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Simulation Based Comparative Performance Analysis of Mobile Ad Hoc Routing Protocols

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Abstract: ***Mobile Ad Hoc Network (MANET) is a group of mobile nodes that are dynamically and arbitrarily located in such a manner that the interconnections between nodes are capable of changing on a continual basis. Routing in MANET is very important issue as dynamic topology of MANET makes routing very difficult. This paper shows comparative performance evaluation of two prominent on-demand reactive routing protocols in mobile ad hoc networks: Ad Hoc On-demand Distance Vector (AODV) and Dynamic Source Routing (DSR). Performance is compared on the parameters like Packet delivery ratio i.e. throughput, Average end to end delay and Normalized routing overhead using network simulator-2(NS-2). The general observation of the results indicate that considered protocols react in similar way in low load and low mobility scenarios, but under high mobility DSR outperforms AODV protocol, although DSR and AODV share similar on-demand behavior.***

Keywords: MANET, DSR, AODV, NS-2, Routing

1. Introduction

Mobile nodes, in infrastructure mobile networks, communicate with fixed access point that acts as a router for them using wireless channels. However, Mobile Ad hoc Network (MANET) is a wireless network without any infrastructure support. It does not require any base station to communicate among participating systems called nodes. In this nodes are mobile i.e. they can move while participating in the network. Routing, as an act of moving information from source to destination trough intermediate nodes, is a fundamental issue for networks. Effectiveness of any network, including mobile ad hoc network, depends on routing protocol. Routing in such networks is major concern as being mobile they have dynamic topology, limited bandwidth and energy resources makes designing of routing protocols very difficult. In this work, we have compared two routing protocols namely DSR and AODV with the help of ns-2 simulator. The evaluation parameters used for comparison include Packet delivery ratio, Average end to end delay and Normalized routing overhead against the input parameter pause time. Classification of routing protocols, as well as description and illustration of considered routing protocols are given in Section 2. Scenarios and simulation parameters are described in Section 3. Simulation results and analysis are presented in Section 4. Section 5 concludes this paper.

2. Routing Protocols

This section provides the review of different routing protocols which will be evaluated in this paper

2.1 Dynamic Source Routing (DSR) protocol

As name suggests this protocol uses source routing i.e. source will decide which route will be followed by a packet and embed it in packet. The key feature of this protocol is that it is a pure on demand protocol, i.e. it does not employ any periodic exchange of packets. Consequently, DSR applies on demand schemes for both route discovery and route maintenance. This makes the routing overhead traffic scales to the actual needed size automatically, which is considered as the main advantage of DSR. On the other hand, DSR employs source routing, so that each data packet contains the full path it should traverse to its destination. Source routing is some time considered as a disadvantage of DSR. The DSR protocol is composed of two main mechanisms route discovery and route maintenance.

Route discovery: is the mechanism by which a source node wishing to send a packet to a destination node, obtains a source route to the destination.

Route Maintenance: is the mechanism by which a node wishing to send a packet to a destination is able to detect, while using a source route to the destination, if the network topology has changed.

A routing entry in DSR contains all the intermediate nodes information of the route rather than just the next hop information maintained in DSDV and AODV. A source puts the entire routing path in the data packet, and the packet is sent through the intermediate nodes specified in the path. If the source does not have a routing path to the destination, then it performs a route discovery by flooding the network with a route request (RREQ) packet. Any node that has a path to the destination in question can reply to the RREQ packet by sending a route reply (RREP) packet. The reply is sent using the route recorded in the RREQ packet.

2.2 Ad hoc On demand Distance Vector (AODV) routing protocol

The key feature of this protocol is that applying a distributed routing scheme. The route discovery is done as required by flooding route request packets when they reach destination, it sends route reply packet using same path which is followed by route request packet in opposite direction. In contrast to the source routing applied by DSR, AODV depends on storing the next hops of a path as entries in the intermediate nodes, which is considered as an advantage. However this may require additional resources form the intermediate nodes, which is the negative side of AODV.

