

Performance comparison of AODV and DSR under various network conditions

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Abstract

Mobile ad hoc networks (MANET) are self-created and self organized by a collection of mobile nodes, interconnected by multi-hop wireless paths in a strictly peer to peer fashion. Ad-Hoc routing protocols such as Dynamic source routing (DSR), Ad-hoc on demand distance vector (AODV) and Destination sequence Vector (DSDV) has been proposed to solve the routing problem in Ad-hoc networks. Extended research has been done in comparing the different proposed ad-hoc routing protocol under various network conditions. Packet delivery ratio (PDR), routing overhead, path optimality, end to end delay and throughput are some parameters commonly used in the comparisons. This survey paper provides the analyzed performance of the routing protocol under the various conditions.

Keywords- MANET, AODV, DSR, Throughput.

I. INTRODUCTION

Mobile ad-hoc network is collection wireless mobile node dynamically forming a temporary network without a infrastructure or centralised administration. The nodes are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may changes rapidly and unpredictably. Mobile nodes that are within each other's radio range communicate directly via wireless links while far apart rely on other nodes to relay messages as routers. In ad-hoc network each node acts both as a host and a router which forwards a data intended for some node. Hence it is appropriate to call such network as "multi-hop wireless ad-hoc networks" [1].

Routing Approaches in Mobile Ad Hoc Network

➤ In ad hoc networks, routes are mainly multi hop because of the limited radio propagation ranges and topology change frequently and unpredictably since each network host moves randomly[3]. Therefore, routing is an integral part of ad hoc communications.

➤ Routing is to find and maintain route between nodes in a dynamic topology with possibly unidirectional links, using minimum resources [5].

Classification of Routing Protocol in MANET

1. **Table-driven or Proactive Protocols:** In Table routing protocols each node maintains one or more tables containing routing information of every other node in the network. Some of table driven protocols are: Distance sequence distance vector (DSDV), Wireless Routing Protocols (WRP), Clustered Gateway Switch Routing (CGSR) etc [2].

2. **On-demand or Reactive Protocols:** In reactive protocols routes are created when it is required. On-demand protocols, unlike table driven protocols ones, establish a route to destination when there is a demand for it, usually initiated by a source node through discovery process with in a network. Some of On-demand protocols are: Dynamic Source Routing (DSR), Ad-hoc On demand Distance Vector (AODV), Temporally Ordered Routing Algorithm (TORA), Associativity Based Routing (ABR) etc [4].

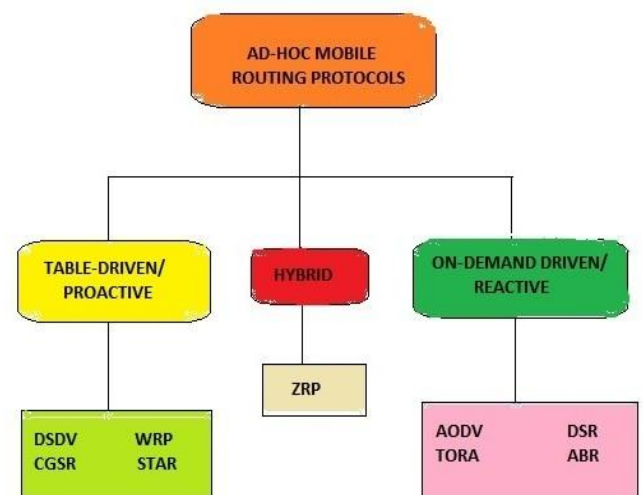


Figure . 1. Classification of Routing Protocol

TABLE I : COMPARISON OF TABLE-DRIVEN AND ON-DEMAND PROTOCOLS

	Table-Driven	On-Demand
Availability of Routing Information	Immediately from routing table	After the route discovery
Route Update	Periodic Advertisements	When requested
Routing Overhead	Proportional to the size of the network regardless to the network traffic	Proportional to the number of communicating nodes and increase with increased node mobility

