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Comparative Analysis of the MDORA and AODV Routing Protocols for Vehicles Operating at Constant and Variable Speeds

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A B S T R A C T

The primary focuses of investigation have been and continue to be strategies for traffic management at intersections and measures to enhance road safety. An essential remedy for this issue is a Vehicular Ad-hoc Network (VANET). At VANET, a variety of protocols are used to route communications between vehicles. At this research, we utilize the Multipath Dynamic Optimized Routing Algorithm (MDORA), which is an acronym for position-based maximum distance on-demand routing. By choosing the vehicle closest to the destination vehicle, this protocol has the advantage of choosing the next best jumping path, which lowers the number of hops. In two scenarios—vehicle travel at a dynamic speed and constant speed—this paper compares the MDORA and AODV protocols. three standards: Factors including the time spent on communication, the pace at which packets are delivered, and the time it takes for information to travel from one end to another, were used to assess how well the two protocols performed. Finally, a comparison of the number of missed packets between the MDORA and AODV protocols was done for moving vehicles at constant and dynamic speeds, The MDORA protocol can identify the optimal route even when cars are moving at varying speeds, resulting in minimal packet loss.

Introduction

Intelligent Transportation Systems (ITS) includes many research and important topics such as VANET [1]. VANET is intended to maintain traffic control and safety on the roads through communications and reduce road accidents via inform drivers about road emergencies and climatic conditions [2,3]. VANET includes several routing protocols that transmit information between vehicles with high accuracies such as the number of vehicles on the road, directions, and speeds. Information is transferred between vehicles through There are two lines of communication: one between cars and another between vehicles and infrastructure. VANET faces many challenges when directing information such as network topology change, the timely transmission of data, inter-vehicle link disconnection, and high vehicle mobility [4,5]. VANET routing protocols must be developed to overcome these challenges when transferring data. Several protocols have been proposed in VANET for routing information between compounds [6,7]. Protocols are divided into topology and position-based protocols, and position-based protocols are based on the Global Positioning System (GPS), so they are the best [8]. This work focuses on the AODV and Multipath Dynamic Optimized Routing Algorithm (MDORA) protocol [9] [11].

Related Works

Routing protocols in a network VANETs It varies as it is in the network MANET, and VANETs are a branch of the network MANET. In MANET, the topology is random, and the node speed is constant. In VANETs, the architecture is non-random, and the vehicle speed is high, so protocols cannot be applied MANET on a network VANETs. In this work, topology and position-based routing protocols are two different types of VANET protocols that are employed [19, 20].

Topology-Based Routing Protocol

There is a table inside each vehicle connected to the VANETs network. The routing table is the name of this table. The data from which packets are sent from the source vehicle to the interface vehicle is what this table is based on. Topology routing protocols include AODV, TORA, and Dynamic Source Routing (DSR) [13–15].

One of the routing protocols created for VANET networks is (DSR) [10]. The path detection stage and the path maintenance stage are the two stages it goes through. The routing tables of the intermediary vehicles are both dependent upon and independent of those of the source vehicle. the drawbacks of a DSR methodology Because it only works in static surroundings with sluggish vehicle movement, it cannot be used in high-mobility environments.

On-demand and ad hoc distance vector AODV [11]. According to this protocol, the vehicle functioning as the source must initially transmit a request message to its neighboring vehicles before establishing a connection with the vehicle functioning as the interface. When the interface vehicle receives the request message, it extracts the source vehicle's address, stores it, transmits a response message to the vehicle that initiated the process. Subsequently, the source vehicle replicates the path traversed by the interface vehicle but in the opposite direction, as shown in Figure 1.

