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PERFORMANCE ANALYSIS OF REACTIVE ROUTING PROTOCL (AODV) AND PROACTIVE ROUTING PROTOCOL (DSDV) IN MANET

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ABSTRACT

AMNET stands for Mobile ad hoc network. It is an infrastructure-less network which means it has the ability to configure by themselves. It dynamically changes the network topology. It consists of wireless mobile nodes which can communicate each other without any central admin. In MANET different types of routing protocols are there namely reactive routing protocol, proactive routing protocol and hybrid routing protocol. This paper compares the performance of two routing protocols for MANET– the Destination Sequenced Distance Vector (DSDV), the table- driven protocol and the Ad hoc On Demand Distance Vector routing (AODV), an On – Demand protocol. These protocols are compared in terms of Throughput, Average End-to-End Delay, Routing Overhead, packet delivery ratio, energy consumption and Packet drop ratio. The performance of AODV is better than DSDV in terms of throughput, packet delivery ratio and routing overhead with less energy consumption. As the DSDV is a proactive routing protocol, it is having a less end to end delay as compare to AODV.

Keywords—AODV, DSDV, End To End Delay, Energy Consumption, MANET, Packet Delivery Ratio, Packet Drop ratio, Routing Overhead, Throughput.

I.INTRODUCTION

A Mobile Ad hoc Network (MANET) is a kind of wireless ad-hoc network, and is a self-configuring network of mobile routers connected by wireless links – the combination of which forms a random topology. The routers are free to move randomly and organize themselves erratically; thus, the network topology may change rapidly and unpredictably. Such a network may operate in a separate fashion, or may be connected to the larger Internet.

Issues in MANETs: If a network consist of only two nodes that want to communicate with one other and are located very close in the network, then no such routing protocols or routing decisions are necessary. Vice versa, if there are a number of mobile hosts wishing to communicate, then the routing protocols come into engage in recreation because in this case, some critical decisions have to be made such as which is the most favourable route from the source to the destination which is very important because often, the mobile nodes operate on some kind of battery power. Thus it becomes necessary to transmit the data with the negligible delay so as to desecrate less power. There may also be some kind of compression involved which could be provided by the protocol so as to waste less bandwidth. Further, there is also a need of some type of encryption so as to protect the data from prying eyes. In addition to this, Quality of Service support is also needed so that the less packet drop can be obtained.

The other factors which need to be considered while choosing a protocol for MANETs are as follows:

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i. Multicasting: This is the skill to send packets to multiple nodes at once. This is alike to broadcasting except the fact that the broadcasting is done to all the nodes in the network. This is essential as it takes less time to transfer data to multiple nodes.

ii. Loop Free: A path taken by a packet never transmit data to the same intermediary node twice before it reaches at the destination. To improve the overall, we want the routing protocol to assure that the routes supplied are loop-free. This reduce any waste of bandwidth or CPU consumption.

iii. Multiple routes: If one route gets broken due to some failure in nodes, then the data could be sent through some another route. Thus the protocol should permit creating multiple routes.

iv. Distributed Operation: The protocol should be in a distributed manner. It should not be dependent on a central node.

v. Reactive: It means that the routes are revealed between a source and destination only when the need arises to send data. Some protocols are reactive while others are proactive which means that the route is discovered to various nodes without waiting for the need.

vi. Unidirectional Link Support: The radio surroundings can cause the arrangement of unidirectional links. Utilization of these links and also the bi-directional links improves the routing protocol performance.

vii. Power Conservation: The nodes in an ad-hoc network can be laptops and thin clients, such as note pad's that are very less in battery power and therefore use some kind of stand-by mode to save power. It is therefore important that the routing protocol has support for these sleep-modes [1] [2].

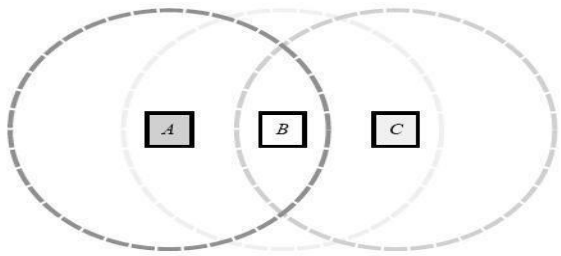

Fig 1: A Simple MANET

In figure 1, let's assume that node A wants to delivers data to node C but node C is not in the range of node A. Then in that case, node A may use the functions of node B to transmit data. Since node B is in range overlaps with both the node A and node C. Certainly, the routing problem in a real ad-hoc network may be more complex than this example suggest, due to the inbuilt non uniform propagation characteristics of wireless transmissions and due to the possibility that any or all of the hosts involved may move at any time [3]. One of the main problems in MANET (Mobile Ad hoc Network) is the routing problem, which is exasperated by frequent topology changes due to network partitions, node movement and radio intrusion. Many Routing protocols have been projected in past and reported in the fiction. The proactive approaches attempts to maintain routing information for each node in the network at all times, where as the reactive approaches only find new routes when required and other approaches make use of geographical location information for routing.