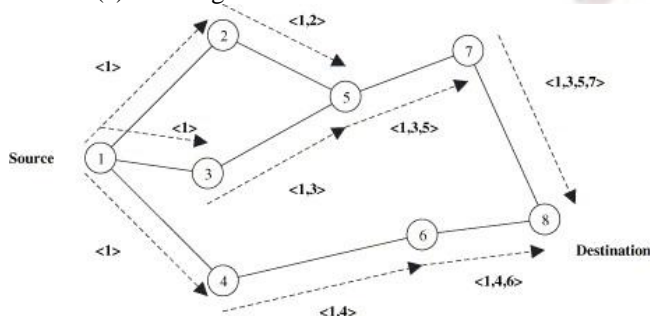
II. Dynamic Source Routing

Dynamic Source Routing (DSR) is the routing protocol for wireless networks. It forms a route on-demand when a transmitting computer request one. However, it uses source routing instead of relying on the routing table at each intermediate device. There are two major phases for the protocol : (a) the route discovery process which is based on flooding and is used to dynamically discover new routes, maintain them in node caches, (b) the route maintenance process, periodically detects and notifies network topology changes[3].

Route Reply would only be generated if the message has reached the intended destination node (route record which is initially contained in Route Request would be inserted into the Route Reply) [4].

To return the Route Reply, the destination node must have a route to the source node. If the route is in the Destination Node's route cache, the route would be used. Otherwise, the node will reverse the route based on the route record in the Route Request message header (this requires that all links are symmetric). In the event of fatal transmission, the Route Maintenance Phase is initiated whereby the Route Error packets are generated at a node. The erroneous hop will be removed from the node's route cache; all routes containing the hop are truncated at that point. Again, the Route Discovery Phase is initiated to determine the most viable route [7].

(a) Building of the route record



(b) Propagation of the route reply.

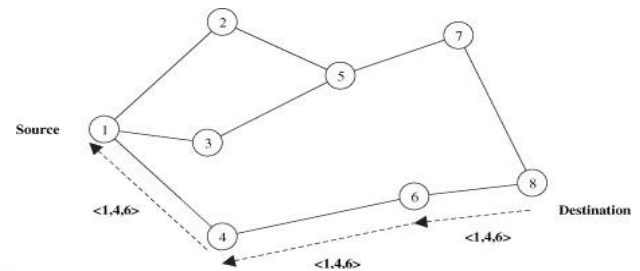


Figure 2: DSR Route Discovery Process.

Advantages and limitations of DSR

This protocol uses a reactive approach which eliminates the need to periodically flood the network with table update messages which are required in a table-driven approach. The intermediate nodes also utilize the route cache information efficiently to reduce the control overhead [8].

The disadvantage of this protocol is that the route maintenance mechanism does not locally repair a broken link. The connection setup delay is higher than in table-driven protocols. Even though the protocol performs well in static and low-mobility environments, the performance degrades rapidly with increasing mobility. Also, considerable routing overhead is involved due to the source-routing mechanism employed in DSR. This routing overhead is directly proportional to the path length [6].

III. Ad hoc On Demand Distance Vector Routing (AODV)

Ad hoc On-Demand Distance Vector (AODV) routing is a routing protocol for mobile ad-hoc networks and other wireless ad-hoc networks. It is an on-demand and distance-vector routing protocol, meaning that a route is established by AODV from a destination only on demand.

AODV is capable of both unicast and multicast routing. It keeps these routes as long as they are desirable by the sources. Additionally, AODV creates trees which connect multicast group members. The trees are composed of the group members and the nodes needed to connect the members. The sequence numbers are used by AODV to ensure the freshness of routes. It is loop-free, self-starting, and scales to large numbers of mobile nodes [9].

