Performance Evaluation of AODV and DSR Routing Protocol in Ad-Hoc Network

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ABSTRACT

An ad-hoc network is a cluster of wireless mobile nodes that dynamically form a temporary network, without the use of any existing network infrastructure or centralized administration. Several routing protocols such as Ad Hoc On- Demand Distance Vector Routing (AODV), Dynamic Source Routing (DSR) Destination- Sequenced Distance-Vector (DSDV) have been implemented. In this paper, we will discuss the performance parameter such as packet delivery ratio, control overhead, throughput, delay, and packet dropping ratio, etc. of the two Reactive Protocols AODV and DSR and compare it with each other. This will be achieved using results from simulation done in NS2 (network simulator) and conclusions will be drawn out of these results.

1. INTRODUCTION

An ad hoc routing protocol is a standard that controls how nodes decide which way to route packets to be transferred between computing devices in a mobile ad hoc network. In accidental networks, nodes are not familiar with the topology of their networks. Instead, they need to find it: generally, a new node announces its presence and listens for announcements broadcast by its neighbours. Each node learns regarding others close and the way to succeed in them and may announce that it too can reach them. Some of the protocols which are called the "Table Driven" protocols which keeps track of other neighboring nodes, and maintain their addresses and shortest path to every node from each another. But these nodes have to keep refreshing and updating route to every once in a while and this affects battery performance. So there is another routing protocol called "On Demand" or "Reactive", which activate nodes and find a path from source and destination only when necessary. On-Demand Distance Vector (AODV) and Dynamic Source routing (DSR) are the types of Reactive routing protocol that we will discuss and evaluate their performance parameters and compare these two protocols with each other to find out a better protocol based on the result from the simulation in NS2 in form of performance parameters. The AODV protocol builds routes between nodes as long as they're requested by supply nodes. AODV is a so thought-about associate degree on-demand algorithmic program and doesn't produce any additional traffic for communication on links. The routes are maintained as long as they are required by the sources. In AODV, networks area unit silent till connections area unit established. Network nodes that require affiliations broadcast missive of invitation for connection. The remaining AODV nodes forward the message and record the node that requested an affiliation. Thus, they produce a series of temporary routes back to the requesting node. A node that receives such messages, it keeps a route to the desired node sends a backward message through temporary routes to the requesting node. The node that initiated the request uses the route containing the smallest amount range of hops through alternative nodes. The entries that don't seem to be employed in the routing table's area unit recycled once your time. DSR protocol allows multiple routes to any node destination allowing each sender individually to control the routes. Other advantages of the DSR protocol can be categorized as support for use in networks containing unidirectional links, easily guaranteed loop-free routing, and very rapid recovery when routes in the network change and use of only "soft state" in routing. The DSR protocol is designed for mobile ad hoc networks of up to two hundred mobile nodes and is designed to work well with even a very high rate of mobility.

2. LITERATURE SURVEY

AODV is another routing protocol developed for use in mobile Ad hoc networks (MANET), Intended for networks that may contain thousands of nodes Source, destination and next hop are addressed using IP Addressing. Each node maintains a routing table that contains information about reaching the destination node. DSR is an efficient and simple routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self- configuring and self-organizing, without the need for any existing network infrastructure or administration help. The protocol contains two main mechanisms of "Route Maintenance" and "Route Discovery", which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network. All aspects of the protocol operate only on demand, which allows routing packet overhead of DSR to scale automatically and only when necessary to only to react to changes in the routes that are currently in use.
Main Features of AODV

