Study and comparative Analysis of AODV and DSR Routing Protocol

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Abstract

A Mobile Ad-Hoc Network (MANET) is a collection of wireless mobile nodes forming a temporary network without using any centralized access point, infrastructure, or centralized administration. Data transmission between two nodes in MANET's, requires multiple hops as nodes transmission range is limited. Ad hoc networks meet the demands of spontaneous network setup. They are characterized by the use of wireless links, dynamically changing topology, multi-hop connectivity and decentralized routing mechanisms and decision-making. AODV and DSR are the two most widely studied on-demand ad hoc routing protocols. Previous studies have shown limitations of these protocols in certain network scenarios. To improve the performance of AODV, we modify AODV to include the source route accumulation feature of DSR. We call this AODV with path accumulation. This protocol optimizes AODV to perform effectively in terms of routing overhead and delay during high load. The performance of the protocol is evaluated by a simulation model under a variety of network conditions. We also compare its performance with that of unmodified AODV and DSR. We demonstrate how a small change to the AODV protocol can lead to significantly improved performance results.

I. INTRODUCTION

Wireless networking is an emerging technology that allows users to access information and services electronically, regardless of their geographic position. Wireless networks can be classified in two types:

1.1 Infrastructure networks:

Infrastructure network consists of a network with fixed and wired gateways. A mobile host communicates with a bridge in the network (called base station) within its communication radius. The mobile unit can move geographically while it is communicating. When it goes out of range of one base station, it connects with new base station and starts communicating through it. This is called handoff. In this approach the base stations are fixed.

1.2 Infrastructure-less (Ad hoc) networks:

In ad hoc networks all nodes are mobile and can be connected dynamically in an arbitrary manner. All nodes of these networks behave as routers and take part in discovery and maintenance of routes to other nodes in the network. Ad hoc networks are very useful in emergency search and rescue operations, meetings or conventions in which persons wish to quickly share information, and data acquisition operations in inhospitable terrain.

These ad hoc routing protocols can be divided into two categories:

1.2.1. Table driven routing protocols: In table driven routing protocols, consistent

and up to date routing information to all nodes is maintained at each node.

1.2.2. On Demand routing protocols: In On Demand routing protocols, the routes are created as and when required. When a source wants to send to a destination, it invokes the route discovery mechanisms to find the path to the destination. There are four multi hop wireless ad hoc network routing protocols that cover a range of design choices:

Destination Sequenced Distance Vector (DSDV),

Temporally Ordered Routing Algorithm (TORA),

Dynamic Source Routing (DSR), Ad Hoc On Demand Distance Vector Routing (AODV). While DSDV is a table driven routing protocol, TORA, DSR, AODV, fall under the On Demand routing protocols category.

II. Overview of AODV and DSR

2.1. *The Ad-hoc On-demand Distance Vector (AODV):* The Ad-hoc On-demand Distance Vector (AODV) routing algorithm is a routing protocol designed for mobile ad hoc networks. AODV is an on-demand algorithm, meaning that it builds routes between nodes only as desired by source nodes. It maintains these routes as long as the source nodes need them. AODV uses sequence numbers to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes. AODV builds routes using a Route Request (RREQ) and Route Reply (RREP) query cycle. When a source node desires a route to a destination for which it does not already have a route, it broadcasts a RREQ packet across the network. Nodes receiving this packet update their information for the source node and set

up backwards pointers to the source node in the route tables. In addition to the source node's IP address, current sequence number, and broadcast ID, the RREQ also contains the most recent sequence number for the destination of which the source node is aware. A node receiving the RREQ may send a RREP if it is either the destination or if it has a route to the destination with corresponding sequence number greater than or equal to that contained in the RREQ.

