Comparative Performance Analysis of DSDV, AOMDV and ZRP Routing Protocols in VANET using NS2

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Abstract—**Vehicular Ad-hoc Network (VANET) could be a new communication paradigm that allows the communication between vehicles moving at high speeds on the roads. This has brought new challenges to develop many applications like, traffic engineering, traffic management, broadcasting emergency information to avoid hazardous situations and other user applications. The communication between vehicles is the core concept of VANETs, because the communication between vehicles is used for safety, comfort, and for handling emergency situations as well. Routing protocols are used to carry out communication by routing data between vehicles. There are various categories of routing protocols in VANETs. Based on the topology, there are three types of routing protocols in VANET. They are named as Proactive, Reactive and ZRP routing protocol. The paper presents comparative analysis of existing routing protocols like Ad Hoc on Demand Multipath Distance Vector (AOMDV), Destination-Sequenced Distance-Vector Routing (DSDV) and Zone Routing Protocol (ZRP). Network Simulator (NS-2) is used to carried out the simulation. The performance evaluation metrics used are packet delivery ratio, end to end delay and throughput. To achieve scalability the simulation is also carried out with varying number of nodes. Simulation results show that AOMDV performs better than DSDV and ZRP protocol by above 14% and 59% respectively in packet delivery ratio and AOMDV, DSDV both perform better than ZRP in terms of Throughput and average End-To-End Delay.**

Keywords—**DSDV, AOMDV, ZRP, NS-2, MANETs, PDR, throughput, end to end delay**

I. INTRODUCTION

Vehicular Ad-hoc network (VANET) may be a new difficult network setting that pursues the idea of omnipresent computing. Vehicles equipped with wireless communication technologies and acting like mobile nodes are going to be on the road before long and this may revolutionize the idea of travelling .The expansion of the augmented range of vehicles square measure equipped with wireless transceivers to speak with alternative vehicles to make a special category of wireless networks, referred to as conveyance spontaneous networks or
VENETs [1].Wireless network should be capable to self – organize and self –configure, the actual fact that the mobile structure is dynamic each time. Mobile hosts have a restricted vary and causing the message to a different host or multiple hosts, that is not within the sender's host transmission vary, ought to be forwarded through the network by mistreatment alternative hosts which can be operated as routers for delivering the message throughout the full network. The mobile host should use broadcast for causing messages and may be in promiscuous mode for accepting any messages that it receives. To boost the protection of drivers and providing comfort driving setting, messages for various functions got to be sent to vehicles through the inter-vehicle communications. VANETs bring several prospects for brand new vary of applications which cannot solely create the travel safer however fun furthermore. So that going to a destination or obtain facilitate would be abundant easier.

II. BACKGROUND

A number of routing protocols have been defined by many researchers for VANET. They have been categorized into various categories. With the passage of time now there is a need of having new protocols in order to have successful communication. The history of VANET routing protocols begins with the traditional MANET routing protocols. A number of "topology" based routing protocols had been analyzed for VANET. [Dr. R.Uma Rani][2] Compared the performance of AODV and AOMDV for VANET on NS-2. Their study showed that AOMDV has better performance than AODV in the VANET, as the performance parameters showed that they used less overhead as well as less end-2-end delay on the network as compared to AODV. Performance analyses of traditional ad-hoc routing protocols like AODV, DSDV and DSR have been presented in [3], and the authors proposed that these routing protocols are suitable for VANET environment. Their simulation results showed that these conventional routing protocols of MANET decrease the routing load on network, and increase the packet delivery ratio and end to end delay. Their study represents that more appropriate routes can be found with and without mobility prediction. They select fewer routes to overcome routing overhead on network and this effect also overcomes the link breakage as compared to AODV. [John A. Hamilton USA][4] Proposed Source-initiated on-demand driven routing protocols that designed

for self-organized network are expected to detect and respond to changes in the network topology and gather such information to use in route construction and mobility management. The performance of three source-initiated on-demand driven routing protocols that are: AODV, DSR and TORA routing protocols was compared. It was observed that TORA and DSR outperformed AODV. We have selected AOMDV, ZRP, and DSDV for analysis as less comparison has done on these three routing protocols. Routing in Vehicular Ad-Hoc networks and some fixed wireless networks use multiple-hop routing. Routing protocols in wireless network should be able to maintain paths to other nodes when the number of nodes varied. So we have chosen number of node as performance criteria for comparing routing protocols.