The Ad hoc On-Demand Distance Vector protocol is both a table-driven and on-demand protocol. The size of packets in AODV is uniform, unlike DSR. Unlike DSDV, there is no need for system-wide Broadcasts because of local changes. AODV supports unicasting and multicasting within a uniform framework. Each route has a specific lifetime after which the route expires. A route is maintained only when it is used and hence old and expired routes need not be used. Unlike DSR, AODV maintains a single route between a source-destination pair. Like other table-driven protocols, AODV also maintains a routing table but only at the beginning of route discovery. A lifetime is associated with the entry in the route discovery table. This is the main feature of AODV. A route is maintained only when it is used regularly. A route that is unused for a long time is assumed to be stale and unused. Routing table size is minimized by only including required parameters such as next-hop information, not the entire route to a destination node. When a data is to be transferred by Source to Destination node ADOV performs route discovery to find the minimal path from source to destination for transmission. This can be done by sending a message to every neighboring node, this message called RREQ – Route request which consists address of destination node and process continues still this message is received by the destination node. And then destination node reply with a message called RREP – Route reply, which tracks minimal path from source to destination. From Fig.1, it can be seen how AODV finds a route from source to destination. In Fig.1 node A is source and node F is a destination and minimal path achieved using AODV protocol is **A-B-D-F.**
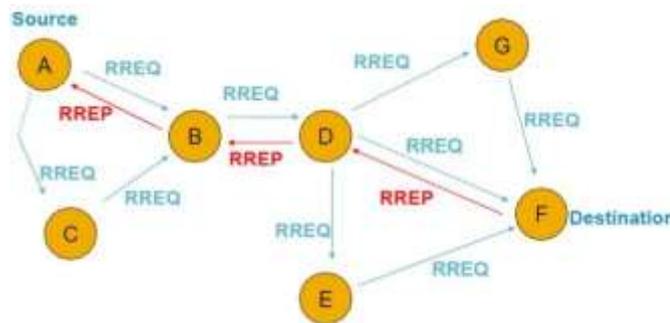

Fig.1: AODV Process of Route Discovery

After route discovery data packet is transferred from source to destination using this route. But as for every protocol performance parameter is the key factor for deciding whether it beneficial to use that protocol or not. So will need performance evaluation of AODV protocol to understand its advantages and disadvantages for application uses.

Main Features of DSR

The DSR protocol includes two main mechanisms that work together to allow the discovery and maintenance of source routes in the ad hoc network. In DSR, Route Discovery and Maintenance both operate entirely "on-demand". In particular, unlike other protocols, DSR doesn't require any periodic packets of any kind within the network. DSR does not use any periodic routing broadcasting, link status sensing, or neighbor detection packets and does not rely on these functions from any underlying protocols. The overall on-demand behavior and lack of requirement of periodic activity allow the number of overhead packets caused by DSR to scale down to zero, when all nodes are almost stationary with respect to each other and all routes needed for current communication has already been discovered. As nodes begin to move constantly or as communication patterns changes frequently, the routing packet overhead of DSR automatically scales to only what is needed to track the routes currently in use. Network topology changes not affecting routes currently being used are ignored and do not cause any reaction from the protocol.
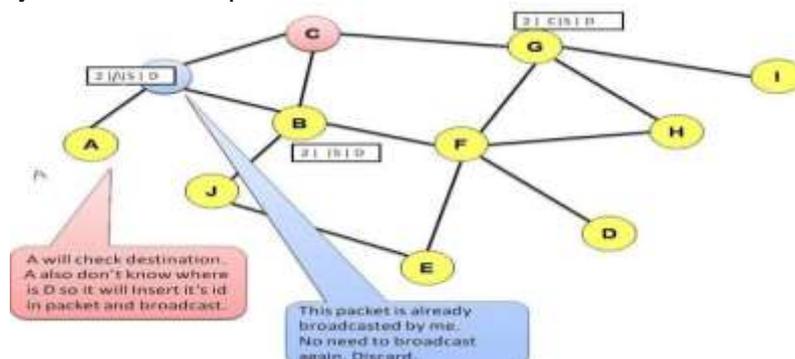

Fig.2: DSR Process of Route Discovery

3. PERFORMANCE EVALUATION

There are several parameters to be evaluated for understanding the performance of AODV routing protocol which are as follow:-

Number of Data packets sent

This is the total number of packets sent by Source to Destination, which can be denoted as Ns.

Number of Data packets Received

This is the total number of packets received by Destination from Source node, can be denoted as Nr.

Packet Delivery Ratio

Packet Delivery Ratio (PDR) is the ratio of all the data packets successfully received by the destinations (Nr) to those generated by the sources (Ns). It describes the delivery capabilities of the network. Higher values of this metric mean better performance of the protocol.

