Evaluation The Performance of MAODV and AODV Protocols In VANETs Models

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Abstract

This paper to study, analyse the performance of multicast technology using the MAODV (Multicast On-demand Distance Vector Routing Protocol) in the VANETs (Vehicle Ad-Hoc Networks), this protocol using widely in MANETs (Mobile Ad-Hoc Network). The wireless nodes in the wireless vehicle networks are the same wireless devices, which are integrated with a sensor and designed specifically for the design of safety, privacy and security applications. Researchers are interested in developing and enhancing the number of service quality parameters (packets received, delay, productivity, node power consumption, etc.). The aim of this paper is to introduce and optimize VANETS multi-cast transmission technology to reduce delay, increase throughput and reduce packet loss. Although, presents an analytical study of the Enhanced Protocol (MAODV) Protocol (AODV) and compares it to AODV performance in VANETs.

Keywords: Wireless Network(VANETS), AODV Protocol, MAODV Protocol.

1. INTRODUCTION

The vehicle industry is developing day by day with new technologies, such as electronic intelligence and smart communication devices, to make road use more comfortable and secure.
One of the developments that vehicle companies have begun to use is the idea of integrating wireless communications with vehicles for greater convenience for road users as well as security through a new technology called VANETs. VANETs are component of MANETs (Mobile AdHoc Networks), which implies that each node can move freely and remain linked within the network coverage. The nodes are mobile in VANETs and MANETs. However, the mobility of VANETs is restricted to roadside infrastructure, while the motion of MANETs in nature is more random. VANET nodes are extremely mobile and have adequate rechargeable battery energy to synchronize to rapid topology modifications. In this technique, each vehicle will be equipped with a wireless connection to enable vehicles to communicate with each other, in addition to communication towers on both sides of the road to connect remote vehicles to each other or to connect to the Internet, and even connect trains and aircraft on this network, making the volume of information exchange is very large as Figure 1 . the Previous studies present in related work section focus on studying, analyzing and improving protocols and routing algorithms that will limit packet loss, delay and energy consumption by node.

The aim of this paper is to apply multichannel transmission technology and optimize its use in VANETs in order to reduce delay, increase throughput and reduce packet loss.

Improving the performance of these networks is the most important objective of this research. We have to study, analyze and employ new routing techniques in VANETs and traffic accidents have a significant role in the death of a large number of people, prompting efforts in developed countries and vehicle manufacturers to find solutions to ensure road safety. Vehicle manufacturers are competing to equip their vehicles with the latest technology to increase road safety. These technologies range from Global Position System(GPS) to Events Data Recorder

(EDR) named as (black box), night vision devices, light and rain sensors to navigation, which is the latest vehicle technology or what is known as computers on wheels [1] .

FIGURE 1: VANETs Wireless Network.

With the development of wireless networking technologies and their use in various aspects of life. The researches has been developed to develop wireless technology that enables vehicles to communicate with each other to exchange information and mitigate traffic accidents VANETs, However, the exchange of information is between mobile vehicles together or between mobile vehicles and fixed roadside units providing road information or Internet access services.

The rest of the paper is organized in eight sections. Section2 presents related work. Section 3 illustrates the classification of Routing protocols in VANETs. In section 4 we present criteria to choosing a routing protocol in VANETs. Section 5 present the Mobility models in VANETs. In section 6 shown the many scenarios are implement in different mobility models. Section 7 present the results and discussion simulation methodology and comparison the performance of AODV and MAODV protocols using the simulation results. Finally section 8 concludes the work.

2. RELATED WORK

More than one previous study has analyzed the performance of routing protocols in VANETs, because of the importance of these networks and their increasing use. Some studied the performance of MANTs when used in wireless network such as [2], which evaluated the routing protocols for wireless mobile networks when used in VANETs using the OPNET simulator for the most appropriate protocols within this type of network, Consistently, AODV,DSR,TORA protocols were studied. Similarly, Study [3] compared AODV, DSR and DSDV routing protocols when used in wireless vehicle networks for throughput and with packet size change. This study shows that DSR has better performance in this type of network. The study also indicates that these protocols are ineffective when used in wireless vehicle networks on highways, It increases the routing load over the network and reduces the data packet delivery rate and the average delay due to interruptions in lanes due to high vehicle speed. Study in [4] compared AODV and DSR with routing protocols for wireless vehicle networks.