III.   ROUTING ALGORITHM

The topology based routing protocols are categorized under three categories Table Driven, Source Initiated and Hybrid. Our key protocols for comparison are DSDV, AOMDV and ZRP. DSDV is a type of table driven/proactive routing protocol. In proactive protocols, routes to all the nodes in the network are discovered in advance. Whole table is broadcasts after a fixed interval of time independent of any route changes or not. This increases the overhead and so decreases the throughput of network using DSDV protocol. [5][6] In DSDV Protocol, every node stores one or more routing tables. Routing table stores all the available destinations, number of hopes (intermediate nodes) to reach the destination node, sequence number assigned by the destination node. The sequence number stored in routing table is used to make the protocol loop free. Every node maintains a monotonically increasing sequence number for itself when it communicates with other nodes. The highest known sequence number for each destination is also maintained in the routing table (called "destination sequence numbers").

AOMDV is enhancement of AODV protocol. AOMDV uses hop-by-hop routing approach and it is based on the distance vector concept. Moreover, AOMDV works on finding routes on demand using a route discovery procedure. The main difference between the two protocols lies in the number of routes found in each route discovery procedure. In AOMDV, source sends RREQ propagation towards the destination which establishes multiple reverse paths both at intermediate nodes as well as the destination node. Multiple RREPs traverse all these reverse paths back to form multiple forward paths to the destination at the source and intermediate nodes. AOMDV also provides intermediate nodes with alternate paths that are found to be useful in reducing route discovery frequency [7][8]. The multiple paths discovered by AOMDV are loop-free and disjoint, and help in finding such paths efficiently using a flood-based route discovery. AOMDV update route according to the rules, applied locally at each node, which play a key role in maintaining loop-freedom and disjointness properties. AOMDV relies mostly on the routing information already available in the underlying AODV protocol, thereby limiting the overhead incurred in discovering multiple paths. Extra RREPs (Route Response)

and RERRs for multipath discovery and maintenance along with a few extra fields in routing control packets are used. These RREQs, RREPs, and RERRs also constitute the additional overhead in AOMDV relative to AODV.

The Zone Routing Protocol (ZRP) combines the benefits of the proactive associated reactive approaches by maintaining an up-to-date topological map of a zone focused on every node. During intervals the zone, routes are in real time offered. For destinations outside the zone, ZRP employs a route discovery procedure, which might be done from the native routing information of the zones. In ZRP, every node maintain the routing information of all nodes at interval its routing zone. Nodes learn topology of its routing zone through a localized proactive theme, referred as associate intra-zone routing protocol (IERP) [11] is to blame for reactively discovering routes to the destination on the far side a node's routing zone. This is often used if the destination is not found at intervals the routing zone. The route request packets are transmitted to any or all border nodes that successively forward the request if the destination node is not found at intervals their routing zone.IERP distinguish itself from commonplace flood search by implementing the conception, known as border-casting. Border-cast resolution protocol (BRP) provides the border-casting packet delivery service. [10]

IV.   SIMULATION AND COMPARISON

NS2.35 is used for simulation of three routing protocols. NS2 is a Network Simulator which is used to simulate all type of networks and can be easily understandable by anyone. To achieve scalability we have taken the number of nodes up to 100 and figure out how it affects the performance of selected routing protocols. Fig 1 shows the general parameters used in simulation and fig 2 shows packets transfer from source to destination.

