Routing Protocols in Mobile Ad Hoc Networks- A Simulation Study final

Dr.Yogesh Chaba[1] and Naresh Kumar Medishetti[2]
[1]Department of Computer Science and Engineering, Yogeshchaba@yahoo.com
[2]Guru Jambheshwar University, Hisar- India, Naresh.nlg@gmail.com

Abstract

Ad-hoc networks are mobile wireless networks that have no fixed infrastructure. There are no fixed routers-instead each node acts as router and forwards traffic from other nodes. MANET (Mobile Ad-Hoc Network) is a type of ad-hoc network with rapidly changing topology. Since the nodes in a MANET are highly mobile, the topology changes frequently and the nodes are dynamically connected in an arbitrary manner. In order to facilitate communication with the network, a routing protocol is used to discover the routes between nodes. Efficient routing of packet is a primary MANET challenge. Today, there exist various routing protocols for this environment. This paper compares the performance of some of the routing protocols. The performance tests are done by using Network Simulator 2 (ns2)

Index Termss: Mobile ad hoc networks, Routing Protocol, Performance, DSDV, DSR, AODV

I. Introduction

Mobile ad hoc network [1][3] is a collection of wireless mobile hosts forming a temporary network without the aid of any established infrastructure or centralized administration. In such an environment, it may be necessary for one mobile host to enlist the aid of other hosts in forwarding a packet to its destination, due to the limited range of each mobile host's wireless transmissions. In order to make that work, typically each node needs to act as a router to relay packets to nodes out of direct communication range. Under these circumstances, routing is much more complex than in conventional (static) networks. Many of the possible solutions are determined by the characteristics of the media, the behavior of nodes and the data flow. Since research in Ad Hoc Networking has resulted in such a large amount of routing algorithms and protocols, it has become more and more difficult to decide, which algorithms are superior to others under what conditions. For a successful deployment, this is an important problem, since a wrong choice may have a severe impact on the performance, and consequently on the acceptance of the new technology. Also, providing just any protocol is not feasible, due to the different requirements on hardware and lower network layers.

II. An Overview Of Routing Protocols

A Proactive and Reactive Routing Protocols

Traditional distance-vector and link-state routing protocols [4] are proactive in that they maintain routes to all nodes, including nodes to which no packets are sent. For that reason they require periodic control messages, which lead to scarce resources such as power and link bandwidth being used more frequently for control traffic as mobility increases. One example of a proactive routing protocol is Destination Sequenced Distance Vector Routing (DSDV) [2].

Reactive routing protocols, on the other hand, operate only when there is a need of communication between two nodes. This approach allows the nodes to focus either on routes that are being used or on routes that are in process of being set up. Examples of reactive routing protocols are Ad hoc On-Demand Distance Vector (AODV) [9], and Dynamic Source Routing (DSR) [7].

Both proactive and reactive routing has specific advantages and disadvantages that make them suitable for certain types of scenarios [6][5]. Proactive routing protocols have their routing tables updated at all times, thus the delay before sending a packet is minimal. However, routing tables that are always updated require periodic control messages that are flooded through the whole network - an operation that consumes a lot of time, bandwidth and energy. On the other hand, reactive routing protocols determine routes between nodes only when they are explicitly needed to route packets. However, whenever there is a need for sending a packet, the mobile node must first find the route if the route is not already known. This route discovery process may result in considerable delay.

B Distance Vector Destination Sequenced Routing

This routing protocol was developed at the IBM, in 1996. The protocol is a distance vector protocol, which uses the modified Bellman-Ford algorithm. This is a Proactive routing protocol, where the route is always available. However, the protocol has some limitations as well. It maintains routing info among all the nodes, it uses periodic update messages, there is a route settling time and routes may not converge.

The DSDV [2] protocol operates in the following way: mobile nodes maintain routes to all possible destinations and exchange routing information between each other. Hop counts are used as routing metrics, and in order to ensure that the routing information is up to date, sequence numbers are used. A given node keeps track of its own time and the sequence of events that happen. Thus, the node assigns sequence numbers to distance vector updates, which updates contain information about the neighbors.

