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Performance Evaluation of AODV and MDORA Protocols in Different Cases of Vehicles Movement

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Abstract: Most important topics that have been under discussion are how to manage traffic at intersections and how to maintain road safety. Vehicular Network (VANETs) is the most significant solutions to solve this problem. And to routing packets between vehicles, many protocols have been proposed. And from this protocols are the MDORA protocol and AODV protocol. This work provides a comparison between the two MDORA and AODV protocols in two cases at variable speed of vehicles, the first in the case of vehicles movement in several directions, and the second in the case of vehicles movement in one direction. The comparison results of the MDORA protocol are worse than the AODV protocol (E2E, PDR, communication overhead), while the comparison results in the second case of the MDORA protocol are better than the AODV, because in the MDORA algorithm there was a condition is choose the vehicles that moved with the same direction when to routing packets to the destination vehicle.

Keywords: E2E, PDR,VANETs, MDORA, AODV.

1. Introduction

The Intelligent or smart Transportation System (ITS) is consists of a number of important research and topics such as VANET [1], the Intelligent Transport System (ITS) is works to maintain road safety and regulate traffic at intersections from informing drivers of accidents, weather conditions, and road emergencies [2, 3]. In order to properly transfer data between vehicles, routing protocols must be developed in order to accurately access this information (speeds, directions, No. of vehicles). This information is obtained through two types of communication technologies VANETs. The driver takes appropriate action to avoid a set of challenges when directing information in the VANETs network some of these challenges (high vehicle mobility, vehicle separation, timely data transfer, and variable topology) [4, 5], to overcome these challenges is to develop the routing protocols to direct data between vehicles. In the VANETs a number of protocols were proposed for data routing [6, 7]. These protocols are the position-based routing protocol, which is better than other protocols, depending on the system (where location information is obtained accurately) [8]. The distance factor must be provided and when the packets are redirected, the following jump vehicle must be known to routing packets in the VANET network. The correct direction needs when routing packets a number of factors including density, speed, direction and location [9]. This work adopted two protocols AODV and MDORA used in a network VANETs to work on routing data between vehicles within the network. In this work Matlab was used to simulate the two protocols through two environments, the first case is environment design similar to the real environment from roads and buildings and the movement of vehicles in several different directions and Movement of vehicles at variable velocity. As for the second case, the environment is design one street with vehicles movement in one direction and Movement of vehicles at variable velocity, and this is what the previous some works lacks in the network VANET, and these two environments were designed through Matlab.

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2. Maximum Distance On-Demand (MDORA)

MDORA is one of the network protocols VANETs type of position based routing protocol which creates paths between vehicles only upon request. Traffic information should be obtained, the longest communication time of the vehicle within the communication range, distance and location, until the path and destination is established. When we get this information the best route is chosen so that the packets are routed and reach the destination vehicle. The algorithm passes in two stages, the first stage path discovery, the second stage path set-up and the data transmission.

2.1 Path Discovery

This stage begins when the source vehicle is deployed hello message to all neighboring vehicles located within the scope of the communication, and the hello messages contained within them include information, location of the source vehicle, and direction of the source vehicle. At the same time, the source vehicle operates temporarily during the transmission process hello message, During the interim period of operation if no vehicle is received from neighboring vehicles hello message Does the source vehicle re-send hello message, When the next vehicle receive hello message starts to start compared, if in the same direction as the source vehicle, sends a response message to the source vehicle. But if it is opposite to the source vehicle, it will ignore a hello message. The response message contains information, the type of the message, the neighbor ID, the identifier of the message. In an algorithm MDORA two factors are used:

A. Distance

This is the distance factor where the distances between the vehicles are calculated and through this factor is chosen the closest vehicle. The following equation calculates the distance factor between vehicles:

$$\text{Distance} = \frac{\text{Distf}^{2(S,D)} + Distf^{2(S,n)} - Distf^{2}(n,D)}{2 \times Distf^{2}(S,D)} \quad \ldots\ldots\ldots\ldots (1)$$

Where

S: source node, D: distance node, n: neighbor node

B. Communication Lifetime

This is the lifetime of the communication and calculates the maximum duration of the vehicle's stay within the range of communication. Calculates the communication life time through the following equation:

$$\text{Communication Lifetime} = \frac{-(ab+ac)+\sqrt{(a)^2 r^2 - (ac-ab)^2}}{a^2} \quad \ldots\ldots\ldots. (2)$$

Where

a=vh-vz , b=xh-xz , c=yh-yz

v : velocity

h,z : vehicles

When an account is finished, the source vehicle begins to create a table containing the neighbor identifier, distf, cltf. The source vehicle updates the schedule after the next jump to the adjacent car which is at the header of the routing table. The path discovery shows in Fig.1.

