Optimum Routing Algorithm for MANET

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Abstract - *An Ad hoc network (MANET) are defined as the category of wireless networks that utilize multi-hope radio relaying and are capable of operating without the support of any fixed infrastructure hence they are also called infrastructureless networks. Ad-hoc On-Demand Distance Vector Routing is a reactive routing protocol associated with MANET which creates a route to destination by broadcasting route request packets through the entire network. This paper proposes an Efficient AODV routing algorithm that has better packets received ratio along with various parameters. Simulation results show the proposed routing algorithm enhances performance in the network as not all network nodes have to participate in the route discovery for a particular source-destination pair.*

***Key Words*: MANET; AODV; DSDV; Reactive Routing; Proactive Routing; DSR**

1. INTRODUCTION

Mobile Ad-Hoc Network (MANET) consists of many wireless nodes that form a temporary network in a certain region. Mobile nodes in MANETs communicate over a shared wireless medium using packet radios. Operations in a MANET are not controlled by any single node's central network, as these networks lack infrastructure. Rather, the control is distributed among all nodes within the network. The communication among these nodes is the backbone for all network operations, including routing and security. The mobile nodes in MANETs require very few CPU capability, power storage, and memory size, hence are generally light weighted. MANETs are employed in many areas, such as data collection, seismic activities, medical applications, military applications, rescue operations, wearable devices, and in other places where pre-installed infrastructure are not possible [1, 2].

These networks have two major challenges in terms of node mobility and energy efficiency. Link breaks, power efficiency and network density are the three main factors of the effects caused by node mobility on a routing protocol's performance. The network load is proportional to the network density, while throughput is affected by the control overhead in the network.[3]

Routing information of a node and its neighbors is propagated through the network using certain routing protocol. This helps all the nodes in a network gain knowledge regarding the topology of a network [4]. Three types of MANETs routing protocols are shown in Fig.1.

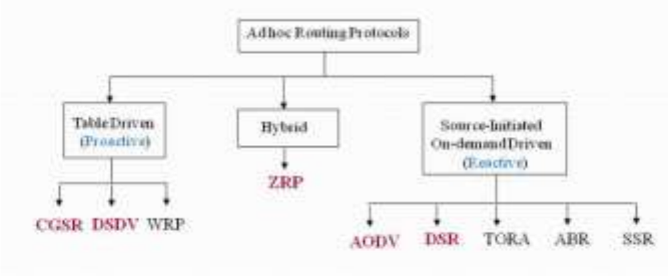

Fig -1: MANET Routing Protocols

Reactive routing protocols are on-demand routing protocols. A route search process is created only when the source node wants to communicate with the destination. Updated routing information will not be kept in the nodes when no communication is active [5]. Ad-hoc On-Demand Distance Vector routing (AODV) and Dynamic Source Routing (DSR) are typical reactive routing algorithms. Proactive routing protocols are table-driven protocols. Every node in the network keeps a routing table to store the routing information. The routing tables will be updated when the network topology is changed [5]. Destination Sequenced Distance Vector (DSDV) routing and Fisheye State Routing (FSR) are the existing proactive routing protocols. Hybrid Routing Protocols, such as Zone Routing Protocol (ZRP), combine characteristics from the aforementioned Reactive and Proactive protocols [5].

This paper proposes an Efficient AODV that determines if a node in a network is relaying or silent in the process of route discovery to send data packets from the source to destination. This can be done by using the Time to Live (TTL) value, which determines the number of hops a route request can go through, and by adding a new field, the Predecessor address (P-addr), in the packet format of the

Route Request Packet (RREQ) packet, which determines the predecessor address value of a node. A relaying node takes part in the route discovery process whereas a silent node drops the route request packet and does not participate in further forwarding of the route request packets throughout the network. This controls congestion in the network and enhances performance, as not all the nodes of the network participate in the route discovery for a particular source-destination pair.