This routing protocol uses an on-demand approach for finding routes, that is, a route is established only when it is required by a source node for transmitting data packets. It employs destination sequence numbers to identify the most recent path. The major difference between AODV and Dynamic Source Routing (DSR) stems out from the fact that DSR uses source routing in which a data packet carries the complete path to be traversed. However, in AODV, the source node and the intermediate nodes store the next-hop information corresponding to each flow for data packet transmission. In an on-demand routing protocol, the source node floods the RouteRequest packet in the network when a route is not available for the desired destination. It may obtain multiple routes to different destinations from a single RouteRequest. When an intermediate node receives a RouteRequest, it either forwards it or prepares a RouteReply if it has a valid route to the destination. All intermediate nodes having valid routes to the destination, or the destination node itself, are allowed to send RouteReply packets to the source. When a node receives a RouteReply packet, information about the previous node from which the packet was received is also stored in order to forward the data packet to this next node as the next hop toward the destination.

3. Performance evaluation of routing protocols

The simulation experiments are performed with the help of Network Simulator-2 which is a freely available networking tool. The traffic sources are CBR (continuous bit – rate). The source-destination pairs are spread randomly over the network. The data packet size is 512 bytes. The mobility model selected is *random waypoint model* in a square filed of 1000m x1000m with 50 nodes. In this mobility model, each node starts its journey from a random chosen location and to a randomly chosen destination. The pause time of nodes is varied between 0 to 500 seconds. Different network scenarios for different numbers of source, pause time are generated. Simulation is performed for 500 seconds. Table 1 shows the simulation parameter setting for the protocol evaluation.

Table 1: Simulation parameters

Number of Nodes	20/30/40
Traffic Pattern	CBR (Constant Bit Rate)
Network Size	1000 x 1000
Mobility Model	Random Way Point
Simulation Time	500 s
Pause Time	0/50/100/200/300/500 s
Routing Protocol	DSR/AODV
MAC Protocol	802.11

Following performance metrics are considered for evaluation:

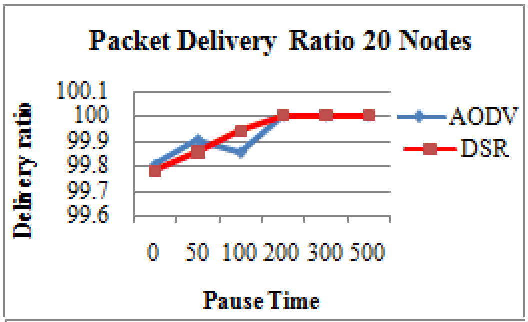
- *Packet Delivery Ratio (PDR)*: The ratio of the data packets delivered to the destination to those generated by the sources.
- *End-to-end delay:* This includes all possible delays caused by buffering during route discovery latency, queuing at the interface queue, retransmission delays at the MAC, propagation and transfer times.
- *Routing overhead:* The number of extra routing packets "transmitted" per data packet "delivered" at the destination.

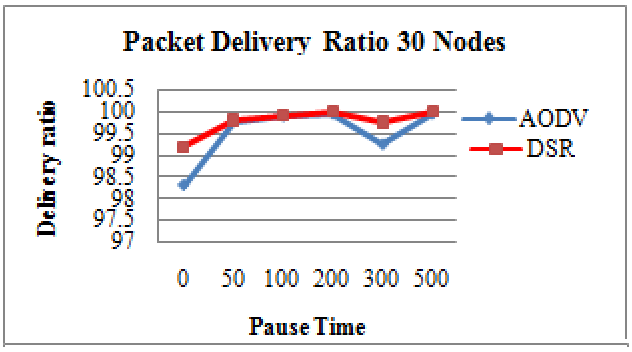
4. Simulation Results

Below are the comparison graphs showing results of our work. In all simulation the pause time is in seconds.

4.1 Packet Delivery Ratio

It is the ratio of data packets received by the destination to the packets send by the source. Figure 1 shows the Packet Delivery Ratio with respect to pause time for 20, 30 and 40 number of sources. Graphs depict both protocols performed well for different pause time and is nearly equal to 100% but DSR slightly beaten AODV due to fact that its route cache stores multiple path to a destination thus if one route fails packet is immediately forwarded through other routes available in the cache.





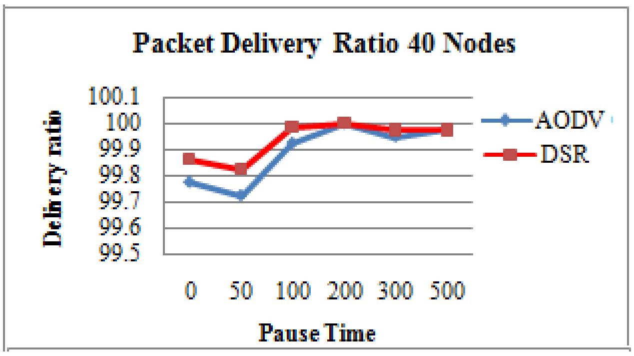


Figure 1: Packet Delivery ratio vs. Pause time for 20, 30 and 40 number of nodes

4.2 Average End To End Delay

It is the difference between the sending time and receiving time of a packet which includes all possible delays like queuing at the interface, retransmission delay at MAC level, buffering during route discovering process, propagation and transfer delay.