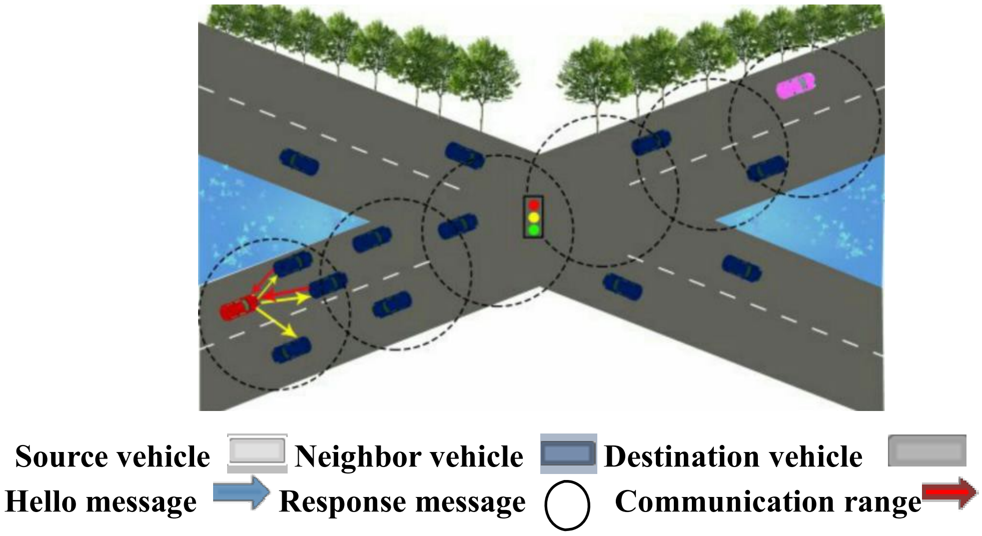

Fig. 1 - Path discovery

2.2 Path Set-Up and the Data Transmission

This point relies on the length of the vehicle's stay within the communication range and communication lifetime between the vehicles. The MDORA protocol check the vehicle jump coming from the neighbors tables through which Cltf to see if it is still within the communication range. And find out what is the least time that the vehicle needed to send packets even when it set a scale (cltf-threshold). It tells how long the next jump vehicle in communication range. So when comparing cltf and (cltf-threshold) if cltf is equal to or greater than (cltf-threshold), the packet routing process begins towards the next jump. If the cltf is less than (clt-f threshold) this vehicle is removed from the neighbors table and another vehicle is added from the neighbors table. If the destination ID and the vehicle ID next to the next hop are a similar result, the protocol will expire. If the result is not identical, the next jump vehicle begins rediscovering the route. The steps previous are repeated until packets arrive to the destination vehicle from the source vehicle successfully. Fig.2. shows the path set-up and the data transmission.

