Simulation and Comparative Analysis of Proactive and Reactive Routing Protocols in Mobile Ad-Hoc Networks (MANeT)

Anil Kumar Sharma[1], Neha Bhatia[2]

[1]*Asst. Prof., Deptt. of ECE, Institute of Engg. and Technology, Alwar, Raj.-301030 (India),*
E-mail: aks_826@Yahoo.co.in
[2]*Deptt. of ECE, Institute of Engg. and Technology Alwar, Raj.-301030 (India),*
E-mail: nehabhatia2006@gmail.com

Abstract - *An ad-hoc network is a collection of wireless mobile hosts forming a temporary network without the aid of any stand-aloneinfrastructure or centralized administration. Mobile Ad-HoC Networks are self-organizing and self-configuring multihop wireless networks where the structure of the network changes dynamically. This is mainly due to the mobility of the nodes. Nodes in these networks utilize the same random access wireless channel cooperating in a friendly manner to engaging themselves in multihop forwarding. The node in the network not only acts as hosts but also as routers that route data to/from other nodes in network. Each device in a MANET is free to move independently in any direction and will therefore change its links to other devices frequently. Each must forward traffic unrelated to its own use and therefore be a router. Routing in Ad-HoC networks has been a challenging task ever since the wireless networks came into existence. The major reason for this is the constant change in network topology because of high degree of node mobility. A number of protocols have been developed for accomplishing this task. Routing is the process of selecting paths in a network along which to send network traffic. In packet switching networks, routing directs packet forwarding, the transit of logically addressed packets from their source toward their ultimate destination through intermediate nodes. An ad hoc routing protocol is a convention, or standard, that controls how nodes decide which way to route packets between computing devices in a mobile ad-hoc network. In ad hoc networks, nodes do not start out familiar with the topology of their networks instead, they have to discover it.The present thesis shows simulation study and comparison of the performance between two categories of routing protocols, table-driven (Proactive) and on-demand (Reactive) routing protocols, this two categories were illustrated by using three different examples of routing protocols. First example is DSDV (Destination Sequenced Distance-Vector) from the Proactive family and the second example is AODV (Ad Hoc On-Demand Distance Vector) and DSR (Dynamic Source Routing Protocol) from the Reactive family. Both protocols were simulated by using NS-2 (network simulator-2) package. Both routing protocols were compared in terms of average throughput (packets delivery ratio), pause time, maximum packets in queue and average delay and Speed. The results are shown in tabular & graphic form.*

Keyword - AD-HoC network, DSDV, DSR, AODV, OLSR.

I. INTRODUCTION

A mobile ad hoc network (MANET) is a type of wireless networks. This type depends on the mobile nodes and there is no infrastructure in such type. There are no routers, servers, access points or cables. Nodes (mobiles) can move freely and in arbitrary ways, so it may change its location from time to time. Each node may be a sender or a receiver, and any node may work as a router and do all router functions. This means that it can forward packets to other nodes. Many applications of MANET's are implemented and used until today like in: meeting conferences; military operations; search and rescue operations, all of them are examples of MANET networks   [1-3]. MAODV protocol keeps sending control packets within static periods, whether there is sending of data packets or not, and it is not concerned with the amount of these data packets. Based on this, many people found out that there are a high number of control packets in the short-lived Connection[4].

II. PROPOSED PROBLEM AND SOLUTION

The objective of this paper is to study the comparison in mobile ad hoc networks and evaluate proposed routing protocols for wireless ad hoc networks based on performance. This evaluation could be done through simulation. The work comprises to simulate and implement Mobile Ad Hoc Routing protocol and detect the various possible properties of various protocols. The simulation environment that could be used as a platform is based on Network Simulator ns2 from Berkeley. The IETF currently has a working group named Mobile Ad hoc Network (MANET) that is working on routing specifications for Ad hoc Networks. Mobile networks that meet the demand for instantaneous communications establishment are called Mobile Ad hoc Networks. Like

the Internet, datagram in an ad hoc network may travel along multiple hops until they reach their destination. In ad hoc networks, routing is a major challenge. Several routing protocols for ad hoc networks emphasis on stable and shortest routes while ignoring major issue of delay in response whenever break occurs. Some other areas of consideration are:-