C Ad hoc On-Demand Distance Vector

Ad hoc On-Demand Distance Vector, AODV, is a distance vector routing protocol that is reactive [9]. The reactive property of the routing protocol implies that it only requests a route when it needs one and does not require that the mobile nodes maintain routes to destinations that are not communicating. AODV guarantees loop-free routes by using sequence numbers that indicate how new, or fresh, a route is.

AODV requires each node to maintain a routing table containing one route entry for each destination that the node is communicating with. Each route entry keeps track of certain fields. Some of these fields are: Destination IP Address, Destination Sequence Number, Next Hop, Hop Count, Lifetime and Routing Flags.

D Dynamic Source Routing

Dynamic Source Routing, DSR, is a reactive routing protocol that uses *source routing* to send packets [7]. DSR was developed in 1996 at CMU. The protocol uses the shortest path as routing metric. Routes are discovered on-demand, and caching is also used. By using the source routing option, a datagram can be routed along a specified path. Giving the addresses of all intermediate routers specifies the path. Then all datagrams have to follow this path to reach the destination. In DSR, first the record-route option is used to discover a given route, then datagrams can be routed with the help of source routing option.

The protocol operates in two phases: first route discovery is performed and then route maintenance.

During route discovery first a route request is broadcasted to all the nodes, then the route reply containing the route-record is propagated back to the source. During the route maintenance phase one has to take care of error packets and inform the source if necessary.

III. Performance Evaluation

In order to evaluate the performance of the routing protocols, the network simulator (ns-2) has been used[8].

A Simulation Scenario

The studied scenario consists of 20, 50 and 100 mobile nodes. The topology is a rectangular area with 800 m length and 600 m width. A rectangular area was chosen in order to force the use of longer routes between nodes, compared to a square area with the same node density. All simulations were run for 150 seconds of simulation time. 10, 25 and 30 of the 20, 50 and 100 mobile nodes respectively are traffic sources sending data packets with a size of 512 bytes, to one of the destination nodes. The sources are distributed randomly within the MANET. A screenshot of the simulation scenario is shown in Figure-1. The 50 small circles represent the mobile nodes.

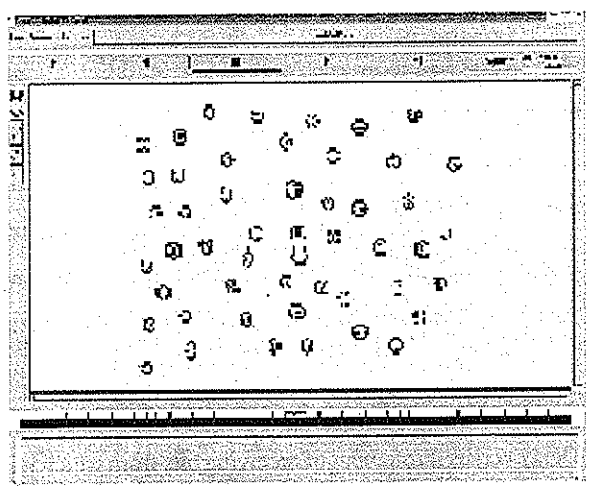

Figure-1. Screenshot of the simulation scenario

B The Mobility Model

The mobile nodes move according to commonly used random waypoint model [11]. With the improved random waypoint model, the mobile node speed reaches steady state after a quick warm-up period. Each mobile node begins the simulation by selecting a random destination in the defined area and moves to that destination at a random speed. The random speed is distributed uniformly in the interval m/s. Upon reaching the destination, the mobile node pauses for some seconds, selects another destination, and proceeds as described. This movement pattern is repeated for the duration of the simulation.

C Performance Metrics

In comparing the routing protocols, the evaluation has been done according to the following metrics [10]:

– The packet delivery ratio is defined as the number of received data packets divided by the number of generated data packets.

