ISSN: 2321-7782 (Online)
Volume 4, Issue 1, January 2016
International Journal of Advance Research in Computer Science and Management Studies
Research Article / Survey Paper / Case Study
Available online at: www.ijarcsms.com

Performance Analysis of AODV Routing Protocol in Mobile ADHOC Networks

Surinder Singh[1]
Research Scholar, GKU
Talwandi Sabo, Punjab, India

B. S. Dhaliwal[2]
Dean Academics, GKU
Talwandi Sabo, Punjab, India

Rahul Malhotra[3]
Director-Principal GTBKIET
Malout, Punjab, India

Abstract: ***An ad hoc network is a wireless and infrastructure less network. Various routing protocols have been discussed so far to improve the routing performance and reliability. In this paper a detail study of reactive routing protocol AODV has been done to check the performance in terms of packet delivery ratio, Packet miss ratio, throughput, routing overhead and energy consumption. The node performance gets affected due to mobility and node density. The simulations are carried out using MATLAB. The results presented in this work specify the importance of careful evaluation and implementation of routing protocols in an ad hoc environment.***

Key words: AODV, MANET, Performance Evaluation, Protocol, MATLAB.

I. INTRODUCTION

MANETs have Dynamic topologies, Bandwidth limitations, variable Capacity links, Energy-constrained operation and limited physical security. Therefore the routing protocols used in ordinary wired networks are not well suited for this kind of dynamic environment [1] .The participating nodes act as routers, are free to move randomly and manage themselves arbitrarily. Such a network may operate in a standalone fashion, or may be connected to the larger Internet [2] .Quick and easy deployment of ad-hoc network makes them feasible to use in battlefield environments, disaster relief and in conference [3]. Because nodes in a MANET normally have limited transmission ranges, some nodes cannot communicate directly with each other. Hence, routing paths in mobile ad-hoc networks potentially contain multiple hops, and every node in mobile ad-hoc networks has the responsibility to act as a router to discover and maintain routes to other nodes in the network [4] .The merit of a routing protocol can be analyzed through metrics-both qualitative and quantitative. Desirable qualitative properties of a routing protocol for MANETs are Distributed operation, Loop-freedom, Demand-based operation, Security and unidirectional link support. Some quantitative metrics that can be used to assess the performance of any routing protocol are End-to end delay, throughput, PDF, NRL [5] .There are three type of Routing protocol. Proactive or table driven routing protocols, Reactive or on demand routing protocols and Hybrid routing protocols [7, 15, 19, 22]. In on-demand or reactive routing protocols, the routes are created on requirement basis. To find a path from source to destination, it invokes the route discovery mechanisms. Only the routes that are currently in use are maintained, thereby maintaining low control overhead and reducing the network load. [20] .Nodes in MANET does not provide reliable services as compared to other wireless networks such as GSM and CDMA. The main sources of unreliability in MANETs are due to limited storage capacity, limited battery life, high mobility and varying channel conditions [10] .The nodes can act as both end systems and routers at the same time. When acting as routers, they discover and maintain routes to other nodes in the network [12, 14] .Routing protocols used in these dynamic networks should be designed in such a way that they can adapt fast and efficiently to unexpected changes in network layout [21]. It is worth mentioning that node density will have significant effect in the performance of the any routing policy due to the fact that an increase in node density will tend to increase the hop count thus changing the topology significantly [17] .The paths are computed based on the

minimization of the number of intermediate nodes between the source and the destination. Thus, some nodes become responsible for outing packets from many source destination pairs. After a short period of time, the energy resources of those nodes get depleted, which leads to node failure. It is therefore significant that the routing protocols designed for Ad hoc networks take into account this problem. Indeed, a better choice of routes is one where packets get routed through paths that may be longer but that contain only nodes that have enough energy [18].