This study showed that AODV and DSR protocols reduce network performance compared to protocols for wireless vehicle networks.

The study in [5] compared AODV, AOMDV, OLSR, DSR and GSR protocols for packet delivery and average delay and indicated that AODV is the best and can be used in vehicle networks. In [6] this study compared the routing protocols AODV, DSDV, and OLSR, this study indicated that the AODV protocol is best for its ability to maintain pathways between nodes by means of information exchanged between nodes, DSDV suffers from routing over the network.

Study [7] proposed position-based routing protocol named (Anchor Based Street and Traffic Aware), and showed that this protocol increases the rate of packets and reduces the delay.

The study [8] proposed position-based protocols called Greedy Perimeter Stateless Routing, which needed geographic information on the nodes closest to the target to pass data packets, this protocol has some problems in large cities because it relies on direct communication.

3. ROUTING PROTOCOLS IN VANETS NETWORKS

Routing protocols in VANETs are classified into two basic classes[9]:

1. Topology Based Routing Protocols
2. Position Based Routing Protocols

There are many routing protocols that can be used in both VANETs and MANETs such as AODV, DSR, TORA and proactive routing protocols such as OLSR. We will analyze AODV, MAODV routing protocols in VANETs.

3.1 Ad-Hoc On-demand Distance Vector (AODV)

It is an interactive routing protocol where paths are detected between nodes on demand, it includes a mechanism to detect and maintain the path[10].

Path detection mechanism :
The path is detected by sending a path exploration Route Request(REQ) from source node and the source node is waiting to receive the path exploration Route Replay(RREP) from the destination, If the source node does not receive a response within a specified period of time, it assumes that no path is available. When a path exploration request reaches the specified target, the path information will be passed using the unicast to the source node for the specified node[11] When a source node sends route request to its neighbors, it will either receive a response from its neighbors if it has a route for the target, or these adjacent nodes will send the request back to its neighbors with the node count increases. If a nodes receives multiple track requests, if it receives a request with the same Broadcast ID as an earlier request, it will ignore the duplicate request in order to maintain free communication with loops[11].

When the request message reaches the target, the target node responds to the request, if the request is automatically returned, the reverse path will be routed towards the source node and retain the path of all intermediate nodes where the reverse path is established. Each node maintains the path within the routing table for a defined period ACTIVE_ROUTE_TIMEOUT, such as figure 2.

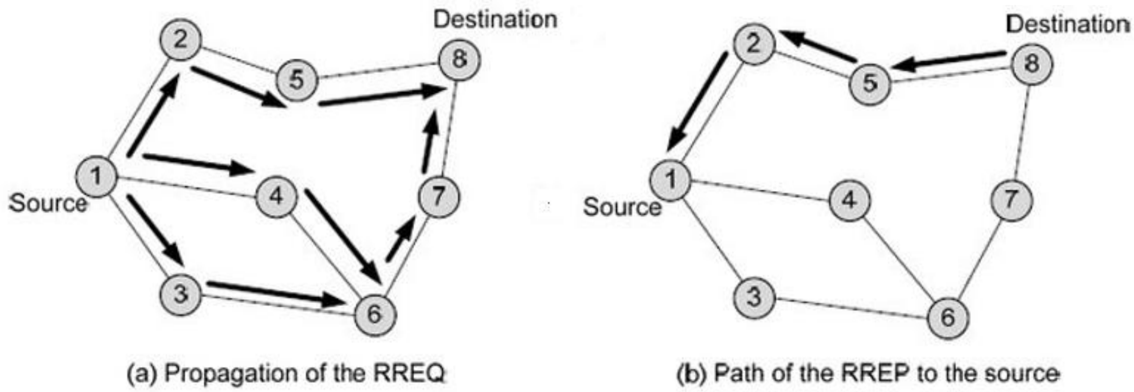


FIGURE 2: AODV Route Discovery.

3.2 Multicast On-demand Distance Vector Routing (MAODV)

Developed by the University of California, it is an extended interactive routing protocol for the AODV protocol that supports multicast[12-15]. In this protocol each group of nodes has an address and the node you want to send data to this group is sent to the address of the group or any node within the group to reach data to all the nodes combine the group.