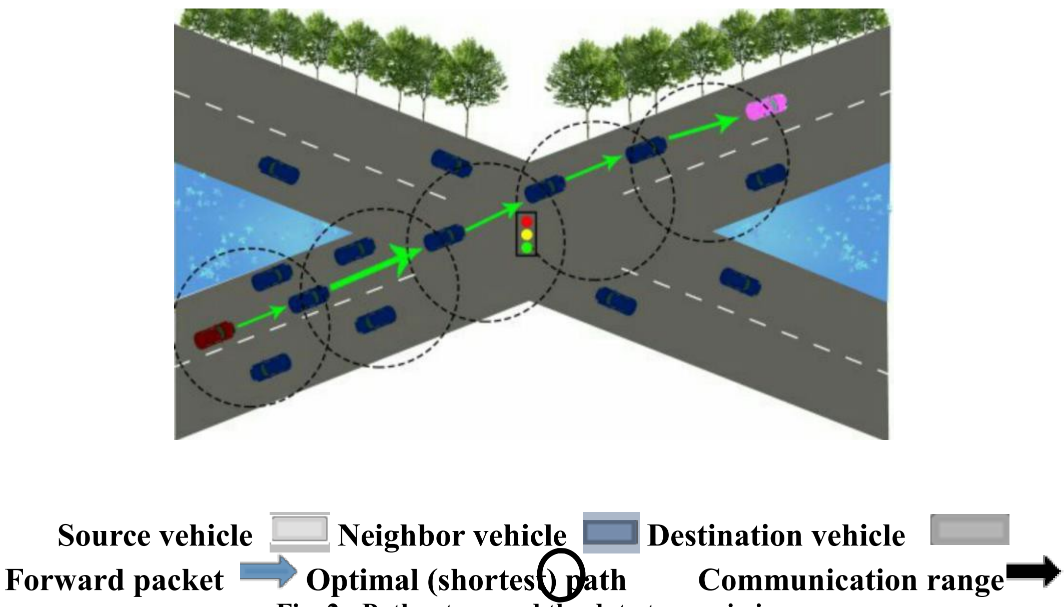

Fig. 2 - Path set-up and the data transmission

3. AODV

The AODV is routing protocol based on the topology of the interactive protocols type. In this protocol the path between the source and destination node is created only if that path is needed for data transmission, the path is maintained only if the source node has a desire in this path. In the protocol AODV Neighboring nodes are detected and monitored, by posting hello messages each node send hello messages periodically to all neighbors around the node. When the vehicle cannot get "hello messages" from the neighbors, it means there has been a failure in the connection.

3.1 Routing process in a protocol AODV

We can Summarization the work of the protocol in two functions: (A) path discovery function between source and the neighbor's nodes, (B) function of delivering packets correctly to the destination node and road maintenance.

A- Path Discovery

When the exporter node needs a new path for the destination node and does not have that path, the reason is that the requested path has not been used before, or that it has been used but it has become expired. The source node broadcast a message requesting the path RREQ to the rest of the nodes. After the RREQ is broadcast, the source node waits for get it a message to respond to the RREP request from a node over a specified period of time. If it does not receive a response during the period, it either re-transmits the route request message again or assumes that there is no known route and modern route for the requested destination node, when the route request message arrives for a node and it does not have modern route and correct route for the interface node specified in the message, it re-broadcasts the route request message (RREQ), as shown in Fig.4.

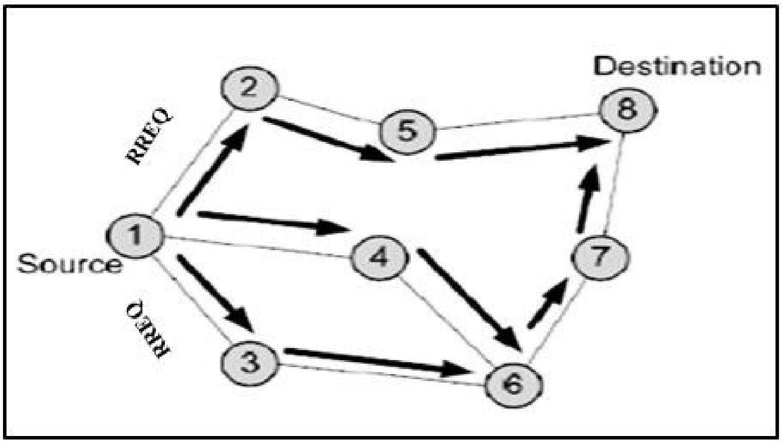

Fig. 3 - Broadcast Route Request Messages

It also creates reverse path to source from which the request originated and record it in the routes table. The objective of the reverse path is to save the way back to the original node that created the route request message (RREQ), as shown in Fig.5.

