain simulation parameters using Network Simulator (NS-2) tool. The performance analysis of routing protocol designed for wireless networks has been very challenging. Hence, simulations are always utilized to obtain the desired performance results.

Keywords - MANETs, AODV, R-AODV, QoS, NS-2.

I. INTRODUCTION

We have latest multimedia applications such as digital television, video telephony, video conferencing and web games and real-time interactive audio and video streaming which needs high throughput and less amount of end to end delay which are main essential quality of service metrics. In MANETs getting good quality of service is the biggest challenge to researcher and even good research topic to determine the better solution for improved performance, by considering different network architecture stage at different network layers they are application, session, physical, network.

In wireless communication, routing process plays an important responsibility for flow of data packets that to specially in mobile adhoc networks and it is a major subject for researchers, presently several concepts have been discussed and lots of changes are made and even many different routing protocols are developed. In this paper, we proposed new routing protocol R-AODV which provides better performance and has different technique when compared to other types of on-demand protocols in wireless ad-hoc networks. In modified R-AODV routing protocol, route reply message is not of unicast type, destination node use reverse RREQ control message to determine source node. It reduces route path fail correction messages and can help to improve the robustness of performance. Thus, the overall maximum rate of route discovery mechanism may be increased even during high node mobility environment in wireless ad hoc networks. We particularly focused on different performance metrics such as throughput, Jitter, end-to-end delay, normalized overhead, packet delivery ratio, energy consumption etc.

The flow of this paper is as follows: In section 2, We completely report about a QoS provided in MANETs. In section 3, we discuss the operation of the existing AODV routing protocol. In section 4, It tells about motivation from existing AODV to modified R-AODV. In section 5, We characterize proposed new steering convention and the progressions made in existing AODV protocol. We formulate later in section 6, 7, and 8, The performance of existing AODV and modified R-AODV routing protocol performed with respective to certain performance parameters by simulation using NS-2, considering several steps. Finally, we end with the conclusion and the future work of our research.

II. QUALITY OF SERVICE IN MANETS

A MANETs is a self-governing system or it is a multi-hop wireless route network which is extended to the internet [10]. As MANETs is a self-determining system, it consists of its own network management techniques and wireless routing protocols. As MANETs is a multi-hop wireless route network, It should give a adjustable and reliable access to the internet service. Of late, as a result of wide increment in prominence of sight and sound applications and future exchange utilization of MANETs, The backing for QoS in MANETs has turned into an anticipated undertaking. Because of the components of transfer speed and changing system topology of MANETs, enhancing the QoS in MANETs is a very demanding task. Presently a lot of research is going on to enhance QoS in Internet services and some other type of wireless network architectures, but generally they are not appropriate in the
MANETs environment vicinity[13]. The QoS model which explains about the network architecture and consists of few assistance which can be afford in the ad hoc network. The challenges of MANETs are the first main criteria that should be considered in QoS model. For example, time-varying route link capacity and dynamic network topology. Beside the wireless network possible commercial applications of MANETs it is necessary to provide the reliable connection to the wireless internet service. So the QoS model for MANETs must also be included in the existing QoS wireless network architectures for better Internet services [11].

