The Effect of Velocity of Nodes on the Performance of Various Routing Protocols in MANET

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ABSTRACT
A MANET "mobile ad hoc network" is an autonomous system of mobile routers and associated hosts connected by wireless links - the union of which form an arbitrary graph. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably. Such a network may operate in a stand-alone fashion, or may be connected to the larger Internet. The range for any transmission through wireless network interfaces is limited so multiple "hops" may be needed to exchange data across the network. Consequently, many routing algorithms have come into existence to satisfy the needs of communications in such networks. Speed of nodes affects the relative performance of routing protocols being studied. Protocols were simulated using the ns-2 and were compared in terms of packet delivery fraction(PDF), normalized routing load(NRL) and average delay(E-E delay), while varying number of nodes, and speed. After making comparison using X-graph, it would become possible to analyze the properties of three protocols so that a new protocol can be designed in future that will have maximum PDF, minimum E-E delay and Minimum NRL in each scenario.

Keywords: MANET, AODV, DSR

1. INTRODUCTION
Notebook computers featuring powerful CPUs, large main memories and disk space are now quite common in everyday business and personal life, that are used as a mobile host [1].

- Now –a-days network connectivity options for use with mobile hosts have increased, including support for a growing number of wireless networking products based on radio and infrared [2].
- It provides ability to share information between mobile users:
  - Employees in a conference room
  - Friends in an airport terminal[2]
  - Search and rescue teams
  - Military data acquisition operations in hospitable terrain[3]

It's a collection of wireless mobile hosts dynamically forming a temporary network without the use of any existing network infrastructure or centralized administration. Due to the limited transmission range of wireless network interfaces, multiple

Network's "hops" may be needed for one node to exchange data with another across the network. It needs a dynamic routing protocol that can efficiently find routes between two nodes [5].

1.1MANET usage areas [4]:
- Military scenarios
- Sensor networks
- Rescue operations
- Students on campus
- Free Internet connection sharing
- Conferences

2. PROTOCOLS IN MANET
2.1Destination-Sequenced Distance Vector (DSDV):

DSDV basically is distance vector Routing protocol. It requires some adjustments in comparison to other distance vector routing protocols. These adjustments consist of triggered updates that will take care of topology changes in the time between broadcasts. Two types of update messages are defined: full and incremental dump [7]. The full dump carries all available routing information and the incremental dump only carries the information that has changed since the last dump. Each link has a sequence number associated with it.[14] This sequence number is periodically incremented by the destination node for the link. Other nodes then choose the route with highest sequence number, as that is the least stale route to the destination. If a node detects that a link has broken, it sets the metric to infinity, and issues a route update to the other nodes regarding the link status [4]. Other nodes repeat this action until they receive an update with a higher sequence number to provide it with a fresh route again [9].

The sequence number shows the staleness of a route and routes with higher sequence numbers are favorable. A route 'U' is considered more favorable than U' if U has a greater sequence number or, if the routes have the same sequence number but U has lower hop-count.[14] The sequence number is increased when a node A detects that a route to a destination D has broken. So the next time node A advertises its routes, it will advertise the route to D with an infinite hop-count and a sequence number that is larger than before [6].

2.2Ad-hoc On Demand Vector Routing (AODV):
AODV is an 'on demand routing protocol' with small delay. That means that routes are only established when needed to reduce traffic overhead.[16] AODV supports Unicast, Broadcast and Multicast without any further protocols [8]. The Count-To-Infinity and loop problem is solved with sequence numbers and the registration of the costs. In AODV every hop has the constant cost of one. The routes change very quickly in order to accommodate the movement of the

mobile nodes. Link breakages can locally be repaired very efficiently[16]. In AODV, three types of messages are used for synchronization: RREQ (Route Request), RREP(Route Reply).[15]

Two main mechanisms of "Route Discovery" and "Route Maintenance" are used, which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network [15].