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II AD HOC ON DEMAND DISTANCE VECTOR (AODV)

Ad hoc On Demand Distance Vector Routing Protocol (AODV) is a reactive routing protocol designed for Ad hoc wireless network and it is skilled of both multicast routing as well as uni-cast [4]. The Route detection process in this protocol is done using control messages RouteRequest (RREQ) and RouteReply (RREP) every time when a node wishes to send packet to destination. Traditional routing tables are used for one entry per destination [5]. During a route discovery process, the source node broadcasts a RouteRequest (RREQ) packet to its near node. Figure 2 indicates the broadcast of RREQ across the network.

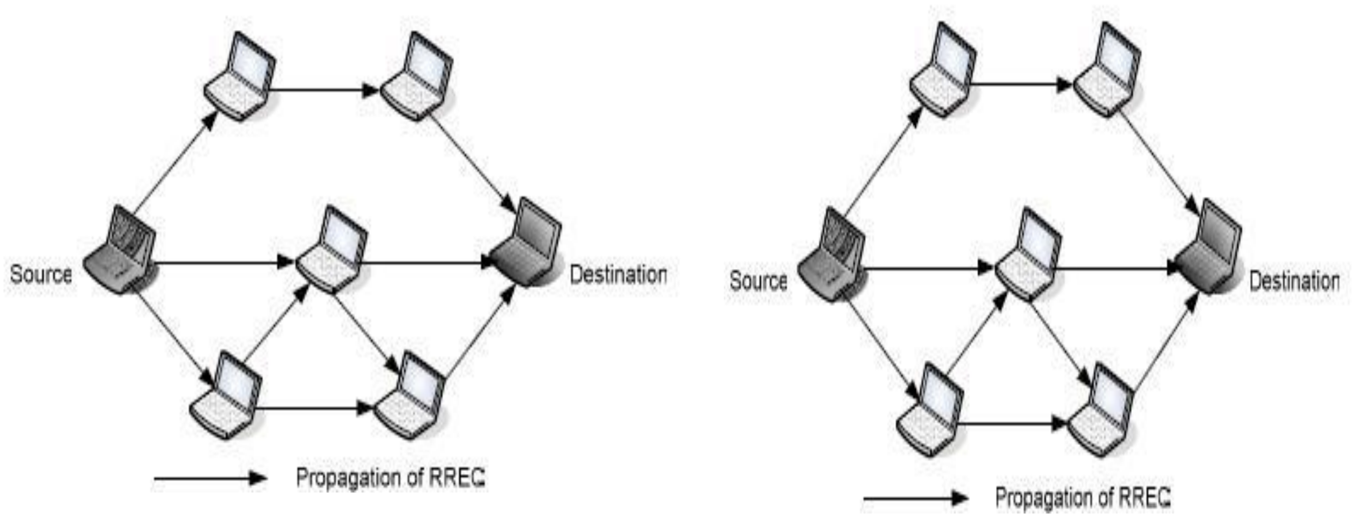

Fig 2: Propagation of RREQ Packet.

The control packet includes the last known sequence number for that destination. If any of the near nodes has a route to the destination node, it replies to the query with RREP packet. Otherwise, the neighbours again broadcast the RREQ packet. Ultimately, some of these query control packets arrive at the destination node, or nodes that have a route to the destination node. At this point, a reply packet is generated and then transmitted tracing back the route traversed by the query control packet. In the event, when a valid route is not found or the query or reply packets are lost, the source node again broadcasts the query packet if no reply is received by the source after a time-out.

