International Journal of Academic Research and Development
ISSN: 2455-4197; Impact Factor: RJIF 5.22
Received: 28-10-2020; Accepted: 13-11-2020; Published: 30-11-2020
www.academicjournal.in
Volume 5; Issue 6; 2020; Page No. 98-100

Comparison of AODV and DSR Protocols for different number of nodes in MANET

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Abstract
Mobile Ad Hoc Networks (MANETs) are a collection of network nodes that work independently. MANETs are used in diverse applications like conferences, e-classrooms, military applications etc. Since the devices in MANETs act as host as well as router and are also used in critical applications, it becomes necessary that they are supported by efficient routing protocols. Efficient routing protocols also result in good Quality of Service (QoS) parameters. In this paper, two popular reactive routing protocols: Ad hoc On Demand Distance Vector (AODV) protocol and Dynamic Source Routing (DSR) protocol are analyzed for less and high density of nodes in MANETs. Their QoS parameters are evaluated and obtained results are analyzed as well as co. Simulation is done in MATLAB.

Keywords: MANETS, AODV, DSR, QOS

Introduction
MANETs are self-configuring network of mobile nodes without any pre-established or fixed architecture [1]. Here, network nodes act as routers and relay each other's packets. Nodes can either communicate through single hop or multihop path [2]. In single hop MANETs several nodes are connected. However, only those nodes that are in communication range of each other can send and receive packets from one another. As applications of MANETs diversified it became necessary that all nodes could communicate with one another. Hence, multihop MANETs came into use wherein two nodes can communicate via intermediate nodes. For proper communication between various nodes in MANET and for proper utilization of resources, it is required that MANETs have efficient routing protocols. MANET routing protocols can be classified as proactive, reactive and hybrid [3]. In proactive routing protocols, route information is maintained in the form of routing tables [4]. In constantly changing environment like MANETs, maintaining route information constantly is not possible. Also, saving information in the form of routing tables results in more bandwidth consumption which is not desirable in a resource constrained environment. Reactive or on-demand routing protocols are more popular in MANETs. These routing protocols establish routes as and when necessary. As routes are established on-demand it results in bandwidth as well as resource conservation. Ad hoc On Demand Distance Vector (AODV) and Dynamic Source Routing (DSR) are the two popular reactive routing protocols.
Hybrid routing protocols are a combination of proactive as well as reactive routing protocols. All the nodes that are within certain radius of each other use a table driven approach. For nodes outside this radius, routes are maintained on demand. However, for a constantly changing system it has been observed that reactive routing protocols provide best possible results.
In this paper, AODV and DSR protocols have been studied and their results have been evaluated for different values of node densities. The results of both AODV and DSR protocols are compared in terms of their QoS parameters. The paper is divided as follows: Section I is introduction, in section II AODV and DSR protocols are explained in detail. Section III describes the simulation setup and implementation details. In section IV results obtained are analyzed. Section V is conclusion of the paper.

AODV and DSR protocols
AODV Protocol
AODV is a reactive routing protocol wherein routes are created as and when necessary [5]. Here, when a node has to send data packets to a destination it broadcasts route request (RREQ) packets. Complete route information is obtained in terms of route reply (RREP) packets. During transmission of packets from destination to the source, all intermediate nodes are updated with the current routing information and current node positions. Apart from RREQ and RREP, AODV transmits route error message (RERR) in the network. RERR is transmitted when link between source to destination or if any intermediate node is broken.

DSR Protocol
DSR protocol uses the technique of route caching. In DSR, sender node knows the complete route to the destination as it is saved in the route cache. DSR consists of route discovery as well as route maintenance. Source node initially searches its route cache to find a route to the destination. Route cache saves multiple routes to the same destination. In case route is not available in the destination, then route discovery process is initiated.
During the route discovery process each node receives a RREQ and rebroadcasts it until either the destination node or route to the destination is found. RREP routes back to the initial or source node by routing itself backward. Similar to AODV, DSR too sends a RERR packet whenever it finds an intermediate link unusable.

Implementation
Fig. 1 shows a rectangular field area of size $100m \times 100m$ with a destination that is initially placed in

the centre. At the start of the data transmission all nodes including the destination node moves randomly. A system with 10 and 100 nodes has been considered. Node mobility being 20 m/sec. All the nodes are randomly placed in the field area and initial energy of a node is 0.5J. Total packets to be transmitted are 4000 and number of transmission rounds being 6000. System with 10 nodes is referred as a sparse MANET and system with 100 nodes is referred as a dense MANET.

Distances between all the nodes are calculated using distance vector calculation [6].

