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Unipath and Multipath Reactive Routing Protocol with 802.11p in VANET

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ABSTRACT: Vehicular networks are emerging class of wireless networks that have emerged because of recent advances in wireless technology. Vehicular Ad-hoc Network (VANET) is an enhanced form of Mobile Ad-hoc Network (MANET). The IEEE 802.11 [13] standard is based on CSMA/CD and used in both MANET and VANET. An enhanced version IEEE 802.11p is developed for VANET, which is suitable for high speed vehicular communication. The present work is an attempt to study the effect of these IEEE standards on reactive routing protocols, AODV and AOMDV in VANET under V2V communication for parameters average throughput, PDR, Number of Drop Packets and NRL with increasing average speed of vehicles.

KEYWORDS: MANET, VANET, PDR, NRL, V2V, 802.11, 802.11p

I. INTRODUCTION

Vehicular networks are emerging class of wireless networks that have emerged because of recent advances in wireless technology. Vehicular Ad-hoc Network (VANET) is an enhanced form of Mobile Ad-hoc Network (MANET). MANET [1] is a gathering of wireless communication devices like laptop and mobile etc. called nodes, these nodes can be easily connected with a wireless medium and form a dynamic and arbitrary network with wireless links and capable in receiving and transmitting the data by help of Mobile Ad hoc Network protocols. In VANET [8] communicating nodes are replaced by moving vehicles. VANETs [7] promises many improvements in terms of accident avoidance and in better utilization of roads and resources such as fuel and time. Because of many applications, VANETs have fascinated many research authorities and automotive industries. Recognizing its importance, IEEE has approved a standard 802.11p [12] for Wireless Access in Vehicular Environment (WAVE). To understand VANET, it is necessary to understand wireless networks.

In VANET, Vehicle [9] can communicate with each other by directly forming vehicle to vehicle communication (V2V) or communicate with fixed equipment next to the road, referred to as road side unit (RSU) forming vehicle to infrastructure communication (V2I).

In present paper, we have reviewed several papers based on studies of factors, which make impact on VANET routing protocols. This paper is organized in three sections. Section 2 is based on paper reviews and Section 3 gives brief description of routing protocols in VANET, AODV and AOMDV. Section 4 related with Simulation setup and result are shown in section 5. Section 6 describes our conclusion and future work.

II. RELATED WORK

Jibhkate et. al. [4] measured the performance of AODV and OLSR vehicular ad hoc network protocols under highway and city scenarios. They considered 50 numbers of vehicles with varying speed between 40 to 120 km/h and channel data rate of 1 mbps. They studied AODV protocol for highway scenarios and OLSR protocol for city scenarios. The PDR, Throughput and End to End Delay parameters are selected to measure the performance.

Jamra et. al. [5] studied difference between MANET and VANET. They discuss the characteristics, applications and limitation of MANET and VANET. They also present the working of AODV and DSDV routing protocols. After review they concluded that AODV suited well over the DSDV, in VANET scenarios for high and moderate mobility.

Patel et. al. [6] measured and analyzed the performance of AODV and DSDV routing protocols in vehicular ad hoc network using NS2 simulator. They examined the performance parameters PDR and End to End delay with respect to

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increasing mobility under rural and urban area based distribution. Their results indicate that in case of both PDR as well as End to End delay, the AODV protocol perform better than the DSDV protocol.

III. ROUTING PROTOCOLS IN VANET

A number of ad hoc based routing protocols [6] were proposed in the last fifteen years for VANET. These protocols can be categorized on the basis of their "routing strategy" because they follow to search a path "route" from a source to a destination and vice versa. The existing vehicular ad hoc network routing protocols [10] can be categorized into five major types.

- Ad Hoc Based Routing Protocols
- Location Based Routing Protocols
- Cluster Based Routing Protocols
- Broadcast Routing Protocols
- Geocast Routing Protocols

AODV fall in ad hoc based routing protocol of VANET. AOMDV is its multipath version. The working of these protocols is as follows:

A. AODV (Ad-hoc On demand Distance Vector)

This is a unipath reactive protocol [2], which performs Route Discovery using control messages route request (RREQ) and route reply (RREP) whenever a node wishes to send packets to destination. To control network wide broadcasts of RREQs, the source node uses an expanding ring search technique. The forward path sets up an intermediate node in its route table with a lifetime association RREP. When either destination or intermediate node using moves, a route error (RERR) is sent to the affected source node. When source node receives the (RERR), it can reinitiate route if the route is still needed. Neighborhood information is obtained from broadcast Hello packet. As AODV protocol is a flat routing protocol it does not need any central administrative system to handle the routing process. AODV tends to reduce the control traffic messages overhead at the cost of increased latency in finding new routes.