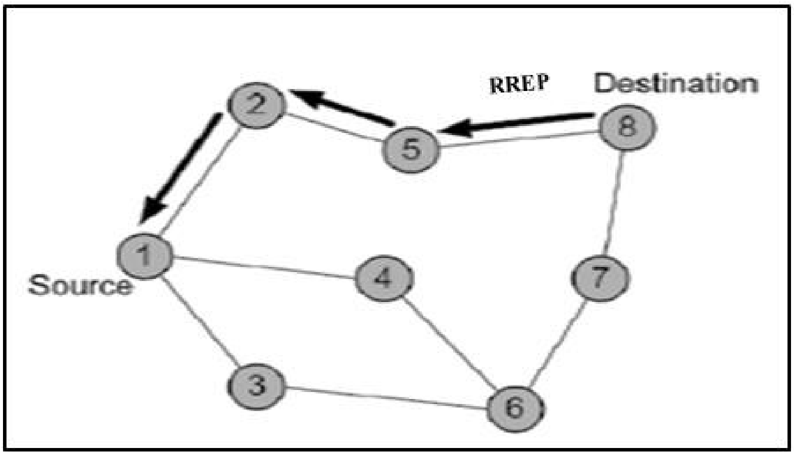

Fig. 4 - Route Replay Messages

B- Path maintenance

It occurs when the node detects a path to a neighboring contract is no longer valid. It deletes that route from its routes table, and then broadcasts an announcement that the routes not valid for all adjacent nodes that are currently using that route. Each node that receives this message re-transmits it to its neighboring nodes until the message eventually reaches the source node that created the packets sent by that Route, and from there It either cancels data transmissions or retries the route request, by sending a new route request message (RREQ).

4. Simulation Parameter

In this work Matlab was used to simulate and design an environment that is similar to the real environment with the velocity of the vehicles variable, and show comparison results in two cases, first in the case of movement of vehicles in several directions, the second case in the case of movement of vehicles in one direction. And the first case of the simulation environment appears in the Fig.6. Table 1 shows the most important simulation parameters used in this work.

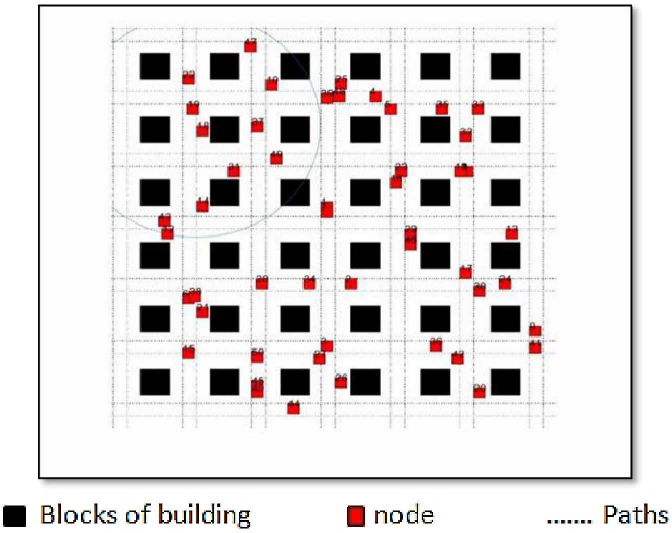

Fig. 5 - Simulation environment in the first case

Table.1 - Simulation Parameter

Parameter	***Value***
Protocol	MDORA, AODV
Network Simulation	Matlab
Simulation time	300 s
Variable velocity	(40-120) km/h
Number of vehicles	50
Transmission Rate (TR)	5 packet/s
Packet size	512 Bytes
Control message size	64 Bytes

5. Discussing the outcome

This part displays the results in two cases when comparing the MDORA protocol and the AODV protocol in these following points (E2E delay, PDR, and communication overhead).

5.1 The first case is the movement of the vehicles in several directions

End to end (E2E) delay is difference between time packet to send from the source vehicle and time when package is received in destination vehicle which measured in milliseconds. In the Fig.7 shows end to end delay.