II. AODV ROUTING PROTOCOL

AODV Protocol has distinguishing feature to provide unicast, multicast and broadcast communication. AODV uses a broadcast route discovery algorithm and then the unicast route reply massage [1]. AODV is a reactive Routing protocol based upon the distance vector algorithm [3]. When a source node desires to send a message to some destination node, and doesn't have a valid route to the destination, it initiates a path discovery process to locate the other node. It broadcasts a route request (RREQ) control packet to its neighbors, which then forward the request to their neighbors, and so on, either the destination or an intermediate node with a new route to the destination is located [2,4]. The AODV protocol utilizes destination sequence numbers to ensure that all routes contain the most recent route information [5]. Each node maintains its own sequence number. During the forwarding process the RREQ, intermediate nodes record the address of the neighbor from which the first copy of the broadcast packet is received in their route tables, thereby establishing a reverse path. Once the RREQ reaches the destination or an intermediate node with a fresh enough route, the destination or the intermediate node responds by unicasting a route reply (RREP) control packet back to the neighbor from which first received the RREQ [9]. In Route Maintenance phase, a route discovered between a source node and destination node is maintained as long as needed by the source node. The destination node or some intermediate node moves, the node upstream of the break initiates Route Error (RERR) message to the affected active upstream nodes. Consequently, these nodes propagate the RERR to their predecessor nodes. This process continues until the source node is reached. When RERR is received by the source node, it can either stop sending the data or reinitiate the route discovery mechanism by sending a new RREQ message if the route is still required [6]. Transmission control protocols uses acknowledgements to confirm successful data transmission. When TCP is used as a transport layer protocol in MANET which employs AODV at network layer, it deteriorates the performance of the network when mobility is high. The main purpose is to increase the possibility of establishing routing path with less RREQ messages than the other protocol, when topology changes by nodes mobility. The modified AODV (R-AODV) protocol discovers routes on-demand using a reverse route discovery procedure. After receiving RREQ message, destination node floods reverse request (R-RREQ), to find source node. When source node receives an R-RREQ message, data packet transmission is started immediately [7]. In AODV less memory space is required, as information of only active routes is maintained, in turn increasing the performance. While the disadvantage is that this protocol is not scalable and in large networks it does not perform well and does not support asymmetric links [20] .Existing routing protocols in ad-hoc networks utilize the single route that is built for source and destination node pair. Due to node mobility, node failures and the dynamic characteristics of the radio channel, links in a route may become temporarily unavailable, making the route invalid. This problem can be solved by use of multiple paths between source and destination node pairs, where one route can be used as the primary route and the rest as backup [15]. Multiple paths can be formed for both traffic sources and intermediate nodes with new routes being discovered only when needed, reducing route discovery latency and routing overheads. Multiple paths can also balance network load by forwarding data packets on multiple paths at the same time [8, 20, 16]. AODV which fits in all scenarios shows the smallest delay and loss ratio and the greatest throughput. Its scalability, connectivity and the adaptive ability is also of relative strength [10]. One of the strengths of AODV is its capability to adapt smoothly in a dynamic network environment like MANET because of its low control message overhead [13] .The black hole attack is a kind of denial of service attack, where it will disrupt the network and the result affects the whole performance of the network. The attack is made by malicious node which attacks the AODV control.

III. Simulation Environment and Performance Metrics

A. Simulation Environment

For the performance analysis of AODV, we have used MATLAB as the network simulator. The mobility model we have chosen is Random Way Point model. The other parameters that we have chosen for the network are as listed in the table:-

TABLE 1: Simulation Parameters

PARAMETERS	USED IN SIMULATION
Simulator	MATLAB(2010)
Channel type	wireless channel
Antenna type	Omni Antenna
Radio-propagation model	two ray ground
Mac type	Mac/802.11
Protocols studied	AODV
Simulation area	1000m×1000m
Transmission range	250m
Node movement model	Random waypoint
Traffic type	CBR(UDP)
Packet size	512 Bytes
Number of nodes	10,20,30,40,50,60,70,80,90,100
Node Speed	10m/s and 50m/sec