The AODV [3] has great advantage in having less overhead over simple protocols which need to keep the entire route from the source host to the destination host in their messages. The RREQ and RREP messages, which are responsible for the route discovery, do not increase significantly the overhead from these control messages. AODV [4] reacts relatively quickly to the topological changes in the network and updating only the hosts that may be affected by the change, using the RRER message. The Hello messages, which are responsible for the route maintenance, are also limited so that they do not create unnecessary overhead in the network. The AODV protocol is a loop free and avoids the counting to infinity problem, which were typical to the classical distance vector routing protocols, by the usage of the sequence numbers.

B. AOMDV (Ad-hoc On demand Multipath Distance Vector)

The main idea in AOMDV [13] is to compute multiple paths during route discovery. It consists of two components: A route update rule to establish and maintain node and a distributed protocol to find link-disjoint paths. In AOMDV each RREQ, respectively RREP arriving at a node potentially defines an alternate path to the source or destination. Just accepting all such copies will lead to the formation of routing loops. In order to eliminate any possibility of loops, the "*advertised hopcount*" is introduced. The *advertised hopcount* of a node *i* for a destination *d* represents the maximum *hopcount* of the multiple paths for *d* available at *i*. The protocol only accepts alternate routes with *hopcount* lower than the *advertised hopcount*, alternate routes with higher or the same *hopcount* are discarded. The *advertised hopcount* mechanism establishes multiple loop-free paths at every node. These paths still need to be disjoint. When a node *S* floods a RREQ packet in the network, each RREQ arriving at node *I* via a different neighbor of *S,* or *S* itself, defines a node disjoint path from *I* to *S*. In AOMDV this is used at the intermediate nodes. Duplicate copies of a RREQ are not immediately discarded. Each packet is examined to see if it provides a node-disjoint path to the source. For node disjoint paths all RREQs need to arrive via different neighbors of the source. This is verified with the *firsthop* field in the RREQ packet and the *firsthop_list* for the RREQ packets at the node. At the destination a slightly different approach is used, the paths determined there are linkdisjoint, not node-disjoint. In order to do this, the destination replies up to k copies of the RREQ, regardless of the firsthops. The RREQs only need to arrive via unique neighbours.

The core of the AOMDV protocol lies in ensuring that multiple paths discovered are loop-free and disjoint, and in efficiently finding such paths using a flood-based route discovery. AOMDV route update rules, applied locally at each node, play a key role in maintaining loop-freedom.

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IV. SIMULATION SETUP

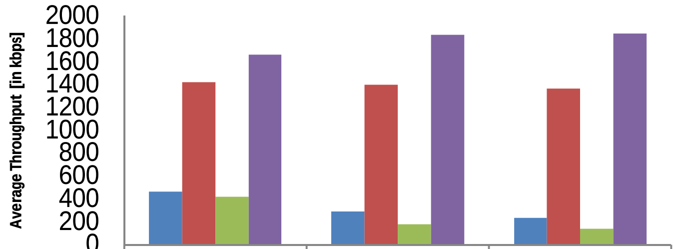
The simulation setup is done with the use of NS 2.35 under Red Hat Linux Server Enterprise Edition 5. The V2V communication network is created with 30, 50 and 70 vehicles or nodes, which are distributed in a square area of 800m X 800m road map created with the help of Manhattan model.