To control network-wide broadcasts of RREQ packets, the source node use an expanding ring search technique. In this technique, source node starts searching the destination using some initial time to live (TTL) value. If no reply is received within the discovery period, TTL value incremented by an increment value. This process will continue until the threshold value is reached. When an intermediate node forwards the RREQ, it records the address of the neighbour node from which first packet of the broadcast is received, thereby establishing a reverse path. When the RREQ is received by a node that is either the destination node or an intermediate node with a fresh enough route to the destination, it replies by unicasting the route reply (RREP) towards the source node. As the RREP is routed back along the reverse path, intermediate nodes along this path set up forward path entries to the destination in its route table and when the RREP reaches the source node, a route from source to the destination established. Figure 3 indicates the path of the RREP from the destination node to the source node [6].

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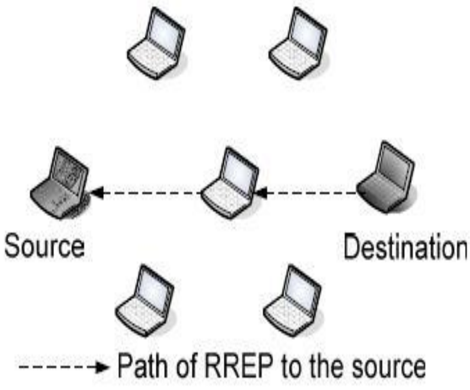

Fig 3: Route Reply through RREP Packet.

A route established between source and destination pair is maintained as long as needed by the source. If the source node moves during an active session, it can reinitiate route discovery to establish a new route to destination. However, if the destination or some intermediate node moves, the node upstream of the break remove the routing entry and send route error (RERR) message to the affected active upstream neighbour nodes. These nodes in turn propagate the RERR to their precursor nodes, and so on until the source node is reached. The affected source node may then choose to either stop sending data or reinitiate route discovery for that destination by sending out a new RREQ message.

III DESTINATION SEQUENCED DISTANCE VECTOR (DSDV)

Destination-Sequenced Distance-Vector Routing (DSDV) [4] is a proactive routing protocol designed for Ad hoc mobile networks based on the Bellman-Ford algorithm [7]. The improvement made to the Bellman-Ford algorithm includes freedom from loops in routing tables by using sequence numbers. In mobile Ad hoc network, using of DSDV protocol assumes that each participating node as a router. Every node always maintains a routing table that consists of all the possible destinations. Each entry of the routing table contains the address identifier of a destination, the shortest known distance metric to that destination measured in hop counts and the address identifier of the node that is the first hop on the shortest path to the destination [8]. Each mobile node in the system maintains a routing table in which all the possible destinations and the number of hops to them in the network are recorded. Each route or path to the destination associated with a sequence number [9]. The route with the highest sequence number is always used and this sequence number helps to identify the stale routes from the new ones and thus it avoids the formation of loops. To minimize the traffic there are two types of packets in the system. One is known as “full dump” [10], which carry all the information about a change. However, when occasional movement occurs in the network, “incremental” [10] packet are used, which carries just the changes and this increases the overall efficiency of the system. DSDV requires a regular update of its routing tables, which uses up battery power and a small amount of bandwidth even when there is no change in the network topology. Whenever the topology of the network changes, a new sequence number is necessary before the network re-converges; thus, DSDV is not scalable in Ad hoc networks, which have limited bandwidth and whose topologies are highly dynamic [11].

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IV SIMULATION ANALYSIS AND PERFORMANCE METRICS

Simulation based study using Network Simulator NS-2 [12] has been used to compare two protocols viz. AODV and DSDV under Throughput, Average End-to-End Delay, Routing Overhead, packet delivery ratio, packet drop ratio and energy consumption. Tables 1 and 2 summarize the parameters used in the communication and movement models for simulation. The simulator assumes constant bit rate (CBR) traffic with a transmission rate of 8 packets per second. Six performance metrics has been measured for the protocols:

1. THROUGHPUT: Throughput is the number of packet that is passing through the channel in a particular unit of time [13]. This performance metric shows the total number of packets that have been successfully delivered from source node to destination node. Factors that affect throughput include frequent topology changes, unreliable communication, limited bandwidth and limited energy. In figure 4 the throughput of AODV is between 0.006536- 0.006668 and the throughput of DSDV is between 0.005311-0.006118. As throughput depends on time and as DSDV is the table driven protocol, it requires extra time to set up routing tables before delivering packets to the next node. Its throughput becomes less than that of AODV. Hence, throughput of AODV is better than DSDV.

