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Enhancing Multipath AOMDV Routing in Vehicular Ad Hoc Networks

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Abstract:
The basic factor for the VANET (Vehicular Adhoc Networks) application success is routing however it must effectively deal with quick configuration changes and a distributed network. Vehicular Ad-hoc network (VANET) is a group of vehicular nodes making a temporary network without the help of any centralized infrastructure or administration. VANETs have no static configuration because of its dynamic feature of nodes. So, efficient and reliable routing is one of the significant issues in VANETs. Hence, so many routing protocols and algorithms have been improved and developed for fulfilling this objective. Thus, it's very complicated to find which protocol performance is best in various network scenarios. This paper introduce improved Multicast AODV (IMAODV) routing protocol with restricted source routing that confirms providing reliable, on-time and accurate data in V2V communication in comparison of Improved AODV (IAODV). In result analysis, introduced IMAODV protocol performance is compared with AODV, IAODV and MAODV protocol with respect to Average End-to-End Delay (Avg. E-to-E Delay), Packet Delivery Ratio (PDR), Packet Loss Ratio (PLR), and Normalized Routing Load (NRL). Simulation analysis results illustrate that the performance of IMAODV protocol is better as compared to IAODV protocol in VANETs

Keywords: VANET, AODV, IMAODV, OPNET

I. INTRODUCTION

Wireless communication technologies have provided several services in our daily life, and also incremented our day by day productivity. Another field where there is much potential for wireless technologies to make a powerful effect is the field of inter-vehicular communications (IVC). The area of IVC is also called vehicular ad hoc networks (VANET) and vehicle-to-vehicle communications (V2V). VANET is a representation of mobile ad hoc networks (MANETs). MANETs have no static infrastructure and rather than depend on normal nodes to perform messages routing and network management services. Since, vehicular ad hoc networks perform in various ways as compared to traditional MANETs. Mobility constraints, Driver behaviour, and high speeds build unique features of VANETs. These features have significant implications for designing choices in these Networks. Hence, various research issues required to be deal with for inter-vehicular communications to be broadly deployed. For instance, routing in traditional mobile ad hoc networks is an important issue due to the network's dynamic configuration changes. Various studies and suggestions of routing protocols have been carried out to relay data in this context; since these solutions cannot be employed to the vehicular environment because of the particular constraints and features of VANETs. In present, many people throughout the world died each year in vehicle accidents, so in most countries some safety information i.e. traffic lights & speed limits are utilized, but however it is not a best solution. Also government and no. of automotive industries considered that vehicular safety is very challenging task. So as a result, to enhance people traffic safety of a novel advanced particular technology is developed i.e. VANET [3].