AODV defines three types of control messages for route maintenance:

RREQ- A route request message is transmitted by a node requiring a route to a node. As an optimization AODV uses an expanding ring technique when flooding these messages. Every RREQ carries a time to live (TTL) value that states for how many hops this message should be

forwarded. This value is set to a predefined value at the first transmission and increased at retransmissions. Retransmissions occur if no replies are received. Data packets waiting to be transmitted (i.e. the packets that initiated the RREQ). Every node maintains two separate counters: a node sequence number and a broadcast_id.

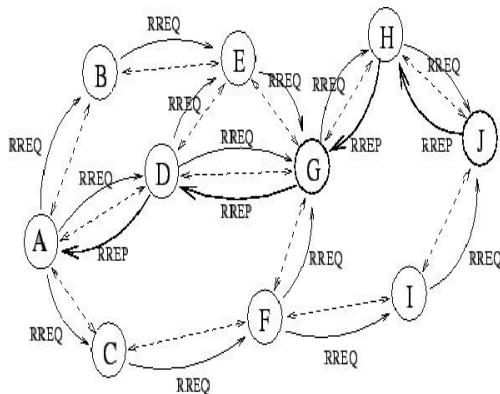


Figure 3: AODV Route Discovery Process.

RREP- A route reply message is unicasted back to the originator of a RREQ if the receiver is either the node using the requested address, or it has a valid route to the requested address. The reason one can unicast the message back, is that every route forwarding a RREQ caches a route back to the originator[12].

RERR- Nodes monitor the link status of next hops in active routes. When a link breakage in an active route is detected, a RERR message is used to notify other nodes of the loss of the link. In order to enable this reporting mechanism, each node keeps a "precursor list", containing the IP address for each its neighbours that are likely to use it as a next hop towards each destination [10].

In Fig.3 A possible path for a route replies if A wishes to find a route to J. The above Figure 3 illustrates an AODV route lookup session. Node A wants to initiate traffic to node J for which it has no route. A transmit of a RREQ has been done, which is flooded to all nodes in the network. When this request is forwarded to J from H, J generates a RREP. This RREP is then unicasted back to A using the cached entries in nodes H, G and D [11].

Characteristics of AODV

- Unicast, Broadcast, and Multicast communication.
- On-demand route establishment with small delay.
- Multicast trees connecting group members maintained for lifetime of multicast group.
- Link breakages in active routes efficiently repaired.
- All routes are loop-free through use of sequence numbers.

- Only keeps track of next hop for a route instead of the entire route.
- Use of Sequence numbers to track accuracy of information.
- Use of periodic HELLO messages to track neighbours.

Advantages and limitations of AODV

The main advantage of AODV protocol is that routes are established on demand and destination sequence numbers are used to find the latest route to the destination. The connection setup delay is less. The HELLO messages supporting the routes maintenance are range-limited, so they do not cause unnecessary overhead in the network.

One of the disadvantages of this protocol is that intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes have a higher but not the latest destination sequence number, thereby having stale entries.

Also multiple Route Reply packets in response to a single Route Request packet can lead to heavy control overhead. Another disadvantage of AODV is that the periodic beaconing leads to unnecessary bandwidth consumption [10].

IV. Performance Metrics

Some important performance metrics can be evaluated:-

A. 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 are taken into consideration.

B. 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 [11].

C. Average end-to-end delay: This is the average time delay for data packets from the source node to the destination node.

D. Packet Delivery Ratio: This is the ratio of number of packets received at the destination to the number of packets sent from the source. In other words, fraction of successfully received packets, which survive while finding their destination, is called as packet delivery ratio [12].

V. EXPERIMENTAL ANALYSIS USING SIMULATION

As already outlined 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.

Scenario 1: In this scenario some parameters with a specific value are considered. Those are as shown in table 2.