B. Performance Metrics:-

The performance evaluation of routing protocol for mobile ad hoc networks has been performed by using MATLAB having the simulation parameters. Routing protocol AODV have been considered for performance evaluation in this work. Some simulation parameters described below:-

i) Mobility Model: -In mobile ad hoc networks the movement of nodes is Dynamic and depends on the scenario. Study of mobility models will help to check the behavior of the network. Mobility models are Random Waypoint Model, Reference Point Group Mobility (RPGM) model, Gauss- Markov Model and Manhattan Mobility Model. Here it used Random Waypoint Model which first used by Jhonson and Maltz in evaluation of AODV routing. This is a random based mobility model used in mobile management scheme for mobile communication.

ii) Traffic Type:-Random traffic connections of Constant Bit Rate (CBR) and Transmission Control Protocol (TCP) can be set up between nodes. This CBR and TCP connections can be used in wireless nodes. For traffic connection generation the requirements are the number of nodes, the type of traffic of connection and total number of connections between nodes etc.

iii) Radio Propagation Model: - Radio propagation model is used to predict the received signal power of each packet. There is receiving threshold at the physical layer of each mobile node. A single line-of-sight path between two mobile nodes is propagation. The two ray ground propagation model considers both direct path and ground reflection path. This Model gives accurate prediction at a long distance.

iv) Mac 802.11:-Medium access control (MAC) plays an important role in coordinating channel access among the nodes to achieve high channel utilization. Wireless channels are suffering from path loss, fading and interference. Network topology may change continuously, cause frequent route breakages and again routing activity starts.

In this paper the following performance metrics have considered:-

- *Packet delivery Ratio: It* is the ratio of the number of packets which received successfully and the total number of packets transmitted.

- *Throughput*: The amount of data transferred over the period of time expressed in kilobits per Second (kbps).
- *Packet Drop Ratio*: The ratio of the data lost at Destinations to those generated by the CBR Sources. The packets are dropped when it is notable to find the proper route to deliver the Packets.
- *Normalized routing load: It* is the number of control packets per data packets transmitted in the network.

IV. Simulation Results and Analysis

Simulation study shows that performance of routing protocol in terms of throughput, packet delivery ratio, and routing overhead strongly depends upon network conditions such as mobility, no. of nodes .The set of experiments uses varying no. of nodes and varying speed.

Performance analysis with varying node density and varying speed

1) packet delivery ratio vs. nodes

Figure 1indicates the plot between packet delivery ratio and no. of nodes. Packet Delivery Ratio decreases as the number of nodes increases. At high node density, more collision occurs due to traffic, which causes loss of packets. At high mobility, nodes moves out of network and packet does not reach the desired destination node.