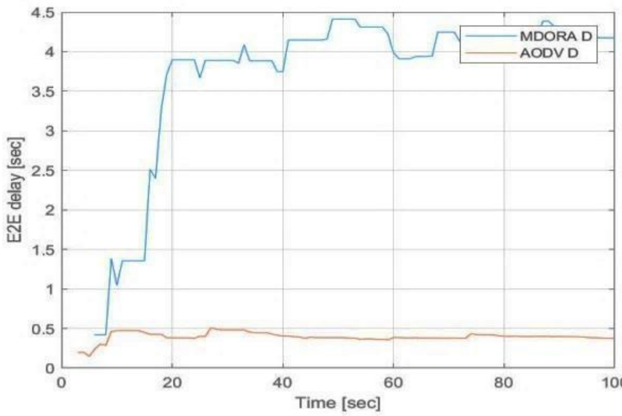

Fig. 6 - E2E Delay in first case

PDR is the success rate of all packets sent from source to destination node. Measured in percentage.

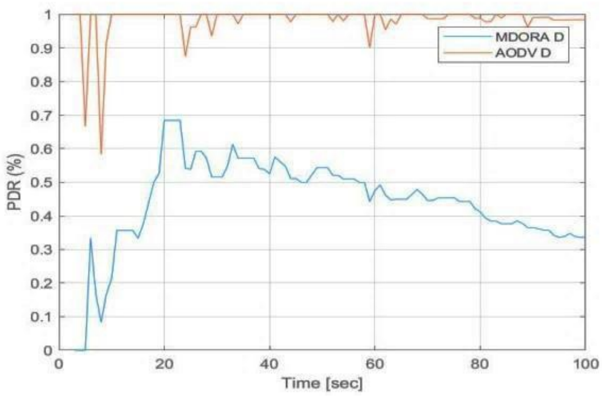

Fig. 7 - PDR in first case

Communications overhead can be characterized "quantity of control messages" that are sent by the MDORA protocol (Hello message, response message) and the controlled messages that are sent from a AODV protocol (route request message, route replay message, route error message) that create and maintain the path between the vehicles., and is measured in bytes. In the Fig.9 shows communication overhead.

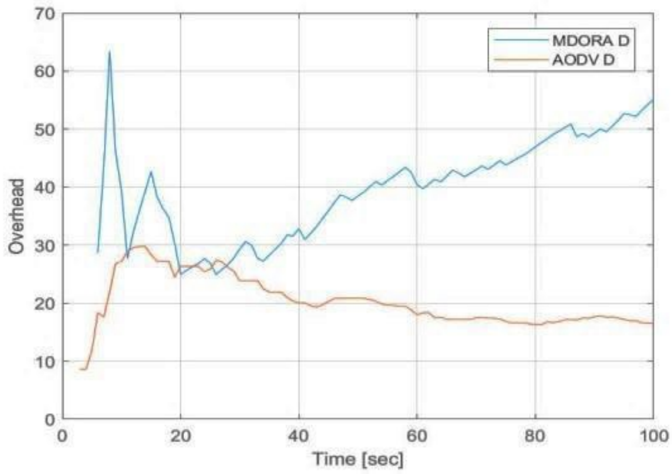

Fig. 8 - Communication Overhead in first case

5.2 The second case is the movement of the vehicles in one direction

Present the results of the comparison between the protocol MDORA and AODV in the case of variable vehicles velocity. In this case, a single path was selected the vehicles moving through it, and be the movement of the vehicles in one direction. Simulation environment in the second case show in the Fig. 10, show E2E delay as shown in Fig. 11, the packet ratio in Fig. 12, and communication overhead in Fig.13.

