

# A Comprehensive Performance Analysis of On-Demand Routing Protocol In Mobile Ad Hoc Network

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**Abstract-** A Mobile Ad Hoc Network (MANET) is an infrastructure less and autonomous systems comprising of mobile nodes that use wireless transmission for communes. MANET network can be setup or deployed in any field without central administration. Various routing protocols have been proposed to support the infrastructure less network in MANET. It is a complex task to find the most preponderant one routing protocol that is energy efficient. This is because of the reason that nowadays various mobility models are used in MANET. In this paper, primary focus to compare well known on demand routing protocols AODV, DSR and DYMO by using Qualnet simulator 5.0.2. In addition to this, scenario designed on the basis of Random Waypoint model with distinct parameters used for the performance evaluation such as average end to end delay, packet delivery ratio and throughput.

**Keywords-** Mobile Ad Hoc Network (MANET), Routing Protocols: AODV, DSR, DYMO

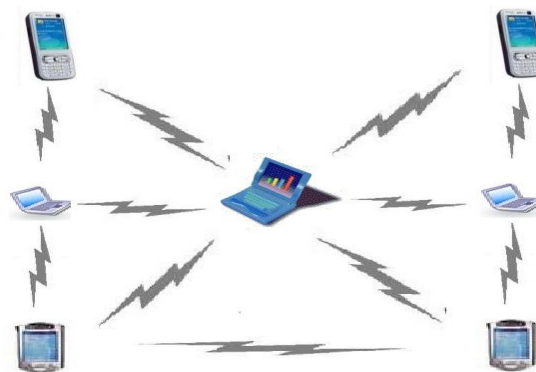
## I. INTRODUCTION

A Mobile Ad-hoc Network (MANET) is a temporary wireless network which consists of mobile nodes and does not require any base infrastructure[1]. In other words, collection of various mobile devices connected to each other via temporary connections is referred as MANET. Due to technological advances in the field of wireless communication, it is now possible to connect different types of devices like, mobile, laptop computer, etc. in MANET.

No one can outlay the fact that research on mobile ad hoc networking increase day by day because of their various fundamental characteristics such as power and transmission conditions, rapidly deployable, traffic distributions, self-configured and self-controlled infrastructure. Topology of the network in MANET changes very frequently due to the movement of devices. In addition to this, the devices connected in MANET work with limited batteries energy. In MANET routing is a convention which controls the routes of the data packets [2].

Furthermore, there is a big challenge in designing ad hoc networks for dynamic routing protocols, no central administration, network security, and restricted range of radio transmission.

The topology of an ad hoc network is very sensitive and transforms with each movement of nodes and nodes in the MANET circuit are characterized by limited memory, channel bandwidth and battery power. Many such protocols have been designed by researchers to provide mobility nodes and the dynamic topology of the network, while maintaining the performance of network. The main objective of these protocols is to discover a route after a link is broken due to movement of devices. To transfer data packets between mobile devices, there is a need for routing to find the best suitable path. Routing in mobile ad hoc network is a very challenging task due to mobility of the mobile devices [3].



**Figure 1: Mobile Ad hoc Network**

There are several factors that affected the performance of routing protocols in MANET but hardly affected factors are mobility model, node placement model, velocity and size of the network.

**TABLE1: Merits, demerits and applications of MANET**

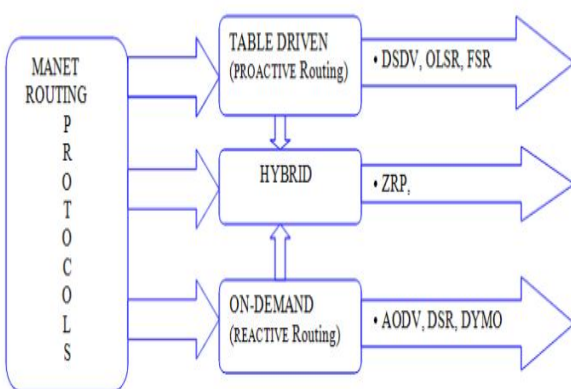
Sr no.	Merits	Demerits	Applications
1.	Autonomous terminals.	Lack of centralized management	Emergency services
2.	Dynamic topology	No pre-defined boundary	Commercial environment
3.	Light weight terminals	Energy consumption problem	Military Environment
4.	Rapidly deployable	Access point nodes	Civilian environment
5.	Self control infrastructure	Restricted range of radio transmission	Disaster Relief operations

In this paper, we have study the comprehensive performance analysis between reactive routing protocol named as AODV, DSR and DYMO over Random Waypoint Model. Simulation of the proposed experimental study is carried out on QualNet 5.02 simulator in order to identified the best efficient and reliable routing protocol between AODV, DSR and DYMO reactive protocols. Different scenario environment is made by using three performance metrics like average end to end delay, packet delivery ratio, and throughput.