2.3Dynamic Source Routing (DSR):

The Dynamic Source Routing protocol (DSR) is a simple and efficient routing protocol designed specifically for use in multi-hop wireless ad hoc networks of mobile nodes. DSR allows the network to be completely self-organizing and self-configuring, without the need of any existing network infrastructure or administration [11]. Dynamic Source Routing, DSR, is a reactive routing protocol that uses source routing to send packets .It uses source routing which means that the source must know the complete hop sequence to the destination. Each node maintains a route cache, where all routes it knows are stored. The route discovery process is initiated only if the desired route cannot be found in the route cache [13]. To limit the number of route requests propagated, a node processes the route request message only if it has not already received the message and its address is not present in the route record of the message [7].

This requires that the sequence of hops is included in each packet's header [13]. A negative consequence of this is the routing overhead every packet has to carry. However, one big advantage is that intermediate nodes can learn routes from the source routes in the packets they receive. Another advantage of source routing is that it avoids the need for up-to-date routing information in the intermediate nodes through which the packets are forwarded since all necessary routing information is included in the packets [10]. Finally, it avoids routing loops easily because the complete route is determined by a single node instead of making the decision hop-by-hop. The protocol is composed of the two main mechanisms of "Route Discovery" and "Route Maintenance", which work together to allow nodes to discover and maintain routes to arbitrary destinations in the ad hoc network.

3. OBJECTIVE

Here Bob analyzed the performance of different protocols like-AODV, DSDV, DSR by increasing and decreasing the speed of nodes present in a network. Bob worked on 3 factors like-PDF (Packet Delivery Fraction), END TO END DELAY, NRL (Normalized Routing Load) .The main objective is to analyze these 3 factors by increasing and decreasing the speed of nodes in a network and after that make a comparison between them.

4. STUDY DESIGN AND METHODOLOGY

For working on MANET, first FEDORA needs to be installed in system. Bob worked on FEDORA15. He used ORACLE VIRTUAL BOX to provide an environment to FEDORA on WINDOWS. After that Bob need to install ns2 i.e. network simulator for simulate the results of my analysis. To simulate results Bob used TCL scripts.

Table:1 General parameters used in all simulations

Parameter	Value
Transmission range	250 m
Simulation time	700 s
Topology size	500m x 500m
Number of mobile nodes	10
Traffic type	constant bit rate
Packet size	512 bytes
Maximum speed	Variable

5. ANALYSIS

5.1PDF (Packet Delivery Fraction):

The ratio of the data packets delivered to the destinations to those generated by the sources. It is calculated by dividing the number of packet received by destination through the number packet originated from source.

PDF= (Pr/Ps)*100

FIGURE:1 SHOWS packet delivery ratio with speed of nodes varying from 1 to 400 for DSDV,AODV and DSR routing protocol. The red line shows graph for AODV, the blue line shows graph for DSR and the green line shows the graph for DSDV protocol.

The delivery ratio for AODV and DSR protocols is always greater than 90 percent because these are reactive protocols and hence no. of received packets is more.

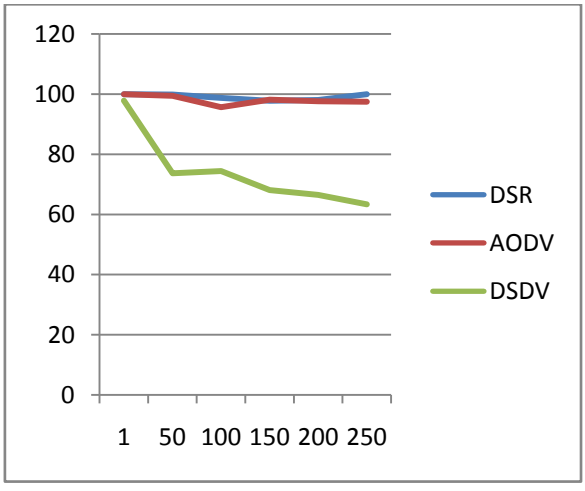

FIGURE:1 Speed verses Packet delivery ratio

For DSDV, the delivery ratio is decreasing as soon as speed is increasing because it is a proactive protocol and the numbers of received packets are less than AODV and DSR. But generally the graph for the DSR protocol lies above than that of DSDV for most cases. However in certain cases the DSDV protocols is also better.