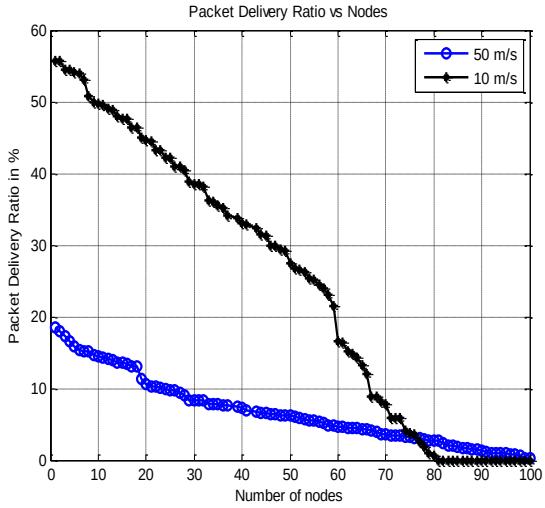

Fig.1 Packet delivery ratio vs. no. of nodes for speed 10m/sec and50m/s

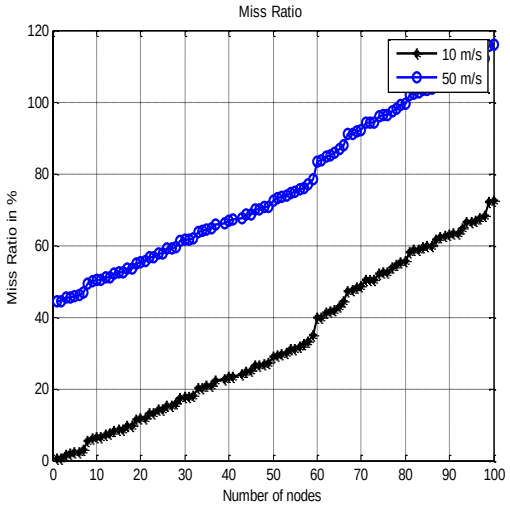

Fig.2 Packet miss ratio vs. no. of nodes for speed for10m/sec and50m/s

2) *Packets miss ratio vs. nodes*

Figure 2 indicates the plot between packet miss ratio and no. of nodes. Packet Miss Ratio increases as the number of nodes increases. As packets move from source to destination, the collision occurs due to traffic, which causes loss of packets. At high mobility of nodes, packet does not reach the desired destination node. Due to this, at more speed and more number of nodes, packet misses ratio increases.

3) *Throughput vs. no. of nodes*

Figure 3indicates the graph between throughputs vs. no. of nodes. As the no. of nodes increase, the throughput decreases. This is due to the fact that packet delivered to the destination are lost during transmission. Routing takes more time to deliver packets to destination due to retransmission attempts.

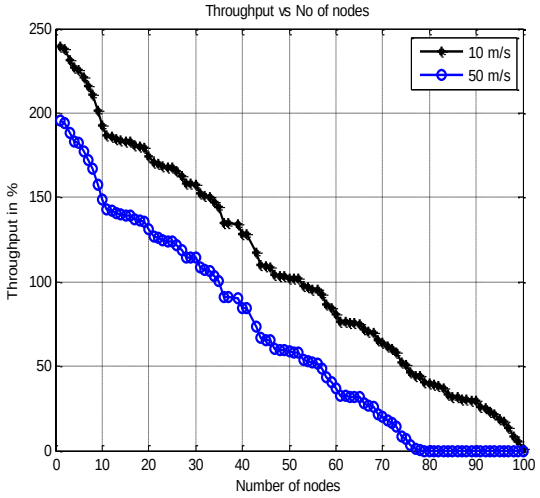

Fig.3Throughput vs. no. of nodes for speed 10m/sec and 50m/sec

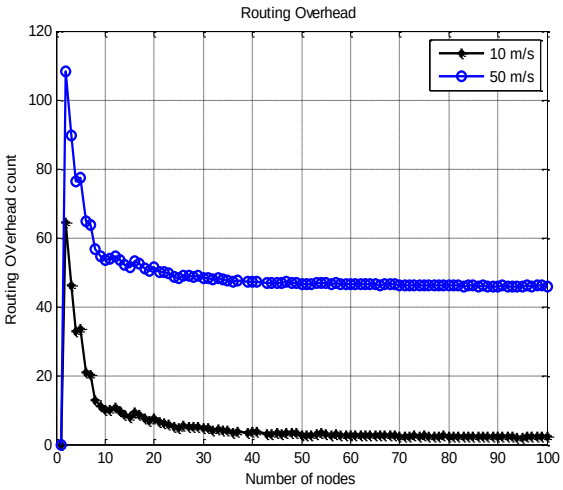

Fig.4 routing overhead vs. no. of nodes for speed 10m/sec and 50m/sec

4) *Routing Over head vs. no. of nodes*

Figure 4 indicates the graph between routing Over head vs. no. of nodes. AODV Routing overhead is more at more speed. AODV maintains single route per destination in its routing table. Due to movement of nodes, the wireless links breaks which results in path loss and to establish a route it generate route request packets which in turn, leads to more retransmission attempts, thereby number of control packets for establishing a new route increases, which leads to increase in routing overhead.

