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# A Comparison and Performance Evaluation of On-Demand Routing Protocols for Mobile Ad-hoc Networks

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***Abstract-*** Mobile Ad-Hoc network is a collection of mobile nodes that form a network without any fixed infrastructure. Each mobile node will act as a host or router to forward the packets to other nodes. an ad-hoc network performance it is necessary to develop and use mobility models that accurately represent movements of the mobile nodes. In this paper we compared various On-demand routing protocols such as Ad hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR). Simulation is universally considered the most effective method of evaluating the routing protocols. NS-2 simulation capabilities, the key performance indicators of the routing protocols have been analyzed such as routing overhead generation, data delivery and delay.

***Keywords:-*** *MANET, AODV, DSR, NS2*

## INTRODUCTION

Mobile ad hoc network (MANET) is a collection of mobile hosts without the required intervention of any existing infrastructure or centralized access point such as a base station. Mobile Ad-hoc networks are self-organizing and self-configuring multi-hop wireless networks where, the structure of the network changes dynamically. This is mainly due to the mobility of the nodes. Nodes in these networks utilize the same random access wireless channel, cooperating in a friendly manner to engaging themselves in multihop forwarding. The node in the network not only acts as hosts but also as routers that route data to/from other nodes in network [1]. The main limitation of ad-hoc systems is the Availability of power. In addition to running the onboard electronics, power consumption is governed by the number of processes and overheads required to maintain connectivity. These protocols are also called reactive protocols since they don't maintain routing information or routing activity at the network nodes if there is no communication. If a node wants to send a packet to another node then this protocol searches for the route in an on-demand manner and establishes the connection in order to transmit and receive the packet . The route discovery usually occurs by flooding the route request packets throughout the network.

### On Demand Routing Protocols (Reactive)

On-demand routing protocols were designed to reduce the overheads in proactive protocols by maintaining information for active routes only. This means that routes are determined and maintained for nodes that require sending data to a particular destination. Route discovery usually occurs by flooding a route request packets through the network. When a node with a route to the destination (or the destination itself) is reached a route reply is sent back to the source node using link reversal if the route request has traveled through bidirectional links or by piggy-backing the route in a route reply packet via flooding. Reactive protocols can be classified into two categories: source routing and hop-by-hop routing. In source routed on-demand protocols, each data packets carry the complete source to destination address. Therefore, each intermediate node forwards these packets according to the information kept in the header of each packet. This means that the intermediate nodes do not need to maintain up-to-date routing information for each active route in order to forward the packet towards the destination. Furthermore, nodes do not need to maintain neighbor connectivity through periodic beaconing messages. The major drawback with source routing protocols is that in large networks they do not perform well. This is due to two main reasons; firstly as the number of intermediate nodes in each route grows, then so does the probability of route failure. The advantage of this strategy is that routes are adaptable to the dynamically changing environment of MANETs, since each node can update its routing table when they receiver fresher topology information and hence forward the data packets over fresher and better routes. Under this category Dynamic Source Routing (DSR) protocol requires each packet to carry the full address (every hop in the route), from source to the destination. Ad hoc On demand Distance Vector (AODV) routing protocol is based on DSR algorithm.

### 1.Ad-Hoc on demand distance vector routing protocol

AODV (Perkins and Royer 1999) is an improvement of DSDV, because it minimizes the number of broadcasts by creating routes on demand basis[1]. In simulations (Larsson and Hedman 1998), AODV has a very good performance in mobile networks. Link breakage detection is performed using lower layers such as MAC to detect transmission errors. This protocol can be used in small, medium and large scale networks. The disadvantage of this protocol is its supports only for symmetric links.