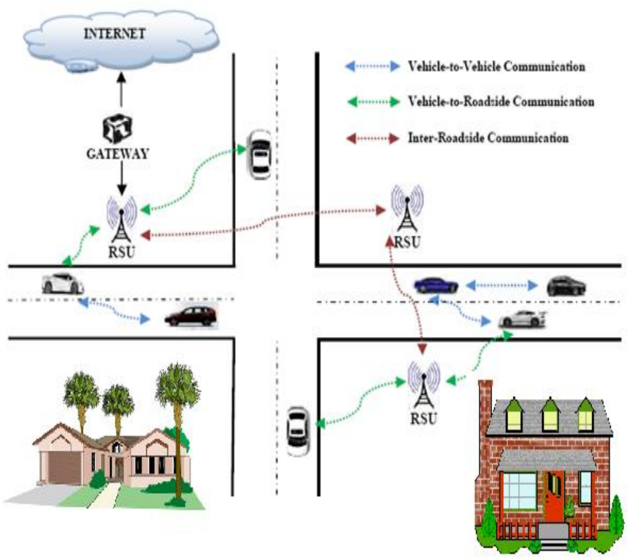

Figure1. Generalized VANET Architecture

It's an advance type of MANET (Mobile Ad-hoc Network). VANET manages a network in which vehicles are act nodes and utilized as mobile nodes to make a robust infrastructure-less ad-hoc network. Figure 1 illustrates the basic elements of VANET architecture. It makes the network between Inter-Vehicle, Vehicle-to-Roadside and Inter-Roadside communication networks [1]. Furthermore, apart from accidental-safety and security characters, there are also wide varieties of applications in VANET are available and possible that can offer passenger comfort like predictable mobility through GPS, web browsing and information updates and so on. Vehicular Ad-hoc Network (VANET) is a novel developed kind of Mobile Ad-hoc Network (MANET), where travelling nodes are vehicles like autos, cars, buses etc.

I. AODV, MAODV AND RELATED WORK

A. *AODV Protocol*

AODV is reactive routing protocol and it only requires to manage the routing information of the active routes. In AODV, each node holds next-hop routing table, which save and manage only those destinations to which it currently has a path. In the routing table, a route entry expires if it has not been utilized for a pre-defined expiration time. AODV also follows the destination sequence number method utilized by DSDV [2,3].

AODV utilizes route discovery phase when a source node wishes to forward packets to the needed destination and begins this phase if no path is existed. In the route discovery phase, the source node forwards RREQ (route request) packets. A RREQ packet involves addresses of the destination node; the source node and the broadcast ID, which primarily utilized as its identifier, the last observed sequence number of the destination as well as the source node's sequence number.

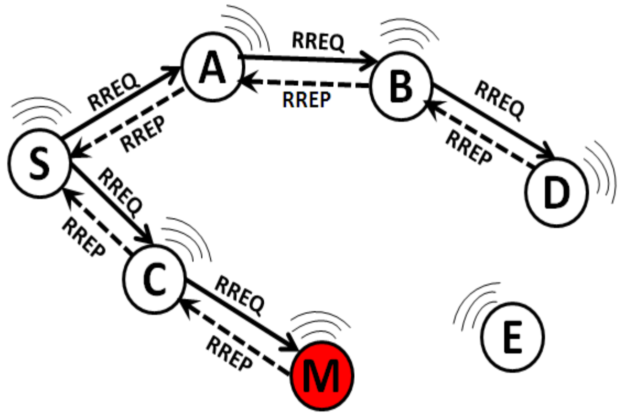

Figure2: AODV Protocol

Moreover, sequence numbers confirm loop-free and up-to-date routes. Also every node in AODV manages a cache to keep track of RREQs it has obtained. The cache also manages the route back to every RREQ originator.

B. *MAODV Protocol*

Multicast Ad Hoc On-Demand Distance Vector (MAODV) protocol is a kind of tree based multicast protocols. Normally, it utilizes broadcast to discover on-demand new paths. As illustrated in Figure 3, when a novel node wishes to combine a multicast group or it wish to forward data but has no path to the multicast tree then it forward a RREQ (route request) message. The remaining nodes will retransmit the message to its neighbouring nodes until it arrives to that node which is a part of the multicast group tree. These nodes store the address of the node that has forwarded them the RREQ message at their routing tables for making a reverse path to the source node of the RREQ.

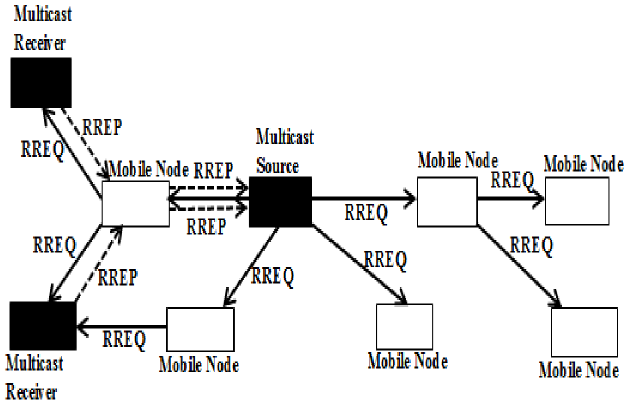

Figure 3: MAODV Protocol

Further, when a member node in multicast group obtains the message it replies back a RREP (request reply) through unicasting. The message sender may obtain many RREP back, in this situation it will chooses the shortest one (computing hop count) and forwards an activation (MACT) message along this route. After this message exchange, the node becomes a member of the multicast group and each node along the chosen route from this node to the node that obtains the MACT becomes a sending node.