Each group of nodes is organized using a tree structure, consisting of group members and a number of routers. Each group of nodes has a leader and the first node to join the group is the leader of this group, in the case of several members, one member is elected as the group leader through a set of periodic messages Group Hello(GRPH). Each group has its own serial number that increases periodically to reflect the novelty of the group, if more than one path is available for the group, the node that wants to send to the group chooses the path with the largest serial number, if the serial number is equal, the path in which the number of hops is less is chosen. Each node in the network can send multicast data to the group and if the source node is not a tree member and has a group path in the unicast route table it sends the unicast data to a group member [16].

How is a node joined to the group?

Figure 3 shows that the new node that want to join sends a RREQ message to all adjacent nodes and waits for the RREP message to confirm the join to the group with a MACT message and builds the entry within the 'Multicast Route Table as a group member.

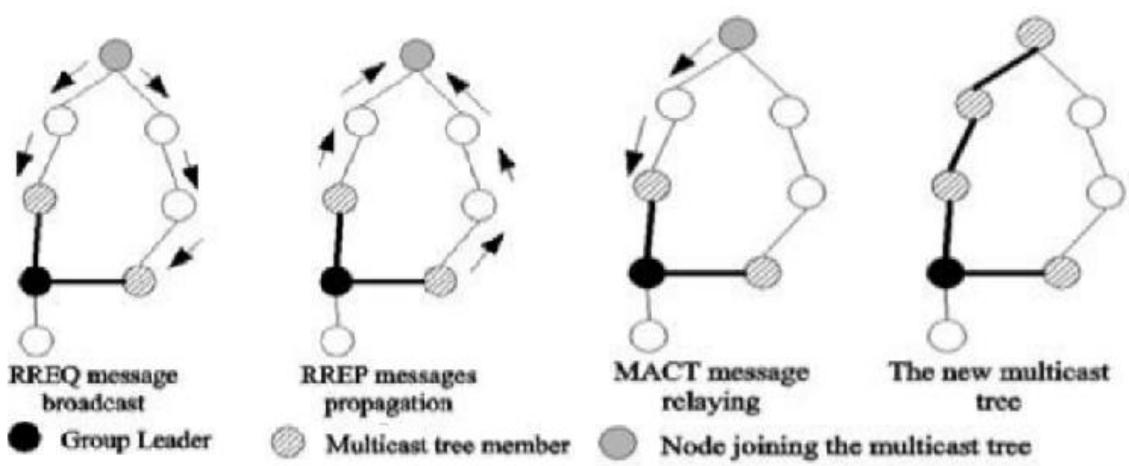


FIGURE 3: A Node Joins The Group In The MAODV Protocol.

Multicast Activation(MACT): The message that the node sends to activate joining the group, If the node not receive an RREP message, the node assumes that this group does not exist and identifies itself as the leader of the group. For leaving group: Any node that wants to leave the group sends a MACT(pure) message to the group leader and becomes out of the group.

4. CHOOSING THE ROUTING PROTOCOL IN VANETS NETWORKS

When choosing a routing protocol it must meet several requirements:

1. The number of control messages and routing messages is too small to affect the narrow bandwidth.
2. Ability to detect multi-hop path
3. Ability to maintain the path and discover new paths
4. Avoid routing loops

4.1 Challenges Facing VANETs

There are several challenges in VANETs:

- The Significant change in network topology: Routing protocol performance in VANETS networks varies depending on the chosen mobility model.
- Propagation model: In VANETs, the propagation model in space is not the same.
- Integrated sensors: Routing protocols provide useful routing information such as vehicle speed and position information.

4.2 VanetMobiSim Simulation

The Vehicular Ad Hoc Networks Mobility Simulator (VanetMobiSim) is a set of extensions to CanuMobiSim, a framework for user mobility modeling used by the CANU (Communication in Ad Hoc Networks for Ubiquitous Computing) Research Group[17].

The VanetMobiSim simulator is used to simulate the movement of vehicles connected to each other with VANET wireless networks[18]. This emulator is written in JAVA and is open source[24]. This emulator generates files to simulate network node traffic in formats compatible with several network emulators such as NS2,Qualnet.