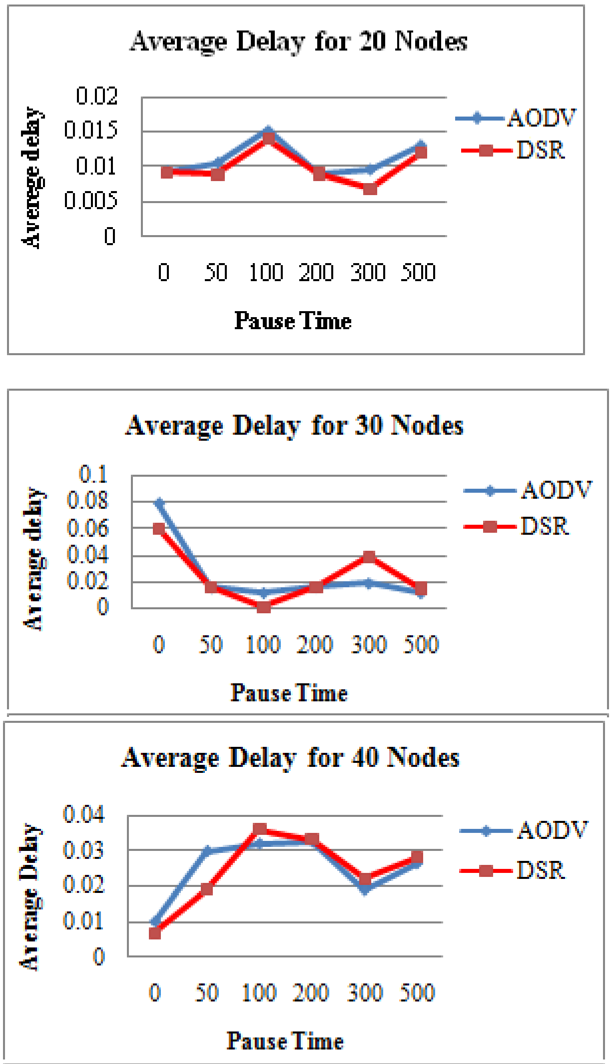


Figure 2: Average end to end delay vs. Pause time for 20, 30 and 40 number of sources

Figure 2 shows the Average Delay with respect to Pause time for 20, 30 and 40 number of sources. Here both protocols performed almost same but AODV was slightly better as it always uses best path available while in DSR cache may contain stale information.

4.3 Normalized Routing Overhead

It is the number of routing packets transmitted by the source per delivery of data packet by the destination. Figure 3 shows the Normalized Routing Overhead with respect to Pause time for 20, 30 and 40 number of sources. In this DSR outperformed AODV due to fact it finds and stores all paths available to destination in a cache after route discovery unlike AODV which stores only one path. Thus DSR does not have to initiate route discovery very often every time a route breaks on other hand AODV as to initiate route discovery every time. At high mobility, routing overload for both increases due to more route breaks. Figure 8 shows the Normalized Routing Overhead with respect to Speed for 20, 30 and 40 number of sources. The results and reasons are same as above.

