

Performance Analysis of AODV Routing Protocol in MANET: An Overview

Amol R. Kotkar¹, Nilesh S. Vani²

¹Research Scholar M. E. Department of Computer Engineering, GF's Godavari College of Engineering, Jalgaon

²Assistant Professor, Department of Computer Engineering, GF's Godavari College of Engineering, Jalgaon

Abstract: *Mobile Ad hoc Network (MANET) is a collection of mobile devices, a self configured, multi-hop network thus each device in network topology acts as a router. Routing protocols are necessary to find paths to reach other node. Due to mobility of nodes, routing plays an important role in communication. This paper gives an introduction to one of the MANET reactive routing protocol AODV i.e. Adhoc on demand distance vector routing protocol. It also includes general working of AODV protocol. It also includes evaluation of performance of AODV protocol depending on different input parameters. Evaluation work has been done on java simulator. This paper is a survey of evaluating performance of AODV protocol in MANET with different network parameters using network simulator.*

Keywords: MANET, AODV, Routing Protocol, Ad-hoc Network

1. Introduction

Wireless Communication is one of the emerging technologies which allow users to access information and services electronically, despite their geographical position. Wireless communication can be classified as: Infrastructured network and Infrastructureless network. Mobile Adhoc network is a special kind of infrastructureless network. It is a collection of mobile nodes that move randomly and dynamically [1]. The mobile nodes with wireless radio interface are connected by wireless links. With dynamic nature of network topology the routes changes very fast and frequent and so the efficient routing protocols plays important roles in handling it. They should be capable to ensure the delivery of packets safely to their destinations. MANETs are also capable of handling topology changes and malfunctions in nodes through network reconfiguration. The mobile adhoc networks are very flexible and suitable for several types of applications, as they allow the establishment of temporary communication without any pre installed infrastructure[2]. The aim of deploying these networks is to provide communication in areas where limited or no connectivity or any communication infrastructure exists. These networks are flexible and can be employed in military rescue operations, interactive lectures, business sharing information and emergency situations [4].

The features of MANETs are highly dynamic topology, bandwidth constrained links, limited physical security and energy constrained nodes. For providing connectivity a MANET uses multi-hop routing rather than a static infrastructure based network. Many protocols have been proposed so far. One such protocol is Adhoc On Demand Distance Vector (AODV) routing protocol. AODV is preferred because it minimizes the routing overhead than the other protocols and hence enhancing the performance of the network.

This paper gives performance analysis of AODV routing protocol on the basis of performance measuring parameters packet delivery ratio & average end-to-end delay. It also includes general working of AODV protocol. The simulation work has been done in Java. The rest of paper is as follows:

In Section II MANET routing protocols are discussed In Section III, Overview of AODV routing protocol is given. Section IV describes the Related Work done by different Authors In Section V simulation of AODV routing protocol. In Section VI, experimental results are presented and in Section VII Conclusions are described.

2. Routing Protocols in Manet

Routing Protocol is used to find valid routes between communicating nodes. They do not use any access points to connect to other nodes .It must be able to handle high mobility of the nodes. Routing protocols can be mainly classified into 3 categories.

- Centralized versus Distributed
- Static versus Adaptive
- Reactive versus Proactive

In centralized algorithms, all route choices are made by central node, while in distributed algorithms, the computation of routes is shared among the network nodes. In static algorithms the route used by source destination pairs is fixed regardless of traffic condition. It can only change in response to a node or link failure. This type of algorithm cannot achieve high throughput under a broad variety of traffic input patterns. In adaptive routing, the routes used to route between source destination pairs may change in response to congestion.

Routing is the process of finding a path from a source to destination among randomly distributed routers. MANET routing protocols are classified as follows on the basis of the way the network information is obtained in these routing protocols.

i. Proactive (or Table-driven) routing protocol

The Proactive routing protocols, consistent and up-to-date routing information to all nodes is maintained at each node. For example

1. Optimized Link state Routing Protocols (OLSR)
2. Destination Sequenced Distance Vector Routing (DSDV)

3. Source Tree Adaptive Routing (STAR)

ii. Reactive or On-demand routing protocol

The reactive routing protocols look for the routes and are created as and when required. When a source wants to send to a destination, it invokes the route discovery mechanisms to find the path to the destination. It does not need to search for and maintain the routes on which there is no route request. Reactive routing protocols are very pleasing in the resource-limited environment. However the source node should wait until a route to the destination is discovered. This approach is best suitable when the network is static and traffic is very light.