The main component of the vehicular oriented model is the support of a microscopic level mobility model named “Intelligent Driving Model with Intersection Management (IDM_IM)” describing perfectly car-to-car and intersection managements and Support for traffic lights at intersections (TrafficLight).

5. MOBILITY MODELS IN VANETS

Wireless vehicle traffic is simulated using mobility models that have a significant impact on the performance of these networks. Popular models:

5.1 Intelligent Driving Model with Intersection Management (IDM_IM)

IDM_IM mobility model is a macroscopic car-following model that adapts a vehicle speed according to other vehicles driving ahead. in The IDM_IM mobility model nodes movement depends on the neighboring nodes movements. In particular, IDM-IM models two different intersection scenarios: a crossroad regulated by stop signs, or a road junction ruled by traffic lights [19].

5.2 Intelligent Driver Model with Lane Changing (IDM_LC)

This model extends IDM-IM model, it allows vehicles to change lane and overtake each other’s. This model takes into account the movement of the vehicle, its speed and the surrounding environment, For example, when the speed of the front vehicle decreases, the next vehicle should slow down [20].

5.3 Traffic Lights Model

Similar to the IDM-LC model, it supports multiple paths, route change mechanism, and simulation of terminal intersections and traffic lights.

6. THE SIMULATION

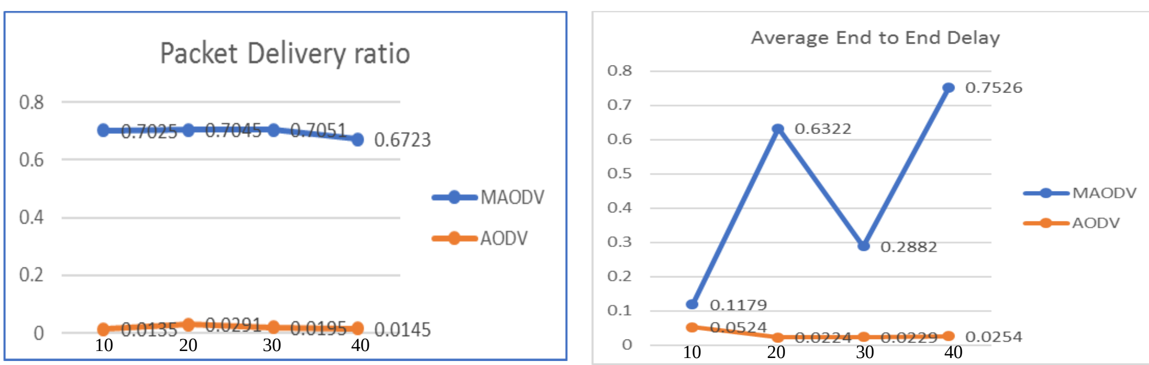
We will use the NS-2 network simulator and embed the MAODV source code in [21]. To analyze the performance of interactive routing protocols (AODV, MAODV) for VANETs using (IDM-IM), (IDM-LC), (Traffic Light). Three files are generated using the VanetMobiSim simulator for each model from the previous models and include these three files that simulate wireless vehicles in the NS-2 simulator. more than one scenario we be will using:

6.1 Scenarios with IDM_LC Model

This simulation with five nodes sent and several receiving nodes, table 1 shows the parameters environment for simulation.

Simulation Parameters	
Routing Protocols	AODV,MAODV
Mobility model	IDM_LC
Simulation time	900 sec
Number of cars(senders)	5
Number of cars (receivers)	10,20,30,40
Simulation area	X=1000 m, Y=1000 m
Speed	Max=20.00 Min=15.00 m/sec
Pause time	0.0
Traffic type	CBR
Packet size	512 Byte
Rate	5 packets/sec

TABLE 1: 5 Nodes Sent and Several Receiving In IDM_LM.