- Get a general understanding of ad hoc networks.
- Study of security issues in ad hoc networks
- Implement some of the proposed routing protocols for wireless networks
- Analyze the protocols through simulation in different mobility scenarios

III. ROUTING PROTOCOLS OF MOBILE AD HOC NETWORKS (MANET)

A mobile ad hoc network (MANET) is a collection of nodes, which have the possibility to connect on a wireless medium and form an arbitrary and dynamic network with wireless links. This means that links between the nodes can change with time, new nodes can join the network, and other nodes can leave it. A MANET is expected to be of larger size than the radio range of the wireless antennas, because of this fact it could be necessary to route the traffic through a multi-hop path to give two nodes the ability to communicate. There are neither fixed routers nor fixed locations for the routers as in cellular networks - also known as infrastructure networks. Cellular networks consist of a wired backbone, which connects the base-stations. The mobile nodes can only communicate over a one-hop wireless link to the base-station; multi-hop wireless links are not possible. By contrast, a MANET has no permanent infrastructure at all. All mobile nodes act as mobile routers.   A MANET is highly dynamic. Links and participants are often changing and the quality of the links as well. Furthermore, asymmetric links are also possible. New routing protocols are needed to satisfy the specific requirements of mobile Ad hoc networks. There exists a large family of ad hoc routing protocols.

IV. CLASSIFICATION OF ROUTING PROTOCOLS

Nodes in ad hoc network also function as routers that discover and maintain routes to other nodes in the network. Thus, the primary goal of MANET is to establish a correct and efficient route between a pair of nodes and to ensure the correct and timely delivery of packets. The protocols for routing can be classified as [18]:

Proactive/ Table Driven : In proactive routing protocols, the routes to all the destination (or parts of the network) are determined at the start up, and maintained by using a periodic route update process. These attempts to maintain consistent up-to-date

routing information from each node to every other node in the network. The routing information is usually kept in tables, which are updated as the network topology changes. The main proactive protocols are Destination Sequenced distance Vector (DSDV) and Optimized Link State Routing (OLSR).

Destination Sequenced Distance Vector (DSDV) : The DSDV algorithm is modification of Distributed Bellman Ford algorithm, which guarantees loop free routes. It provides a single path to destination that is selected using the distance vector shortest path routing algorithm. Two types of update packets are transmitted in order to reduce the amount of overhead through the network. These are referred to as a "full dump" and "incremental" packets. The full dump packets carry all the available routing information and the incremental packets carry only the information changed since the last full dump. The incremental update packets are sent more frequently than the full dump packets. DSDV introduces large amount of overhead to the network due to the requirement of the periodic update messages. Therefore the protocol does not scale in large network since large portion of network bandwidth is used in updating procedures.

Reactive/On-Demand : In these protocols, the routing information is maintained only for active routes. That is, the routes are determined and maintained only for nodes that require sending data to a particular destination. Route discovery usually occurs by flooding a route request packet through the network. Route reply is sent back if the destination itself or node with route to the destination is reached. The reactive protocols are classified as source routing, where each data packet carries the complete source to destination address and hop-by-hop routing, where each data packet only carries the destination address and next hop address. The two main reactive protocols are Dynamic Source Routing (DSR) and Ad hoc On-Demand Distance Vector Routing (AODV).

Dynamic Source Routing : The Dynamic Source Routing Protocol (DSR) is a reactive routing protocol .By the means of this protocol each node can discover dynamically a source route to any destination in the network over multiple hops. It is trivially loop free owing to the fact that a complete, ordered list of the nodes through which the packet must pass is included in each packet header. The two main mechanisms of DSR are Route Discovery and Route Maintenance, which work together to discover and maintain source routes to arbitrary destinations in the network.

