Abstract- Wireless Communication is one of the popular areas of research these days. The Mobile Adhoc Networks (MANETs) is an infrastructureless network consisting of wireless mobile nodes. MANET is a self configuring network and the topology of the network keeps on changing as the nodes move randomly and organize themselves in an arbitrarily manner. Many protocols have been proposed for such networks. One such protocol is Adhoc On Demand Distance Vector (AODV) routing protocol. AODV is preferred because it minimizes the routing overhead than the other protocols and hence enhancing the performance of the network. In this paper, the performance analysis of AODV routing protocol is done on the basis of few performance metric parameters such as average end-to-end delay, throughput and packet delivery ratio. The simulation is done in MATLAB.

Keywords- MANET, AODV, MATLAB

1. Introduction

Wireless Communication is one of the emerging technologies which allow users to access information and services electronically, despite their geographical position. Wireless communication can be classified as: Infrastructure network and Infrastructureless network. Mobile Adhoc network is a special kind of infrastructureless network. It is a collection of mobile nodes that move randomly and dynamically [1]. Due to the mobile nature of the nodes the network topology keeps on changing. Each node acts as a host and a router forwarding and receiving packets from the other nodes in the network that may not be in the transmission range of the network. The nodes in MANETs discover other nodes dynamically. Routing in such networks is a challenging task due to the highly dynamic network topology. The aim of deploying these networks is to provide communication in areas where limited or no connectivity or any communication infrastructure exists. These networks are flexible and can be employed in military rescue operations, interactive lectures, business sharing information and emergency situations [6].

The features of MANETs are highly dynamic topology, bandwidth constrained links, limited physical security and energy constrained nodes. For providing connectivity a MANET uses multi-hop routing rather than a static infrastructure based network. Many protocols have been proposed so far. One such protocol is Adhoc On Demand Distance Vector (AODV) routing protocol.

AODV is preferred because it minimizes the routing overhead than the other protocols and hence enhancing the performance of the network. In this paper, the performance analysis of AODV routing protocol is done on the basis of few performance metric parameters such as average end-to-end delay, throughput and packet delivery ratio. The simulation is done in MATLAB.

The paper is structured as follows: In Section 2, MANET routing protocols are discussed. In Section 3, overview of AODV routing protocol is given. Section 4 describes the simulation of AODV routing protocol. In Section 5, performance matrices parameters are presented and in Section 6, results and analysis are described.

2. Types of Routing Protocols in MANETs

MANET routing protocols are classified as following:

2.1 Table Driven (Proactive) Routing protocols

In these protocols, every node maintains one or more tables containing routing information to every node in the network. All nodes update these tables so as to maintain a consistent and up-to-date view of the network. These protocols are also called as proactive because routing information is maintained by them even before it is required. Since, these protocols maintain node entries for each and every node in the form of table; it causes more overhead in the routing table which leads to more bandwidth consumption. So these protocols are not
unsuitable for larger networks. Table Driven Protocols are: Destination Sequence Distance Vector (DSDV) routing, Cluster-head Gateway Switch Routing (CGSR) and Wireless Routing Protocol (WRP) [1]. There are some differences among the protocols on the basis of routing information being updated in each routing table.

2.2 On Demand (Reactive) Routing protocols

On demand protocols obtain routes only on demand basis rather than maintaining a complete list of routing information all the time. The routes are created when desired by the source node. Whenever a node requires a route to destination a route discovery is initiated within the network. This process is completed once a route is found. Once a route is established, it is maintained by a route maintenance procedure till the destination becomes inaccessible or the route is not desired. On demand routing protocols include: Dynamic Source Routing (DSR) protocol, the Adhoc On demand Distance Vector (AODV) protocol, the Temporally Ordered Routing Algorithm (TORA), and the Associativity Based Routing (ABR) protocol [1].

2.3 Hybrid Routing Protocols

In this, various approaches of routing protocols are combined to form a single protocol. ZRP (Zone Routing Protocol) is one of the hybrid protocols which are the combination of table-driven and on-demand routing protocol. It has the characteristics of adaptive to network conditions [7].

3. Overview of AODV Routing Protocol

AODV routing protocol uses a broadcast route discovery mechanism and it depends on dynamically established route. AODV builds routes by using a route request (RREQ)/ route reply (RREP) query cycle. When a source node requires a destination route for which it does not have a route already, it broadcasts RREQ packet across the network [1], [2]. The nodes receiving this packet update the information for the source node and sets up backward pointer information for the source node in the routing table.

RREQ contains source node Internet Protocol (IP) address, destination’s IP address, Broadcast ID [1], [2], [10]. The source node broadcasts RREQ packets to its neighbours for initiating path discovery. After receiving RREQ, it sends RREP packet back to the destination, otherwise it again broadcasts RREQ packet further to its neighbours. It automatically sets up the reverse path from all nodes back from source to destination [15]. As RREP is propagated back to the source, nodes sets up forward pointer to the destination [2]. For desired destination, a single route table entry (i.e. address of destination, next hop along the path, the number of hops to the destination) is maintained by a node. A node chooses fresh node out of two different routes. If both routes are discovered at the same time, then the route with fewer hops is preferred. The nodes generate and forward route error messages to their neighbours that have been using routes that include the broken link. After receiving the route error messages, route discovery is initiated by a node to replace the failed paths [1], [7].