(a) (b)

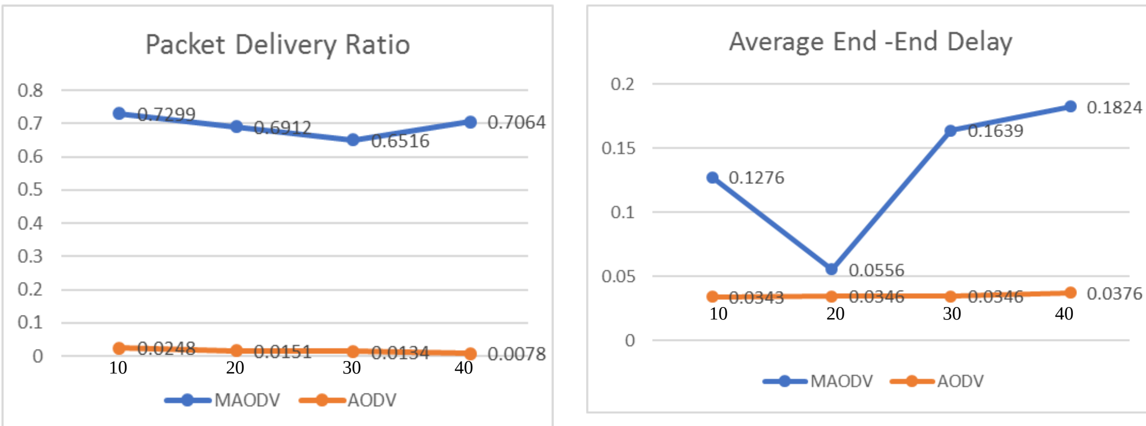
FIGURE 4: (a) Packets Delivery Ratio in IDM_LC Model with 5 nodes, (b) Average End to End Delay in IDM_LC Model with 5 nodes.

The second scenario with 10 nodes sent and several receiving nodes, table 2 shows the parameters environment for simulation.

Simulation Parameters	
Routing Protocols	AODV,MAODV
Mobility model	IDM_LC
Simulation time	900 sec
Number of cars(senders)	10
Number of cars (receivers)	10,20,30,40

Simulation area	X=1000 m, Y=1000 m
Speed	Max=20.00 Min=15.00 m/sec
Pause time	0.0
Traffic type	CBR
Packet size	512 Byte
Rate	5 packets/sec

TABLE 2: 10 Nodes Sent and Several Receiving In IDM_LM.



(a) (b)

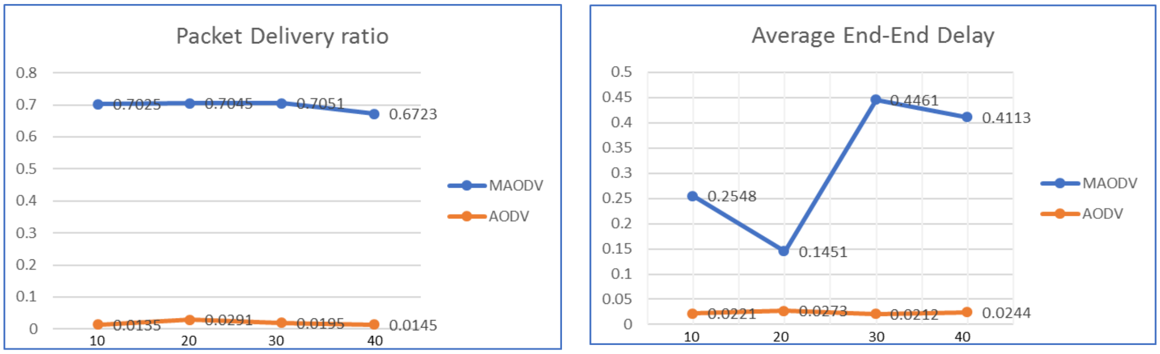
FIGURE 5: (a) Packets Delivery Ratio in IDM_LC Model with 10 nodes, (b) Average End to End Delay in IDM_LC Model with 10 nodes.

6.2 Scenarios with IDM_IM Model

This simulation with five nodes sent and several receiving nodes, table 3 shows the parameters environment for simulation.

Simulation Parameters	
Routing Protocols	AODV,MAODV
Mobility model	IDM_IM
Simulation time	900 sec
Number of cars(senders)	5
Number of cars (receivers)	10,20,30,40
Simulation area	X=1000 m, Y=1000 m
Speed	Max=20.00 Min=15.00 m/sec
Pause time	0.0
Traffic type	CBR
Packet size	512 Byte
Rate	5 packets/sec

TABLE 3: 5 Nodes Sent and Several Receiving In IDM_IM.