The rest of the article is devised as follows. Section II contains classification of routing protocols while section III provides a brief explanation on reactive protocols. In section IV concerned with simulation environments and performance metrics. Section V contains results and discussions. In the last section VI, we conclude the entire paper.

**II. CLASSIFICATION OF ROUTING PROTOCOLS IN MANET**

The routing protocols used in MANET are broadly categorized as table driven, on-demand and hybrid [4]. As shown in figure 2 in which MANET routing protocols are broadly categorized.



**Figure :2 Types of Routing Protocols in MANET**

**Table Driven /Proactive Routing Protocols**

The proactive routing protocols constantly maintains routing information. In proactive routing protocol, routing is done with the help of having the complete hop by hop information. When any frequent change in topology, each node is updated in order to maintain the routing path in the network. [5]. Due to specified information already in routing table, increased the forwarding speed of data packets. Destination Sequenced Distance Vector (DSDV) and FISH EYE Routing (FSR), Optimized Link State Routing (OLSR), Protocol are well known proactive routing protocols.

**Hybrid Routing Protocols**

As it named clearly explained that it is a combination of different routing protocols which are known for the combination of proactive and on-demand routing protocol. Hybrid routing protocol defines a zone around nodes. Within that zone proactive routing is used, outside of it nodes use reactive routing. Zone routing protocol (ZRP) are well known hybrid routing protocol.

**On Demand Driven / Reactive Routing Protocols**

Reactive routing protocols are not having the prior routing information of the network. In this type of routing protocols, route discovery mechanism is used to make a connection between nodes for the communication of one node to another node. Furthermore, routes are available at a time when needed. Enormous type of reactive protocols is available but the most remarkable are the Ad-hoc on-demand Vector (AODV), Dynamic source Routing (DSR) and Dynamic Manet on demand (DYMO).

**III. BRIEF AODV, DSR AND DYMO OVERVIEW**

As we know in MANET, Routing protocols are of three types Proactive, hybrid and reactive. But in this work, we will take only on-demand routing protocols (AODV, DSR and DYMO) for the performance evaluation. Therefore, detail description of on demand routing protocols are given below.

**AODV (Ad-hoc on-demand Vector)**

AODV is a reactive protocol that includes the DSDV and DSR feature. AODV protocol uses an on-demand approach to search routes in a network [6].

The route discovery and route mechanism phases are the part of DSR and sequence number as well as the hop by hop routing taken from DSDV. This protocol takes less time in

the convergence and no loop is found. AODV is scalable and efficient algorithm for MANET.

It is on demand routing algorithm which find the route for the source node with the help of route discovery mechanism. RREQ, RREP AND RRERR are the control messages used in communication process.

In this mechanism, broadcasting the RREQ (Route request) packets to its neighbors until it reaches to the destination. RREQ packet contains the fields in which source and destination sequence number are included. Also, RERR (error message) are used whenever route breakage is detected in the network. Due to route discovery on demand the number of control packets which are exchanged between the mobile nodes is limited. In this routing protocol, the use of network bandwidth increases compared to proactive routing protocols. In this less control overhead is required to announce the link breakage as compared to DSR.

#### **DSR (Dynamic Source Routing)**

DSR is one of the routing protocol that store routing information in its cache. It is on-demand routing protocols in which source routes are determined by accumulating the address of every node between the originator an target during path discovery. Originator node firstly checks its cache to find out the path for target. If path is not found then source node broadcast the route request to reach the target node. After getting route request packet, target node sends reply on a backward path.

