INDIAN JOURNAL OF SCIENCE AND TECHNOLOGY

REVIEW ARTICLE

Comparative Analysis of DSR, AODV, AOMDV and AOMDV-LR in VANET by Increasing the Number of Nodes and Speed

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OPEN ACCESS

Received: 21-12-2022

Accepted: 12-03-2023

Published: 17-04-2023

Citation: Kushwaha US, Jain N, Malviya J, Dhummerkar M (2023) Comparative Analysis of DSR, AODV, AOMDV and AOMDV-LR in VANET by Increasing the Number of Nodes and Speed. Indian Journal of Science and Technology 16(14): 1099-1106. https://doi.org/10.17485/IJST/v16i14.2446

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Funding: None

Competing Interests: None

Published By Indian Society for Education and Environment (iSee)

ISSN
Print: 0974-6846
Electronic: 0974-5645

Abstract

Objectives: To analyze different VANET routing methods. **Methods:** The simulation result of reactive, proactive and hybrid multipath routing protocols is obtained in NS-2.34 by increasing the number of nodes and mobility. The outcomes are summarized in tables and figures. **Findings:** After simulation and comparison of existing protocols and the latest hybrid protocol, we found that the latest hybrid routing protocol gives the best result in the case of a higher number of participants and of high speed with minimum overhead. **Novelty :** In previous reviews and research, reactive and proactive routing protocols were compared. In this review, we compared the recently implemented hybrid protocol AOMDV-LR with the existing proactive and reactive protocol which gives better results.

Keywords: DSR; AODV; AOMDV; AOMDVLR; Vehicle Ad Hoc Networks (VANet)

