Performance Comparison of AODV, DSDV and DSR Protocols in Mobile Networks using NS-2

R. F. Sophia Pearlin* and G. Rekha

1. Introduction

An adhoc wireless network is an accumulation of one or more devices armed with wireless networking and communications facility. These armed devices can communicate with other devices or nodes those who are in their radio range or in other outside radio ranges. For relaying or forwarding the packets from source to destination, an intermediate node can be used. Usually, the adhoc wireless networks are adaptive and self-organizing networks. These networks do not have any centralized administration. The word “ad hoc” refers to “can take different forms” and “can be networked, mobile or stand-alone".

These mobile adhoc networks are more dynamic in nature so that the routing protocols should be more adaptable to the changing topologies and to the changing connectivity of the network. These ad hoc networks can find its applications in military, exploration missions and in emergency rescue operations. These can be useful for some other commercial applications also. The following sections will be discussing about the MANET routing protocols, simulation model, performance matrices and finally conclusion.

2. Manet Routing Protocol

So many different criteria are there for classifying and designing the routing mechanisms for manets1,2. For example, what are all the routing mechanisms has to be exchanged and how it should be exchanged, when and how the routes has to be toted up etc?

2.1 Table-Driven Routing Protocols

These routing mechanisms are the natural elongation of the routing protocols for the wired networks. In table driven mechanisms, each node will be having one or more routing tables that contains the routing information of any other nodes in the network. These routing protocols
are always adaptive to the changing topologies of the network by updating the routing tables for the changing environment. These mechanisms are more convenient for networks which are larger, as they maintain so much entries for every node in the network. This increases the bandwidth in the network. Destination Sequenced Distance Vector (DSDV) routing is an example for table driven routing protocol.

2.2 Destination-Sequenced Distance-Vectors Routing (DSDV)

DSDV is one of the table driven routing protocol which is based on Bellman - Ford routing algorithm. This Bellman - Ford routing algorithm has a routing loop problem which gets solved by DSDV. For solving this problem, it uses sequence number for each entry in the routing table. If the link is present, then the sequence number will be even. If the link is not present, then the sequence number will be odd. These numbers are usually generated by the destination and the generators should send this sequence number along with the next update. This protocol can disperse the information of routing between nodes by the full dumps or by smaller incremental updates.

2.3 On-Demand Protocols

On-demand protocols are also called as reactive routing protocols. In this on-demand routing, whenever a source node desires for a route, then this mechanism creates route for it. When a node needs a route to reach the destination, a process of route discovery gets initiated. This computes all possible routes. After the discovery and establishment of the route, it gets maintained by the route maintenance procedure. This protocol is suitable for larger networks. Examples are Ad-hoc On demand Distance Vector (AODV) routing and Dynamic Source Routing (DSR).

2.4 Ad-Hoc On Demand Distance Vector (AODV)

AODV is an example for reactive protocols. In AODV routing mechanism, each node is maintaining a routing table which consists of next hop IP and destination addresses and also their sequence numbers. Along with these information, the routing table also consists of lifetime information, distance to destination and precursor nodes list. A node sends a route request (RREQ) packet for initiating the route discovery process. The source node will be sending the route request packet to its neighbor until it finds the destination or it finds an alternate route to reach the destination. AODV ensures that all nodes in the network are loop free. After receiving the RREQ packet, the destination responds it with a route reply (RREP) packet to the source. Then the node updates the routing table information once it finds the better route.

2.5 Dynamic Source Routing (DSR)

DSR algorithm is one of the important on demand routing protocol in adhoc networks. This type of protocol uses only less bandwidth in networks where the mobility is low. This is one of the efficient and simple routing protocol for adhoc networks. There are two phases in this protocol. They are route discovery phase and route maintenance phase. The source node will first search for the route cache to reach the destination. If it does not find any route cache, then the node initiates the process of route discovery, which is executed by a route request message to find the route to reach the destination. After finding the route, the node responds with the route reply packet which consists of the routing information required by source. Using this newly discovered route, the data packets can be forwarded to the destination. DSR can be able to support rapid topology changes.