Ad-Hoc On-Demand Distance Vector Routing (AODV) : The Ad hoc On demand Distance Vector routing protocol (AODV) joins mechanisms of DSR and DSDV. The periodic beacons, hop-by-hop routing and

sequence numbers (guarantee of loop-freedom) of DSDV and the pure on-demand mechanism of Route Discovery and Route Maintenance from DSR are combined.

V. SIMULATION AND RESULT OF THE THREE PROTOCOLS

In this we have chosen the simulation of 5 nodes in 500x400   square meter area, in other words we have chosen two dimensional area (2D) rectangle. The position of each mobile node is represented in 2D grid; the X-axis value is chosen from the range of (0,500) and Y-axis value is chosen from the range of (0,400). The mobile node then moves to the destination at given speed. Once the destination is reached, the mobile node stops for a given pause time. The mobile node then chooses another random destination for mobile node's next movement. We have used CBR sources that started at different times because we want to get a general view of how routing protocol behaves. We have assumed bi-directional links during our simulations. Because bi-directional links are necessary if 802.11 acknowledgements are supposed to be used. Traffic load is taken very low. The complete simulation parameter are shown in Table.1.

TABLE 1: SIMULATION PARAMETERS FOR DSDV, DSR, AODV

Parameter	Value	Value	Value
Number of odes	5	5	5
Simulation time	280 sec	280 sec	280 sec
Pause Time	0.01 sec	0.01 sec	0.01 sec
Environment Size	500×400 m	500×400 m	500×400 m
Traffic Type	Constant Bit Rate	Constant Bit Rate	Constant Bit Rate
Packet size	512 bytes	512 bytes	512 bytes
Protocol	DSDV	AODV	DSR

VI. COMPARISION OF DSDV, DSR AND AODV

The relative throughput performance of three routing protocols is shown in Fig.1 as pause time for 20 nodes changes.
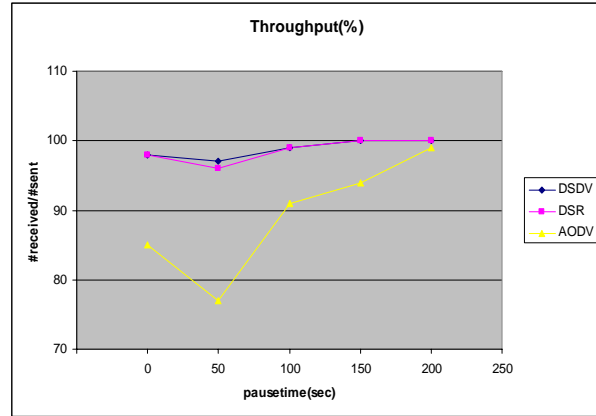

Fig 1.Throughput vs Pause Time.

Although implicitly related to the pause time metric, we found it relevant to use another terminology for the "mobility" of the nodes, which basically shows how fast the nodes are moving. We will consider a wide range of speeds for our mobile nodes from 1 m/s (3.6 km/hour) that corresponds to walking at a slow pace, to 50 m /s (180 km/hour), the speed of a very fast car. Refer Fig.2.
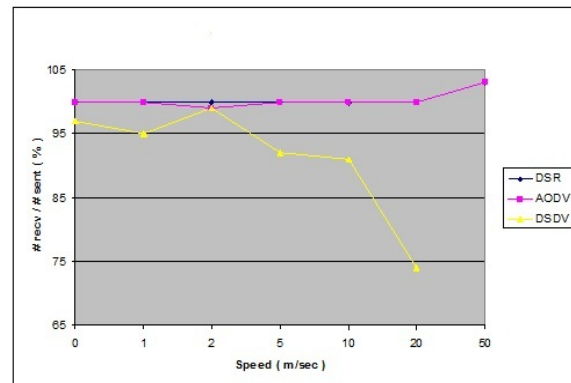

Fig 2. Throughput vs Speed.