Average distance between the transmitting device and destination D_{bs}

$$D_{bs} = \text{(one dimension of field)}/\sqrt{2\pi k} \quad (k=1) \qquad (1)$$

$$D_{bs} = (0.765 \times \text{one dimension of field})/2 \qquad (2)$$

The calculated average energy E_a of a node after a particular round is given by

$$E_a = E_t \times \left(\frac{1-(r/R_{max})}{n}\right) \qquad (3)$$

R_{max} = Maximum number of Rounds

E_t = Total Energy

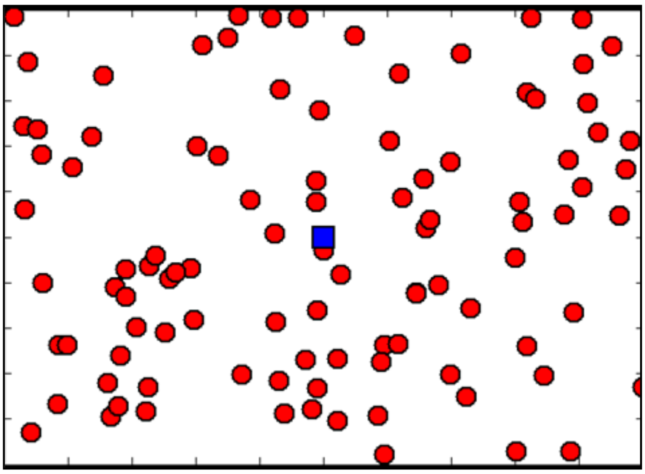

Fig 1: MANET Simulation Setup

Table 1: Network Specifications

Simulation Parameters	
Field Size	100mX100m
Number of Nodes	10, 100
Number of Packets	4000
Number of Rounds	6000
Speed of the nodes	20m/sec
Protocols	AODV, DSR

Simulation results

Simulations were performed in MATLAB, an open source package and QoS parameters were obtained in terms of throughput, end to end delay and packet delivery fraction.

Throughput

It is defined as the total number of data packets received by the destination over the total simulation time [7]. Fig. 2 shows throughput obtained for sparse MANETs. As seen from Fig. 2, throughput is maximum for AODV protocol, followed by DSR protocol. It is observed that after round 2000, throughput is 3965 bits transmitted for DSR protocol. In case of AODV protocol, throughput is 7459 bits transmitted after 2000 rounds. Fig.3 represents throughput obtained for dense MANETs. In this case too, throughput obtained is higher in case of AODV protocol with its value being 75700 bits after 2000 rounds. In case of DSR protocol, value of PDF obtained is 41930 bits after 2000 rounds.

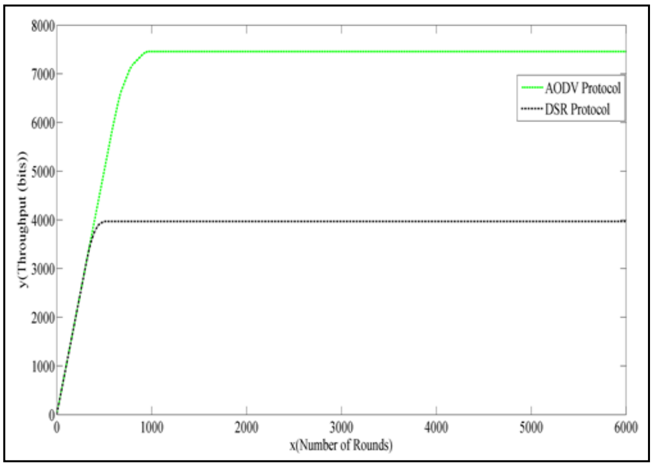

Fig 2: Throughput (Nodes 10)

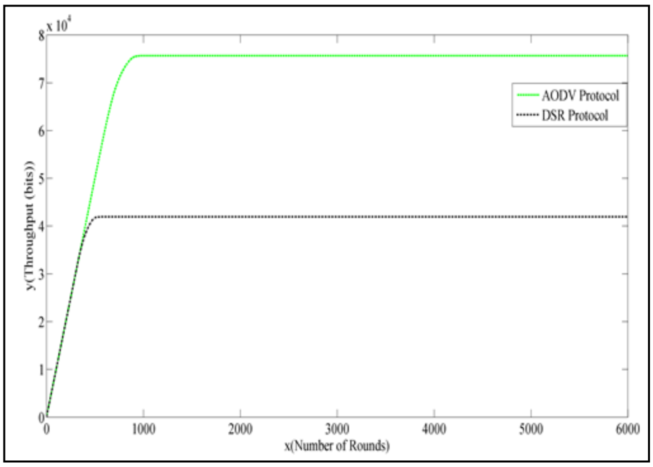

Fig 3: Throughput (Nodes 100)

PDF

Packet Delivery Fraction (PDF) defined as the ratio of the total number of data packets received by the destination to the total number of data packets transmitted.

$$\text{PDF} = \frac{\text{Data received by destination}}{\text{Data sent by transmitter}} \qquad (4)$$

Fig. 4 and Fig. 5 shows PDF obtained in case of sparse MANETs as well as dense MANETs respectively. For sparse MANETs, PDF obtained after 2000 rounds for DSR protocol is 0.1048. In case of AODV protocol, PDF is 0.1892 after 2000 rounds onwards. Similarly for dense MANETs too, the results obtained is better in case of AODV protocol.