Simulations were carried out on NS2 to compare the existing reactive protocols to the proposed AODV based on packet loss, packet delivery ratio, end-to-end delay, and throughput. The results show that the proposed AODV performs better in all four aspects when compared to the existing reactive routing protocols.

2. AD HOC ON-DEMAND DISTANCE-VECTOR ROUTING PROTOCOL

Ad hoc on-demand distance vector (AODV) routing protocol uses an on demand approach for finding routes, that is, a route is established only when it is required by a source node for transmitting data packets. It employs destination sequence numbers to identify the most recent path. The major difference between AODV and DSR stems out from the fact that DSR uses source routing in which a data packet carries the complete path to be traversed. However, in AODV, the source node and the intermediate nodes store the next-hop information corresponding to each flow for data packet transmission. In an on demand routing protocol, the source node floods the RouteRequest packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single RouteRequest. The major difference between AODV and other on-demand routing protocols is that it uses a destination sequence number (DestSeqNum) to determine an up-to-date path to the destination. A node updates its path information only if the DestSeqNum of the current packet received is greater than the last DestSeqNum stored at the node.

A RouteRequest carries the source identifier (SrcID), the destination identifier (DestID), the source sequence number (SrcSeqNum), the destination sequence number (DestSeqNum), the broadcast identifier (BcastID), and the time to live (TTL) field. DestSeqNum indicates the freshness of the route that is accepted by the source. When an intermediate node receives a RouteRequest, it either forwards it or prepares a RouteReply if it has a valid route to the destination. The validity of a route at the intermediate node is determined by comparing the sequence number at the intermediate node with the destination sequence number in the RouteRequest packet.

If a RouteRequest is received multiple times, which is indicated by the BcastID-SrcID pair, the duplicate copies are discarded. All intermediate nodes having valid routes to the destination, or the destination node itself, are allowed to send RouteReply packets to the source. Every intermediate node, while forwarding a RouteRequest, enters the previous node address and its BcastID. A timer is used to delete this entry in case a RouteReply is not received before the timer expires. This helps in storing an active path at the intermediate node as AODV does not employ source routing of data packets. When a node receives a RouteReply packet, information about the previous node from which the packet was received is also stored in order to forward the data packet to this next node as the next hop toward the destination.

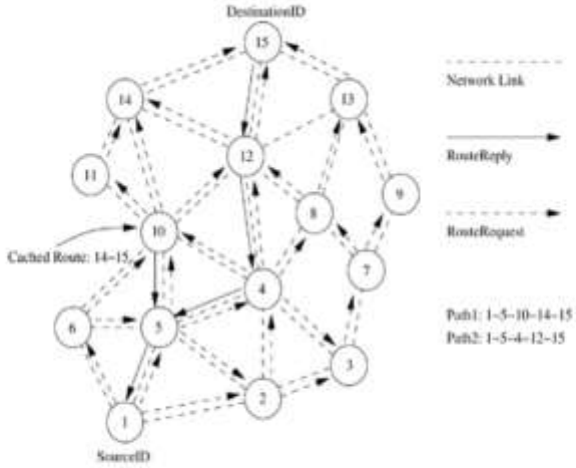

Fig -2: Route establishment in AODV

AODV does not repair a broken path locally. When a link breaks, which is determined by observing the periodical beacons or through link-level acknowledgments, the end nodes (i.e., source and destination nodes) are notified. When a source node learns about the path break, it reestablishes the route to the destination if required by the higher layers. If a path break is detected at an intermediate node, the node informs the end nodes by sending an unsolicited RouteReply with the hop count set as ∞.[6]

3. DESTINATION SEQUENCED DISTANCE VECTOR ROUTING PROTOCOL

The destination sequenced distance-vector routing protocol (DSDV) is one of the first protocols proposed for ad hoc wireless networks. It is an enhanced version of the distributed Bellman-Ford algorithm where each node maintains a table that contains the shortest distance and the first node on the shortest path to every other node in the network. It incorporates table updates with increasing sequence number tags to prevent loops, to counter the count-to-infinity problem, and for faster convergence. As it is a table-driven routing protocol, routes to all destinations are readily available at every node at all times. The tables are exchanged between neighbors at regular intervals to keep an up-to-date view of the network topology. The tables are also forwarded if a node observes a significant change in local topology.