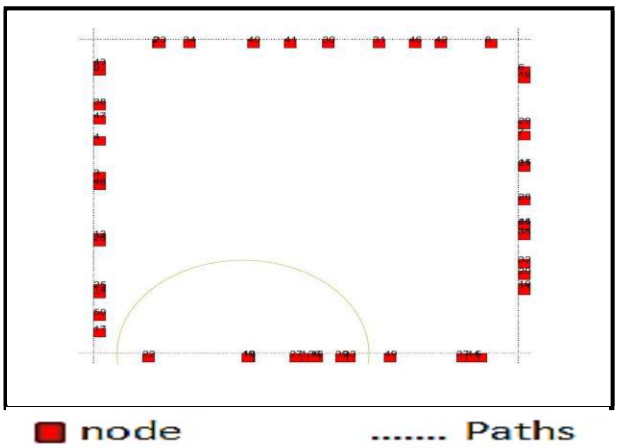

Fig. 9 - Simulation Environment in second case

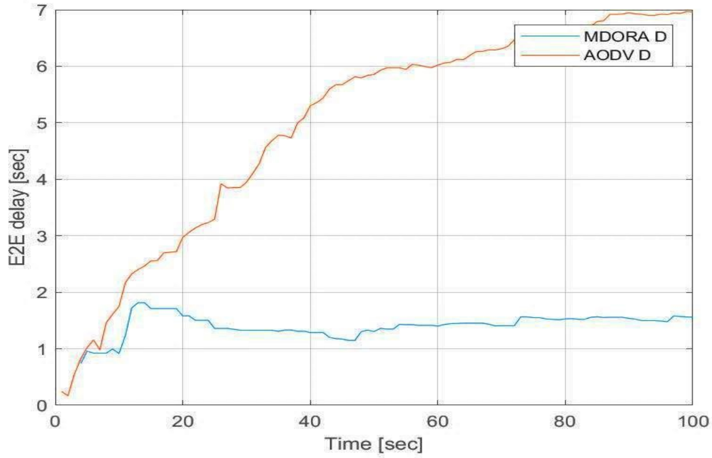

Fig. 10 - E2E in second case

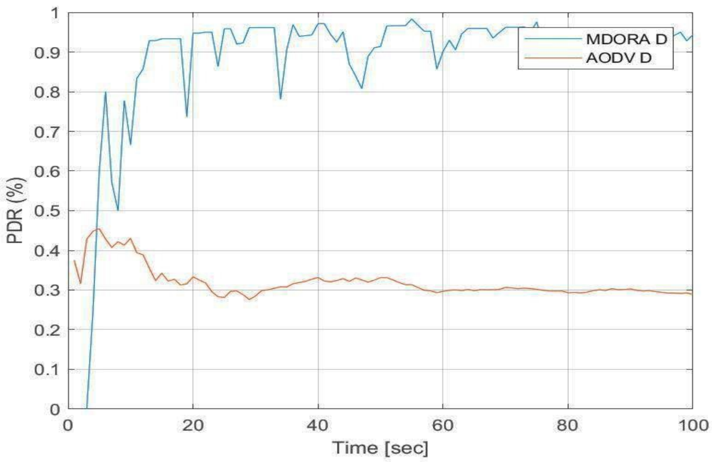

Fig. 11 - PDR in second case

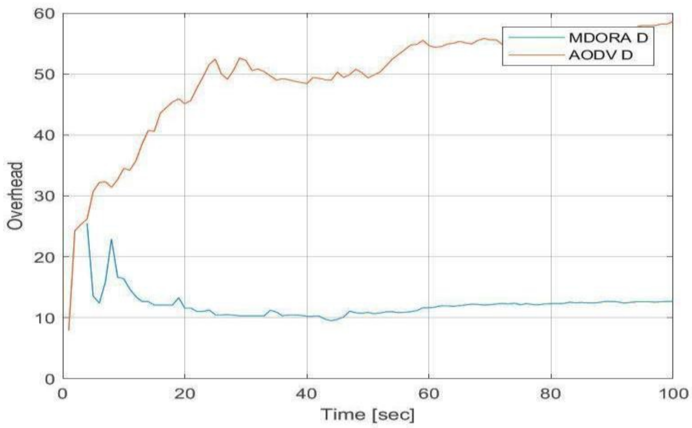

Fig. 12 - Communication Overhead in second case

6. Conclusion

This work adopted MDORA protocol and AODV protocol, and the comparison was done between this protocols, the first case is comparison results between the MDORA and AODV protocols in case of movement of vehicles at variable velocity, and movement of vehicles in several directions. The obtained results demonstrate AODV protocol is more efficient compared MDORA protocol in these following points (E2E delay, PDR, communication overhead). The second case is comparison results between the MDORA and AODV protocols in case of movement of vehicles at variable speeds, and movement of vehicles in one direction only. Also for MDORA protocol, the obtained results are better than the AODV protocol in E2E delay, PDR, and communication overhead. It follows from this that MDORA protocol works well if applied to a single-way traffic environment because in the MDORA algorithm there is a condition that it only selects vehicles which moves with him in the same direction when routing packet to the destination vehicle.

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