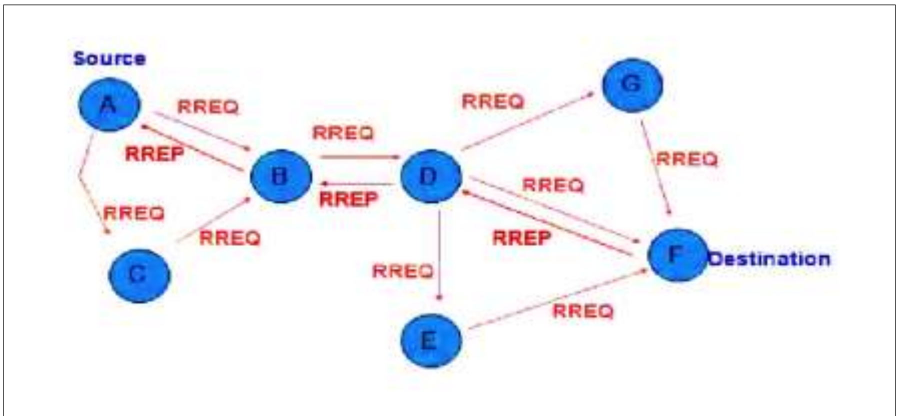


Figure 1. AODV Routing Protocol

Protocols for Routing Based on Position

This kind of protocol is reliant on GPS which is located inside the vehicles to determine the location of the adjacent vehicles, and through the information coming from the system GPS, this type of protocol does not pass through the maintenance phase between source and destination vehicle.

Predictive Directional Greedy Routing (PDGR) [12], from two approaches, can calculate the results of this algorithm, which is the position and direction of the state of the first directive. This protocol cannot be relied upon in some circumstances because depending on the next jump by predicted. If the vehicle can be the next jump, in this case, the vehicle will receive the packets, but if it is not the next jump, do not receive the packages. In this case, the delay will increase, the communication overhead will increase, and it will decrease the packet delivery ratio.

The (MDORA) is a protocol designed specifically for (VANETs) [9]. This protocol goes through two stages, path discovery, path preparation, and data transmission as shown in Figure 2 and Figure 3.

This protocol creates pathways between vehicles only on demand. The route from the source to the destination can be computed by measuring the time it takes for each vehicle to communicate within its communication range and the distance between them and the location of the destination vehicle. When the source vehicle obtains this information, the vehicle with the highest communication life within the communication range and the closest distance from the destination vehicle is selected, the subsequent action entails directing the packets to their ultimate destinations.