The table updates are of two types: incremental updates and full dumps. An incremental update takes a single network data packet unit (NDPU), while a full dump may take multiple NDPUs. Incremental updates are used when a node does not observe significant changes in the local topology. A full dump is done either when the local topology changes significantly or when an incremental update requires more than a single NDPU. Table updates are initiated by a destination with a new sequence number which is always greater than the previous one. Upon receiving an updated table, a node either updates its tables based on the received information or holds it for some time to select the best metric (which may be the lowest number of hops) received from multiple versions of the same update table from different neighboring nodes. Based on the sequence number of the table update, it may forward or reject the table.

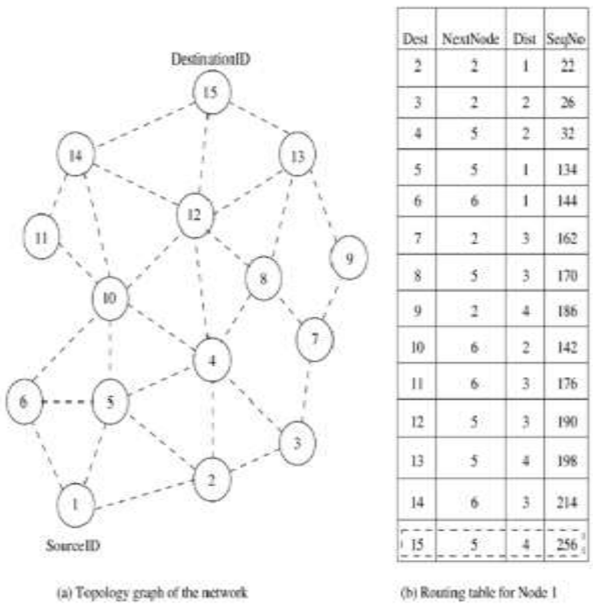

Fig -3: Route Establishment in DSDV

Consider the example as shown in Fig.3 (a). Here node 1 is the source node and node 15 is the destination. As all the nodes maintain global topology information, the route is already available as shown in Fig.3 (b). Here the routing table of node 1 indicates that the shortest route to the destination node (node 15) is available through node 5 and the distance to it is 4 hops, as depicted in Fig.3 (b).

3. SOFTWARE

Network Simulator (Version 2), generally known as NS2, is just an occasion driven tool that is helpful in concentrate the dynamic idea of correspondence systems. Recreation of wired and in addition remote system capacities and conventions (e.g., steering calculations, TCP, UDP) should be possible utilizing NS2. As a rule, NS2 gives clients a method for indicating such system conventions and finding their relating practices.

Fig. 4 shows the basic architecture of NS2. NS2 provides users with an executable command "ns" which takes one input argument, the name of a Tcl simulation scripting file. In most cases, a simulation trace file is created and is used to plot graph and/or to create animation.[7]

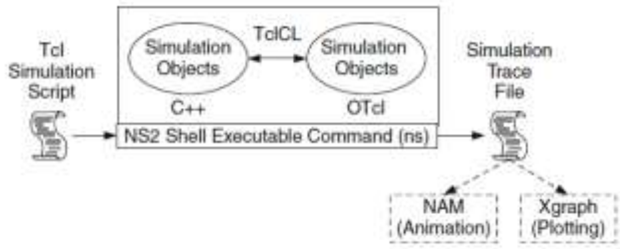

Fig -4: Basic Architecture of NS

After simulation, NS2 outputs either text-based simulation results. To interpret these results graphically and interactively, tools such as NAM (Network AniMator) and XGraph are used. To analyze a particular behavior of the network, users can extract a relevant subset of text-based data and transform it to a more conceivable presentation.