Parameter	Value
Number of nodes	10
Simulation Time	10 sec
Pause Time	5ms
Environment Size	800x800
Transmission Range	250 m
Traffic Size	CBR (Constant Bit Rate)
Packet Size	512 bytes
Packet Rate	5 packets/s
Maximum Speed	20 m/s
Queue Length	50
Simulator	ns-2.29
Mobility Model	Random Waypoint
Antenna Type	Omnidirectional

Table 2: Scenario 1 for implementation of AODV and DSR

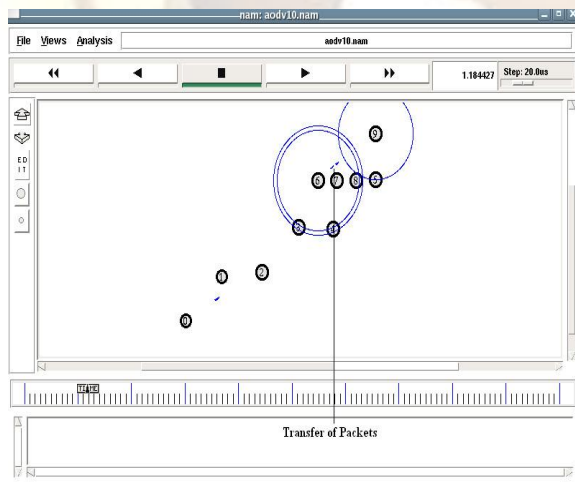


Figure 4: A Screenshot of 10 nodes of AODV NAM – Network animator

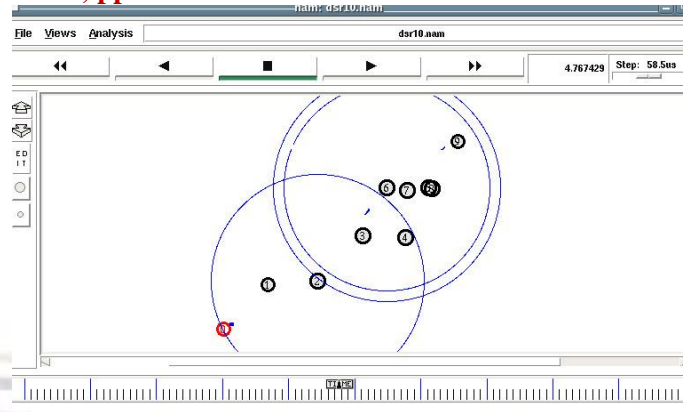


Figure 5: A Screenshot of 10 nodes of DSR NAM – Network animator

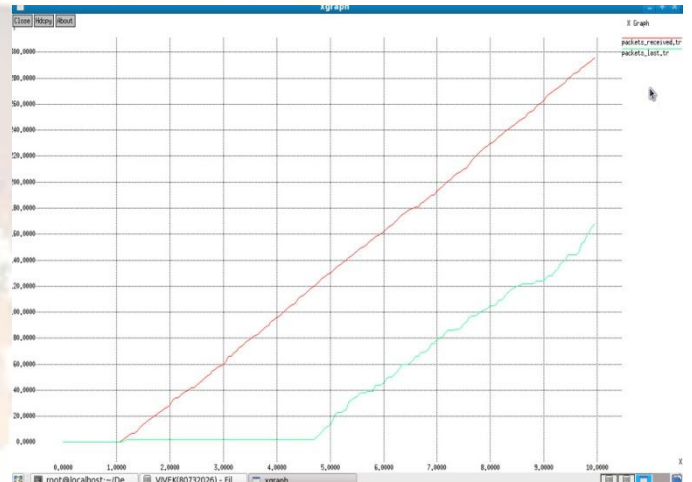


Figure 6: X Graph of 10 seconds simulation time of AODV

The Figure 6 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 establish between the nodes the number of packet 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.