C. *Related Work*

Zhong Mingyang et al. [5], in 2011 introduced a multicast protocol NMP-MAODV for the problem of connection dis-connection due to fast moving nodes so that the node is out of its upstream node's signal coverage range. NMP-MAODV enhances the Average Delay and PDR in highly mobile network by the usage of node mobility estimation and active-connection switch. Xu Li et al. [6], in 2013 suggested a paper which stresses on the improvement of MAODV by enhancing it for group team intercommunication. Finding the occurrence of particular nodes and analyzing the optimal repair node, this enhanced protocol is introduced. Assuming the difficulty of connection repair technique of MAODV, a link repair technique--GTR-MAODV is introduced which increases the successful repair rate efficiently by differentiating the several multicast branches of tree depending on GT-MAODV. Xu Li et al. [7], in 2014 introduced an optimized protocol such as MAODV-BB (Multicast Ad hoc On-demand Vector with Backup Branches), which improves the MAODV protocol robustness by combining benefits of mesh structure and the tree structure. This protocol not only maintains the shorter tree branches, also it makes a multicast tree with backup branches. Also this protocol enhances the network performance over traditional MAODV in higher load ad hoc networks.

III. PROPOSED WORK

A. *Proposed IMAODV Protocol*

In this presented work, a protocol known as IMAODV (Improved Multicast-AODV) is designated. IMAODV protocol integrates routing techniques of DSR and MAODV

protocols. IMAODV is inspired from techniques introduced by Dr. Shrikant Pradhan and Dharmendra Sutariya [9] which suggested for the Vehicular Ad hoc network with Limited Source Routing up to two hops with Backup route between Destination node and Source node and Alberto Gordillo Muñoz [4] with Multicast in VANETs. The introduced IMAODV protocol guarantees low delay, providing accurate and timely information with less no. of transmissions between nodes in comparison of MAODV. After comparing the simulation parameters: Avg.E-2-E Delay, PLR, PDR, NRL of AODV, IAODV, MAODV and IMAODV; it is observed that IMAODV is performed better as compared to AODV. Introduced method is categorized into two sub parts as change in:1) Route Discovery Mechanism, 2)Route Maintenance Mechanism. During the route discovery technique of IMAODV protocol route request phase is changed for limited source routing and route reply phase is changed to make backup route between destination and source node for all paths. While, Route maintenance technique is changed such a manner that if primary path is failed then source node utilizes the backup path for transmission of data and if backup path itself failed then new route discovery mechanism is performed.
The introduced IMAODV works for multicasting mechanism, while the IAODV protocol of base paper work for many unicasting in which the no. of transmissions are more as compared to IMAODV protocol.