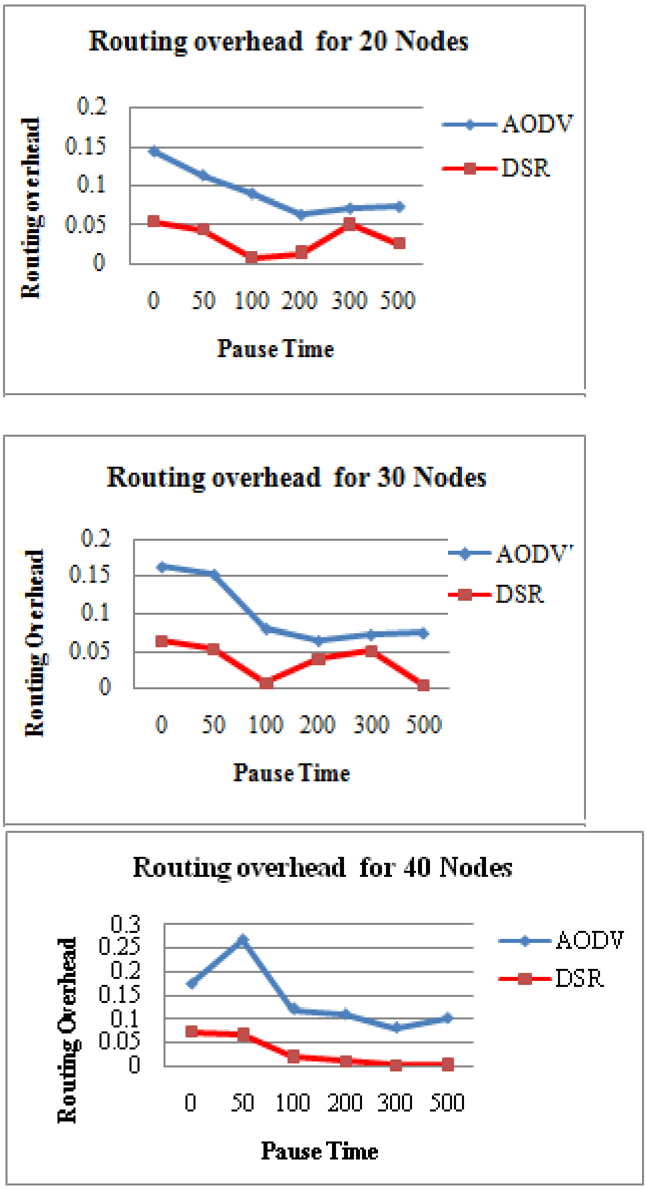


Figure 3: Normalized Routing Overhead vs. Pause time for 20, 30 and 40 number of sources

5. Conclusion

The analysis shows that routing is very important factor for evaluating the performance of the system. Traditional routing algorithms cannot satisfy the requirements of an ad hoc network, because of the dynamic topology and the limited bandwidth that characterize these networks. For this reason there is a lot of research that deal with the extension of the existing routing algorithms or with the discovery of new and more efficient routing algorithms. This paper evaluated and compared AODV and DSR routing algorithm using simulation. Results of our work shows that DSR has performed slightly better than AODV for performance parameters like Packet Delivery Ratio and Normalized Routing Overload but performed slightly poor in terms of

Average Delay. This is due to fact that DSR uses route cache very aggressively.

References

[1] Kapil, Dheeraj Nitnaware, Oct 2007, Performance Evaluation Of On-Demand Routing Protocols, in proceedings of national conference on Wireless and Mobile Computing held at PEC, Chandigarh.
[2] J. Broch, D.A. Maltz, D.B. Johnson, Y.C. Hu and J. Jetcheva, October 1998, A Performance Comparison of Multi hops Wireless Ad Hoc Network., In proceedings of the 4th Int. Conference on Mobile Computing and Networking (ACM MOBICOM'98), pp. 58-97.
[3] D.B. Johnson, D.A. Maltz and J. Broch, November 1999, The Dynamic Source Routing (DSR) Protocol for Mobile Ad Hoc Networks, Internet Draft, MANET Working Group, draft-ietf-manet-dsr-03.txt.
[4] C. Perkins and E. Royer, March 2000, Ad Hoc on Demand Distance Vector (AODV) Routing, Internet Draft, MANET Working Group, draft-ietf-manet-aodv-05.txt.
[5] S.R. Das, C.E. Perkins and E.M. Royer, March 2000, Performance Comparison of Two On-Demand Routing Protocols for Ad Hoc Networks, In Proceedings of IEEE Infocom
[6] Carlos Cano and Pietro Manzoni, March 2000, A Performance Comparison of Energy Consumption for Mobile Ad Hoc Network Routing Protocols, In Proceedings of IEEE Infocom,
[7] Humaira Ehsan and Zartash Afjal Uzmi, 2004, Performance Comparison of Ad Hoc Wireless Network Routing Protocols, In Proceeding of IEEE.
[8] "The Network Simulator-2," http://www.isi.edu/nsnam-ns/ and http://www.isi.edu/nsnam/ns/tutorial
[9] C. Perkins and P. Bhagwat, October, 1994, Highly Dynamic Distance Destination Sequenced Distance Vector Routing (DSDV) for Mobile Computers, Computer Communication, pp. 234-244.