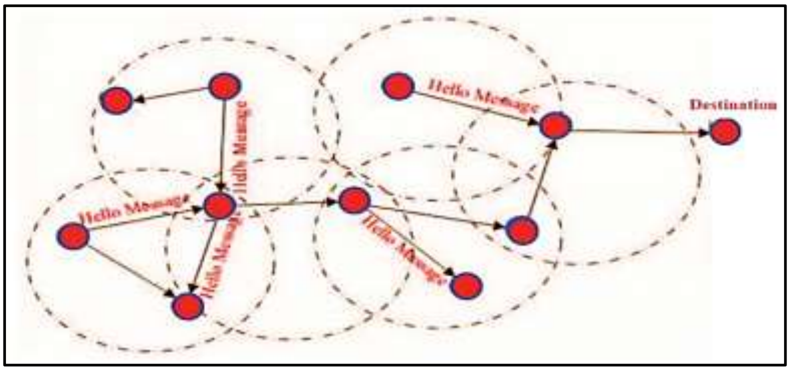


Figure 2. Path Discovery

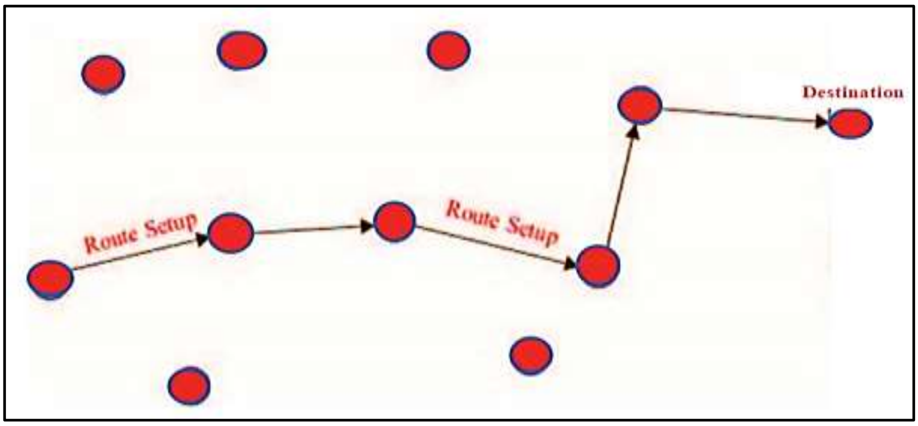
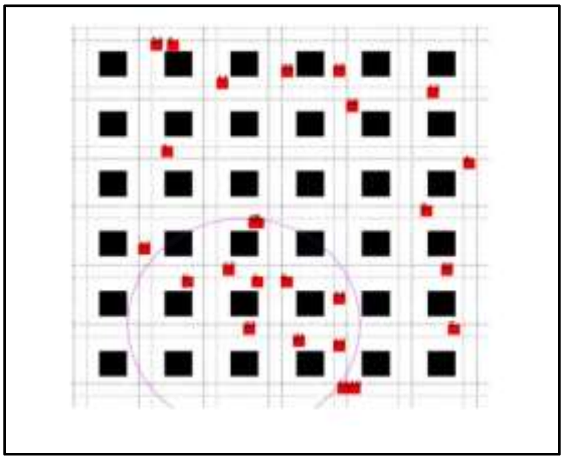


Figure3. Path Preparation and Data Transmission.

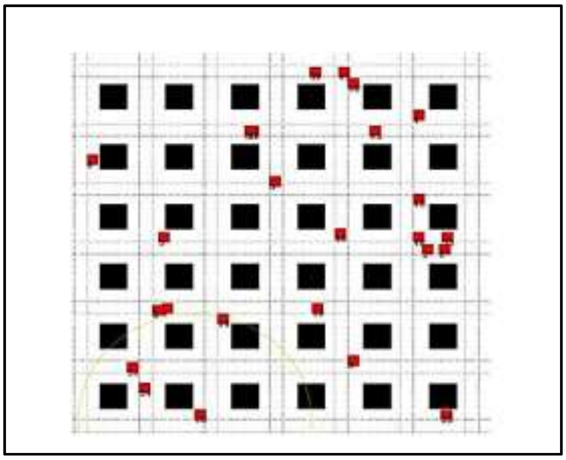
The Parameters Used for the Simulation

The project involves the creation and simulation of a city scenario using MATLAB. In two cases, the AODV and MDORA protocols' performance was compared. The simulation environment for the first scenario in which the vehicle is moving at a constant speed is shown in Figure 4. The simulation environment for the second scenario, in which the vehicle is moving at a dynamic speed, is shown in Figure 5. The most significant simulation parameters are displayed in Table 1.



Blocks of Building   Vehicles ----- Paths

Figure 4. Simulation Environment in the First Case.



Blocks of Building   Vehicles ----- Paths

Figure 5. Simulation Environment in the Second Case.

Table1. Simulation Parameter.

Parameter	Value
Protocol	MDORA, AODV
Lines Number's	2 bidirectional
Vehicle's Number	25
Number of lines	2 bidirectional
Area for Simulation	5 km*5 km
Constant Speed	60 km/h
Dynamic_Speed	40 - 120 km/h
Data_Rate	5 Packet/s
Network simulation	MATLAB
Size of the control message	64 B
Packet's sizes	512 B

Result Analysis

The initial case comparison between the AODV and MDORA techniques with relation to end-to-end latency, Packet Delivery Ratio (PDR), and overhead is shown in this section.

The First Case in Constant Speed

Measured in bytes, communication overhead is the quantity of messages transmitted by protocols to create and maintain a path for packet routing [16]. Figure 6 shows the overhead view.