If this is the case, it unicasts a RREP back to the source. Otherwise, it rebroadcasts the RREQ. Nodes keep track of the RREQ's source IP address and broadcast ID. They discard the RREQ and do not forward it if they receive a RREQ, which have already been processed by them. Nodes set up forward pointers to the destination as the RREP propagates back to the source. Source node may begin to forward data packets to the destination once it receives the RREP. Source node may update its routing information for that destination and begin using the better route if it later receives a RREP containing a greater sequence number or contains the same sequence number with a smaller hop count. Route would be maintained as long as it remains active. A route is considered active as long as data packets are sent periodically from the source node to the destination along that path. If the source node stops sending data packets, the links will time out and eventually be deleted from the intermediate node routing tables. If a link break occurs while the route is active, the node upstream of the break propagates a route error (RERR) message to the source node to inform it of the unreachable destination(s). After receiving the RERR, if the source node

still desires the route, it can reinitiate route Discovery. Because the network nodes are mobile, it is likely that many link breakages along a route will occur during the lifetime of that route. AODV allows mobile nodes to respond to link breakages and changes in network topology in a timely manner.

2.2. *Dynamic Source Routing (DSR):*

The Dynamic Source Routing protocol (DSR) is a reactive (on-demand) routing protocol that is based on the well-known concept of source routing. The protocol includes two major operational components: Route Discovery and Route Maintenance, and three types of route control messages, i.e. Route Request (RREQ), Route Reply (RREP), and Route Error (RERR). When a source node in the mobile ad hoc network attempts to send a packet to a destination but it does not have a route to that destination in its route cache, it initiates a route discovery process by road casting a Route Request packet (RREQ). This route request packet contains the source node address, the destination node address, unique sequence number, and an empty route record. Each intermediate node, upon receiving a route request for the first time, will check its own route cache. If it has no route to the destination, the intermediate node will add its own address to the route record and rebroadcast the RREQ. If it has a route to the destination in its route cache, the intermediate node will append the cached route to the route record and initiate a Route Reply (RREP) back to the source node. The RREP contains the complete route record from the source to the destination. The intermediate node ignores the late arrival of the same route request by examining the sequence number. If the node receiving the route request is the destination node, it will copy the route record contained in the route request and send a RREP back to the source.

In most simulation implementations, the destination node will reply to all the route requests received, since DSR is capable of caching multiple paths to a certain destination. Moreover, the replies from the destination reflect the up-to-date communication topology the most accurately.

Due to the node movement, the routes discovered may no longer be valid over time. The route maintenance mechanism is accomplished by sending route error packets (RERR). If a link break occurs while the route is active, the node upstream of the break propagates a RERR to the source node to inform it of the unreachable destination(s). Each node, upon receiving the RERR, removes all the routes that contain the broken link from its cache. Consequently, if the source node still desires the route, it can reinitiate route discovery. In DSR, each node transmitting the packet is responsible for confirming that the packet has been received by the next hop along the source route. This can be done by either a link layer acknowledgement (as in IEEE 802.11), or a passive acknowledgement (in which the first transmitting node confirms the receipt at the second node by overhearing the second node transmitting the packet to the third node). It can also be achieved by a DSR-specific software acknowledgement returned by the next hop. Once a route is entered into the cache, the failure of the route can only be detected when it is actually used to transmit a packet but fails to confirm the receipt by the next hop.

RREQ
A → A,B → A,B,C → A,B,C,D →

(A)   (B)   (C)   (D)   (E)
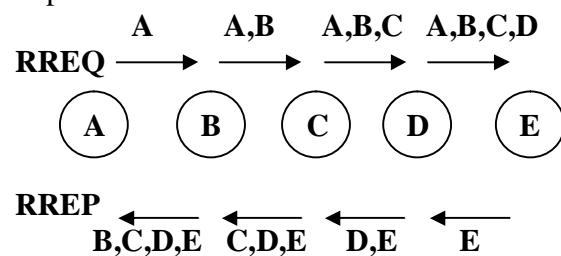
RREP
← B,C,D,E ← C,D,E ← D,E ← E

Fig.1. Path Accumulation in AODV-PA. contained in the packet header. If a link breaks and the next node on the source route is currently not its neighbor, the node reports an error back to the source, and leaves it to the source to establish a new route. Alternatively, the node may try a different path, if it has an alternate route cached. DSR stores multiple paths per destination and does not use any expiry timers on route cache entries.