$PDR = (Nr/Ns)*100$

End to End Delay

The time required for data transmission from source to destination is called End to End Delay

Throughput

In simple words, Throughput is the average number of bits transferred in one second. Higher Throughput means better performance of the protocol.

Packet Dropping Ratio

It is the ratio of the total number of packets dropped while transmission to the total packets sent. Lesser the packet dropping ratio better is the performance.

4. SIMULATION ENVIRONMENT

To evaluate all above-mentioned performance parameters we need to simulate an Ad hoc network topology which used AODV and DSR routing protocol to yield result out of it. This simulation is conducted in Network Simulator (NS2).

Table.1 Parameter Table for Simulation Environment.

Parameter	AODV	DSR
No. of nodes	30	30
Area	600 x 600	600 x 600
Simulation Time	100 sec	100 sec
Start Time	5 sec	5 sec
Stop Time	95 sec	95 sec
Packet Size	512 bytes	512 bytes
No. of Scenarios	10	10

For more accuracy, we run the same topology ten times with random and different movements of every node in every situation. And calculate all the parameters mentioned above for each situation.
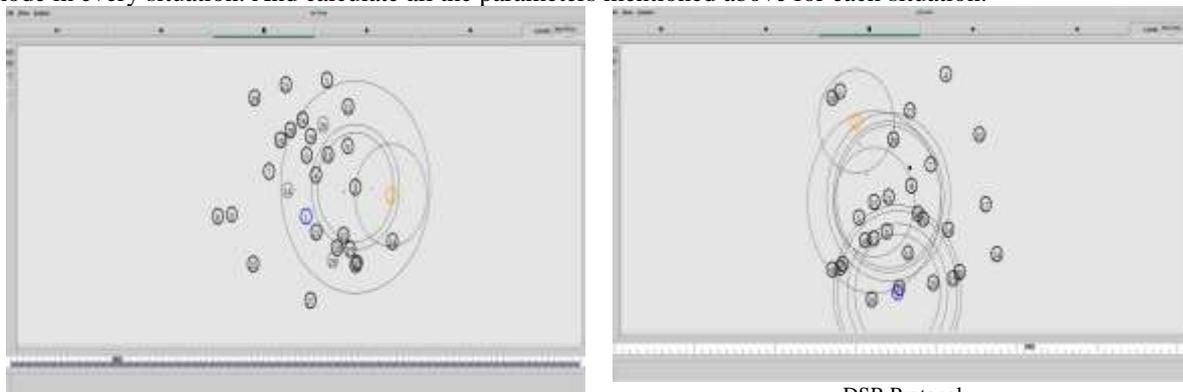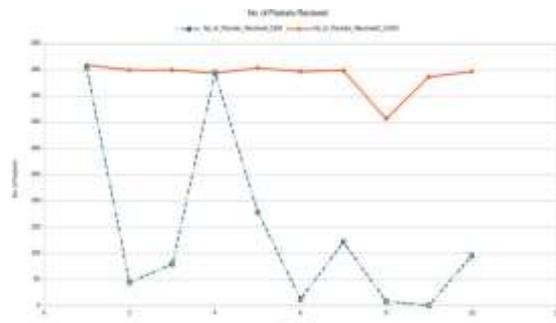

AODV Protocol

DSR Protocol

Fig.3 shows the network topology for both AODV and DSR its route discovery and data transmission.

5. RESULT AND ANALYSIS

This is all the data for the fifteen random situations for the above-mentioned network topology from NS2. From Table.1 it can be observed that every parameter varies according to the movement of the node.

Table.2 Parameter Table for AODV protocol in ten random movements of nodes.

Simulation_Number	No of Packets_Sent	No_of Packets_Received	Packet_Delivery_Ratio	Delay	Throughput	Packet_Dropping_Ratio
1	463	459	99.14	0.01	21.73	0.86
2	450	450	100	0.01	21.31	0
3	455	450	98.9	0.01	21.3	1.1
4	451	444	98.45	0.02	21	1.55
5	454	454	100	0.01	21.5	0
6	451	447	98.11	0.01	21.16	0.89
7	451	449	99.56	0.04	21.28	0.44
8	444	357	80.41	0.02	16.9	19.59
9	448	437	97.33	0.02	20.7	2.67
10	451	447	98.11	0.02	21.15	0.89
Average	451.9	439.4	97.201	0.017	20.803	2.799

Table.3 Parameter Table for DSR protocol in ten random movements of nodes.