In Fig.3 it can be seen that increase in node speeds results in significant increase in the average end-to-end packet delivery delay of AODV protocol. This is because when a node receives a route request for which it has the answer in its routing table, it immediately replies with the route rather than forwarding it to the destination. The source can now start to communicate with the destination. Since AODV maintains only one routing entry per destination, it has to do more route discoveries as the speed increases. Therefore, in Fig 3.the average delay increases as the time taken to find a route to the destination increases when there is no entry for it in the intermediate nodes.
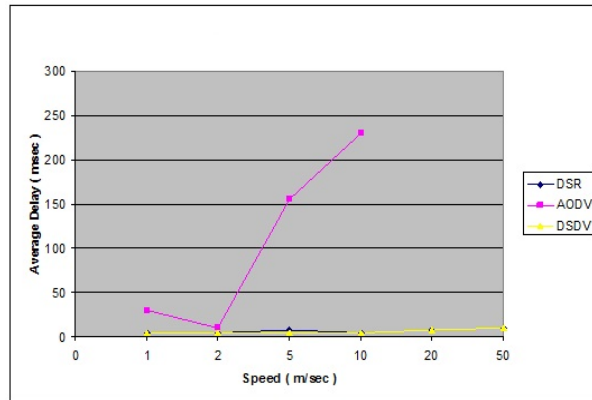
Fig. 3 Average delay vs speed.

VII. CONCLUSION

After Studing and Simulating the protocols (AODV,DSDV And DSR) of mobile Ad-HoC Network on Network Simulator-2.The following result have been found:

- When nodes pause for larger times, the protocols deliver a greater percentage of the originated data packets. When there is no mobility all protocols achieve 100% throughput. DSR and AODV perform well in all cases, delivering an average of 98% of the data packets. However, DSDV throughput degrades to 80% as the pause time gets smaller, since a stale routing table entry causes data packets to be forwarded over a broken link. DSDV maintains only one route per destination, so each packet that the MAC layer is unable to deliver is dropped due to the lack of alternate routes.

- We have seen that AODV throughput did not degrade with increase in pause time. The hidden cost of keeping the throughput constant becomes apparent. The routing overhead of AODV almost doubles at each step of the decrease in pausetime. So, although AODV incurs comparable overhead to DSR protocol at low mobility, the overhead explodes when mobility is high.

- Effect of increased speed on throughput. shows that all of the protocols have higher throughput (DSR and AODV have 100% while DSDV has 96%) when the nodes move at low speeds. When the speed increases, all the routing protocols suffer a decrease in throughput. Higher speeds cause frequent link changes and connection failures. Overall performance of DSR and AODV is better than DSDV. DSDV drops about 25% of the packets when the speed is increased to 50m/s. Since DSDV maintains only one route per destination, packets that cannot be delivered by the MAC layer are dropped due to the lack of alternate routes.

- It can be seen that increase in node speeds results in significant increase in the average end-to-end packet delivery delay of AODV protocol. This is because when a node receives a route request for which it has the answer in its routing table, it immediately replies with the route rather than forwarding it to the destination. The source can now start to communicate with the destination. Since AODV maintains only one routing entry per destination, it has to do more route discoveries as the speed increases. Therefore, in the average delay increases as the time taken to find a route to the destination increases when there is no entry for it in the intermediate nodes.

VIII. REFERENCES

[1] Marina, M.k. and S.R. Das, 2002. Routing performance in the presence of unidirectional links in multihop wireless networks.Proceedings of MOBIHOC EPFL, Lausanne, Switzerland.

[2] Lee, S., W. Su, J. Hsu, M. Gerla and R. Bagrodia, 2000. A performance comparison study of ad hoc wireless multicast protocols. Proceeding of IEEE INFOCOM, Tel Aviv, Israel.

[3] Varshney, U., 2002. Multicast over wireless networks.Communications of ACM.

[4] Ilyas, M., 2003.The hand book of ad hoc wireless network. CRC press LLC.