Table 1 Simulation Scenario

Parameter	Value
No. of nodes	30, 50, 70
Speed in km/h	30, 60, 90
Simulation Time	100s
Propagation Model	Two Ray Ground
Antenna	Omni Antenna
Traffic Type	CBR
Packet Size	512byte
Routing Protocol	AODV, AOMDV
Area	800m X 800m
Network Interface	WirelessPhy. WirelessPhyExt
MAC Type	802.11, 802.11p

V. RESULTS

The evaluation has been measured with 50 numbers of vehicles or nodes with increasing mobility speed. Figure 1 show that the Average Throughput is decreases in both AODV and AOMDV protocols with increasing average speed of vehicles under 802.11 standards, while Average Throughput is decreases in AODV and increases in AOMDV protocols with increasing average speed of vehicles under 802.11p standard. The Average Throughput of AODV protocol is better than the AOMDV protocol under 802.11 standards, while Average Throughput of AOMDV protocol is better than the AODV protocol under 802.11p standard in all the cases. Thus in terms of Average Throughput, both AODV and AOMDV protocol under 802.11p standard perform much better than 802.11 standards with increasing average speed of vehicles.



	30 KM/H	60 KM/H	90 KM/H
AODV-802.11	462.77	292.26	233.9
AODV-802.11p	1422.71	1399.1	1368.64
AOMDV-802.11	422.89	176.84	141.86
AOMDV-802.11p	1665.85	1835.29	1846.47

Average Speed

Figure 1: Average Throughput in AODV and AOMDV under 802.11 and 802.11p standard

Figure 2 shows the performance of Packet Delivery Ratio (PDR) parameter in AODV and AOMDV protocols with increasing average speed of vehicles under 802.11 and 802.11p standard. The PDR is decreases in both AODV and AOMDV protocols with increasing average speed of vehicles under 802.11 standards, while PDR is slightly decreases in

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AODV and increases in AOMDV protocols with increasing average speed of vehicles under 802.11p standard. The PDR of AODV protocol is better than the AOMDV protocol in all the cases under 802.11 standards, while PDR of AOMDV protocol is better than the AODV protocol in all the cases under 802.11p standard. Thus in terms of PDR, both AODV and AOMDV protocol under 802.11p standard perform much better than 802.11 standards.

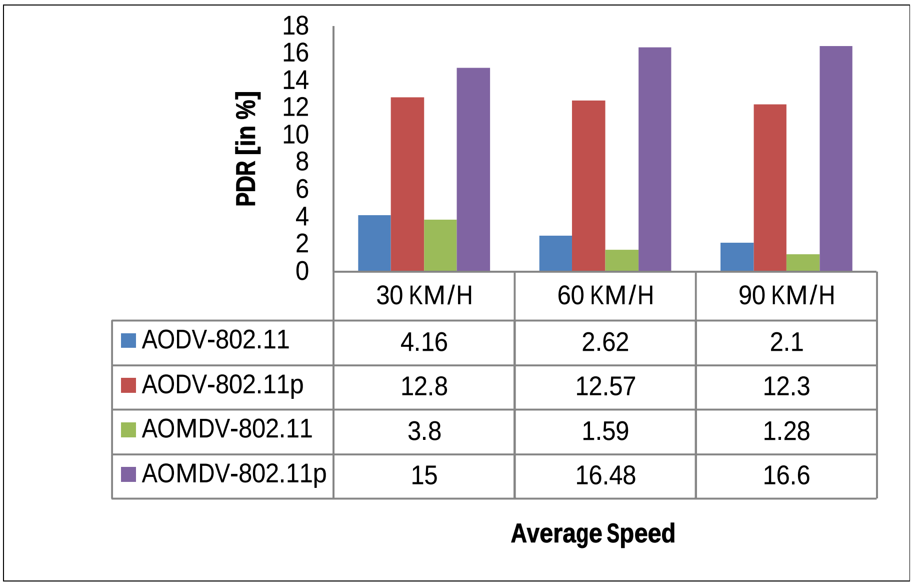

Figure 2: PDR in AODV and AOMDV under 802.11 and 802.11p standard

The Normalized Routing Load (NRL) in AODV and AOMDV protocols with increasing average speed of vehicles under 802.11 and 802.11p standard is shown in the figure 3. The NRL is increases in both AODV and AOMDV protocols under 802.11 and decreases in both AODV and AOMDV under 802.11p standard with increasing number of vehicles. The NRL of AODV protocol is less than the AOMDV protocol in all the cases under 802.11 standards, while NRL of AOMDV protocol is less than the AODV protocol in all the cases under 802.11p standard. Thus in terms of NRL, AODV perform better under 802.11 standard and AOMDV perform better under 802.11p standard with increasing average speed of vehicles.