$$Throughput = \frac{received\ packet\ size}{time\ to\ send}$$

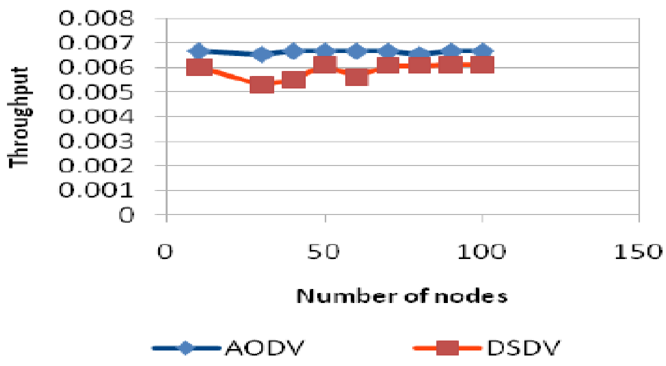

Fig 4. Throughput of AODV and DSDV

2. AVERAGE END-TO-END DELAY: A specific packet is transmitting from source to destination node and calculates the difference between send times and received times. This metric describes the packet delivery time. Delays due to route discovery, queuing, propagation and transfer time are included metric [14]. In Figure 5 End to end delay of DSDV is less than AODV. End to end delay of AODV is between 0.011701-0.044079 and end to end delay of DSDV is between 0.01068-0.012614.DSDV keep routing tables to deliver packets, and hence it sets up the new routes when there is a change in the network topology. On the other hand, AODV is the on-demand protocols, and it has to initiate the routing discovery mechanism whenever a new route is to be established.

$$Average\ end\ to\ end\ delay = \left(\sum_{1}^{n}(CBR\ sent\ time - CBR\ recv\ time)\right) / \sum_{1}^{n}(CBR\ recv)$$

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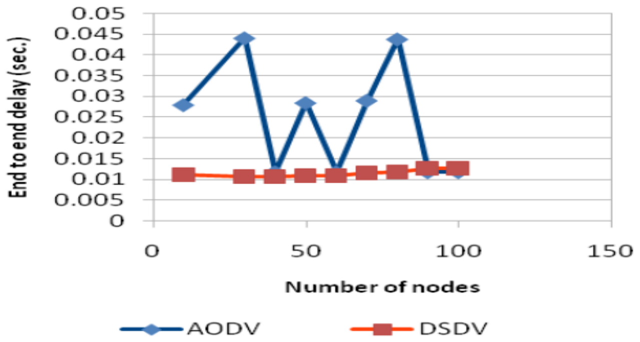

Fig 5. Average end to end delay

3. ROUTING OVERHEAD: Routing Overhead is the ratio of total number of routing packet received and total number of data packets received [7]. AODV delivers required packets on demand of communication between the nodes. And hence it reduces the network pressure caused by the heavy overload. DSDV is more likely to cause the heavy overload and congestion problems. Routing Overhead of AODV is between 0.000536 - 0.007216 and that of is DSDV is between 0.004697-0.068614 as it increases with number of nodes.

$$Routing\ overhead = \frac{number\ of\ routing\ pkts\ recvd}{number\ of\ data\ pkts\ recvd}$$

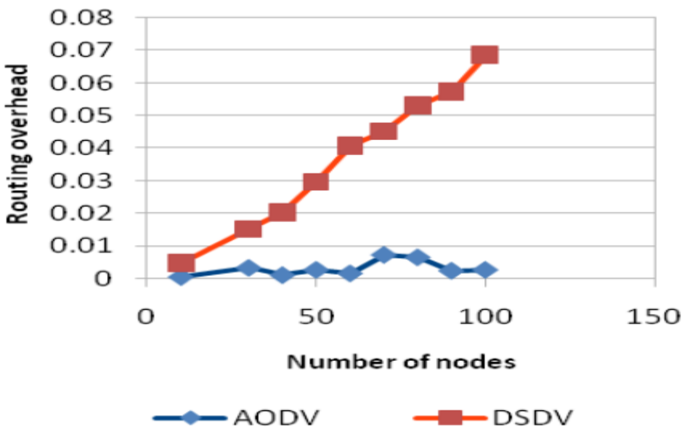

Fig 6. Routing overhead

4. PACKET DELIVERY RATIO (PDR): It is a ratio of number of packets received by destination to number of packet sent by sourc**e.** In Figure 7 the packet delivery ratio of AODV is between 0.980403-1.00. The packet delivery ratio of DSDV is between 0.79651-0.917584. Hence AODV is having better packet delivery ratio as compare to DSDV.