III. AODV ROUTING PROTOCOL

AODV is a on-demand routing protocol which consists of unicast and multicast method. Generally in AODV, the correspondence way between source and destination node is calculated when there is need of data transfer. Whenever source want to send data packets to destination, it is necessary to find the routing path between source and destination. AODV finds the shortest path with the help of routing mechanism and this routing path should be maintained till routing link breaks off. The distinguishing and keeping up routing path is performed by set of control packets in the middle of source and destination nodes consists of: RREQs Control Packet (Route REQuests), RREP Control Packet (Route Replies), RERRs Control Packet (Route Errors) and RREP-ACK Control Packet (Route Reply Acknowledgment). RREQ control packets is firstly begun by the source node in order to calculate the shortest path in multicast sort. RREP control packet is produced by the destination node and answered to closest node on receiving RREQ control packet for finding unicast routing type, generally in AODV routing protocol. Hello messages are firstly used to maintain the uniformity of a previously recognized route path. Each node in a wireless network maintains its own routing table which helps to find the routing path, each routing table contains the information such as: destination address, the complete information of nearest neighbours nodes, the sum of multiple route hops between source and to reach the destination node, period of termination after which section of packets is discarded, AODV routing protocol uses the concept of data packet sequence numbers which is assigned to all the packets, restricting to the unnecessary broadcast of initial control packets; these sequence number permits the use of new routes subsequently the mobility of nodes, as they make sure of rationality and regularity of route information. generally the nodes in ad hoc network are having mobility as a result there will be chance of path breaks or even because of problem of energy consumption, under such situation routing protocol calls local repair procedure which will help to reconstruction the communication path from breakup point. If internal local repair process doesn’t resolve the difficulty then the source node will try to search alternatively fresh route path and the number of attempts is reduced by one, until the achievement or disappointment of data communication link. The above method produces a sustainable amount of control packets [8]. A disadvantage of having existing reactive routing protocols their major route detection and route mechanisms method are not more worried about loss of route reply control message during communication of data. More the number of route reply messages within the network leads to drop of network efficiency [3].

IV. MOTIVATION

In MANETs, the nodes have mobility as a result they move from one position to another with different node speed. As the result, the wireless network topology changes continuously and randomly in a unpredictable manner. within a short span of time nearest node may go out of the transmitting range which leads to communication link breakage, especially when the mobility of the node is more. In routing protocols such as on-demand technique, communication route link breakage between nodes leads to packet losses. Usually, missing the RREP messages of AODV routing protocol leads to a more disablement on the AODV protocol. In AODV protocol, the RREP messages is obtained by the cost of source flooding the entire wireless network or a partial area. RREP message loss leads to source node to reinitiate route discovery mechanism which results in decrease of the routing efficiency, like less packet delivery ratio, more end-to-end delay and high energy consumption, long. Therefore, we are more concerned about reducing the loss of RREP messages as much as possible [15].

Let us consider an example from Fig. 1, consisting of 8 nodes out of which S is a source node, D is the destination and others are intermediate nodes. In usual AODV routing protocol, when RREQ message is broadcast by source node S and these RREQ message reach to destination node with different route paths. The destination node in turn sends the RREP message to source node. Finally with respect to the reverse paths D-3-2-1-S and D-6-5-4-S, RREP message reaches to source node. If the node 1 moves in arrow direction then it goes out of transmission range of node 1 and node 2, as a result RREP message will be lost and route discovery mechanism will be waste. We can easily find that alternate route paths built by RREQ message are ignored [9].

Fig. 1: RREP Message Delivery Fail
In this paper, we proposed the R-AODV routing protocol to avoid RREP control message loss and get better performance of routing in MANETs. R-AODV routing protocol uses exactly same operation of RREQ message of AODV protocol in order to deliver route reply message from destination to source node. We define route reply control messages as reverse request (R-RREQ). The newly proposed R-AODV routing protocol can reply the packets from destination to source node, even if there is at least one route reply path to source. In this way, R-AODV routing protocol avoids a more number of retransmissions of route request control messages, as a result it reduces the congestion in the wireless network.

V. PROPOSED METHOD OF R-AODV ROUTING PROTOCOL

In this section, we present a complete overview and purpose of proposed R-AODV routing protocol.

A. Routing Protocol Overview

As analysed previously in AODV routing protocols, we can predict that most of reactive protocols in ad hoc networks, other than multipath routing, presently think that single route reply beside initial reverse route path to discover routing. As we effectively characterized, at high node portability, pre-decided reverse route path can be detached and route reply control message that is sent from destination node to source node can be lost. In this process, route request message needs to be retransmitted by source node. Imperative piece of our work is to increase possibility of getting routing path with fewer RREQ control messages than other routing protocols have on network topology change by nodes mobility. Explicitly, the newly proposed modified R-AODV protocol identifies routes on-interest through a reverse route mechanism method. In route discovery procedure source and destination nodes play equal role for the purpose of sending control messages. As result, behind receiving RREQ control message, immediately destination node floods R-RREQ control message to find source node.