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### *1.1Characteristics of AODV*

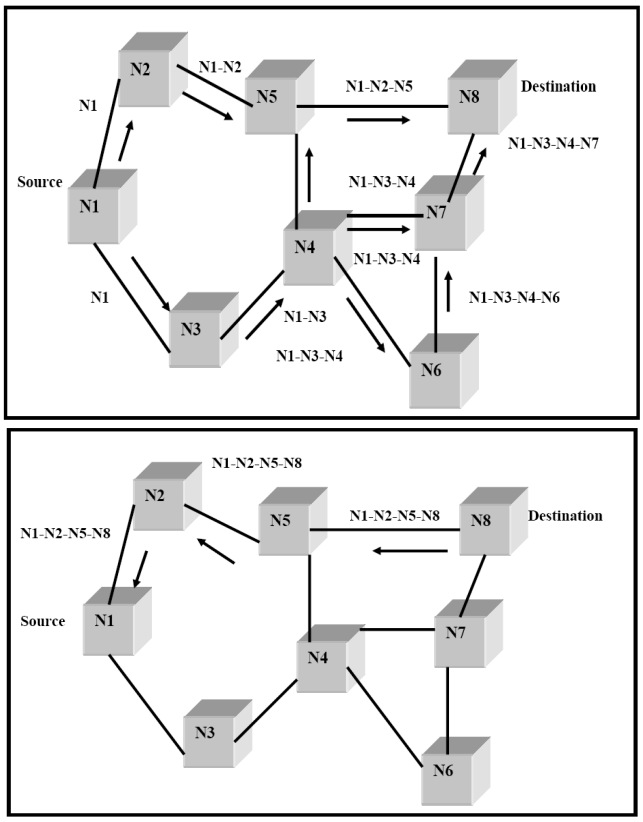
- Unicast, Broadcast, and Multicast communication.
- On-demand route establishment with small delay.
- Multicast trees connecting group members maintained for lifetime of multicast group.
- Link breakages in active routes efficiently repaired.
- All routes are loop-free through use of sequence numbers.
- Use of Sequence numbers to track accuracy of information.
- Only keeps track of next hop for a route instead of the entire route.
- Use of periodic HELLO messages to track neighbors.

### *1.2 Advantages and Disadvantages*

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[20]. 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.

## 2. Dynamic source Routing Protocol (DSR)

DSR is an On-demand (Reactive) routing protocol. It is source initiated i.e. whenever a node wants to communicate with another node it looks up into its cache to determine the route towards destination if it exists, and then it is used to send the packet[2]. DSR (Broch et al 1998) is an on demand routing protocol based on the concept of source routing. Mobile nodes maintain route caches that contain the source routes that the mobile is aware of. Entries in route caches are continually updated as new routes are learned[19]. DSR is intended for networks where the mobiles move at moderate speed with respect to packet transmission latency. Simulation results show a good behaviour in highly mobile networks as well as in static networks. In large networks there is a source overhead as a packet grows. It is similar to AODV in that it forms a route on-demand when a transmitting computer requests one. Except that each intermediate node that broadcasts a route request packet adds its own address identifier to a list carried in the packet. The destination node generates a route reply message that includes the list of addresses received in the route request and transmits it back along this path to the source. Route maintenance in DSR is accomplished through the confirmations that nodes generate when they can verify that the next node successfully received a packet. These confirmations can be link-layer acknowledgements, passive acknowledgements or network-layer acknowledgements specified by the DSR protocol. However, it uses source routing instead of relying on the routing table at each intermediate device. When a node is not able to verify the successful reception of a packet it tries to retransmit it. When a finite number of retransmissions fail, the node generates a route error message that specifies the problematic link, transmitting it to the source node. When a node requires a route to a destination, which it doesn't have in its route cache, it broadcasts a *Route Request (RREQ)* message, which is flooded throughout the network. The first RREQ message is a broadcast query on neighbors without flooding.




Creation of route record in DSR – Building DSR - Propagation of the route reply with the of the route record during route discovery route record

### *2.1. Advantages and Disadvantages*

DSR 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. The disadvantage of DSR is that the route maintenance mechanism does not locally repair a broken down 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.