B. *Proposed Work Flow*

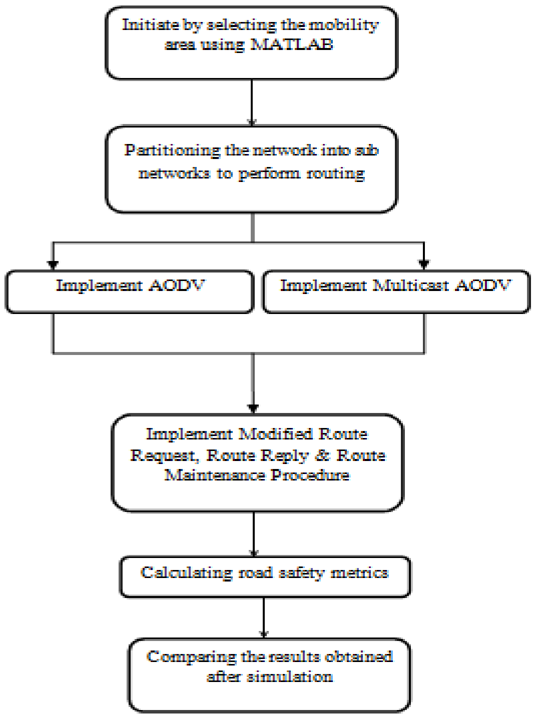

Figure 4: Work Flow

IV.COMMUNICATION PATTERN IN VANETS

VANETs confirm a very promising technology by offering traffic reliability and safety, and it also enables many other applications in the area of vehicular information sharing pattern. The VANETs applications have different properties and normally need non-standard communication protocols. Moreover, the vehicular ad hoc network dynamics because of the node movement more complexes the pattern of a suitable exhaustive communication system. Here, in this research paper we collect and categorized imagined applications from several sources and classify the unique network features of VANETs. In addition, depending on this analysis a novel communication pattern is suggested which decreases the no. of transmissions and it also make the basis of almost all the VANET applications. The analysis and information sharing pattern heightens the VANETs knowledge and ease the further progress of VANET communication systems.

V. PERFORMANCE ANALYSIS

A. Simulation Setup

In this paper work, to examine the performance of new improved protocol and the other protocols different experiment analysis is being performed with various scenarios utilizing OPNET modeler. It is excellent simulation software which can analyze network configuration and nodes transmission in the network.
In this, a set of 20 and 80 nodes scenario being implemented utilizing AODV, IAODV, MAODV, IMAODV protocol. Some simulation parameters which involves in the experimental analysis is provided in simulation table 1.

B. Simulation Table

Table 1: Simulation Table

Examined Protocols	AODV ,
Number of Nodes	20, 80
Types of Nodes	Mobile
Simulation Area	50*50 km
Simulation Time	3600 seconds
Mobility	Uniform(10-100) m/s
Pause Time	200 seconds
Performance Parameters	Throughput, Delay, Network load
Traffic type	FTP, Http
Active Route Timeout(sec)	4
Hello interval(sec)	1,2
Hello Loss	3
Timeout Buffer	2
Physical Characteristics	IEEE 802.11g (OFDM)
Data Rates(bps)	54 Mbps
Transmit Power	0.005
RTS Threshold	1024
Packet-Reception Threshold	-95
Long Retry Limit	4
Max Receive Lifetime(seconds)	0.5
Buffer Size(bits)	25600
Mobility model used	Random waypoint
Data Type	Constant Bit Rate (CBR)
Packet Size	512 bytes

C. *Scenarios Using AODV, IMAODV, MAODV and IMAODV*

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Experiment has been conducted for two different scenarios; in every scenario different situation of nodes are taken and measured:
Scenario1: It is computed for 20 nodes
Scenario 2: It is computed for 80 nodes

Scenario 1

In this scenario no. of nodes distributed are 20 in the region 81 X 81. In this scenario some nodes forward request (RREQ) message to the destination nodes. Neighboring node obtains the message and sends it to other nodes. All nodes obtains message along with the destination node. With respect to request, a response (RREP) message will be send back only by the destination node for which really the request message is created. Scenario 1 is illustrated in figure 5.