5) Energy consumption vs. no. of nodes

When the number of nodes increases, the energy consumption of AODV increases .To maintains the routing information of all nodes, the number of the packets needed increased rapidly at high node density. So the consumption increases sharply.

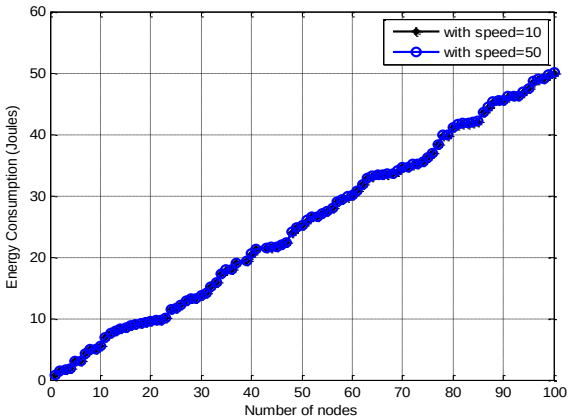

Fig.5 *Energy consumption* vs. no. of nodes for speed 10m/sec and 50m/s

V. CONCLUSION

In this work, performance of mobile ad hoc network routing protocol AODV has been studied and evaluated by using MATLAB. AODV protocol Performance carried out in terms of packet delivery ratio, Packet miss ratio, Throughput, Routing overhead and Energy consumption. From the analysis, it is observed that packet delivery ratio, throughput decreases as node density and node speed increases. Packet miss ratio, routing overhead and energy consumption increases as node density and node speed increases.