DSR is another reactive routing protocol that is primarily used for multi-hop communication in MANET. Two main mechanism that are used in DSR routing protocol that is route discovery and route maintenance. The route discovery process applies in that case where one host does not know the route to another device while route mechanism process is required only for those nodes that are active. DSR allows the packet to be forwarded from source to destination on the basis hop by hop process. Maintenance of routes is required only for those nodes which are active.

#### **DYMO (Dynamic MANET On-demand)**

DYMO is an on-demand, unicast and multi-host routing protocol. In another words, it can be concluded that it is a small memory that stores routing information and produced Control Packets when host receives the data packet from route path.

With the few modifications in DYMO routing protocol inherits AODV's route maintenance and discovery operations.

Dynamic MANET On demand source router generates RREQ (Route Request) and broadcast the messages throughout the whole network to come across a target destination host. Moreover, each intermediate node first receives RRREQ message after that stores the route address at the originator node. And target node finally sent the RREP (Route Reply) message towards the source host by unicast technique.

### **IV. SIMULATION ENVIRONMENT AND PERFORMANCE METRICS**

Qualnet 5.0.2 network simulator tool is used to evaluate the performance of on demand (AODV, DSR and DYMO) routing protocols of Mobile Ad hoc networks. At the physical layer IEEE 802.11b standard is used with a data rate of 2Mbps. In addition to this, Wireless Channel with Two Ray Ground radio propagation model is used for propagation, multi-path fading and path loss. Also, At the network layer, User Datagram protocol is used for the transportation of packets and transmission packets rate is 1 Mbps.

In this paper, we have design the scenario by varying the number of nodes, with the pause time of 60 sec and using random waypoint mobility model. Table 2 shows the simulation parameters.

**Table 2: Simulation Parameters**

Number of Nodes	100,150,200
Routing Protocols	AODV, DSR, DYMO
Mobility model	Random waypoint
Simulation area (meter square)	1500m X 1500m
Simulation time	120sec
Pause time	60 seconds
Mobility speed	0 to 20 m/s
Source data pattern	4 packets per sec
Battery model	Linear model
Radio type	802.11b
Antenna type	Omni direction
Simulator	QUALNET 5.0.2

#### **Performance Metrics**

To analyze the performance evaluation of three on-demand routing protocols, the following parameter metrics are used.

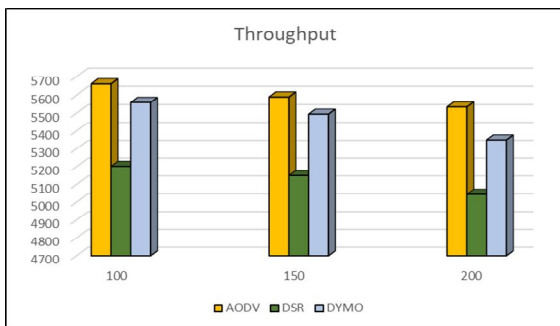
- **Throughput:** The ratio between total data packets received at destination node per unit time [7]
- **Average End-to-end Delay:** Average end to end delay can be defined as the ratio of total end to end delay to number of packets received at destination node.
- **Packet delivery ratio:** ratio of the number of packets successfully delivered by the source node to the destinations node.

**V. RESULTS AND DISCUSSIONS**

In this work, we have comparing the AODV, DSR and DYMO on the basis of changing the nodes, random waypoint mobility model is selected for a scenario having 100, 150, and 200 nodes using tertian dimension 1500\*1500, with the Pause time used is 60 second.

**Throughput**

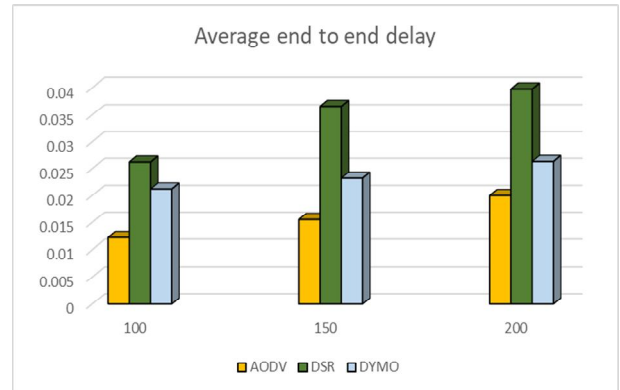
In figure3, throughput of 100,150 and 200mobile nodes are shown graphically. It is observed from the graph that AODV has highest throughput value than DYMO and DSR. As number of nodes increased, DSR performance starts to decline and shows worst performance than other remaining protocols. But the performance throughput of AODV and DYMO protocols slight decline is seen.