4. PERFORMANCE METRICS

Packet delivery fraction: - The ratio of the data packets delivered to the destinations to those generated by the CBR sources. Packets delivered and packets lost 33 are taking in to consideration.

Throughput: - There are two representations of throughput; one is the amount of data transferred over the period of time expressed in kilobits per second (Kbps). The other is the packet delivery percentage obtained from a ratio of the number of data packets sent and the number of data packets received.

5. SIMULATIONS & RESULTS

As we have taken two On-demand (Reactive) routing protocols, namely Ad hoc On-Demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR). The mobility model used is Random waypoint mobility model because it models the random movement of the mobile nodes.

For all the simulations, the same movement models were used, the number of traffic sources was fixed at 10, the maximum speed of the nodes was set to 20m/s and the simulation time was varied as 10s, 15s, and 20s.

In this scenario some parameters with a specific value are considered. Those are as shown in table 6.1.

Table -1: Scenario 1 for implementation of AODV and DSR

Scenario 1 for implementation of AODV and DSR	
Parameter	Value
Number of nodes	10
Simulation Time	10 sec

Pause Time	5ms
Environment SIze	800x800
Transmission Range	250m
Traffic Size	CBR
Packet Size	512 bytes
Packet Rate	5 packets/s
Maximum Speed	20 m/s
Queue Length	50
Simulator	NS2
Mobility Model	Random Waypoint
Antenna Type	Omnidirectional

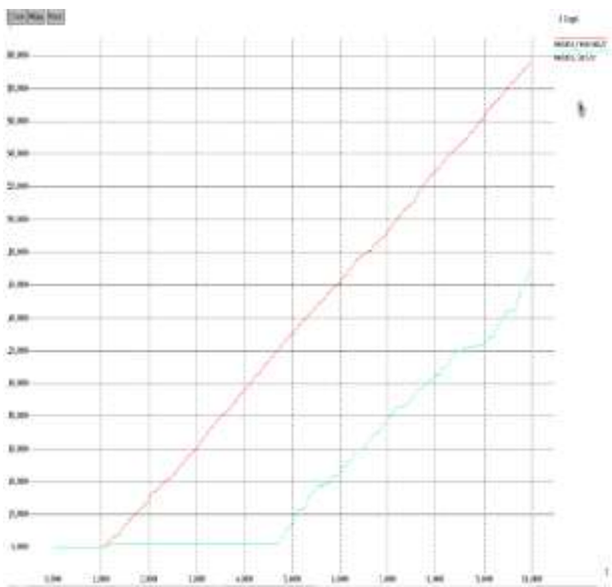

Figure-5: X Graph of 10 seconds simulation time of AODV

The Figure 5 shows the X graph of AODV. By the Figure we see that as the simulation start the packet received and packet loss is initially zero, because initially there is no CBR connection and nodes taking their right place. As the CBR connections established between the nodes the number of packets received increases but no packet loss is there, it means all generated packets are being received by the nodes. But the packet loss increases substantially on the simulation time increases. Finally the packet received is more than the packet loss.

3. CONCLUSION

So, we can conclude that if the MANET has to be setup for a small amount of time then AODV should be prefer due to low initial packet loss and DSR should not be prefer to setup a MANET for a small amount of time because initially there is packet loss is very high. If we have to use the MANET for a longer duration then both the protocols can be used, because after sometimes both the protocols have same ratio of packet delivering. But AODV have very good packet receiving ratio in comparison to DSR The two protocols Ad hoc On-Demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR) have been compared using simulation, it would be interesting to note the behavior of these protocols on a real life test bed. In this work other network parameters such as number of mobile nodes, traffic type-CBR, simulation area etc. are kept constant. Whereas the simulation time is varied in the three different simulation scenarios. It would be interesting to observe the behavior of these two protocols by varying these network parameters.

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