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Performance Analysis of Routing Protocols in MANETs

Roshni Inamdar[1], AfzalSiddique[2], OmkarSawant[3], Jyoti Kolap[4]
[1](Electronics and telecommunication, Atharva College Of Engineering/ Mumbai University, India)
[2](Electronics and telecommunication, Atharva College Of Engineering/ Mumbai University, India)
[3](Electronics and telecommunication, Atharva College Of Engineering/ Mumbai University, India)
[4](Electronics and telecommunication, Atharva College Of Engineering/ Mumbai University, India)

Abstract: *Mobile ad hoc networks (MANETs) are networks that consist of wireless nodes. These nodes are mobile and self-configurable. MANETs do not have any fixed infrastructure. Due to its dynamic nature, nodes can be added or removed at any time. The performance requirements of such a network depends on the routing algorithms used. Thus, the routing algorithms are a crucial part of designing this specialized network. This paper presents performance evaluations and analyses for two routing protocol types: Proactive and Reactive routing protocols. This paper shows the produced simulation results after evaluating the normalized routing load, packet delivery ratio, throughput and average end-to-end delay of a MANET under two different scenarios viz. variation in number of nodes and velocity of nodes. Lastly, a calculated conclusion of the simulation results will be presented.*

Keywords: *MANETs; Protocols; Parameters; scenarios.*

I. Introduction

In the last couple of years, the use of wireless networks has become more and more popular. There exist three types of mobile wireless networks: *infrastructure networks*, *ad-hocnetworks* and *hybrid networks* which combine infrastructure and ad-hoc aspects. An infrastructure network consists of wireless mobile nodes and one or more bridges, which connect the wireless network to the wired network. These bridges are called *base stations*. A mobile node within the network searches for the nearest base station (e.g. the one with the best signal strength), connects to it and communicates with it.The important fact is that all communication is taking place between the wireless node and the base station but not between different wireless nodes. While the mobile node is traveling around and all of a sudden gets out of range of the current base station, a *handover* to a new base station will let the mobile node communicate seamlessly with the new base station. In contrary to infrastructure networks, an ad-hoc network lacks any infrastructure. There are no base stations, no fixed routers and no centralized administration. All nodes may move randomly and are connecting dynamically to each other.Therefore all nodes are operating as routers and need to be capable to discover and maintain routes to every other node in the network and to propagate packets accordingly. Mobile ad-hoc networks may be used in areas with little or no communication infrastructure: think of emergency searches, rescue operations, or places where people wish to quickly share information, like meetings etc.

Fig. 1.1 A mobile ad-hoc network

II. Routing Protocols In Manets

In MANET, there are two types of routing protocols: Proactive routing (table-driven) protocols and Reactive routing (on-demand) protocols that direct data from a host to the destination.

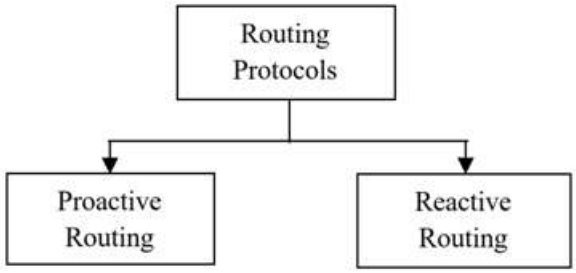

Fig. 1.2 Types of Routing Protocols

A. Proactive Routing Protocols:

In proactive routing protocols, each node maintains and updates one or more tables that contain routing information to other nodes. The information in these tables is consistently updated so as to keep routing information consistent and updated as the network status changes. Some of the proactive routing protocols are:

- Destination Sequence Distance Vector (DSDV)
- Fisheye State Routing (FSR)

B. Reactive Routing Protocols:

In reactive protocols (on-demand routing protocols), there is no need for the nodes in the network to keep routing information. Whenever a node needs to send data to a destination, a route generation mechanism will create a route based on the current network situation. The route will be cancelled when the transaction is done. Some of the Reactive routing protocols are:

- Ad hoc On-demand Distance Vector(AODV)
- Dynamic Source Routing (DSR)

This paper presents comparative analysis of four routing protocols (two Proactive and two Reactive) viz.

1. Destination Sequence Distance Vector (DSDV):

The DSDV routing algorithm is based on the classic Bellman-Ford Routing Algorithm. In DSDV, all nodes keep information of neighboring nodes and direct data to subsequent nodes. Before nodes in any route pass a data package to the next nodes, an agreement has to be acknowledged by both. Therefore, all nodes will update routing tables to keep all position information in the network consistent and up to date. This causes no disturbance in the route

2. Ad hoc On-demand Distance Vector (AODV):

In the AODV routing algorithm, all nodes work separately and do not hold any information of adjacent nodes. Instead, all nodes have information of predefined routes through which data can be delivered to the destination. A route will be formed only when a data arrives at a node so as to deliver said data to the destination node.