For example,

1. Ad-Hoc On-demand Distance Vector (AODV) [9]
2. Dynamic Source Routing (DSR)

iii. Hybrid Protocols

These protocols are using the best features of both the on-demand and table driven routing protocols. The Ad Hoc network can use the hybrid routing protocols that have the advantage of both proactive and reactive routing protocols to balance the delay and control overhead (in terms of control packages). The difficulty of all hybrid routing protocols is the complexity of organizing the network according to network parameters. The common disadvantage of hybrid routing protocols is that the nodes that have high level topological information maintains more routing information, which leads to more memory and power consumption.

For example

1. Temporally ordered routing algorithm (TORA)
2. Zone Routing Protocol (ZRP)

There are two approaches to evaluate routing protocols:

- Network Environment Parameters like network size, connectivity, mobility, link capacity etc.
- General Performance Metrics of Routing Protocols like message delivery ratio, control overhead, hop count, end to end delay, etc. [2,4]

In this paper packet delivery ratio and average end to end delay performance parameters are considered.

3. Overview of AODV

Ad-hoc On Demand Distance Vector Routing Protocol (AODV) is one of the reactive protocol in which source node initiates data packet to destination node only when requires the route discovery is occur. there are no periodical exchanges of routing information.[9] The Protocol consist of two phases:

- i) Route Discovery
- ii) Route Maintenance.

i. Route Discovery

AODV routing protocol uses a broadcast route discovery mechanism and it depends on dynamically established route. AODV builds routes by using a route request (RREQ)/ route reply (RREP) query cycle. When a source node requires a destination route for which it does not have a route already, it broadcasts RREQ packet across the network [1], [2] The

nodes receiving this packet update the information for the source node and sets up backward pointer information for the source node in the routing table. A lifetime is associated with each reverse route entry, i.e. if the route entry is not used within the lifetime it will be removed. As shown in fig.1[6]

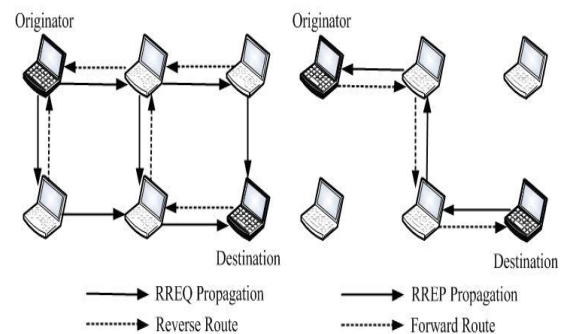


Figure 1: AODV route discovery process

ii. Route Maintenance

The second phase of the protocol is called route maintenance. It is performed by the source node and can be subdivided into: i) source node moves: source node initiates a new route discovery process, ii) destination or an intermediate node moves: a route error message (RERR) is sent to the source node. Intermediate nodes receiving a RERR update their routing table by setting the distance of the destination to infinity. If the source node receives a RERR it will initiate a new route discovery. To prevent global broadcast messages AODV introduces a local connectivity management. This is done by periodical exchanges of so called HELLO messages which are small RREP packets containing a node's address and additional information.[9]

4. Related Work

Several researchers have done the qualitative and quantitative analysis of Ad Hoc Routing Protocols by means of different performance metrics. They have used different simulators for this purpose.

J Broch et al. [11] performed experiments for performance comparison of both proactive and reactive routing protocols. In their simulation, a network size of 50 nodes with varying pause times and various movement patterns were chosen. The simulation was done with ns-2 simulator.

Arun Kumar B R et al. [12] in this paper they present their observations regarding the performance comparison of the routing protocols for variable bit rate (VBR) in mobile ad hoc networks (MANETs). They perform extensive simulations, using NS-2 simulator [13]. Their studies have shown that reactive protocols perform better than proactive protocols.

N Vetrivelan & Dr. A V Reddy [13] analyzed the performance differentials using varying network size and simulation times. They performed two simulation experiments for 10 & 25 nodes for simulation time up to 100 sec.

Nilesh. P. Bobade & Nitiket. N. Mhala et. al.[14] evaluate the performance of routing protocol with varying network size and simulation time. They use 10 nodes for simulation time up to 200 seconds. They use NS-2.34 as simulator.

Parma Nand & Dr.R.C.Sharma et.al.[7]study the performance of AODV,DSR & DYMO routing protocol. AODV perform better in term of packet delivery ratio in increased traffic load & mobility.They use Qualnet 5.0.2 simulator.