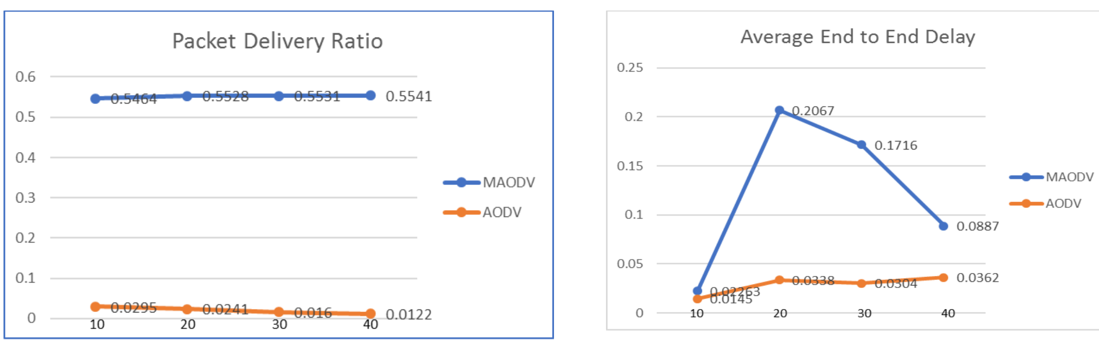
(a) (b)

FIGURE 6: (a) Packets Delivery Ratio in IDM_LM Model with 5 nodes, (b) Average End to End Delay in IDM_LM Model with 5 nodes.

The second scenario in IDM_IM with 10 nodes sent and several receiving nodes, table 4 shows the parameters environment for simulation.

Simulation Parameters	
Routing Protocols	AODV,MAODV
Mobility model	IDM_IM
Simulation time	900 sec
Number of cars(senders)	10
Number of cars (receivers)	10,20,30,40
Simulation area	X=1000 m, Y=1000 m
Speed	Max=20.00 Min=15.00 m/sec
Pause time	0.0
Traffic type	CBR
Packet size	512 Byte
Rate	5 packets/sec

TABLE 4: 10 Nodes Sent and Several Receiving In IDM_IM.



(a) (b)

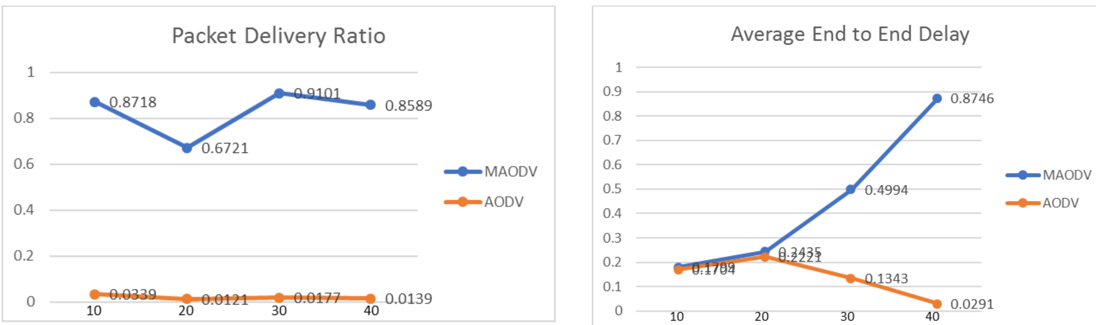
FIGURE 7: (a) Packets Delivery Ratio in IDM_LM Model with 10 nodes, (b) Average End to End Delay in IDM_LM Model with 10 nodes.

6.3 Scenarios with Traffic Light Model

This first simulation with 5 nodes sent and several receiving nodes, table 5 shows the parameters environment for simulation.

Simulation Parameters	
Routing Protocols	AODV,MAODV
Mobility model	Traffic Light
Simulation time	900 sec
Number of cars(senders)	5
Number of cars (receivers)	10,20,30,40
Simulation area	X=1000 m, Y=1000 m
Speed	Max=20.00 Min=15.00 m/sec
Pause time	0.0
Traffic type	CBR
Packet size	512 Byte
Rate	5 packets/sec

TABLE 5: 5 Nodes Sent and Several Receiving In Traffic Light.