3. Dynamic Source Routing (DSR):

The DSR protocol is a source routed on-demand routing protocol. In DSR, all the nodes have a route cache to keep the routing information from the source nodes.If the source node needs to send data to a destination, it will check the route cache first. If the route from the source to the destination is valid, then it will send the packets. If there is no valid route, it will start to discover and try to build routes by sending a route request packet that contains the address of the source and the destination.A route will be created if the request packet reaches a node that already has a route from the source to the node.

III. Simulation Scenario

To simulate mobile ad-hoc networks using different routing protocols we choose Network Simulator 2 (Ns2) since it is an open source and free software that can modify different specifications in the environment. Performance of the routing protocols AODV, DSDV and DSR are evaluated based on four performance metrics, Average throughput, Packet Delivery Ratio, Average end-to-end delay and Normalized Routing Load for different simulation scenarios. AWK scripts are used to calculate and analyse these metrics from the trace files generated from the simulations. In Table I the specification parameters for the different simulation scenarios are shown.

Table I: Simulation Scenarios

	Scenario 1	**Scenario 2**
Operating System	Ubuntu 18.04	Ubuntu 18.04
Radio Propogation Model	TwoRayGround	TwoRayGround
Channel Type	Wireless Channel	Wireless Channel
Number of Nodes	10 ,20, 30, 50	20
Packet Size (bytes)	512	512
Traffic rate (m/s)	10	2, 4, 6, 8
Traffic Type	TCP	TCP
Simulation Time (s)	300	300
Area of Simulation	500*500	500*500

Fig 2.1: Simulation Scenarios

IV. Simulation Results And Discussion

A. Scenario 1

In this scenario we vary the number of nodes (10,20,30,50) keeping the velocity of nodes constant. We analysed all the four parameters of the three protocols.