References

1. Anuj K. Gupta, Dr. Harsh Sadawarti, Dr. Anil K. Verma, "Performance analysis of AODV, DSR & TORA Routing Protocols", International Journal of Engineering and Technology, Vol.2, No.2, April 2010, pp226 -231.
2. Davesh Singh Som, Dhananjaya Singh, "Performance Analysis and Simulation of AODV,DSR and TORA Routing Protocols in MANETs" International Journal of Recent Technology and Engineering (IJRTE), Volume-1, Issue-3, August 2012.
3. Manish Singh Chaudhary and Varsha Singh, "Simulation and Study of AODV Routing Protocol under CBR and TCP Traffic Source,"International Journal of Future Computer and Communication, Vol. 3, No. 2, April 2014.
4. Mehemed Bashir Aliwa, " Performance Simulation Evaluation of Various Routing Protocols in Mobile Ad-Hoc Networks Using ns-2 Simulator," IJCSNS International Journal of Computer Science and Network Security, VOL.15 ,No.5, May 2015.
5. Akshai Aggarwal1, Savita Gandhi, Nirbhay Chaubey, "Performance Analysis Of AODV, DSDV, and DSR in Manets," International Journal of Distributed and Parallel Systems (IJDPS) Vol.2, No.6, November 2011
6. Patil V.P, "Efficient AODV Routing Protocol for MANET with enhanced packet delivery ratio and minimized end to end delay," International Journal of Scientific and Research Publications, Volume 2, Issue 8, August 2012.
7. Humaira Nishat, Vamsi Krishna, Dr. D.Srinivasa Raoand Shakeel Ahmed, "Performance Evaluation of On Demand Routing Protocols AODV and Modified AODV (R-AODV) in MANETS," International Journal of Distributed and Parallel Systems (IJDPS), Vol.2, No.1, January 2011.
8. Sandeep Gupta, B.S. Dhaliwal, Rahul Malhotra, "A REVIEW OF ADHOC ROUTING PROTOCOLS: AODV, TORA & DSR", in International Journal of Research In Computer Applications And Robotics, Vol.3 Issue.6, June 2015, pp. 40-47.
9. Radha Rani Gupta, Mahendra Ku. Mishra,"Power Saving Routing Protocol for Ad hoc Networks based on AODV,"International Journal of Computer Applications, Volume 85 – No 19, January 2014.
10. Humaira Ehsan, Farrukh Aslam Khan,"Malicious AODVImplementation and Analysis of Routing Attacks in MANETs," IEEE 11th International Conference on Trust, Security and Privacy in Computing and Communications, 2012 ,pp 1181-1187.
11. Harsimranjit Singh, "To Investigate the Performance of MANETRouting Protocols with Varying Node Densities," International Journal of Computer Science and Mobile Applications, Vol.2, Issue. 10, October2014, PP. 01-11.
12. Er.Punardeep Singh, Er.Harpal Kaur, Er. Satinder Pal Ahuja, " Brief Description of Routing Protocols in MANETS And Performance And Analysis AODV, AOMDV, TORA," International Journal of Advanced Research in Computer Science and Software Engineering, Volume 2, Issue 1, January 2012.
13. Kamarularifin Abd. Jalil, Zaid Ahmad, Jamalul-Lail Ab Manan, " Mitigation of Black Hole Attacks for AODV Routing Protocol,"international journal on new computer architecture and there application,2011,pp336-343.
14. Sandeep Gupta, Dr. B S Dhaliwal, Dr. Rahul Malhotra, "Performance Comparison of Proactive Routing Protocols: OLSR, DSDV, WRP", International Journal of Advanced Research in Computer Science, Vol. 6 (No. 8), Nov–Dec, 2015, pp 73-77.
15. Xiaoxia Qi1, Qijin Wang and Fan Jiang , "Multi-path Routing Improved Protocol in AODV Based on Nodes Energy," International Journal of Future Generation Communication and Networking, Vol. 8, No. 1 ,(2015), pp. 207-214.
16. Reza Fotohi, Shahram Jamali, " An Improvement over AODV Routing Protocol by Limiting Visited Hop Count," I.J. Information Technology and Computer Science, 2013, Vol. 09, PP. 87-93.
17. Biswaraj Sen1, Sanku Sinha, " A Simulation Based Performance Analysis of AODV and DSDV Routing Protocols in MANETs, International Journal of Modern Engineering Research (IJMER) ,Vol.2, Issue.4, July-Aug. 2012 ,pp2404-2408.
18. Fahamida Firoze, "Performance of Energy Aware Routing Protocol(MECB-AODV): A Modified Energy ConstrainedProtocol for Mobile Ad hoc Networks," International Journal of Innovative Research in Computerand Communication Engineering, Vol. 2, Issue 2, February 2014.
19. Surinder singh , Dr B.S Dhaliwal, Dr.Rahul Malhotra, "Comparative Appraise and Future Perspectives of Reactive and Proactive Routing Protocols in Manets,'' International Journal of Research Studies in Computer Science and Engineering (IJRSCSE) Volume 1, Issue 1, May 2014, PP 36-41.
20. R.Balakrishna, U. Rajeswar Rao, N.Geethanjali , " Performance issues on AODV and AOMDV for MANETS," International Journal of Computer Science and Information Technologies, Vol. 1, 2010, PP .38-43.
21. Mehemed Bashir Aliwa, " Performance Simulation Evaluation of Various Routing Protocols in Mobile Ad-Hoc Networks Using ns-2 Simulator," International Journal of Computer Science and Network Security, VOL.15 ,No.5, May 2015.
22. Sandeep Gupta, BS Dhaliwal, Rahul Malhotra, "ALL-EMBRACING REVIEW OF WIRELESS NETWORK PROTOCOL, OPTIMUM NETWORK SIMULATOR", International Journal of Computer & Organization Trends –Volume3Issue3- 2013, pp 45-54.