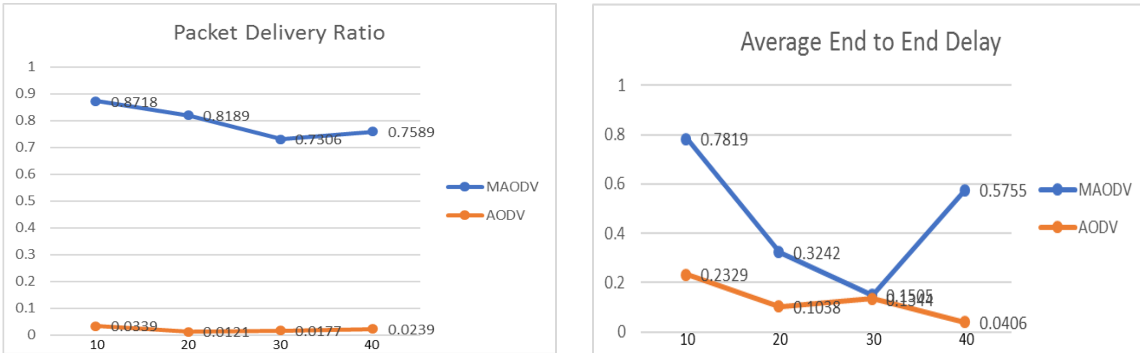
(a) Light (b)

FIGURE 8: (a) Packets Delivery Ratio in traffic light Model with 5 nodes, (b) Average End to End Delay in traffic light Model with 5 nodes.

The second scenario in Traffic Light with 10 nodes sent and several receiving nodes, table 6 shows the parameters environment for simulation.

Simulation Parameters	
Routing Protocols	AODV,MAODV
Mobility model	Traffic Light
Simulation time	900 sec
Number of cars(senders)	10
Number of cars (receivers)	10,20,30,40
Simulation area	X=1000 m, Y=1000 m
Speed	Max=20.00 Min=15.00 m/sec
Pause time	0.0
Traffic type	CBR
Packet size	512 Byte
Rate	5 packets/sec

TABLE 6: 10 Nodes Sent and Several Receiving In Traffic Light.



(a) (b)

FIGURE 9: (a) Packets Delivery Ratio in traffic light Model with 10 nodes, (b) Average End to End Delay in traffic light Model with 10 nodes.

7. RESULTS AND DISCUSSION

From the results in all scenarios in all figures (4-9) and with the three mobility models, the delivery rate of packets using MAODV is better than that of packets using AODV. Because the MAODV protocol sends all packets from the source node to the target in a Unicast way, while the MAODV protocol sends packets in a multicast way, by transmitting to the group address where all nodes within the group have the group address and receive the data packets.

From the results, in all scenarios in all figures (4-9) and in the three different mobility models, the average packet delay when using AODV is lower than the average packet delay when using AODV. Because the MAODV protocol sends the data packet to one of the group members that it publishes to the rest of the group members, the delay is less than the transmission of all packets from the source node to the target node, as well as using the AODV protocol which needs to detect the path of the nodes sent to the target node.

8. CONCLUSIONS

In this paper we evaluate the efficiency i.e. the performances of both (AODV and MAOVD) Protocols. The performance metrics such as packet delivery ratio (PDR), throughput, average end-to-end delay and normalized routing load are evaluated using NS-2. The realistic vehicular mobility traces are generated using Intelligent Driving Model with Intersection Management (IDM_IM) , IDM_IC and traffic light models , based tool VanetMobiSim. These two protocols were tested by varying constant bit rate (CBR) against various metrics. It is concluded that MAODV outperforms AODV when packet delivery ratio is concerned. Even then MAODV protocol is more suitable for highly VANET networks where network partitioning and route failure occur very frequently because of its capability to determine multiple routes but at the cost of additional overheads involved for route discovery. Therefore we can say that MAODV routing protocol is more efficient than AODV routing protocol for VANET networks.

For the future studies, we recommend the following:

- Study the impact of site-based routing protocols, and protocols that depends on topology together.
- development of protocols for the network of vehicles supports multicasting and broadcasting for all Vehicles.
- Develop mobility model so that it is as close as possible to reality.
- Development of the improved algorithms and technologies in MANETs to VANETs.

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