As an advantage, source routing in DSR eliminates routing. However, there are two primary disadvantages of DSR, as found in. Route reply flooding in DSR results in costly MAC layer overhead. Secondly, DSR is not scalable to large networks tables and the aggressive caching reduces the overhead of DSR.
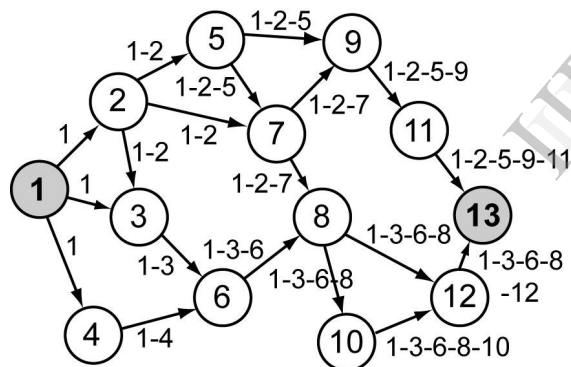
(a) Building of the route record

The Source lists the complete sequence of nodes from source to destination in the header of the packet. Each node along the route forwards the packet to the next hop indicated in the packet's header, and attempts to confirm that the packet was received by that next node. If, after a limited number of local retransmissions of the packet, a node in the route are unable to make this confirmation, it returns a ROUTE ERROR to the original source of the packet, identifying the link from itself to the next node is broken. The sender then removes this broken link from its Route Cache; for subsequent packets to this destination, the sender may use any other route to that destination in its Cache, or it may attempt a new Route Discovery for that target if necessary. Figure 1(a) shows the route discovery process with node 1 as source node and node 13 as destination node.

III. PROPOSED METHOD

The performance comparison of DSR and AODV routing protocols are analyzed and tested for 70 nodes when mobility is introduced. In the presence of ambient noise the performance metrics such as throughput, end-to-end delay, packets drop and network load are measured for both on-demand routing protocols. Ambient noise is the noise from the environment. No precautionary measures are taken to lessen the noise level. It is presumed that the wireless links between nodes are affected with equal ambient noise level of 1.0E-26. All nodes are placed very close to each other at a distance of 1 cm. When the source node sends the data packets, all data packets are affected with noise which results in loss of signal strength. As the distance between nodes increases signal strength decreases, but the noise level remains constant. A signal which is received at the receiver side is considered as a valid one or a noise based on pre-defined received signal threshold level which we have set in our TCL (Tool command language) script that is, if the received signal strength is less than the threshold value then the signal gets weakened and it is dropped by the receiver node. The performance of AODV and DSR routing protocols are compared based on the performance metrics which are defined below. These four metrics are evaluated against pause time:

Throughput: It is defined as the successful delivery of data packets.

End to End delay: It is the difference between the packet received time and packet sent time.

Packets drop: It is the number of packets lost in transit.

Network Load: The total traffic (bits/sec) received by the network layer from the higher MAC that is accepted and queued for transmission.

In the simulation when the movements are introduced, all nodes move to a particular point and then ceases for a sec at that particular time the throughput level is measured.

Similarly for other two metrics delay and Network load.

IV. Simulation Tool

The Simulation research tool can be used by the majority of MANET community that estimates how an event may occur in the real world. Commonly, this method can be used to evaluate the performance of the network in terms of different proposed metrics. Discrete event simulation is a software based method that can be employed on the network models of the real environment so that we can draw a conclusion from the output. There are many discrete event simulators available for MANET community; but research shows that network simulator NS-2 is the most widely used discrete event network simulator in MANET research. The most important reasons for using NS-2 are software availability, large community of developer and also supporting energy models.

V. Conclusion and Future Work

This study was conducted to analyze the performance between AODV and DSR. We have used the NS-2(Network Security) simulator. From this simulation we conclude that the performance of DSR is better than AODV. We have compared the performance on the basis of: Throughput, end-to-end delay, packet delay and network load. Our future work is to undergo performance analysis in case of different topology networks and to analyze the behavior of the protocols under different situations.

VI. References

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