[5] Al-Maashri, A. and Ould-Khaoua, "Performance analysis of MANET routing protocols in the presence of self-similar traffic". In, Proceedings of the 31st IEEE Conference on Local Computer Networks, 2006, pp. 801-807, 14-16 November 2006,

[6] V.Ramesh, Dr.P.Subbaiah, N. Koteswar Rao and M.Janardhana Raju, "Performance Comparison and Analysis of DSDV and AODV for MANET " in (IJCSE) International Journal on Computer Science and Engineering Vol. 02, No. 02, 2010, 183-188.

[7] Preetam Suman, Dhananjay Bisen, Poonam TomarVikasSejwar Rajesh Shukla, "Comparative study of Routing Protocols for Mobile Ad-Hoc Networks". Manuscript received November 20, 2009.

[8] Sung-Ju Lee, William Su, Julian Hsu, Mario Gerla, and RajiveBagrodia, "A Performance Comparison Study of Ad Hoc Wireless Multicast Protocols", This work was funded in part by the Defense Advanced Research Projects Agency (DARPA) under contract DAAB07-97-C-D321, as a part of the Global Mobile Information Systems (GloMo) program.

[9] Kapang Lego, Pranav Kumar Singh, DipankarSutradhar, "Comparative Study of Adhoc Routing Protocol AODV, DSR and DSDV in Mobile Adhoc NETwork", Indian Journal of Computer Science and Engineering Vol. 1 No. 4 364-371.

[10] Buruhanudeen, S. Othman, M. Ali, "Existing MANET routing protocols and metrics used towards the efficiency and reliability - an overview", Telecommunications and Malaysia International Conference on Communications, ICT-MICC 2007. IEEE International Conference, PP 231 – 236, Penang, 14-17 May 2007.

[11] Elizabeth M. Royer, Santa Barbara, Chai-KeongToh, "A Review of Current Routing Protocols for Ad Hoc Mobile Wireless Networks" 1070-9916/99/ IEEE Personal Communications, April 1999.

[12] Yongguang Zhang, Wenke Lee, "Intrusion Detection in Wireless AdHoc Networks", Proceedings of the Sixth Annual International Conference on Mobile Computing and Networking (MobiCom'2000), Boston, Massachussetts, August 6–11 2000.

[13] MehranAbolhasan a, TadeuszWysocki a, ErykDutkiewicz, "A review of routing protocols for mobile ad hoc networks", Motorola Australia Research Centre, 12 Lord St., Botany, NSW 2525, Australia. 4 June 2003

[14] Kalwar, S., "Introduction to reactive protocol", Potentials, IEEE, Vol : 29 Issue:2 PP: 34, March-April 2010.

[15] Mohseni, Shima Hassan, Rosilah Patel, Ahmed Razali, Rozilawati, " Comparative review study of reactive and proactive routing protocols in MANETs" Intelligent Systems and Informatics (SISY), 2010 8th International Symposium, PP: 304, 10-11 Sept. 2010.

[16] A. S. Pomportsis, G.I. Papadimitriou, M.S.Obaidat, P. Nicopolitidis, "Wireless Networks" John Wiley & Sons.Ltd.

[17] Deng, W. Li & D.P. Agrawal, "Routing Security in Wireless Ad hoc Networks", IEEE Communications Magazine, pp. 70-75, Oct 2002.

[18] Yongguang Zhang, HRL Laboratories, LLC "Security In Mobile Ad-Hoc Networks" IEEE

[19] S. Basagni, I. Chlamtac, V. R. Syrotivk, B. A. Woodward, "A Distance Routing Effect Algorithm for Mobility (DREAM)". In Proceedings of the Fourth Annual ACM//IEEE International Conference on Mobile Computing and Networking (MOBICOM 03), October 2003.

[20] K. Sanzgiri, B. Dahill, B. N. Levine, C. Shields, and E. M. Belding- Royer, "A Secure Routing Protocol for Ad Hoc Networks," in ICNP '02: Proceedings of the 10th IEEE International Conference on Network Protocols, Washington, DC: IEEE Computer Society, pp. 78-89, 2005.