The packet delivery ratio must be maximum. In our analysis, AODV and DSR show the maximum packet delivery ratio.

5.2END-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, and propagation and transfer times.

FIGURE: 2 shows that the average end-to-end delay is least for the DSDV approach, then for AODV approach and highest for the DSR approach. The reason is that the periodic gateway information sent by the gateways allows the mobile nodes to update their route entries for the gateways more often, resulting in fresher and shorter routes. With the DSR (reactive approach) a mobile node continues to use a route to a gateway until it is broken.

In some cases this route can be pretty long (in number of hops) and even if the mobile node is much closer to another gateway it does not use this gateway, but continues to send the data packets along the long route to the gateway further away until the route is broken.

Therefore, the end-to-end delay increases for these data packets, resulting in increased average end-to-end delay for all data packets. The average end-to-end delay is decreased slightly for short pause time intervals when the advertisement interval is increased

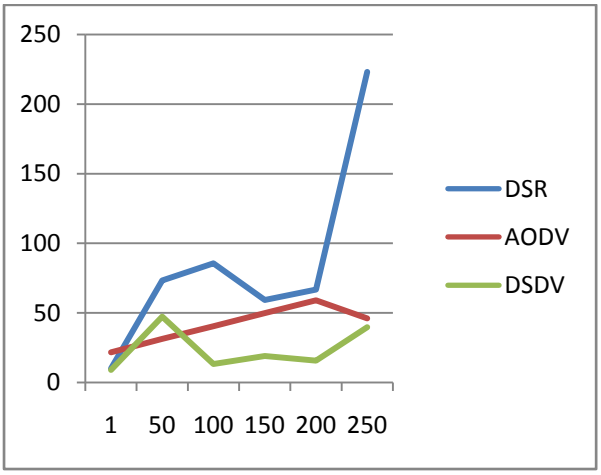

FIGURE: 2 Speed verses end-to-end delay

At the first thought this might seem unexpected. However, it can be explained by the fact that very short advertisement intervals result in a lot of control traffic which lead to higher processing times for data packets at each node.

The end-to-end delay must be minimum. In our analysis DSDV shows the minimum end-to-end delay.

5.3Normalized Routing Load:

Number of routing packets transmitted per data packet delivered at destination. Each hop-wise transmission of a routing is counted as one transmission. It is the sum of all control packets sent by all nodes in network to discover and maintain route.

NRL=Routing Packet/Received Packet

FIGURE:3 shows normalized routing load with speed of nodes varying from 1 to 400 for DSDV,AODV and DSR routing protocol. The red line shows graph for AODV, the blue line shows graph for DSR and the green line shows the graph for DSDV protocol. For DSDV, the NRL is increasing with increase in speed because it is proactive and no of received routing packets are less than data packets.

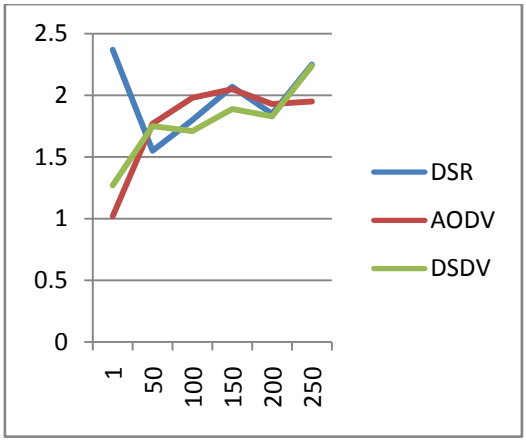

FIGURE:3 Speed verses Normalized Routing Load

For AODV, the NRL is increasing with increase in speed because no of received routing packets are less than data packets. For DSR, the NRL is decreasing with increase in speed because no of received routing packets are more than data packets.