3. Simulation and Comparison

NS2.34 has been used for the simulation of AODV, DSDV and DSR routing mechanisms. It is a network simulator which can be intelligible easily and it is used to favor all types of networks. This simulator is also known as discrete event driver simulator because it can able to start and stop the packet transmission at the specified time. We have taken nodes range in the scenario as 20, 30, 40, 50, 60 and the source node is 0 and the destination node is 2. Node 2 is moving in nature, so path to the destination is changing every time. The following figures Figure 1, 2, 3, 4, 5 will be showing creation of nodes in the scenario.

Thus the nodes have been created in the scenario and then the transmission is also done between the nodes 0 and 2. Then these 3 protocols were compared based on 3 functional parameter metrics given below.
3.1 Packet Delivery Ratio:
Packet Delivery Ratio (PDR) is defined as the ratio of how much of packets sent by the source to the how much of packets received by the destination. The measurement of loss rate is done here. For a good network connectivity, a great packet delivery ratio is needed.

3.2 End-to-End Delay:
End-to-End delay is defined as the average network time that the network forwards the packet from the source to the destination. This includes all the delays that are available in the network.

3.3 Control Overhead:
Control overhead is defined as the extra time that it takes to transmit the data on a switched network. Some packets usually require the extra formatting information which decreases the overall transmission speed of the raw data.

Now the performance metrics for the three protocols to the scenarios with changing number of nodes are given in the following Figure 6, 7, 8, 9, 10. At first, AODV protocol is used in the changing scenario and the performance metrics are simulated as follows. Similarly, by changing the number of nodes in the scenario. We can get the following results.

Secondly, by using DSDV protocol in the changing scenario, the performance metrics results are given in the following Figure 11, 12, 13, 14, 15.

Then, at last, by using the DSR protocol in the changing scenario, the performance metrics results have been given in the following Figure 16, 17, 18, 19, 20.

Thus, the protocols such as AODV, DSDV, DSR have been simulated in the scenario of changing number of nodes and got the performance metrics also. The following will give the performance comparison of the three
Figure 7. Performance metrics of AODV protocol when the number of nodes is 30.

Figure 8. Performance metrics of AODV protocol when the number of nodes is 40.

Figure 9. Performance metrics of AODV protocol when the number of nodes is 50.

Figure 6. Performance metrics of AODV protocol when the number of nodes is 20.

Figure 10. Performance metrics of AODV protocol when the number of nodes is 60.

Figure 11. Performance metrics of DSDV protocol when the number of nodes is 20.

protocols by its end to end delay, packet delivery ratio and the control overhead with respect to the changing number of nodes.

The tabulations are given in the following Table. 1, 2, 3.

Performance comparison of the three protocols by the graphical representation is shown in Figure 21, 22,23.

By comparing the packet delivery ratio of the three protocols, DSR and AODV routing protocols can deliver more packets than DSDV routing protocol. The comparison of the three protocols by its end to end delay implies that end to end delay is outrageous in AODV followed by DSR and DSDV, which have the lowest and most stable End to End Delay in mobility. By increasing number of nodes, increases the end to end delay in AODV. In DSR and DSDV, there is slightly lower delay compared to AODV. The comparison of three protocols by its control...
overhead shows that DSDV has huge control overhead because it updates the routing table periodically in the network. Then AODV is slightly lower than the DSR and DSDV, because it is having lower control overhead than the two other routing protocols.
Figure 19. Performance metrics of DSR protocol when the number of nodes is 50.

Figure 20. Performance metrics of DSR protocol when the number of nodes is 60.