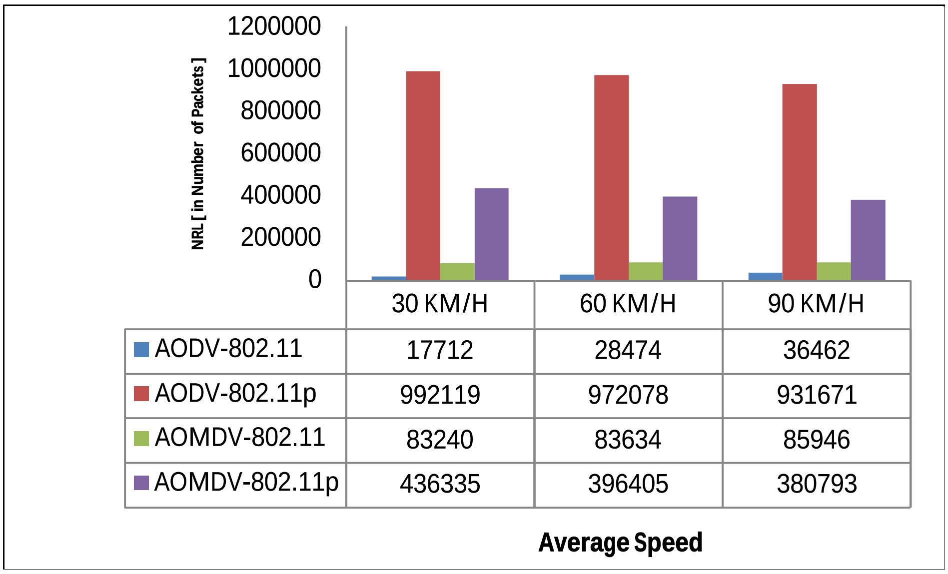

Figure 3: NRL in AODV and AOMDV under 802.11 and 802.11p standard

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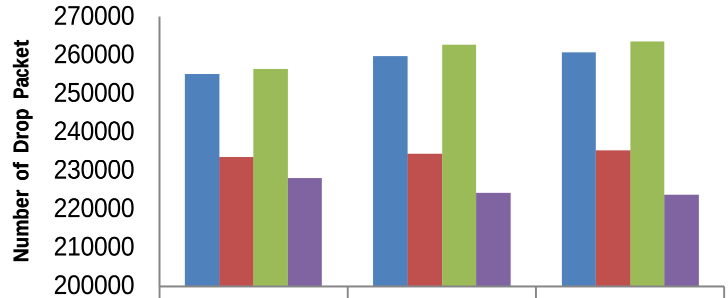
The figure 4 shows number of Drop Packets in AODV and AOMDV protocols with increasing average speed of vehicles under 802.11 and 802.11p standard. The number of Drop Packets increases in both AODV and AOMDV protocols with increasing average speed of vehicles under 802.11 standards. The number of Drop Packets is slightly increases in AODV protocol and decreases in AOMDV protocol under 802.11p standard. Thus in terms of number of drop packets, AODV perform better under 802.11 standard and AOMDV perform better under 802.11p standard with increasing average speed of vehicles.



	30 KM/H	60 KM/H	90 KM/H
AODV-802.11	255031	259650	260682
AODV-802.11p	233630	234488	235242
AOMDV-802.11	256377	262625	263472
AOMDV-802.11p	228039	224205	223788

Figure 4: Number of Drop Packets in AODV and AOMDV under 802.11 and 802.11p standard

VI. CONCLUSION AND FUTURE WORK

The simulation results indicate that AODV protocol perform well over AOMDV protocol in 802.11 standard and in its contrast, AOMDV protocol perform well over AODV protocol in 802.11p standard in terms of parameter Average Throughput, PDR, NRL and number of Drop Packets with increasing number of vehicles. It indicates that 802.11p standard is more suitable for VANET applications than 802.11 standards, which is basically used in MANET. In future attempt will be made to analyse and evaluate the other routing protocols performance under various scenarios.

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