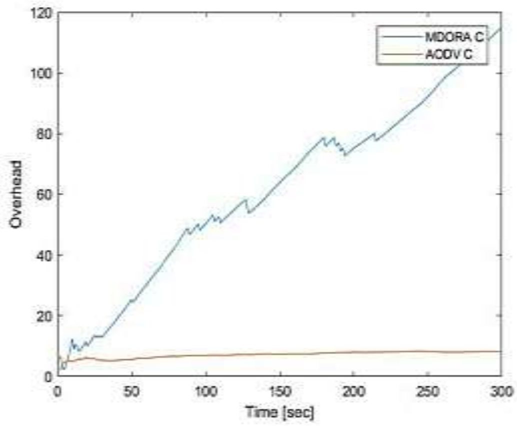


Figure 6. Overhead

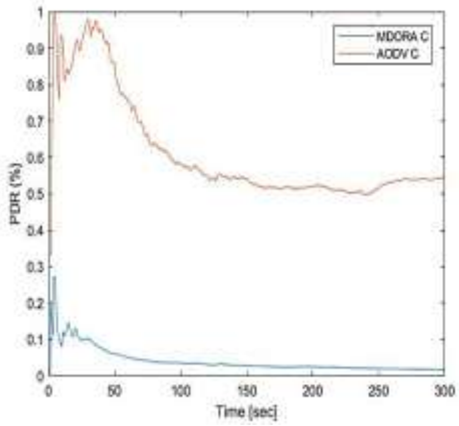


Figure 7. PDR

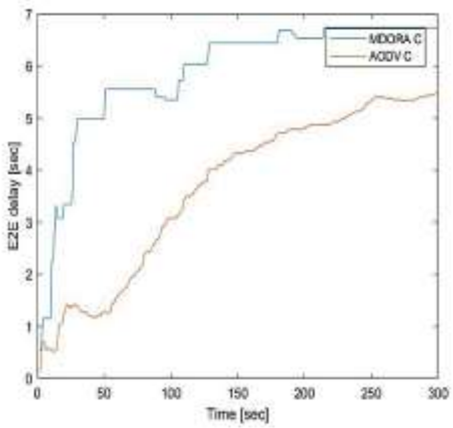


Figure 8. E2E Delay.

The packet delivery ratio quantifies the efficacy of transmitting data packets from the source to interface vehicles [17]. A percentage is used to represent PDR. Figure 7 shows a picture of the PDR.

End-to-end latency is the time interval, measured in milliseconds, between during the transit period of a packet from its source vehicle to its target vehicle [18]. Figure 8 depicts the E2E lag.

The Second Case in Constant Speed

A comparison is made between the MDORA and AODV protocols for facilitating the passage of vehicles at varying speeds, is shown in this section. Figures 9 and 10 show the PDR, Figure 11 shows the E2E delay, and Figure 11 shows the overhead.