– The end-to-end delay is defined as the time a data packet is received by the destination minus the time the data packet is generated by the source.

D Simulation Results

We have done the simulation for three network sizes. First we have taken 20 nodes, 50 nodes and then 100 nodes network respectively.

First Case

In the first simulation scenario, we consider a very small MANET having the values of various parameters as follows

Parameter	Value
Number of Nodes	20
Number of Traffic Sources	10

Node Speed	10,15,20 m/s
Type of Traffic	TCP
Packet Size	512 bytes
Topology Size	800m X 600m
Mobility Patterns	Random waypoint

We have done the simulation for 20 nodes network. For the 20 node network we used 10 traffic sources and we used TCP as the type of traffic. **Figure 2** and **Figure 3** shows graph for throughput of generating and receiving packets against simulation time. It is found that throughput of DSDV is better as compared to DSR and AODV protocols. **Figure-4** shows graph for End-to-End Delay versus throughput of receiving bits from which it is clear that performance of DSR is lower than DSDV and AODV protocol.

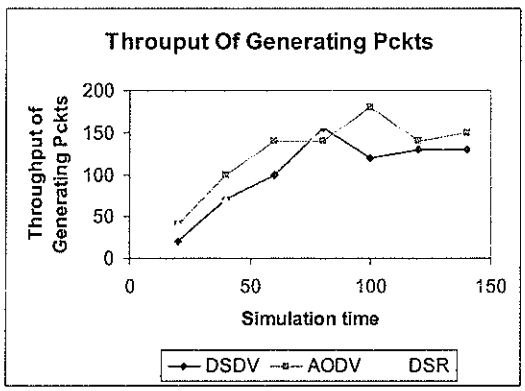

Figure-2 Throughput of Generating Packets

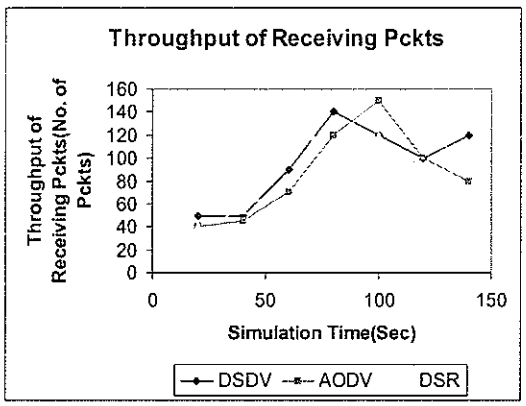

Figure-3: Throughput of Receiving Packets

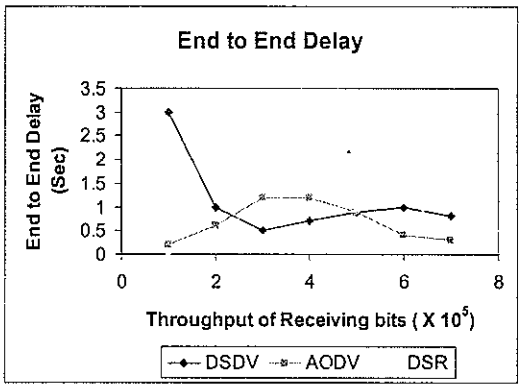

Figure-4: End to End Delay

Second Case

In second Scenario, we consider MANET having 50 nodes and the various parameters as follows

Parameter	Value
Number of Nodes	50
Number of Traffic Sources	25
Node Speed	10,15,20 m/s
Type of Traffic	TCP
Packet Size	512 bytes
Topology Size	800m X 600m
Mobility Patterns	Random waypoint

Here we have done the simulation for 50 nodes network. For the 50 node network we used 25 traffic sources and we used TCP as the type of traffic. **Figure 5** and **Figure 6** shows graph for throughput of generating and receiving packets against simulation time. It is found that throughput of DSR protocol increases gradually than DSDV and AODV protocols. **Figure-7** shows graph for End-to-End Delay versus throughput of receiving bits from which it is clear that performance of AODV is better than DSDV and DSR protocol in terms of delay.