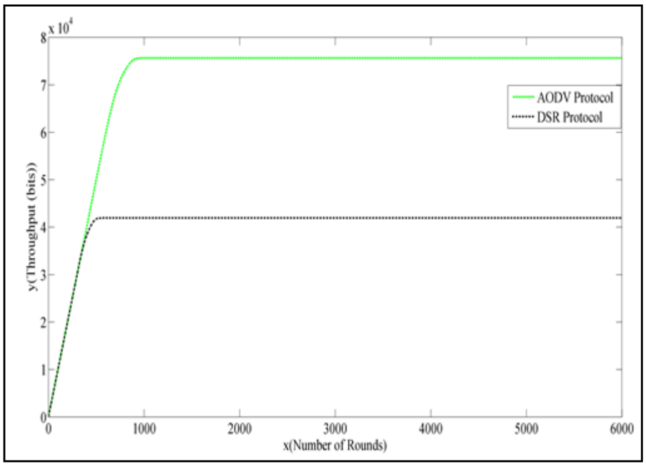

Fig 4: PDF (Nodes 10)

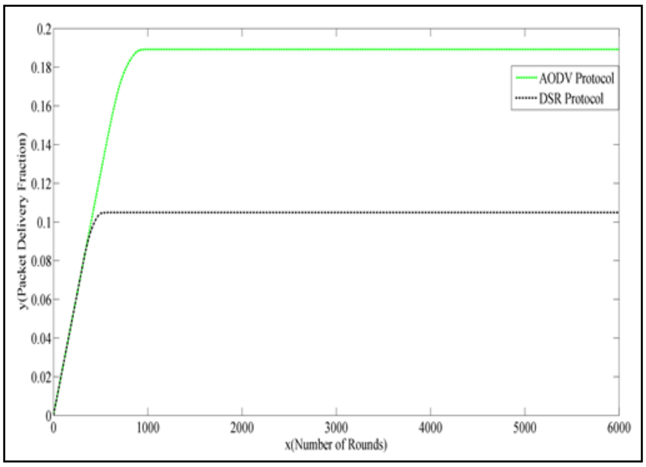

Fig 5: PDF (Nodes 10)

End to End delay

End to end delay is a measure of the number of rounds taken by the data packets to reach the destination. Fig. 6 and Fig. 7 shows end to end delay obtained in case of sparse as well as dense MANETs. In case of sparse MANET, after 2000 rounds delay is 0.02642 secs, after 4000 rounds it is 0.05284 secs and 0.07927 after 6000 rounds. For DSR protocol, end to end delay value after 2000 rounds is 0.0477 secs, 0.09539 secs after 4000 rounds and 0.1431 secs after 6000 rounds.

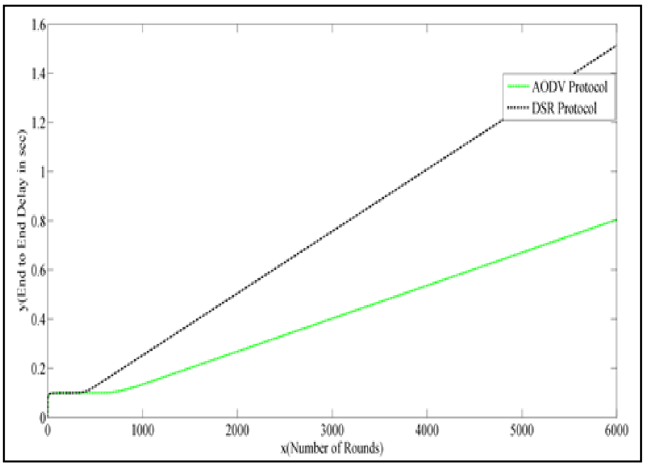

Fig 6: End to End Delay (Nodes 10)

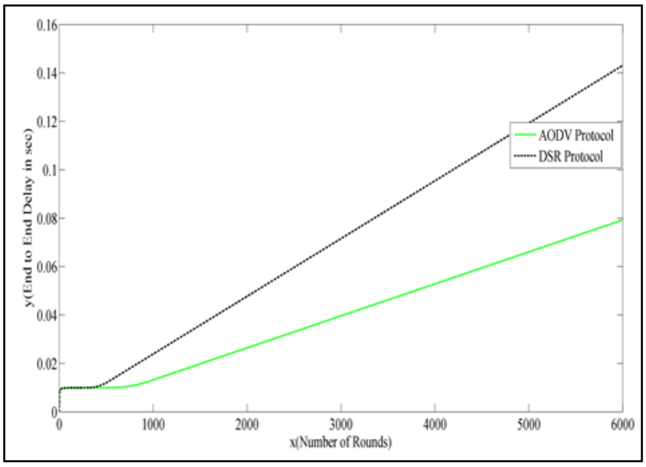

Fig 7: End to End Delay (Nodes 100)

Conclusion

In this paper AODV as well as DSR protocols have been simulated for different values of node densities. QoS parameters have been obtained in terms of throughput, packet delivery fraction as well as end to end delay. From the observed results it can be concluded that AODV protocol performs better than DSR protocol for MANETs with different ode densities.

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