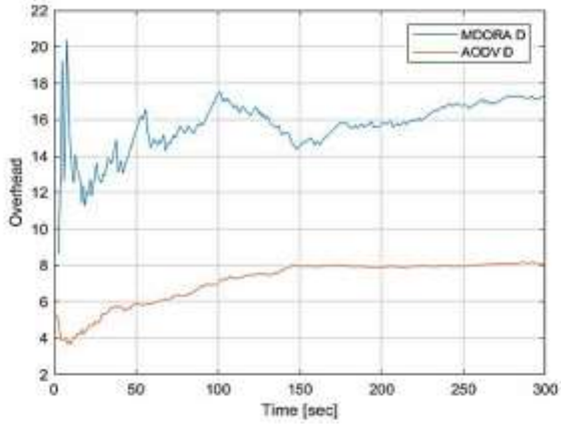


Figure 9. Overhead

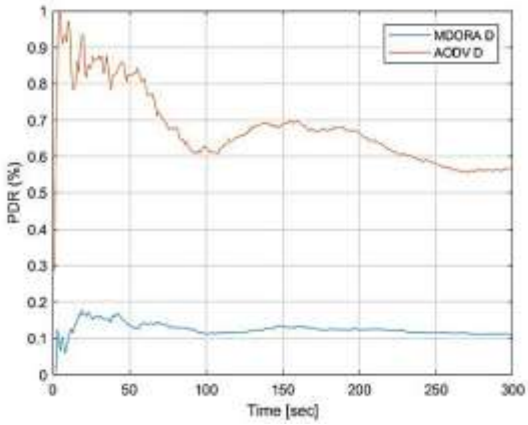


Figure 10. PDR

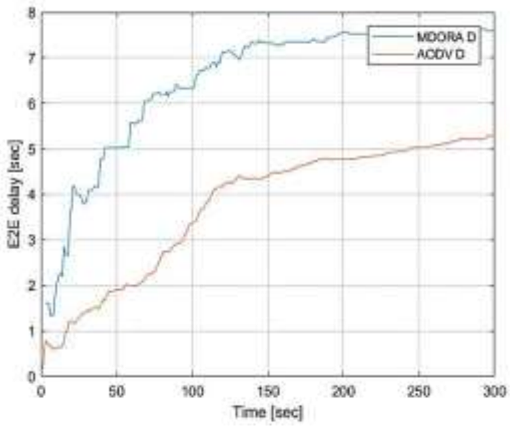


Figure 8. E2E Delay.

The Third Case in Constant Speed

In the table below, the number of dropped packets for a vehicle driving at a constant and variable speed is compared between the AODV and MDORA protocols. Table 2 displays the quantity of packets that were dropped. The MDORA protocol can identify the optimal route even when cars are moving at varying speeds, resulting in minimal packet loss

Table2. The Number of Dropped Packets in Vehicles Traveling at Constant and Dynamic Speeds

	Packet was dropped because of packet lifetime				Packet dropped because of a path break			
Time Unit (sec)	AODV		MDORA		AODV		MDORA	
	Constant speed vehicle	Dynamic speed vehicle	Constant speed vehicle	Dynamic speed vehicle	Constant speed vehicle	Dynamic speed vehicle	Constant speed vehicle	Dynamic speed vehicle
0.1	1075	1114	1350	1344	-	3	-	2
0.01	601	599	1346	1337	-	13	-	-
0.001	268	353	1367	1256	5	9	-	-

Results Discussion

The results showed that in the case of vehicles moving at a constant and dynamic speed, the AODV protocol has a lower communication overhead than the MDORA protocol, owing to the increased flooding of control messages in MDORA, so the communication overhead in MDORA is higher than of AODV protocol.

Due to the high percentage of dropped packets in the MDORA protocol, regarding cars operating at steady and changing speeds, the AODV protocol surpasses the MDORA protocol regarding the ratio of successfully delivered packets, and the percentage of packets delivered to the destination vehicle is lower in the MDORA protocol.

The AODV protocol has less end-to-end delay than MDORA protocol in the case of vehicles moving at a constant and dynamic speed, due to the dropped packets because of the end of the packet's life before it is delivered to the destination vehicle, Consequently, the MDORA protocol has a longer end-to-end delay than AODV.

Finally, we observed that the AODV protocol exhibited fewer lost packets due to its extended length compared to the MDORA protocol. Table 2 demonstrates a reduction in the number of lost packets caused by broken routes while employing the MDORA protocol.

Conclustion

This paper provides a comparison between the MDORA and AODV protocols. We compared the scenario where the car's speed remained consistent with the situation in which the speed fluctuated. AODV demonstrated superior performance over MDORA regarding cars moving at different speeds because of its reduced overhead, delay, and error rates. Finally, they confirmed the extent of packet loss experienced by the AODV and MDORA protocols. Comparison data indicates that the AODV protocol has the lowest number of missed packets while a vehicle moves consistently, thanks to its longer packet duration. The MDORA protocol can identify the optimal route even when cars are moving at varying speeds, resulting in minimal packet loss.

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