$$Packet\ delivery\ ratio\ = \frac{no.of\ pkts\ recvd}{no.of\ pkts\ send}$$

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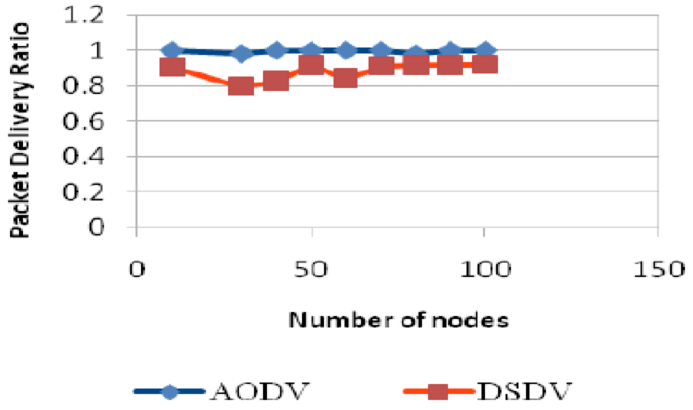

Fig 7. Packet delivery ratio

5. PACKET DROP: It occurs when one or more packets of data travelling across a computer network fail to reach their destination. Packet drop is typically caused by network congestion. Packet drop is measured as a no. Of packets drop with respect to packets sent. In Figure 8 it shows AODV Packet loss is less because AODV uses route request route reply techniques for searching a route b/w source & destination. While in DSDV is a table driven protocol. When the N/W Load increased it is very difficult to maintain routing table. So some time routing tables are not updated continuously so the packet loss increased.

$$\textit{Packet drop ratio} = \frac{\textit{no. of pkts lost}}{\textit{no. of pkts recvd}}$$

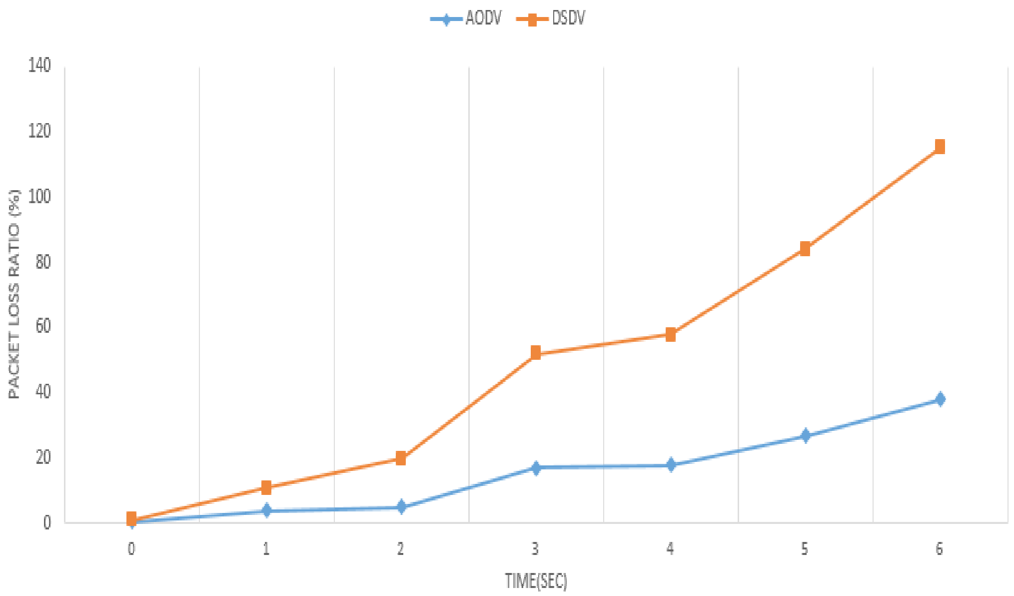

Fig 8. Packet drop for AODV and DSDV protocol

6. Energy Consumption: Energy consumption can be can be calculated as follows:

ENERGY CALCULATION ON EACH AODV

It is a reactive routing protocol which establishes a route to a destination only after getting request from the source or whenever it is needed that is, on demand. In disparity, the most communal routing protocols of the Internet are proactive; they find routing paths autonomously of the usage of the paths. AODV is a distance-vector routing protocol. AODV evades the counting-to-infinity problem. AODV is accomplished of both unicast