1 Introduction

VANETs [1,2] are a unique category of mobile ad-hoc networks (MANETs) [3,4], consisting of vehicles called nodes with the ability to exchange information without fixed roadside units [5]. VANET integrates both ad hoc and infrastructure operation modes and interworks with various wired and wireless networks. Several interesting features differentiate VANET from other ad-hoc networks. It can be widely used to ensure the traffic safety of future highly advanced transportation systems. VANET can be infrastructure-to-vehicle or vehicle-to-vehicle [6]. The vehicles are in mobile positions with different transmission ranges but can transmit data to each other. The vehicle finds the closest position in its surroundings and transmits information based on that node. There are many types of routing protocols accessible on VANET [7]. As a result of technology enhancement, several new routing protocols are introduced that support very efficient fault maintenance. This document estimated the performance of the DSR, AODV, AOMDV and AOMDV-LR routing protocols. Choosing a primary routing protocol for different scenarios has always been a difficult task over the years. This study has focused on this issue by evaluating various performance measures. Many researchers have successfully evaluated and measured different routing protocols in VANET with different performance metrics, but knowing which routing protocol is right for which situation is difficult. To get the desired simulation performance, we focused on choosing the right routing protocol. To emphasize this topic, this document uses four different protocols and four types of parameters so that this vehicular ad-hoc network can simulate more realistic results. Comparing AOMDV-LR routing protocols to other types of routing protocols is also rare due to the different characteristics of AOMDV-LR. This task has also been carefully performed in this article so that in the future, other researchers will also have reliable knowledge of the working protocol. AODV, DSDV and DSR routing protocols in VANET in two different scenarios: fixed network and mobile network models configured over wireless sensor networks. The DSR routing protocol is beneficial when delays are acceptable, and it is recommended to use AOMDV when there is a high rate of dead links, and the highest throughput is needed[8]. Cooperative Wireless Network with Adaptive Relays is analyzed to measure the performance of AODV, DSR and GPSR routing protocols under different scenarios in VANET. They used the SUMO and NS2 simulators to show the performance of various performance metrics called throughput, packet loss, packet delivery rate, and end-to-end delay[9]. AODV, AOMDV, and DSR routing protocols estimate the effects in a scenario called vehicular ad-hoc networks. They explained that AODV works perfectly in both large and small network environments, but the power consumption during transmission is higher[10]. Proactive and reactive routing protocols are analyzed for vehicular ad-hoc networks. They described his AODV, AOMDV, DSR, and DSDV for simulation and got better end-to-end delay and DSR throughput, but higher packet loss and lower normalized routing load rice field[11]. The performance of Wireless Sensor Network is analyzed using AOMDV Routing Protocol. They concluded that AOMDV gives higher throughput in case of failure due to its multipath capability[12]. The efficiency of AODV, DSDV, and DSR ROUTING PROTOCOLS are analyzed under different simulation environments. They concluded that DSDV is useful when delay and normalized routing load are considered. DSR is recommended when considering throughput and packet loss rate for evaluation[13]. There are a large number of routing protocols available on VANET. Proactive routing protocols maintain information about routing on a per-node basis and also require reliable updates. Optionally, a route discovery method is required in a reactive routing protocol. In geo-based routing, all nodes have information about network topology changes[14]. Dynamic Source Routing (DSR) is a well-known on-demand routing protocol in which a sequence number is calculated, and information is stored in the packet header between the nodes to which the packet needs to be sent. Each cellular node in the network must store a route cache. When a packet is sent, the nodes in the route cache are compared with the actual route. If the result is positive, the packet is sent. Otherwise, the route discovery strategy will resume. The source node sends a request packet consisting of the site node's address to all neighbors in the network. A response is returned to the source node listing the network nodes and the process cycles. The request packet also contains an identification number called the request ID, which is counter-extended when a new route request packet is sent from the originating node[15]. Ad Hoc On-Demand Distance Vector Routing (AODV) is a type of topology-based on-demand routing protocol[16]. AODV is used to find a route from origin to destination when a route is needed. This routing protocol routes three important types of information: Route Request (RREQ), Route Reply (RREP), and Route Error (RERR). If the source and destination routes are broken, RERR messages are delivered to the source and object nodes separately. An originator MAY proceed to set up challenge/response generation to discover new paths through the receipt of Link Failure Response (RERR) messages that are recursively forwarded to the originator. The higher the serial number, the more accurate and fresher the value is. To follow the freshness of the loop and the latest route news, the serial number and broadcast ID are essential. The original serial number is used to keep it updated through the reverse route and end node serial number list[17]. Ad Hoc On-Demand Multipath Distance Vector Routing Protocol (AOMDV) is an extension of the AODV routing protocol based on multipath decision-making capabilities. Use alternate paths in case of root failure. If all paths fail, a new path must be found. The AOMDV protocol establishes multiple routes between a source and a destination. It requests all nearby nodes and selects only nodes in a trusted range. Then check if the node is freely reachable or if an occupied path isn't blocking the whole process of reaching the destination. The benefit is managing network load, eliminating potential congestion and increasing reliability. To prepare multiple routes from a source to a desired destination, AOMDV ensures proper and reliable connectivity. It has advanced features such as there are also restrictions such as B. Being a multipath routing protocol, there is more message overhead during new path discovery[18].

DSR and AODV protocols do not have a mechanism to repair routes locally. The connection setup delay is higher. AOMDV provides routes for fault maintenance but does not repair routes locally. Every time source is responsible for route setup, which increases connection setup delay[19]. As a hybrid protocol, AOMDV-LR uses both proactive and reactive routing principles to achieve the fastest transmission. As a proactive routing protocol, it first looks up the routing table to see the outbound route to the destination. Once a route is found, AOMDV-LR will start transmitting using the existing route. This will improve the performance of this protocol. As a reactive protocol, it uses RREQ and REEP packets to initiate route discovery on demand when there are no active routes in the routing table. If a failure originates from an intermediate node, the backup route will be used for further transmissions, but if no backup route is found, the AOMDV-LR intermediate node in the active path will instead attempt to maintain the path in the event of a failure will do. Turn on RERR for sending source nodes. If the route is repaired or a new route is found, further transmissions are performed via that route. AOMDV-LR reduces end-to-end latency and improves throughput compared to AODV and AOMDV. If an intermediate node fails to recover from a failure event within a given timestamp, it will send a RERR to its ancestors. Again, the RERR receiving node initiates a local repair process for fast route maintenance. When predecessors attempt to repair active network failures, a minimal number of data packets are lost, allowing routes to be maintained at a lower cost. Also, the source node doesn't care about route maintenance and rediscovery of new routes. AOMDV-LR increases the packet reception rate at the destination. As networks grow in size, path length increases when the destination is farther from the source. It is highly mobile and more likely to fail due to other factors such as network bandwidth. AOMDV-LR will attempt a local repair on a node closer to the failed node. If the near node cannot recover from the error, it forwards the RERR to the previous node and attempts local repair to this new nearby node. In this protocol, all preceding nodes participate in local repair, thus distributing a minimal number of control packets RREQ, REEP, and RERR, thus repairing routes quickly with low routing overhead. Since the source node is not involved in route knowledge, it has less end-to-end delay, almost no overhead and higher throughput for transmission [20].