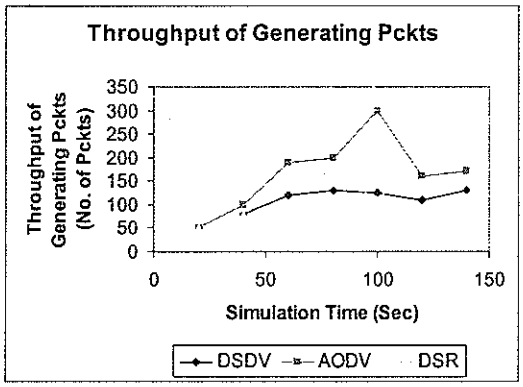

Figure-5: Throughput of Generating Packets

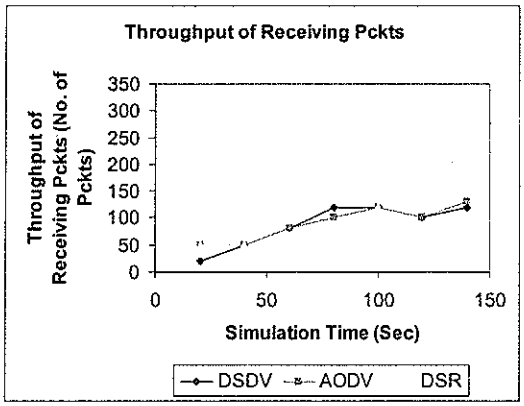

Figure-6: Throughput of Receiving Packets

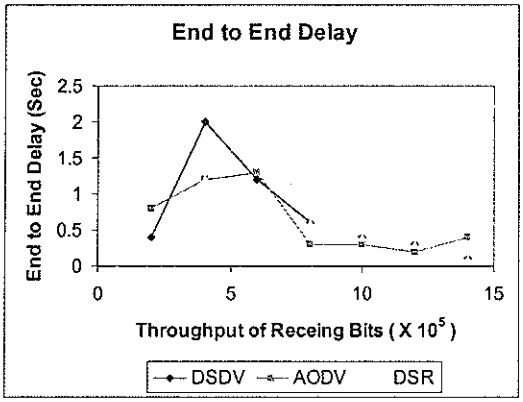

Figure-7: End to End Delay

Third Case

In Third Scenario, we consider MANET having 100 nodes and the various parameters as follows

Parameter	Value
Number of Nodes	100
Number of Traffic Sources	30
Node Speed	10,15,20 m/s
Type of Traffic	TCP
Packet Rate	5 packets/s
Packet Size	512 bytes
Topology Size	800m X 600m
Mobility Patterns	Random waypoint

We have done the simulation for 100 nodes network. For the 100 node network we used 30 traffic sources and we used TCP as the type of traffic. **Figure 8** and **Figure 9** shows graph for throughput of generating and receiving packets against simulation time. It is found that throughput of AODV protocol is greater than DSDV and DSR protocols. **Figure-10** shows graph for End-to-End Delay versus throughput of receiving bits from which it is clear that performance of DSR is better than DSDV and AODV in terms of delay.