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and multicast routing. In AODV, the network is hushed until a connection is needed. At that fact the network node that requires a connection broadcasts a request for connection. Other AODV nodes forward this message, and top the node that they perceived it from, making an burst of impermanent routes back to the destitute node. When a node collects such a message and already has a route to the desired node, it sends a message rearward through an impermanent route to the requesting node. The destitute node then initiates consuming the route that has the smallest number of hops over other nodes. Idle entries in the routing tables are cast-off later a time. Routing error message will be passed backward to the transmitted node in case of any link failures and again the same process will be repeated. Moreover, the main complexity is falls on the number of messages communicated to preserve the capacity of the network. The advantage of AODV is that it produces no additional traffic for communication along existing links. Also, it never requires any memory and calculation because of its simplicity. However AODV needs further time to begin a connection, and the primary communication to establish a route is heftier than some other methods. Based upon the formula's we are calculating the energy consumed on each node.

Residual Energy=Total Energy-energy consumed

Total energy consumed (i^{th} node) =energy consumed (i^{th} node)

ENERGY CALCULATION ON EACH DSDV

It **is** a table-driven routing scheme for ad hoc mobile networks. The key influence of the algorithm is to resolve the routing loop problem. Each entry in the routing table comprises a sequence number, the sequence numbers are usually level if a link is present; otherwise an odd number is used. The number is created by the destination, and the emitter requires sending out the succeeding apprise with this number. Routing information is dispersed among nodes by sending full dumps rarely and lighter incremental apprises more regularly.If a router accepts new information, then it uses the latest sequence number. If the sequence number is the same as the one previously in the table, the route with the improved metric is used. Stale entries are those entries that have not been rationalized for a while. Such entries as well as the routes expending those nodes as next hops are deleted. Even though network is idle it requires a continuous update of its routing table which consumes battery power and little amount of bandwidth. A new sequence number is needed whenever the topology of the network changes that too before the network re-converse. Thus, DSDV is not proper for highly dynamic networks. Based upon the formula's we are calculating the energy consumed on each node. In Figure 9 it shows that that energy consumption of AODV protocol is higher than DSDV protocol.

Residual Energy=Total Energy-energy consumed

Total energy consumed (i^{th} node) = energy consumed (i^{th} node)

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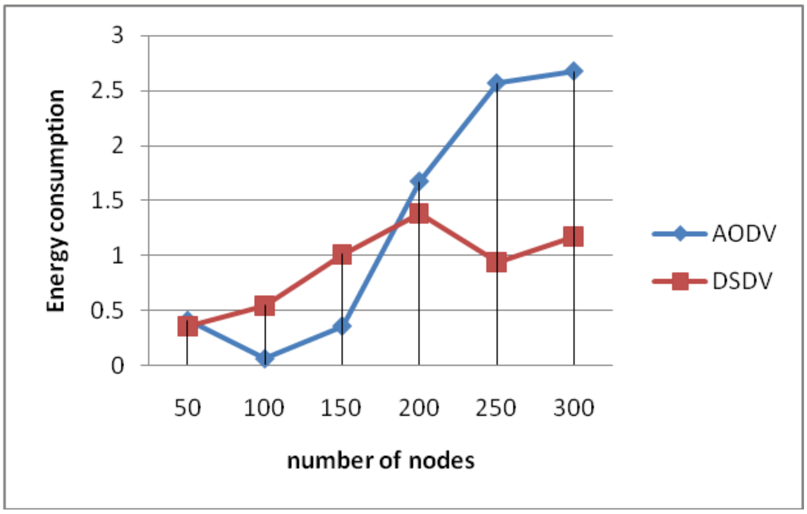

Fig 9. Energy consumption

V CONCLUSION

This paper discusses the taxonomies of routing protocols in MANETs. The routing protocols are categorized into 3 different categories: 1. proactive, 2. reactive, and 3. hybrid protocols. Each protocol has different characteristics. We have obtained the comparison between AODV and DSDV protocol, analysis and simulation is done using NS2 environment. The simulation results show that AODV outstanding performance than DSDV in terms of end-to-end delay, packet loss ratio and throughput over number of transmitted packets. When the number of nodes increases, throughput for both reactive and proactive protocol increases as throughput is related to packet drop. Similarly, when the number of nodes in the network increases the delay also increases. DSDV shows less delay than AODV. Also packet delivery ratio and energy consumption of AODV is high and routing overhead is less than DSDV. Overall, AODV showcases better performance but the performance of AODV decreases as we start increasing the number of nodes. Hence size of the network determines the best routing protocol.

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