**Simulation and Analysis method**

The simulations were performed using Network Simulator (Ns-2), which is popularly used for ad hoc networking community. The routing protocols were compared based on the following 3 performance metric[18]s:

**Packet Delivery Fraction (PDF):** The ratio of Data packets delivered to those generated by the sources.

End to End delay: the delay in delivering a packet to the destination which is inclusive of all kinds of delay.

**Routing Load:** This is the routing packets sent per delivered packet at the destination.

### 1.2 SIMULATION ENVIRONMENT

To evaluate and compare the performance of these routing protocols in Mobile Ad hoc network, we performed extensive simulations using NS-2 simulator [10]-[13]. Each simulator is carried out under the constant mobility.

**THE SIMULATION PARAMETER**

| **S** Experiment Parameter | Experiment Value | Description |
|---|---|---|
| Simulation Time | 200 S | Simulation Duration |
| Terrain Dimension | 1000*1000 m | X,Y Dimension of Motion |
| No. of Mobile Nodes | 100 | No. of nodes in a network |
| Node Placement | Random waypoint | Change Direction Randomly |
| Mobility Speed | 0-50 mps | Mobility of Nodes |
| Mobility Model | Random | Mobility Direction |
| Routing Protocols | DSR, AODV | Path-finding |
| MAC protocol | 802.11g | Wireless |
| Traffic | VBR | |
| Traffic rate | 25 pkt/sec | |
| Packet Send rate | 256kb | |
| Packet Size | 1 kb | |
| Pause Time | 100 sec | |

***Performance Metrics Packet received***: It is the number of packets received by the application layer of destination nodes.

***Throughput***: It is the average at which data packet is delivered successfully from one node to another over a communication network. It is usually measured in bits per second. Throughput = (no of delivered packets * packet size) / total duration of simulation

***Routing Overhead*** : This is the total number of routing control packets generated by all nodes to the total data packets during the simulation time.

***Network Load :*** It is the total traffic received by the network layer from the higher MAC that is accepted and queued for transmission. It is measured as bits per second

### 1.3 Simulation Results and Performance Comparison

Performance of AODV and DSR routing protocols is evaluated under Variable Bit Rate multimedia traffic[13].

1) ***Packet Received*** In the reactive protocols, AODV and DSR, AODV outperforms the DSR in terms of number of packets received by all destination nodes[18].

2)

| DSR | AODV |
|---|---|
| 4569 | 45183 |

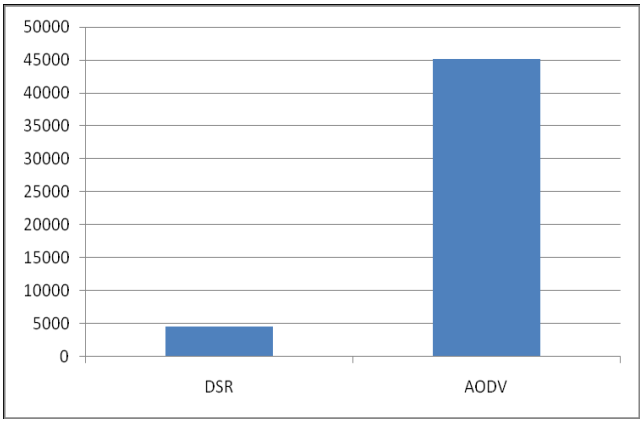



Figure 1: Number of Packet Received of AODV and DSR for 100 nodes

From the above figure, we have seen that the number of packets received in AODV protocol is very high than the number of packets received in DSR protocol for 100 nodes.