4. Simulation of AODV Routing Protocol

The main method of evaluating the performance of MANETs is simulation. The simulation of AODV routing protocol is done in MATLAB. The network is taken as 100X100 square kilometers. The performance is recorded taking different number of nodes. The nodes are placed randomly in the network. The packet size is taken as 512 bytes and the traffic type is Constant bit rate (CBR). The parameters taken for simulation are listed below in the Table 1.
Table 1: Simulation Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Simulator</td>
<td>MATLAB (R2008b)</td>
</tr>
<tr>
<td>Area</td>
<td>100 Km X 100 Km</td>
</tr>
<tr>
<td>Nodes of Nodes</td>
<td>20, 40, 60, 80 and so on up to 300</td>
</tr>
<tr>
<td>Packet Size</td>
<td>512 bytes</td>
</tr>
<tr>
<td>Traffic Type</td>
<td>CBR</td>
</tr>
</tbody>
</table>

Fig 2: Deployment of network in 100X100 square kilometers of area taking 100 nodes

Fig 3: Finding the path from source to destination
Fig 2 shows the deployment of network in the area of 100X100 square kilometers taking 100 number of nodes and Fig 3 shows finding of path from source to destination in the same area of network as in Fig 2.

5. Performance Measuring Parameters

The performance is measured on the basis of some parameters which are described as follows:

Packet Delivery Ratio- Packet delivery ratio is defined as the number of packets actually delivered to the destination to the number of data packets supposed to be received [8]. The better the packet delivery ratio, the more complete and correct is the routing protocol.

Average end-to-end delay- Average end-to-end delay signifies how long it will take a packet to travel from source to destination node. It includes delays due to route discovery, queuing, propagation delay and transfer time [8]. This metric is useful in understanding the delay caused while discovering path from source to destination.

Throughput- Throughput is the ratio of number of packets sent and total number of packets. It describes the average rate of successful message delivery over a communication channel [9], [12]. Throughput measures the efficiency of the system.

Packet Loss Ratio- Packet loss ratio defines the number of packets that are dropped or lost due to congestion in the network.

6. Results and Analysis

The simulation results show the characteristics of AODV routing protocol. The analysis of the simulation of AODV routing protocol is done on the basis of performance matrices which is as following:

![Variation of Packet Delivery Ratio and No. of nodes](image)

Fig. 4: Variation of Packet Delivery Ratio and Number of Nodes

The packet delivery ratio is shown in Fig. 4. It is varying between 76% to 85%. It decreases as the number of nodes is increased. As the packets move from to destination the collision between packets occur due to traffic causing loss of packets. Moreover, the mobility of nodes may lead nodes to move out of network and thus the packets can’t reach the desired node. Since, it is a property of the AODV protocol to find the other path again if one is lost, therefore again the transfer of packet starts. Thus, an increase in packets delivery is seen after some time.
According to the Fig. 5, the average end-to-end delay varies from 0.327 to 2.62 seconds. It increases with the increase of number of nodes waiting in the interface queue while routing protocols trying to find valid route to the destination. Besides the actual delivery of data packets, the delay time is also affected by route discovery, which is the first step to begin a communication session. The source routing protocols have a longer delay because their route discovery takes more time as every intermediate node tries to extract information before forwarding the reply. The same thing happens when a data packet is forwarded hop by hop. Hence, while source routing makes route discovery more profitable, it slows down the transmission of packets.

Fig 6 shows the variation of throughput and number of nodes. As the number of nodes increases, more routing information will be transmitted, consuming a portion of the useful throughput bandwidth. Thus, reducing the throughput. Moreover, as nodes become more and more stationary, the path from source to destination becomes more stable. Therefore, data sent along transient routes (resulting from quick node movement) decreases, thus reducing the overall throughput.
The packet loss ratio varies from 14% to 17.5% as shown in the Fig. 7. It increases with the increase in number of nodes. At higher loads, number of false route breaks increases due to congestion created by more number of active sessions. False route breaks occur as nodes falsely assume that a route break has occurred, when there are lots of packet drop because of collisions created by congestion. Moreover, since the topology keeps on changing in AODV network there is possibility of losing the packet as nodes get displaced from their previous position.

7. Conclusions and Future Scope

In this paper, the analysis of simulation of AODV routing protocol is done using different performance matrices. It is observed that AODV routing protocol performs with satisfactory results of packet delivery ratio but on the cost of some delay and packet loss. The performance of AODV can be further enhanced using fuzzy logic by taking different input parameters to reduce the uncertainty for finding an optimal path. This will drastically reduce the packet loss and average end to end delay and thereby making an efficient AODV routing protocol.

REFERENCES