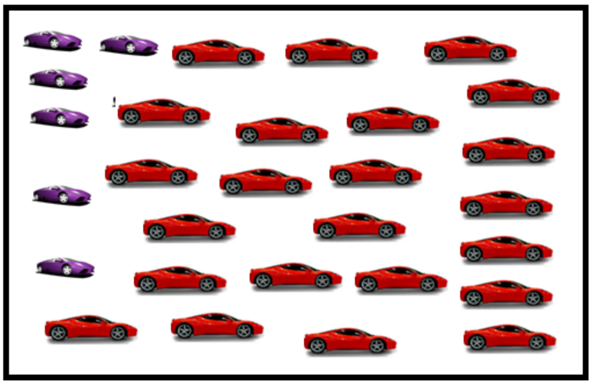

Figure 5.VANET with 20 nodes

Scenario 2:

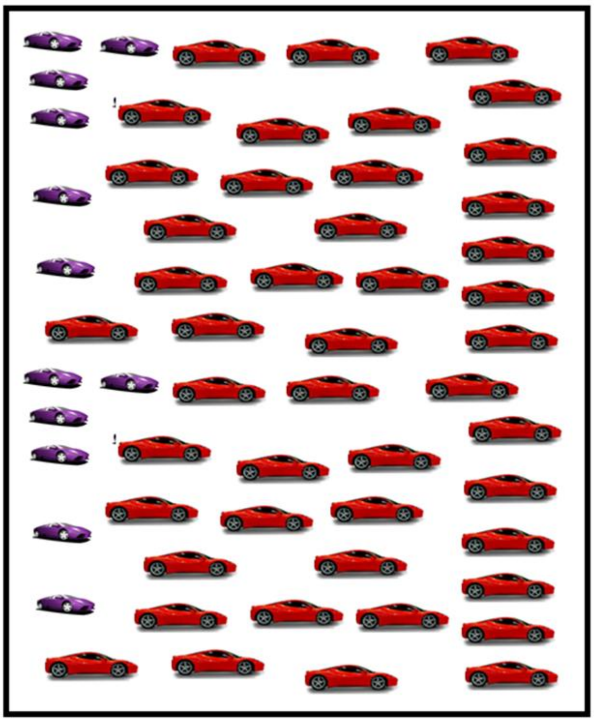

Figure 6: VANET with 80 nodes

In this scenario no. of nodes distributed are 80 in the region 163 X 163. In this scenario nodes forward request (RREQ) message to the destination nodes. Neighbouring node obtains the message and sends it to other nodes. All nodes obtains message along with the destination node. With respect to request, a response (RREP) message will be send back only by the destination node for which really the request message is created. Scenario 2 is illustrated in figure 6

VI. RESULT ANALYSIS

For result analysis, several performance parameters have been selected for results comparison for AODV, IAODV, and MAODV and introduced IMAODV at defined scenarios. The performance indicators are:

1. Average. End to End Delay: - It is the computation of period of time considered by which something is postponed or late (in average packets) to cover its journey from the source to the destination end. Delay is the amount of time that something must wait for some time. For the simulation parameter Average End-to-End Delay, the result analysis work for four protocols AODV, IAODV, MAODV and IMAODV have been measured at nodes 20 and 80 in a random manner.

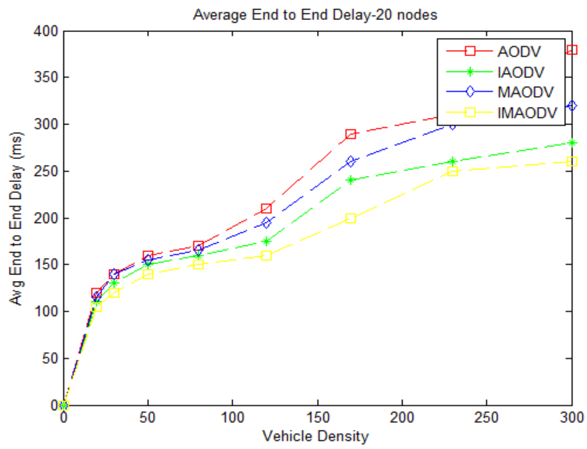

Fig 7: Comparison between IAODV and IMAODV for Avg. E2E Delay (20 nodes)