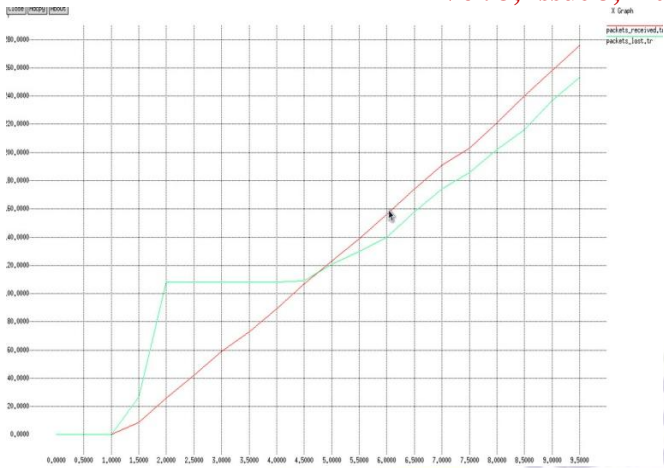


Figure 7: X Graph of 10 seconds simulation time of DSR

The Figure 6.6 shows the X graph of DSR. 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 establish the number of packet lost increases very much as compare to packet received. It shows that mostly generated packets are being dropped by the nodes. But the packet loss decreases substantially on the simulation time increases, and number of packet received increases substantially on the simulation time increases.

Scenario 2: In this scenario some parameters with a specific value are considered. Those are as shown in table 3

Parameter	Value
Number of nodes	10
Simulation Time	15 sec
Pause Time	5ms
Environment Size	800x800
Transmission Range	250 m
Traffic Size	CBR (Constant Bit Rate)
Packet Size	512 bytes
Packet Rate	5 packets/s
Maximum Speed	20 m/s
Queue Length	50
Simulator	ns-2.29
Mobility Model	Random Waypoint
Antenna Type	Omnidirectional

Table 3: Scenario 2 for implementation of AODV and DSR

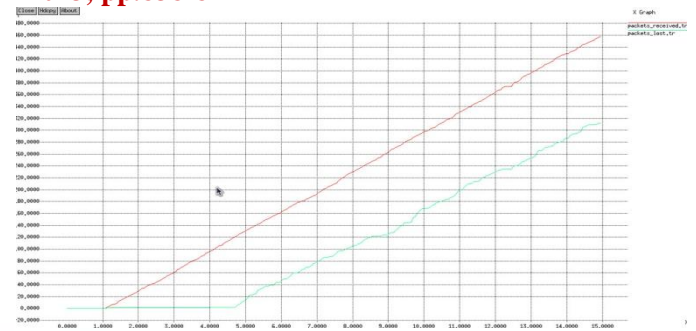


Figure 8: X Graph of 15 seconds simulation time of AODV

The Figure 8 shows that the number of packet received increases according to simulation time; it means generated packets are being received at a good ratio by the node. But the simulation time increases the packet loss increases substantially.

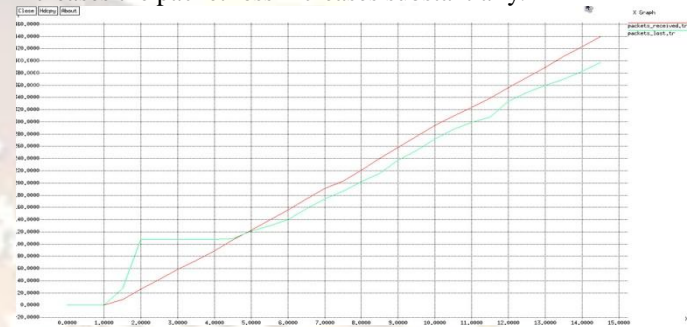


Figure 9: X Graph of 15 seconds simulation time of DSR

Figure 9 shows that initially there is very high packet loss but the number of packet received increases according to simulation time; it means generated packets are being received at a good ratio by the nodes. Because the simulation time increases the packet loss decreases substantially. The

Scenario 3: In this scenario some parameters with a specific value are considered. Those are as shown in table 4

Parameter	Value
Number of nodes	10
Simulation Time	20 sec
Pause Time	5ms
Environment Size	800x800
Transmission Range	250 m
Traffic Size	CBR (Constant Bit Rate)
Packet Size	512 bytes
Packet Rate	5 packets/s
Maximum Speed	20 m/s
Queue Length	50
Simulator	ns-2.29
Mobility Model	Random Waypoint
Antenna Type	Omnidirectional

Table 4: Scenario 2 for implementation of AODV and DSR

10sec15sec and 20 sec. Other network parameters are kept constant during the simulation.