***2) Throughput*** Throughput is better for AODV protocol than DSR protocol.

| DSR | AODV |
|---|---|
| 103.85 | 262.59 |

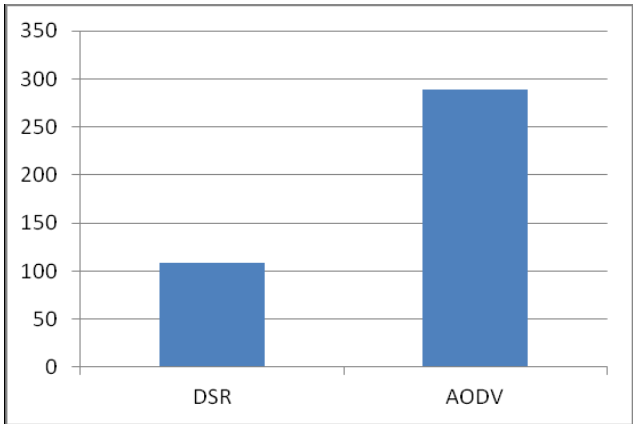



Figure 2: Throughput of AODV and DSR for 100 nodes

From above figure, it is observed that the AODV protocol outperforms the DSR protocol in terms of throughput when the number of nodes is 100.

***3) Routing Overhead*** Routing Overhead is higher in case of AODV than DSR.

| DSR | AODV |
|---|---|
| 37139 | 45285 |

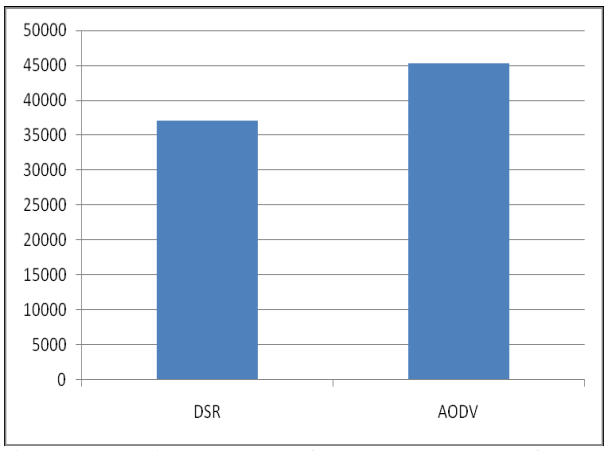



Figure 3: Routing Overhead for AODV and DSR for 100 nodes

It is observed from the figure above; in which AODV present the worse behavior in terms of routing overhead measurements than DSR for VBR traffic[14].

***4) Network Load*** Network Load is very high for DSR protocol than AODV protocol.

| DSR | AODV |
|---|---|
| 8.12 | 1.0 |

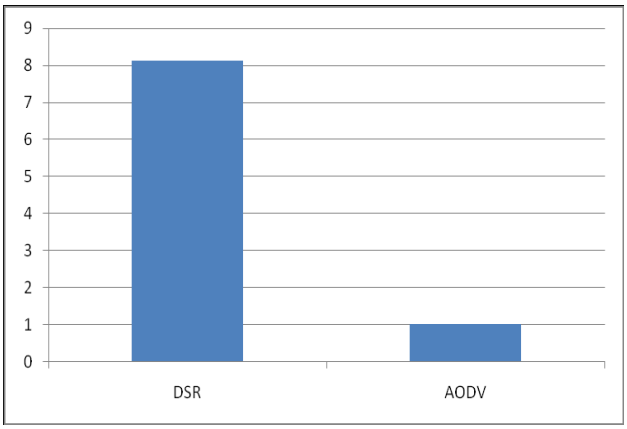



Figure 4: Network Load for AODV and DSR for 100 nodes

As shown in the above figure that DSR has higher Network Load than AODV. With the increase in hops the network overloads.

## CONCLUSION

In this paper we evaluated two On demand routing protocols AODV and DSR. Here presented performance of AODV and DSR in two aspects, reliability and efficiency of protocols. Various simulation results performed on the analysis of various on-demand routing protocols shows, for low to moderate loads. On demand Routing protocols are more effective in high traffic diversity as well as high mobility. Average end to end delay, the performance of DSR and AODV are almost uniform. In terms of Packet Delivery Traction (PDF), DSR performs well when the number of nodes is less as the nodes increase performance declines. The performance of AODV is consistently uniform. PDF changes rapidly when number of nodes increases. In terms of throughput, DSR remains consistent. AODV toggle with respect to increase in number of nodes. In terms of Normalized Routing Load, AODV performs well even the nodes are increased in comparison with DSDV and DSR.

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