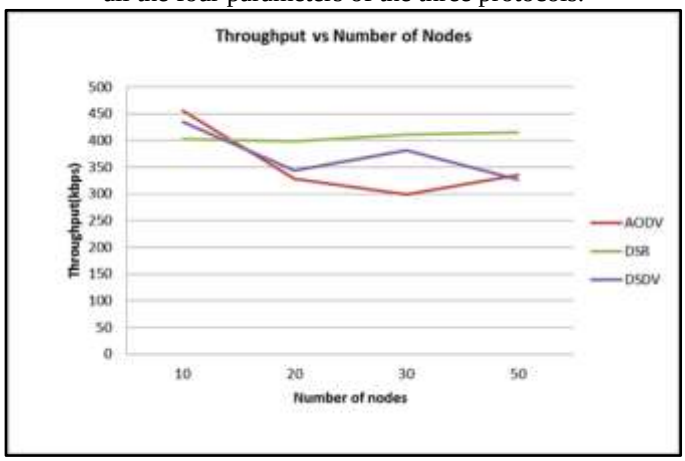

Fig 3.1: Throughput vs Number of Nodes

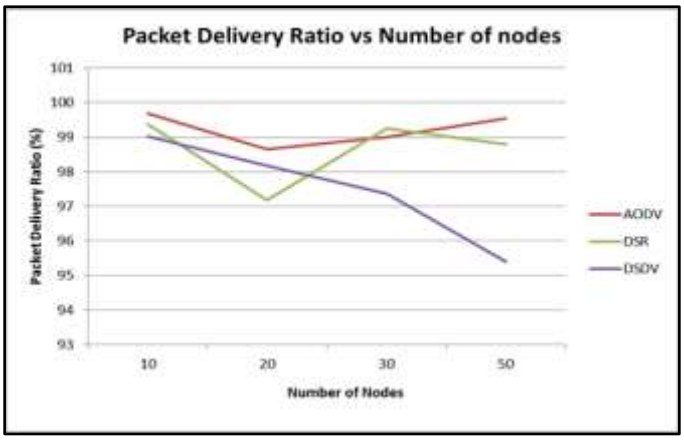

Fig3.2: Packet Delivery Ratio vs Number of Nodes

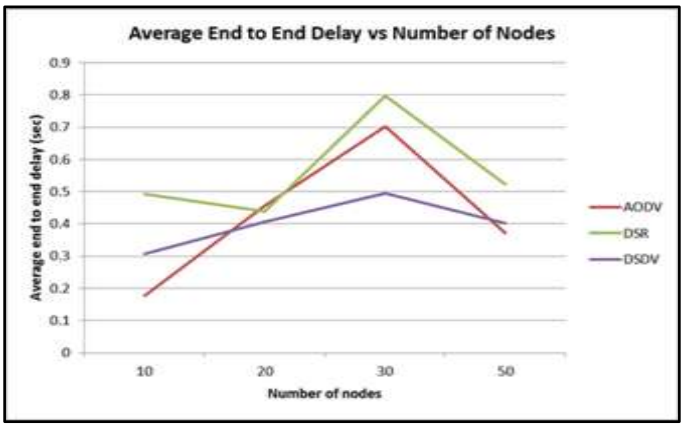

Fig 3.3:. Average End to End Delay vs Number of Nodes

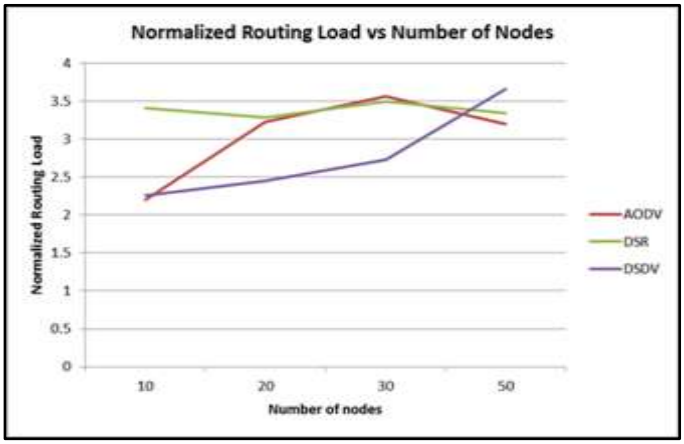

Fig.3.4: Normalized Routing Load vs Number of Nodes

Analysis of Simulation Results

Fig3.1, Fig3.2, Fig3.3 and Fig3.4 present graphical representations in Table II.Fig3.5 and Fig3.6 show us the movement of nodes that is Animation file(nam file). From the simulation results, we can draw the following conclusions.

I. Scenario 1

- Throughput of AODV protocol was the highest for less number of nodes. As the number of nodes increase, we observed that DSR gives a constant high throughput as compared to others.
- As the number of nodes increase, AODV becomes the best performer in terms of packet delivery ratio and DSDV shows a steep decline.
- With increase in number of nodes, we observed that the Average End-to-End Delay increases. DSDV gives the best outcome.
- In terms of Normalized Routing Load, DSR proved to be a very efficient protocol because of its constant nature.
- In terms of the Average End-to-End Delay, DSDV is the best performer.
- The Normalized Routing Load almost remains constant across all the protocols. DSDV numerically gives the best outcome.

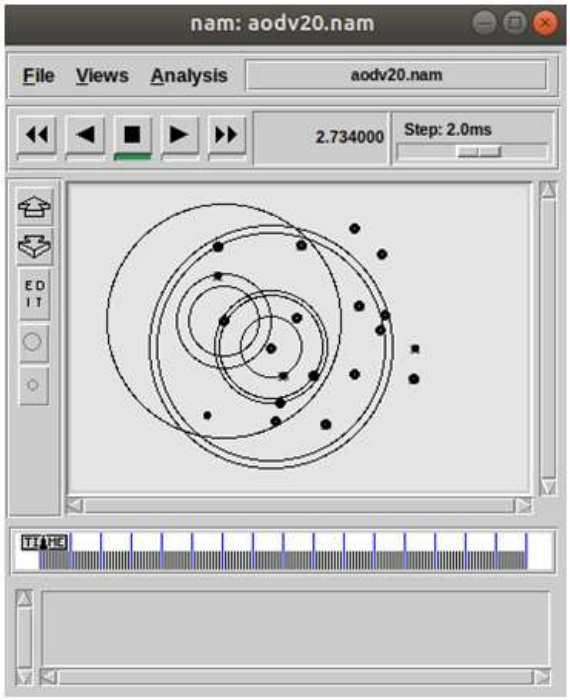

Fig3.5: Nam File (20 nodes)

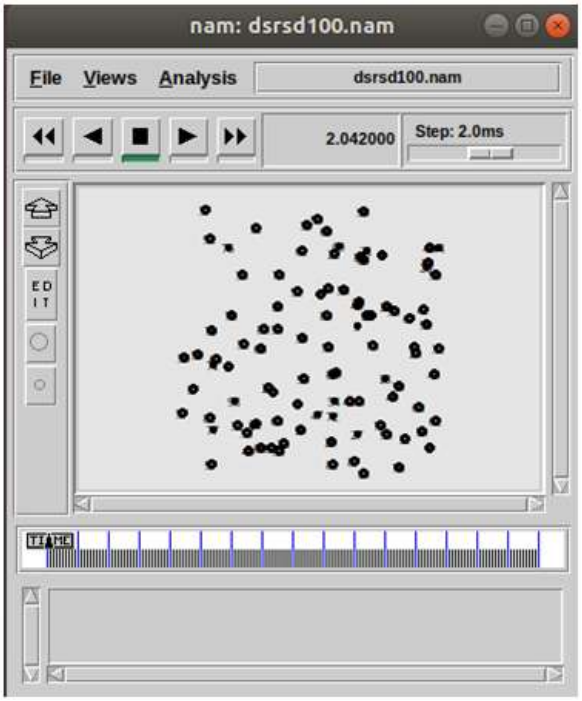

Fig3.6: Nam File (100 nodes)

V. Conclusion

From all the graphs and tables, it is observed that performance of DSDV protocol gives us better results when mobility of nodes increases. AODV performed better in some scenarios than DSR protocol but overall DSR gives us optimum results than AODV protocol. On a wider perspective, reactive protocols perform better than proactive protocols since there is no need for the nodes in the network to maintain and update routing information.

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