Simulation_Number	No_of_Packets_Sent	No_of Packets_Received	Packet_Delivery_Ratio	Delay	Throughput	Packet_Dropping_Ratio
1	454	454	100	0.01	20.68	0
2	46	45	97.83	0.01	20.62	2.17
3	81	80	98.77	0.02	20.19	1.23
4	444	444	100	0.01	20.23	0
5	180	179	99.44	0.01	20.23	0.56
6	14	13	92.86	0.01	21.52	7.14
7	123	122	99.19	0.01	20.57	0.81
8	9	9	100	0.03	22.9	0
9	1	1	100	0	21.2	0
10	97	96	98.97	0.01	20.58	1.03
Average	144.9	144.3	98.706	0.002	18.752	1.294

Graph.2 No. of packets received.
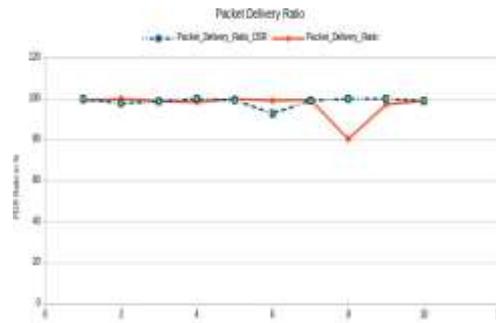
Graph.3 No. Packet Delivery Ratio
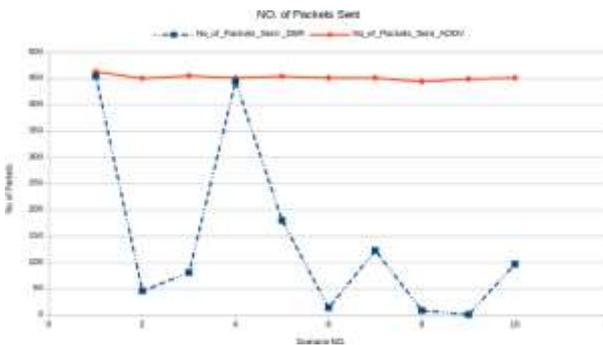
Graph.1 No. of packets sent from source to receiver node.
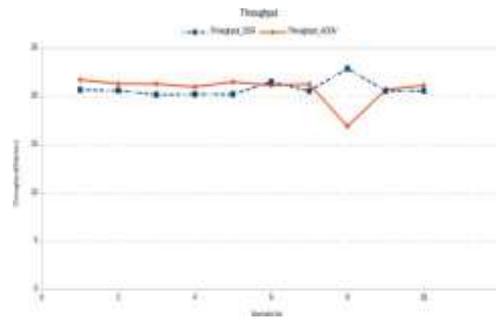
Graph.4. End to End Delay

For understanding Performance with respect to packet delivery ratio, we should concentrate on the Graph.1, Graph.2, and Graph.3. Graph.1 represents the no. of data packets sent in both AODV and DSR protocols, the same way Graph.2 represents no. of data packets received. Both these graphs suggest the requirements of data packets by each protocol to send particular information. But actual performance can be evaluated from Graph.3 which represents the Packet Delivery ratio for both AODV and DSR. In addition to this graph Table 2 and Table.3 also suggest the same result. And it can be easily observed from Graph.3 that AODV provides a relatively constant and good packet delivery ratio.
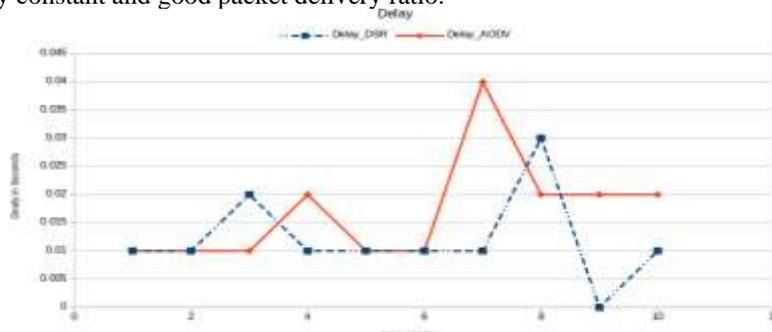