Table 1. Performance metrics for AODV protocol

| No. of nodes | Packet Delivery Ratio | End to end delay | Overhead |
|--------------|-----------------------|------------------|----------|
| 20           | 99.8976               | 0.00701998       | 34       |
| 30           | 98.567                | 0.0655349        | 87       |
| 40           | 100                   | 0.0119369        | 40       |
| 50           | 88.6387               | 0.6616           | 103      |
| 60           | 67.5537               | 1.65949          | 1406     |

Table 2. Performance metrics for DSDV protocol

| No. of nodes | Packet Delivery Ratio | End to end delay | Overhead |
|--------------|-----------------------|------------------|----------|
| 20           | 80.2456               | 0.00581059       | 548      |
| 30           | 78.5056               | 0.00786292       | 947      |
| 40           | 94.8311               | 0.0121158        | 1286     |
| 50           | 51.433                | 0.0221576        | 1814     |
| 60           | 27.5333               | 0.87667          | 2234     |

Table 3. Performance metrics for DSR protocol

| No. of nodes | Packet Delivery Ratio | End to end delay | Overhead |
|--------------|-----------------------|------------------|----------|
| 20           | 100.051               | 0.00711864       | 6        |
| 30           | 100                   | 0.0087362        | 11       |
| 40           | 100                   | 0.0122731        | 6        |
| 50           | 99.6929               | 0.154969         | 126      |
| 60           | 90.8393               | 1.08911          | 36       |

Figure 21. Packet Delivery Ratio Vs number of nodes.

Figure 22. End to end delay vs. number of nodes.

Figure 23. Control overhead Vs number of nodes.
4. Conclusion

From all the tabulations and graphs, it is clear that AODV and DSR are performing their best at their less packet sizes and at their less number of nodes in the scenario. DSDV protocol is not as good as the DSR and AODV because it has a very low packet delivery ratio. But it is having high control overhead. By comparing the end to end delay, DSR protocol is performing best then other protocols.

5. References

1. Arora Vasudha. Performance Evaluation of Routing protocols for MANETs under Different Traffic Conditions, 2nd IEEE International Conference on Computer Engineering and Information Technology. 2010; p. 79-84.
2. Yasser, Mohamed, and Safwat Ahmed. Performance Evaluation of Mobility Speed over MANET Routing Protocols. International Journal of Network Security. 2010; 11:128-38.
3. Aggarwal Akshai, Gandhi Savita, Chaubey Nirbhay. Performance analysis of AODV, DSDV and DSR in manets. International Journal of Distributed and Parallel Systems (IJDPS). 2011 November; 2(6):11.
4. Perkins, Royer and Das. Ad hoc On-demand Distance Vector (AODV) Routing, RFC 3561. 2003 July; p. 1-37.
5. Vaidya NH. Mobile Ad hoc networks routing, Mac and transport issues. Proceedings of the IEEE International Conference on Computer Communication INFOCOM. 2004.
6. Rao Meena, Singh Neeta. Performance evaluation of AODV nth BR routing protocol under varying node density and node mobility for MANETs. Indian Journal of Science and technology. 2015 August; 8(17):1-9.
7. Kaur Rupinder, Singh Paramdeep, Gaba Gurjot Singh, Pasricha Ruchi. Performance enhancement of AODV with distributed - DSR routing protocol in MANET. Indian Journal of Science and Technology. 2015 October; 8(28):1-6.
8. Er. Abhishek, Parashar. Performance Comparison of Ad-hoc Network Routing Protocols Using NS-2 Simulator, IRACST - Engineering Science and Technology: An International Journal (ESTIJ). ISSN: 2250-3498; 2012 April, 2(2):330-35.
9. Sabina, Kasapovic and Jasmina. Comparison of MANET Routing Protocols in Different Traffic and Mobility Models. Telfor Journal. 2010; 2(1):8-12.
10. Vikas. Traffic Pattern based performance comparison of Reactive and Proactive Protocols of Mobile Ad-hoc Networks. International Journal of Computer Applications. 2010 August; 5(10):16-20.
11. Azzedine, Bamis, Chatzigiannakis, Nikoletseas. A mobility aware protocol synthesis for efficient routing in ad hoc mobile networks. The International Journal of Computer and Telecommunications Networking. 2008 Jan; 52(1):130-54.