B. Routing Discovery Mechanism in R-AODV Routing Protocol

As R-AODV is one among the reactive routing protocols, there is no permanent route paths stored in intermediate nodes. Initially source node starts route discovery procedure by broadcasting RREQ messages. As shown in the Fig. 2, RREQ control message consists of parameters such as message type, source node address, destination node address, broadcast node ID, route path hop count, sequence number of packet which are sent from source, sequence number of packet which are sent from destination, request time of packet.

At whatever point the source node gets a new RREQ control message, the broadcast ID is augmented by one. Along these lines, the source and destination addresses, mutually with the broadcast ID, exceptionally distinguish this RREQ control packet. The source node surges the RREQ control message to every single neighbouring nodes within its coverage area. These nearest nodes will send the RREQ control message to different nodes in the same way. As the RREQ control messages are broadcast in the whole network, some intermediate nodes may get a few duplicates of the same RREQ control messages. When an intermediate node receives a RREQ control message, the node checks if officially got a RREQ control message with the similar broadcast id and source address. The intermediate node checks broadcast id and source address form routing table at the first time and rejects excess RREQ control messages. The methodology is the same with the RREQ message of existing AODV routing protocol.

At the point when the destination node gets first route request control message, it creates the purported R-RREQ control message and broadcasts it to neighbour nodes which comes under its transmission range like the RREQ control message of source node does. As appeared in the Fig. 3, the R-RREQ message consists of following parameters: reply source id, reply destination id, reply broadcast id, hop count, sequence number of packet. At the point, When a broadcast R-RREQ control message reaches to intermediate node, it will test for repetition. If the message is already received, the newly arrived message is dropped, otherwise it is forwarded to further nearest nodes.

Furthermore, Routing table of all nodes update or store the following information:
• Address of Destination Node
• Address of Source Node
• Multiple route hops to Destination node
• Sequence Number of Destination
• Route expiry time and next route hop to destination node.

As soon as original source node receives initial R-RREQ control message, it starts data packet transmission, and late arrived R-RREQs message are saved for future use. The other route paths can be accessed whenever the primary path fails to communicate.

C. Route Discovery And Maintenance

Whenever the control packets are received, the source node selects the better path to update, that is the first node compares sequence numbers, and if it is higher sequence number meaning it indicates recent routes. If we have same sequence numbers, then next number of route hops up to destination are compared, usually routing path with lesser hops is selected. As the wireless communication channel quality is time changing the best path differs after some time. The advice from the medium access layer can be utilized to distinguish the availability of the connection. On the off chance that disappointment happens closer to destination node, RRER control message received nodes can attempt neighbourhood repair, generally the nodes forward RRER control message until it comes to the source node. The source node can choose option route or trigger another route disclosure strategy.

VI. PERFORMANCE PARAMETERS

In order to calculate the performance of routing protocol such as modified R-AODV and existing AODV, we compare them with set of execution parameters for example, Throughput, Packet Delivery Ratio (PDR), Normalised Overhead Load and Energy Consumption.

• Packet Delivery Ratio (PDR)
It is a proportion of packets received to packets sent during certain simulation period, it is given by

\[ \text{PDR} = \frac{\text{PR} \times 100\%}{\text{PS}} \]

Where, PR is Sum of packet received by destination node, PS is Sum of packet sent by source node.

• Throughput
It is defined as average transform rate or bandwidth of route, it is given by

\[ \text{TP} = \frac{\text{PR} \times \text{SZ}}{\text{SE}} \]

Where, SZ is Packet Size, SE is Simulation End Time.

• Normalized Overhead Load
It is described as sum of number of routing packets sent per data packet during communication.

VII. SIMULATION RESULTS & ANALYSIS

The performance analysis of AODV and R-AODV routing protocol in MANETs is performed in a simulated environment. NS 2.35 [7] simulator is used under Linux (ubuntu 11.10) and windows platform for simulation. The performance analyses are performed by following simulation parameters for both protocols. Tab. 1 shows the main simulation parameters used for scenarios.