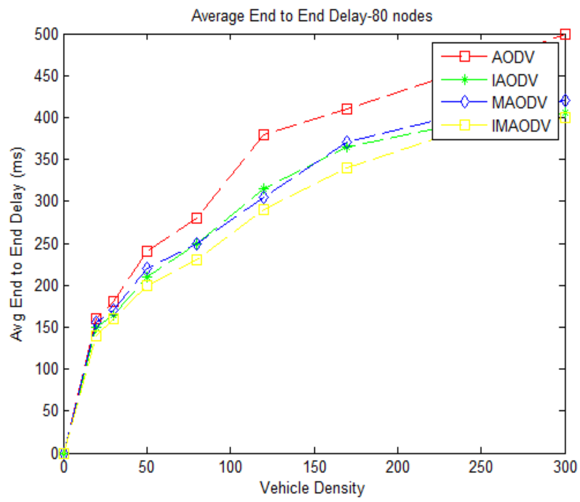

Fig 8: Comparison between IAODV and IMAODV for Avg. E2E Delay (80 nodes)

2. Packet Loss Ratio:-When packets are transmitted among nodes all packets are not successfully obtained some of them are discarded because of congestion or change in configuration this ratio is called packet loss ratio. Packet loss happens when one more no. of packets fails to arrive the destination. For the simulation parameter PLR, the result analysis work for four protocols AODV, IAODV, MAODV and IMAODV have been performed at nodes 20 and 80 in a random manner.

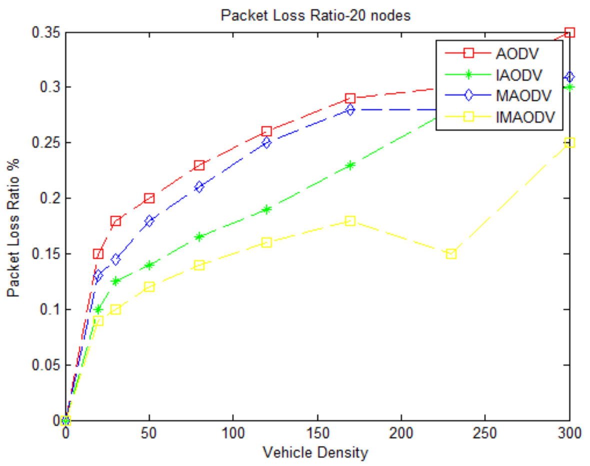

Fig 9: Comparison between IAODV and IMAODV for PLR (20 nodes)

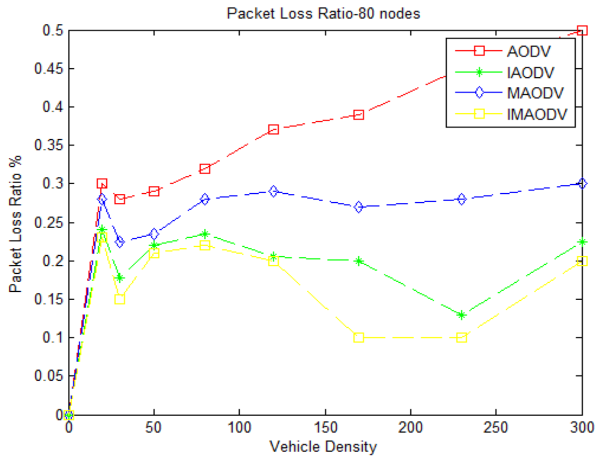

Fig 10: Comparison between IAODV and IMAODV for PLR (80 nodes)

it is observed that in Improved AODV (IAODV) the no of discarded packets are less as in comparison of AODV. With increasing vehicle density the delay ratio in situation of AODV and IAODV is high but in case of multicast protocols MAODV and IMAODV it is less. Also, from figure 8 (b) and (e) enhanced MAODV performs better results as compared to AODV, IAODV and MAODV by comparing them in both situations.