**Figure3: Throughput**

**Average end to end delay**

From figure4, it can easily observe from the graph that as the number of nodes increases from 100 to 200, the average end to end delay increases for DSR. Therefore, DSR is the worst protocol in terms of delay due to increase in the number of broken routes. It can also be noted that the best average End-to-End delay for AODV protocol is less than both DYMO and DSR.

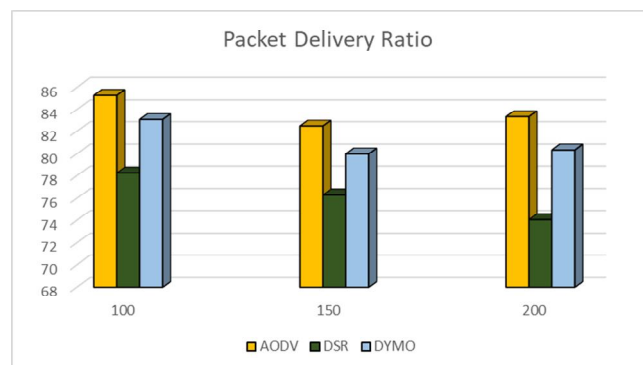


**Figure4: Average End to End Delay**

**Packet Delivery Ratio**

From Figure 5 shows the packet delivery ratio, the packet delivery ratio of AODV is better than DSR and DYMO with increasing in the number of nodes. As the number of nodes increases from 150 to 200 , packet delivery ratio of DYMO is slightly increases.

AODV and DYMO manages to maintain a reasonably high packet delivery ratio. DSR performance starts decline when the number of nodes increases.



**Figure5: Packet Delivery Ratio**

**VI. CONCLUSION**

In this paper, we presented the comparison analysis of three reactive routing protocols (AODV, DSR and DYMO) which are performed on the basis of different parameters such as average delay, throughput and packet delivery and ratio. AODV shows best results in terms of packet delivery ratio and throughput while DSR shows worst performance than DYMO and AODV. Also, DYMO protocol gives the moderate results in the whole analysis. Finally, from the above comparison it is concluded that AODV better than DSR and DYMO. This is due to high efficiency under high mobility. Therefore, it is concluded that AODV routing protocol is used for large area network.

**REFERENCES**

- [1] Khanvilkar, TejashreeS., and K.P Patil “Performance evaluation and comparison of routing protocols in MANETs” , 2013 Fourth International Conference on Computing Communications and Networking Technologiues( ICCCNT), 2013.
- [2] A.B. Malany, V.R.S. Dhulipala and R. M. Chandrasekaran,“Throughput and Delay Comparison of MANET Routing Protocols,” InternationalJournal of Open Problems inComputer Scienceand Mathematics, vol. 2, no. 3, pp. 461–468, 2009.
- [3] S. Rahul, S.K. Maurya, Y. Rajvanshi and B.K. Verma, “Performance Analysis of Bellman, DSR and ZRP Routing Protocols in MANET,” International Journal of All Research Education and Science Methods, vol. 3, no. 10, pp. 47 –52, 2015.
- [4] A. Mahmood, M.S. Hossain and F.A. Aziz,“Comparative performance analysis of DSR and AODV protocol based on mobility factor,” International conference on computer and information technology in Khulna, pp. 681–685, 2008.
- [5] R. Mkhija and R.Saluja, “Performance Comparison of Ad-Hoc Routing Protocol in Different Network Size”, Proc.of 2nd National Conf. Mathematical Techniques: Emerging Paradigms in Electronics and IT Industries,(Sept 26-28,2008).
- [6] S.B. Shaik,“Effect of Placement Model on Average Jitter in Reactive Routing Protocols,” Journal of Engineering Science and Technology, vol. 1, no. 2, pp. 16–20, 2012.
- [7] Priyanshu and A.K. Maurya,“SURVEY : Comparison Estimation of Various Routing Protocols in Mobile Ad hoc Network,”International Journal of Distributed and Parallel System, vol. 5, no. 1, pp. 87–96, 2014.