It is observed that the packet loss is very less in case of AODV, initially but it increases substantially on the simulation time increases. In case of DSR simulation the packet loss is very high initially but it decreases substantially on the simulation time increases.

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 some times 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 behaviour 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 behaviour of these two protocols by varying these network parameters.

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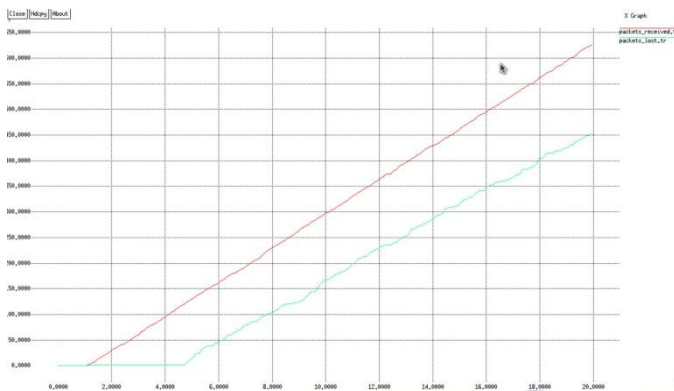


Figure 10: X Graph of 20 seconds simulation time of AODV

The above figures shows the same behavior of AODV & DSR in fact of packet receiving and packet loss, initially in AODV no packet loss and in DSR very high packet loss. But as simulation time increases the packet loss goes down and packet receiving increases.

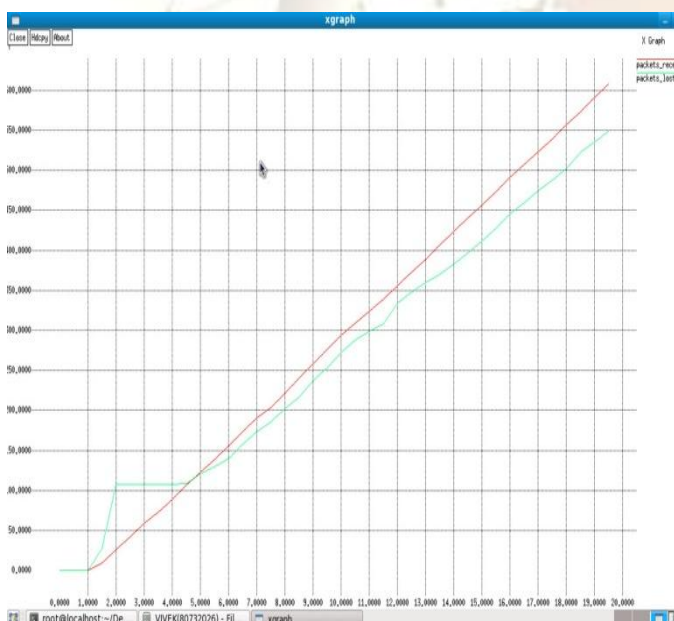


Figure 11: X Graph of 20 seconds simulation time of DSR

VI. Conclusion and Future Scope

We have compared two On-demand routing protocols, namely, Ad hoc On-Demand Distance Vector Routing (AODV) and Dynamic Source Routing (DSR). The simulation of these protocols has been carried out using Ns-2 simulator on a —Pentium-IV, 2.0Ghz /RAM-1 GB /HDD- 120GB| computer and —Linux operating system.

Three different simulation scenarios are generated and the simulation time has varied from

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