Amandeep & Gurmeet Kaur et.al.[15]analyse the Performance of AODV Routing Protocol in MANET.AODV perform better in term of packet delivery ratio but delay & some packet loss is happen. The Simulation is done in MATLAB

5. Simulation of AODV Routing Protocol

Many of Researchers evaluate AODV routing Protocol Performance in NS-2. We use Java as a simulating tool to evaluate AODV simulator in java. It simulates an Ad-hoc network with AODV algorithm; it uses a high level view and only works in Routing layer. it has a user-friendly graphical user interface and has been written in java language. Platform independent because of implementation in java language.[8] interactive user interface (user can change nodes arrangement during the simulation). Drag & Drop feature. Searching nodes by their name.

Automatic parameter setter: user can specify each node parameters: at least should see how many nodes and if their connection is bidirectional. Then the application fills automatically the nodes power, IP and name. Independence of UI and simulation engine. So developers can use another user interface for that engine.

- Logging the state of each node
- Animated UI

i. Node Creation

To create a node, click on the “new node drag” icon and drag it to the map. By default it has IP address 192.168.10.1 and no name: You can set the name, IP and power of each node individually or use “Auto parameter setter tools” to set them see.[8] Note the name of a node cannot be changed. The position of the node can be changed by drag & drop the node or “Node Properties” panel.

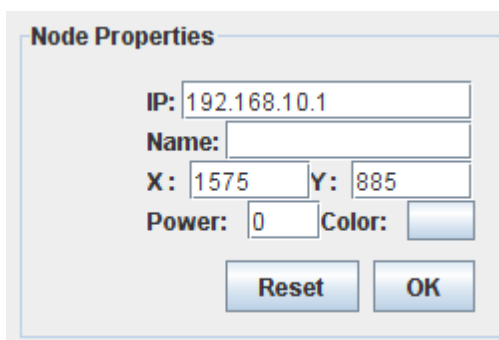


Figure 2: Node Creation

ii.Auto Parameter Setter

Auto parameter setter tools are positioned in the toolbar. It sets node’s name, IP, and power automatically. Min neighbors and Double Direction parameters control the auto power setter algorithm.[8] The first specifies number of node’s neighbors. The neighbors connection can be either one directional or bidirectional (double direction) based on the second parameter.

iii. Node’s range Circle

Usually first you position the nodes on the map, and then fill the parameters using this tool. To set the parameters click on “Fill Parameter” button.[8] After that if you select a node you can see the parameters and set range on the map as a circle

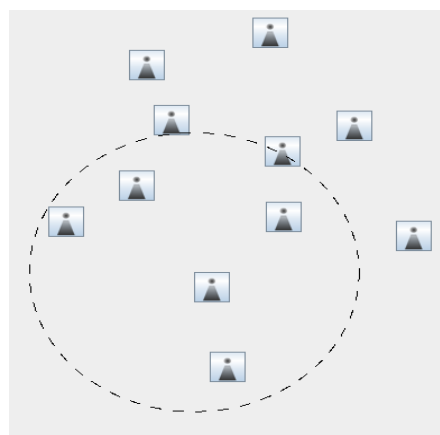


Figure 3: Node’s range Circle

The main method of evaluating the performance of MANETs is simulation. The simulation of AODV routing protocol is done in JAVA. The network is taken as 3000m * 3000m .The performance is recorded taking different number of nodes. The nodes are placed randomly in the network. The packet size is taken as 512 bytes and the traffic type is Constant bit rate (CBR).

The parameters taken for simulation are listed below in the Table 1.

Table 1: Simulation Parameters

Simulation Area	3000m * 3000m
Simulation Time	300 sec
No of Nodes	10,15,20,25,30,35,40,45,50
Packet Size	512 bytes
Traffic Type	CBR
Type of Protocol	AODV

Performance Evaluation Metrics :

The Performance is measured on the basis of some parameter which are described as follows:

Packet delivery ratio (PDR): the ratio of total number of packets received by destinations to total number of packets sent by sources.

The formula for calculation of Packet Delivery ratio is as follows:

Packet Delivery Ratio= (total no. of received packets/total no. of sent packets)*100

End-to-End delay: the average amount of time to take all packets to reach destination.

End-to-end delay = Packet Received time- Packet Sent time

6. Conclusion

In this paper, We have evaluated the performance of existing routing protocol Ad-hoc On Demand Distance Vector (AODV) Routing Protocol in MANET. We take general performance evaluation metric parameters such as Packet Delivery Ratio & end-to-end delay. Simulation work has been done in Java. we have provided a vast information regarding AODV protocol and its various modifications. The work done in this survey research aims to develop a good understanding of AODV protocol and improvements done to it to enhance its performance.

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