TABLE I
GENERAL PARAMETERS USED IN ALL

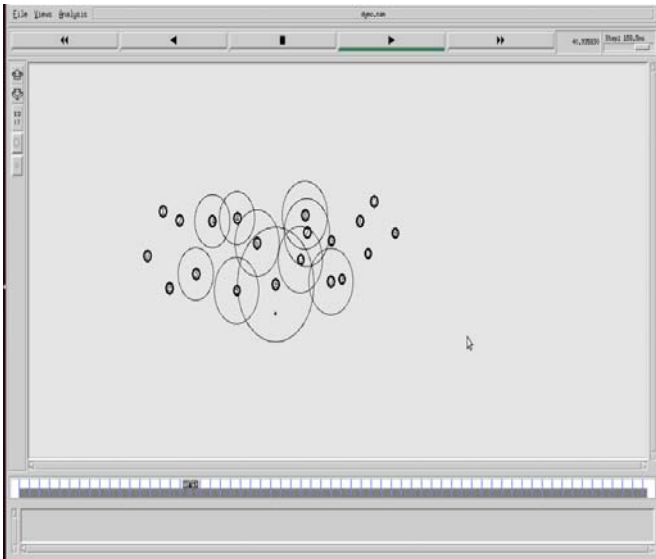| Processor	Intel Core i3
OS	Fedora Linux 3.3.4 fc17
RAM	3.00 GB
Ns-2 version	2.35
DSDV	NS default
AOMDV	NS default
ZRP	Hybrid
Number of nodes	100
Data type	CBR
Packet size	1000 byte
MAC Protocol	802.11
Simulation time	180 sec.
Topology size	2500*1500
Maximum speed	8 m/s
Traffic type	Constant bit rate
Packet rate	5 packets/sec.
Number of sources	1

Fig 1 Simulation showing packet transfer

V. PERFORMANCE METRICS

The main goal of this paper is to compare the performance of the three routing protocols. Comparing the different protocols is done by simulating them and examining their behaviour. The evaluation is done in the following three metrics:

A. Packet delivery ratio
The packet delivery *ratio* is defined as total number of received data packets divided by the number of generated data packets.

B. End to end delay
The end to end delay defined as the time a data packet is received by the destination minus the time the data packet is generated by the source.

C. Throughput
The throughput is defined as average ratio of the successful packets delivered to particular destination to those of generated by the traffic sources. This is measured as bits per second.

Fig. 2 shows the graphs of packet delivery ratio with number of nodes (vehicles) varying from 20 to 100 for DSDV, AOMDV and ZRP routing protocol. The red line, green line and blue line shows graph for AOMDV, ZRP and DSDV routing protocol respectively. After number of nodes increased by 50, the packet delivery ratio for AOMDV protocols is always greater than 90%. While DSDV also shows high packet delivery ratio compared to ZRP. The basic difference in the packet delivery ratio of AOMDV and DSDV is less. The packet delivery ratio of DSDV is greater than 85% when the number of nodes is 50, 60, 80, and 90. But in case of ZRP, it gives lowest packet delivery ratio. So it is clearly shown that AOMDV outperformed both DSDV and ZRP in terms of packet delivery ratio.
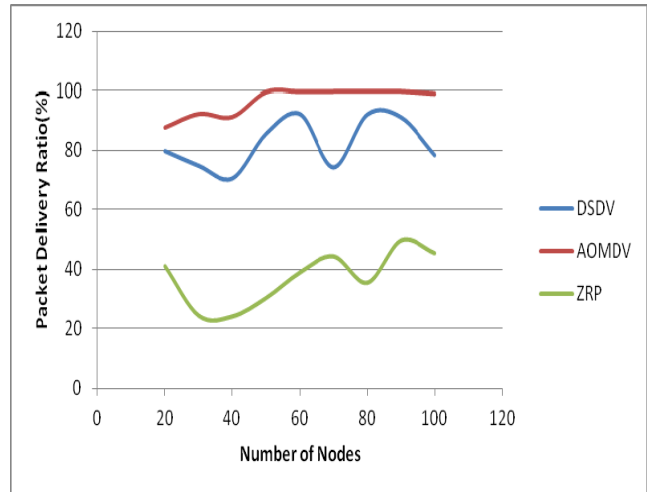