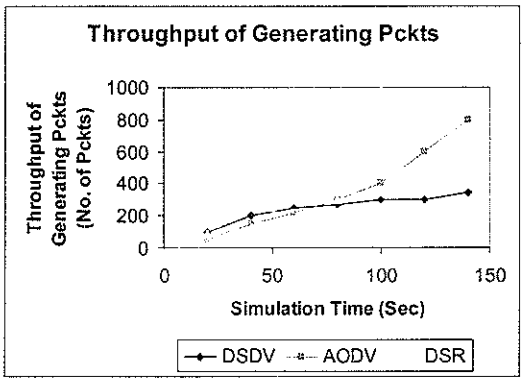

Figure-8: Throughput of Generating Packets

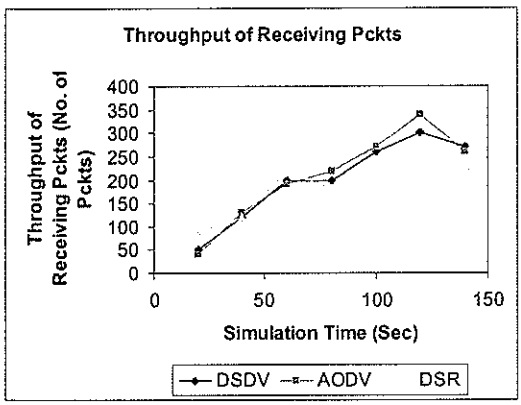

Figure-9: Throughput of Receiving Packets

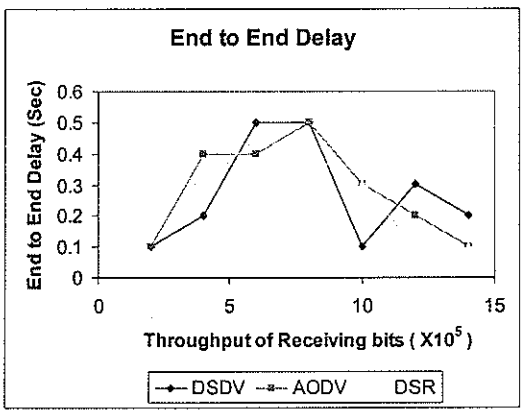

Figure-10: End to End Delay

IV. Conclusion

To improve efficiency of mobile ad hoc networks, it is essential to model the performance of existing protocols. In order to do so, we have compared the performance of Proactive (DSDV) and Reactive (DSR and AODV) routing protocols for mobile ad hoc networks in terms of Throughput and End to End Delay.

It was observed from simulation that DSDV gives maximum throughput in small sized network, DSR for Medium sized networks and AODV for large sized networks.

For End to End Delay, the performance of DSDV and AODV is better then DSR in case of small sized networks. In medium sized networks End to End Delay of AODV is little smaller that DSR and DSDV protocol. DSR has lower Delay in case of large sized networks due to gain of information by the source routes to many more destination than AODV protocol.

V. References

[1] C.E. Perkins, Ad Hoc Networking, Addison-Wesley, 2001.

[2] C.E. Perkins and P. Bhagwat, Highly Dynamic Destination-Sequenced Distance- Vector Routing (DSDV) for Mobile Computers, Comp. Comm. Rev., Oct. 1994, pp.234-244.

[3] C.K. Toh, Ad hoc Mobile Wireless Networks: Protocols and Systems, Prentice Hall, New Jersy 2002.

[4] Comer D.E, "Internetworking With TCP/IP Volume I: Principles, Protocols, and Architectures, 4th edition, 2000.

[5] Daniel Lang, A comprehensive overview about selected Ad Hoc Networking Routing Protocols, M.S Thesis, March 14, 2003

[6] Elizabeth M. Royer, Chai-Keong Toh, A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks, IEEE Personal Communications, Vol. 6, No. 2, April 1999, pp. 46-55.

[7] Johnson D.B.; Maltz D.A.; Hu Y.; Jetcheva J.G, The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR), IETF Internet Draft, Feb 2002.

[8] McCanne S.; Floyd S. Network Simulator. http://www.isi.edu/nsnam/ns/. Kevin Fall, Kannan Varadhan, and the VINT project. The ns manual.

[9] Perkins C, Belding-Royer E.M, Das S, Ad hoc On-Demand Distance Vector (AODV) Routing, IETF Internet Draft, Jan 2002.

[10] Samir R. Das, C.E. Perkins, E.M. Royer; Performance Comparison of Two On-Demand Routing Protocols for Ad hoc Networks, Infocomm 2000.

[11] T. Camp, J. Boleng, and V. Davies, A survey of mobility models for ad hoc network research, Wireless Communication and Mobile Computing (WCMC): Special issue on Mobile Ad Hoc Networking Research, Trends and Applications, vol. 2, no. 5, 2002,pp. 483–502.