3. Packet Delivery Ratio: - Packet Delivery Ratio provides the ratio of the total data packets successfully obtained at the destination node and total no. of data packets created at source. For the simulation parameter PDR, the result analysis work for four protocols AODV, IAODV, MAODV and IMAODV have been performed at nodes 20 and 80 in a random manner.

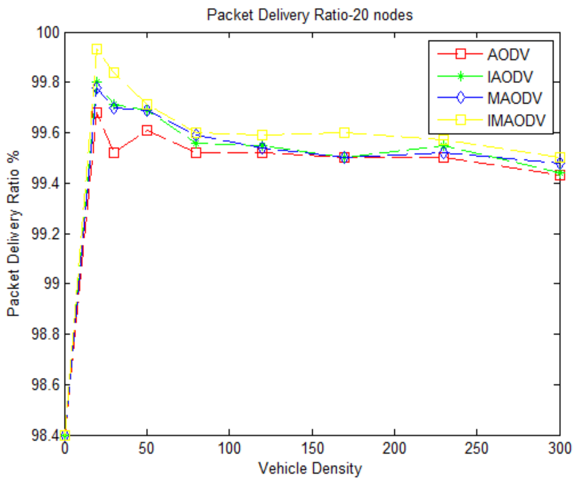

Fig 11: Comparison between IAODV and IMAODV for PDR (20 nodes)

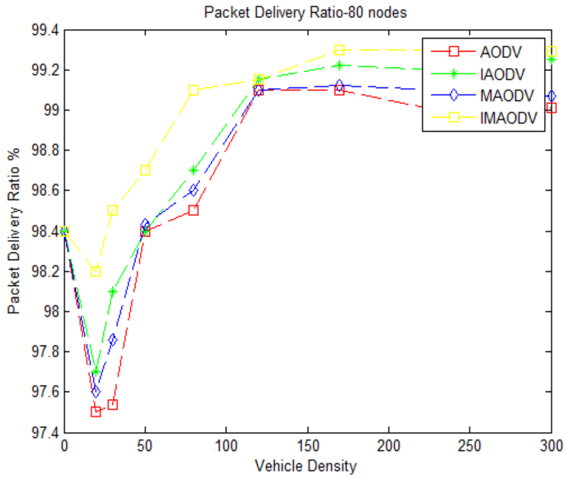

Fig 12: Comparison between IAODV and IMAODV for PDR (80 nodes)

From the simulation results is observed that IAODV provides more packet delivery ratio delay in comparison of AODV; it is noticed that IMAODV provides more delivery ratio in comparison of MAODV. By comparing IMAODV with AODV, IAODV and MAODV it is summarized that performance of IMAODV is better as compared to these protocols in both situations. From the results observed that IAODV provides better results as compared to AODV, MAODV and IMAODV because in MAODV and IMAODV transmission of packets is performed by using multicasting so, the network load increases in comparison of AODV and IMAODV in which many unicasting is performed. So, IAODV performs better totally in both the situations.

CONCLUSION

Inter-vehicle communication is a significant function of the Intelligent Transportation System (ITS) architecture. The conventional ITS traffic monitoring systems depends on a centralized structure in which cameras and sensors along the roadside maintain traffic density and transmit the result to a central unit for future processing

In this paper work, scenario of VANETs with nodes coverage ranging from 20 to 80 is produced which basically stresses on the routing problem in VANETs. An enhanced protocol is developed to overcome the challenges of routing in VANETs. IMAODV represents better results in comparison of AODV, IAODV MAODV depending on some parameters: Packet delivery ratio, Average End-to-End Delay and Packet Loss Ratio but in situation of Normalized Routing Load it decreases the results because of multicasting of packets produces multiple paths and thus network load increases so performance of IAODV is better in NRL only. Introduced IMAODV performs better in comparison of IAODV overall for offering a reliable communication in a multicast groups. The several conclusions of this work that IMAODV provides:

- decreased Delay
- Decreased Packet Loss
- Increased Packet Delivery

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