Fig. 2 Analysis of Packet Delivery Ratio

Fig. 3 shows the graph of average end to end delay with number of nodes (vehicles) varying from 20 to 100 for DSDV, AOMDV and ZRP protocol. The basic difference between AOMDV and DSDV is very less. Initially average end to end delay of AOMDV is higher than both ZRP, DSDV. When the numbers of nodes are 50, end to end delay of all three protocols is almost same. But after number of nodes increased by 50, AOMDV is giving lesser end to end delay than DSDV. In case of ZRP, initially it is giving lesser end to end delay as compared to AOMDV. After number of nodes increases 50, there is consistently increment in the value of end to end delay.
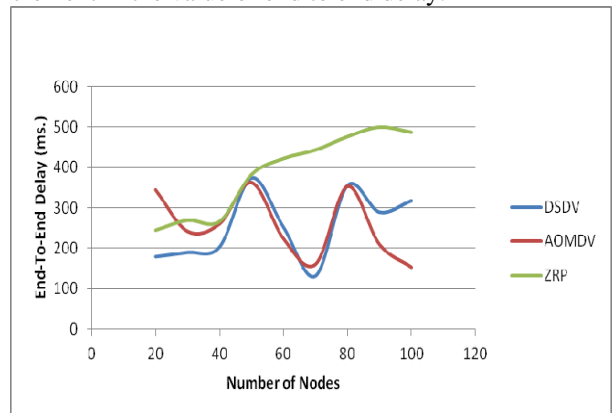
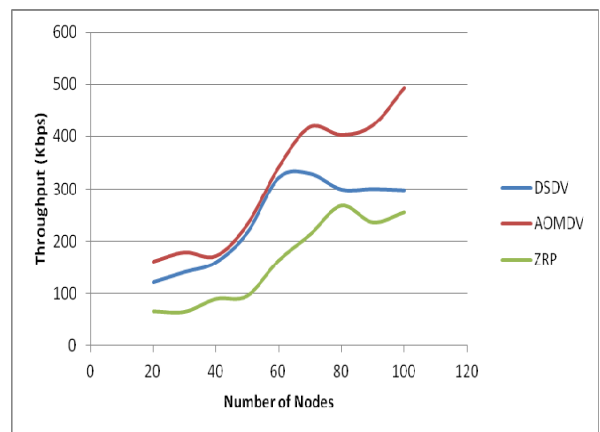
Fig. 3 Analysis of End To End Delay

Fig. 4 Analysis of Throughput

Fig. 4 shows the graph of throughput with number of nodes varying from 20 to 100 nodes for AOMDV, DSDV and ZRP routing protocol. Throughput of AOMDV is better than DSDV and ZRP.As the number of nodes is increasing, the value of throughput is also increasing which shows that AOMDV supports scalability. DSDV also shows higher throughput as compared to ZRP. Up to 60 nodes there is slightly difference in the throughput of both AOMDV and DSDV. But after this, AOMDV is showing consistently increment in throughput value. Whereas DSDV throughput is remains constant after number of nodes become 80. So AOMDV only routing protocol which supports scalability as the numbers of nodes are increasing its throughput also increased.

VI.   CONCLUSION

The results of the simulation indicate that performance of the AOMDV protocol is superior to both DSDV, ZRP protocols. It is also observed that when the number of nodes is increased the performance is better especially. Simulation results show that AOMDV performs better than DSDV and ZRP protocol by above 14% and 59% respectively in packet delivery ratio. However the statistic of AOMDV delivery ratio is close to DSDV. But for higher number of nodes AOMDV outperform other two protocols. In case of ZRP protocol it gives lowest packet delivery ratio. Average end-to-end delay of AOMDV is lesser than both DSDV and ZRP. However DSDV statistics for average end-to-end delay is close to AOMDV but still it is higher than AOMDV. ZRP statistics for end-to-end delay is highest. In case of throughput AOMDV protocol gives best results and DSDV gives better results than ZRP. Finally we can conclude that AOMDV outperformed both DSDV and ZRP in terms of all three qualitative measures and it is preferable protocol than both DSDV and ZRP in case of packet delivery ratio, end-to-end delay as well as throughput.

VII.   FUTURE WORK

As ZRP is hybrid protocol which uses features of both reactive as well as proactive routing protocols but still it is weak in terms of performance. So, in the future work improvement can be done in this protocol to enhance its performance. AOMDV also has some weakness due to which it gives high end to end delay. So in the future work this protocol can be modified so that the name of this protocol will be placed as Universal protocol for all scenarios.

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