The NRL ratio must be minimum. In our analysis, DSR shows the minimum normalized routing load.

6. RESULT

Bob implement the Destination Sequenced Distance Vector, Ad hoc On Demand and Dynamic Source Routing protocols in Tool command language and integrated the module in the ns-2 Simulator. Bob have made the performance comparison of the protocols based on 3 factors i.e.PDF, NRL, E2E Delay. Simulations were carried out with identical topologies and running different protocols on the mobile node.

The results of the simulation indicate that performance of the DSR protocol is superior to standard DSDV. It is also observed that the performance is better especially when the pause time is low. For higher pause time although DSR is better for most cases but their delivery ratio remains close to each other.

The packet delivery ratio must be maximum. In our analysis, AODV and DSR show the maximum packet delivery ratio. The end-to-end delay must be minimum. In our analysis DSDV shows the minimum end-to-end delay. The NRL ratio must be minimum. In our analysis, DSR shows the minimum normalized routing load.

7. CONCLUSION

The protocol that is having maximum PDF, minimum e-to-e delay and minimum NRL is the required protocol for any network in any scenario. If all these factors are satisfied then the number of drop packets will be minimized and ratio of received packets to the sent packets will be increased. In near future a protocol need to be designed that can satisfy all these properties.

8. REFERENCES

[1] Magnus Frodigh, Per Johansson and Peter Larsson,Wireless ad hoc networking—The art of networking without a network

[2] David B. Johnson,Routing in Ad hoc networks of Mobile hosts .

[3] Obraczka,J-C Cano,P.Manzoni,A Multipath Energy-Aware On demand Source Routing Protocol for Mobile Ad-Hoc Networks

[4] Charles E. Perkins, An Adaptive Congestion Control Mechanism for Streaming Multimedia in Mobile Ad-hoc Networks

[5] C.E. Perkins and E.M. Royer, "Ad-Hoc on-Demand Distance Vector Routing," Proc. Workshop Mobile Computing Systems and Applications (WMCSA '99), Feb. 1999 pp. 90-100

[6] David B. Johnson and David A. Maltz. "Dynamic source routing in ad hoc wireless networks", Mobile Computing, Kluwer Academic Publishers. 1996 pp.153–181, 1996.

[7] M. S. Corson, J. P. Maker and G. H. Cirincione , "Internet-Based Mobile Ad Hoc Networking," IEEE Internet Computing.

[8] David F. Bantz and Frederic J. Bauchot. Wireless LAN Design Alternatives.IEE Network, 8(2):43–53, March/April 1994.

[9] Vaduvur Bharghavan, Alan Demers, Scott Shenker, and Lixia Zhang. MACAW: A Media Access Protocol for Wireless LAN's. In Proceedings of the ACM SIGCOMM '94 Conference, pages 212–225. ACM, August 1994

[10] Robert T. Braden, editor. Requirements for Internet Hosts—Communication Layers. RFC 1122, October 1989.

[11] Josh Broch, David A. Maltz, David B. Johnson, Yih-Chun Hu, and Jorjeta Jetcheva. A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols.In Proceedings of the Fourth Annual ACM/IEEE International Conference on Mobile Computing and Networking (MobiCom'98), pages 85–97, Dallas, TX, October 1998.

[12] Josh Broch, David B. Johnson, and David A. Maltz. The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks. Internet-Draft, draft-ietf-manet-dsr-03.txt, October 1999.Work in progress.

[13] C.A. Dhote,M.A. Pund,R.S. Mangrulkar,Makarand R.Shahade,Hybrid Routing protocol With Broadcast Reply For MANET

[14] Tony Larsson and Nicklas Hedmen. *Routing protocols in* wireless *Ad-hoc Networks-A simulation study*

[15] Muhammad Hisyam Lee,Mazalan,SarahintuPerformance analysis of DSR protocol for Ad-Hoc Networks Based on Taquchi's Method

[16] Rainer Baumann,Vehicular ad hoc networks (engineering and simulation of mobile ad hoc routing for VANET on highways and in cities)