Graph.5 Throughput

Graph.4 is for End to End delay for both AODV and DSR protocol and Packet end-to-end delay for

DSR is larger than AODV. This is due to the fact that in the case of congestion or routing overhead, control messages get lost and so decreasing its advantage of fast establishing new routes with DSR routing. Increasing the number of nodes causes to decrease in the delay of DSR. Clearly, large multiple routes to the destination node are increased in high density and low mobility nodes, and also it causes a decreasing route discovery time to the destination. In addition, the route discovery time for AODV is decreased. This is due to the large number route request messages forwarded to the destination node with routing information for the newest routes to it, during its route discovering process. However, AODV still performs better than DSR.

Graph.5 represents throughput which is average no bits transferred per second, and it is clearly suggested that even the results form AODV and DSR are fairly comparable with each other, AODV performs better.
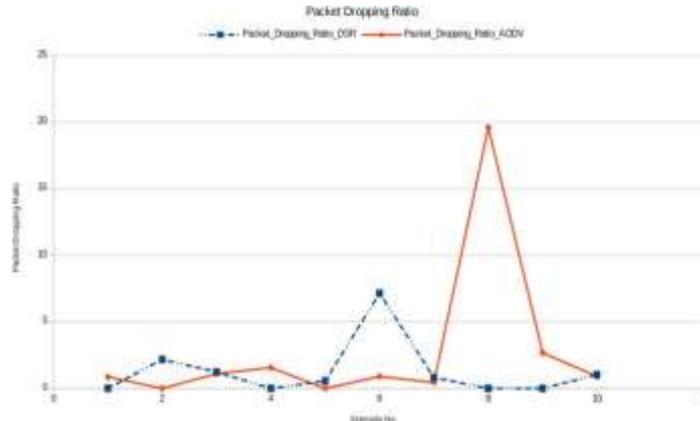
Graph.6 Packet Dropping Ratio

Packet dropping ratio is evaluation of data loss when a protocol drops a data packet and it is an undesirable parameter hence less the packet dropping ratio, better is the performance. Expect some scenarios excluded, AODV performs better in most of the scenarios.

6. CONCLUSION

Above we discussed two reactive (on-demand) routing protocols in ad-hoc communication. We also found out results in form of performance parameters for each protocol and compared them with each other to evaluate them on the basis of these performance parameters. Simulation results also showed that AODV reactive routing protocol is the best suited for MANET networks compared with DSR. But, DSR has multiple routes, during its route discovering process increasing the number of nodes make DSR identifies many routes to the destination node in which these routes are increased in high density and low mobility nodes. It causes a decrease in route discovery time for the destination and makes DSR better. But, AODV is slightly better compared with DSR. This is because AODV uses the newest route to the destination compared with DSR. In lower-mobility scenarios, the performance of DSR is better than AODV as the route is always found quickly in cache avoiding the route discovery process. In the presence of high mobility, frequent link failures can happen. And these frequent link failures cause new route discoveries in AODV since it has at most one route per destination in its routing table. Thus, the frequency of route discoveries in AODV is directly proportional to the number of link failures. In opposite to that, the reaction of DSR to link failures in comparison is mild and causes route discovery less often. DSR has an abundance of cached routes at each node. Hence route discovery is delayed in DSR until all cached routes fail. But with higher mobility, the chances of the caches being stale are quite high in DSR. Eventually, when a route discovery is triggered, the very large number of replies are received as a response which is associated with high MAC overhead and causes increased interference to data traffic in the network. Hence, high MAC overhead and cache staleness together cause significant degradation in performance for DSR in high mobility scenarios. From our discussion, we can observe that both of the protocols are designed by keeping in the mind a particular scenario, in some cases DSR will be best suited and in some cases AODV. We need to consider all the possible scenarios to select the perfect protocol suitable for our application

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