<table>
<thead>
<tr>
<th>Simulator</th>
<th>NS-2.35</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protocol</td>
<td>AODV, R-AODV</td>
</tr>
<tr>
<td>Simulation duration</td>
<td>0-100 seconds</td>
</tr>
<tr>
<td>Simulation area</td>
<td>600m x 600m</td>
</tr>
<tr>
<td>Number of nodes</td>
<td>25 nodes</td>
</tr>
<tr>
<td>Movement model</td>
<td>Random Waypoint</td>
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<tr>
<td>MAC Layer Protocol</td>
<td>IEEE 802.11</td>
</tr>
<tr>
<td>Queue size</td>
<td>50</td>
</tr>
<tr>
<td>Transmission range</td>
<td>250</td>
</tr>
<tr>
<td>Interference range</td>
<td>550</td>
</tr>
<tr>
<td>Packet Size</td>
<td>1500 bytes/packet</td>
</tr>
<tr>
<td>Application Type</td>
<td>CBR</td>
</tr>
<tr>
<td>Agent Type</td>
<td>TCP</td>
</tr>
<tr>
<td>RxPower</td>
<td>25.0 W</td>
</tr>
<tr>
<td>TxPower</td>
<td>15.0 W</td>
</tr>
<tr>
<td>SensePower</td>
<td>0.0175 W</td>
</tr>
<tr>
<td>Initial Energy</td>
<td>100 Joules</td>
</tr>
</tbody>
</table>

Fig. 4: Jitter, when the number of pause time varies

Fig. 4 shows the average jitter of each routing protocol. It should be noted that the variation in the delay of received packets is lower in our proposed R-AODV than
AODV routing protocol. The reason is R-AODV prevent a more number of route request messages retransmissions as a result it has high success rate of route discovery. Lower the jitter value lesser the delay in the network.

Fig. 5 shows average end to end delay that exist at AODV and R-AODV routing protocol. It is observed that R-AODV has less end-to-end delay than AODV routing protocol. The reason is AODV chooses route earlier, while R-AODV routing protocol selects recent updated route according to route reverse request mechanism.

Fig. 6 shows average throughput with respect to different pause time. It is seen that R-AODV has higher throughput value than AODV routing protocol. Higher the throughput value more number of messages are delivered successfully.

Fig. 7 shows packet delivery ratio of each routing protocols on varying pause time. It is seen that R-AODV has higher packet delivery ratio than AODV routing protocol. Higher the packet delivery ratio more the packets received with respect to packets sent. R-AODV routing protocol shows better performance in packet delivery ratio.

Fig. 8 shows average energy remained at different node mobility. Whereas overall average energy remained at R-AODV is more when compare to AODV routing protocol. Which will helpful for nodes to communicate.

Fig. 9 shows the relation between normalized overhead load and node mobility. Normalized overhead control packet required by the transferral of the routing packets.
Protocol AODV has less number of control packets overhead when compared to R-AODV protocol. The reason behind this is R-AODV floods route reply message, message in AODV protocol the route reply is unicast along reverse route path. Hence we can come to conclusion that, half of these messages are R-RREQ messages.

VIII. CONCLUSION

Overall successful delivery of RREP control messages are important in on-demand routing protocols for wireless networks. However, the loss of RREPs control messages will causes serious impairment on the routing performance. This is because the cost of a RREP control message is very high. If the RREP message is lost, a large amount of route discovery effort will be wasted. Furthermore, the source node has to initiate another round of route discovery to establish a route to the destination node. We have proposed the technique of reverse AODV, which attempts reverse RREQ control message. R-AODV route discovery succeeds in fewer tries than AODV routing protocol. We have carried out an extensive simulation study to analysis the performance of proposed R-AODV and compared it with that of existing AODV routing protocol using NS-2 simulator tool. The simulation results show that the performance of R-AODV routing protocol is better than AODV routing protocol in most of the metrics, such as the energy consumption, timing jitter, average packet delivery ratio, average end to end delay and average throughput. Our future work is to focus on table driven routing protocols and improve their performance for large scale ad hoc networks.

REFERENCES