2 Methodology

The overall work strategy is depicted in Figure 1. First initialize the NS-2 simulator and set the required VANET scenario and parameters for vehicle and network conditions. Once the parameters and scenario is set, the object model is configured to check the valid scenario. If the valid parameters and scenario is found, then implementation of the protocol is done. When all the parameters and scenario are valid, then a run simulator analyzed the result with other protocol. If all the parameters and scenario are not found valid, then start with the initial step. This whole process continues till all the protocol is not simulated and analyzed successfully.

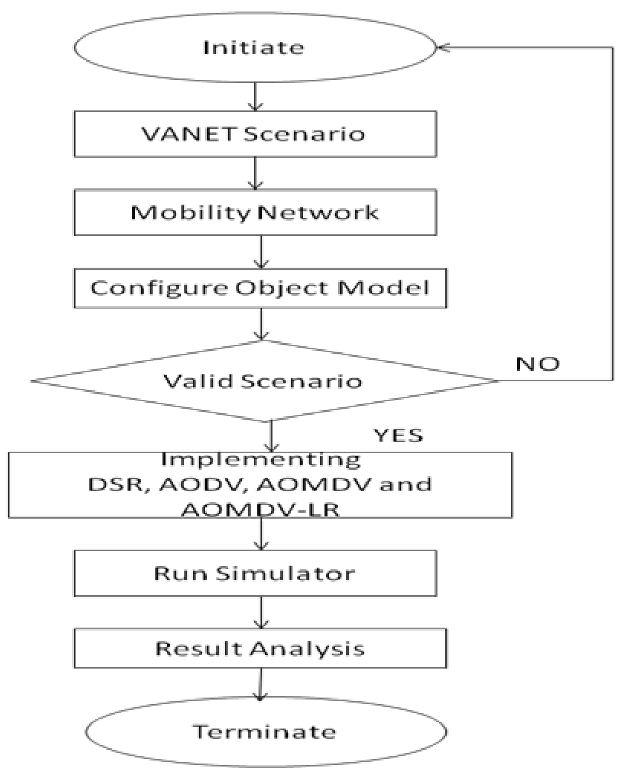

Fig 1. Work strategy

We tried to analyze the overall performance of five different routing protocols by varying the number of nodes and node speed values. A detailed presentation of the parameters used for performance measurement is shown in Table 1.

Table 1. Simulation Parameter

Parameter	Details
Channel type	Wired / wireless channel
Antenna model	Omni directional
Network interface type	Phy / Wireless phy
Radio propagation model	Two ray ground
Interface queue type	Queue/Drop Tail/Pri/Queue
Mac layer protocol	IEEE 802.11
Topology size	500m x 500m
Number of nodes	20,25,30,40,50,60,80
Number of Source	10,20,30,40
Speed of nodes	10m/s, 30m/s, 50m/s, 70m/s, 90m/s
Packet size	512 Byte
Traffic type	Constant bit rate
Simulation tool	NS-2.35
Simulation Time	900 sec
Node placement	Random
Protocols	DSR, AODV, AOMDV, AOMDV-LR

3 Results and Discussion

Following performance metrics are used and compared to analyze the result:

3.1 End-to-end average delay

End-to-end average delay is the time counted to make the journey from source to destination. This metric calculates the total count time required to deliver a packet from the source node to the intended destination.

$$AvgE2E = (N * L/R)100$$

Where AvgE2E= (N*L/R)*P, N = link, L = packet length, R = transmission rate. Figure 2 (a,b) shows the performance comparison of DSR, AODV, AOMDV and AOMDV-LR routing protocols for measuring the average end-to-end delay by varying the number of nodes and speed of nodes. DSR, AODV, AOMDV and AOMDV-LR are considered on-demand routing protocols, so dropped packets can remain in the buffer as long as an alternate path can be found to resend the packet. Therefore, the average final delay of AOMDV, AODV, and DSR is higher than AOMDV-LR.

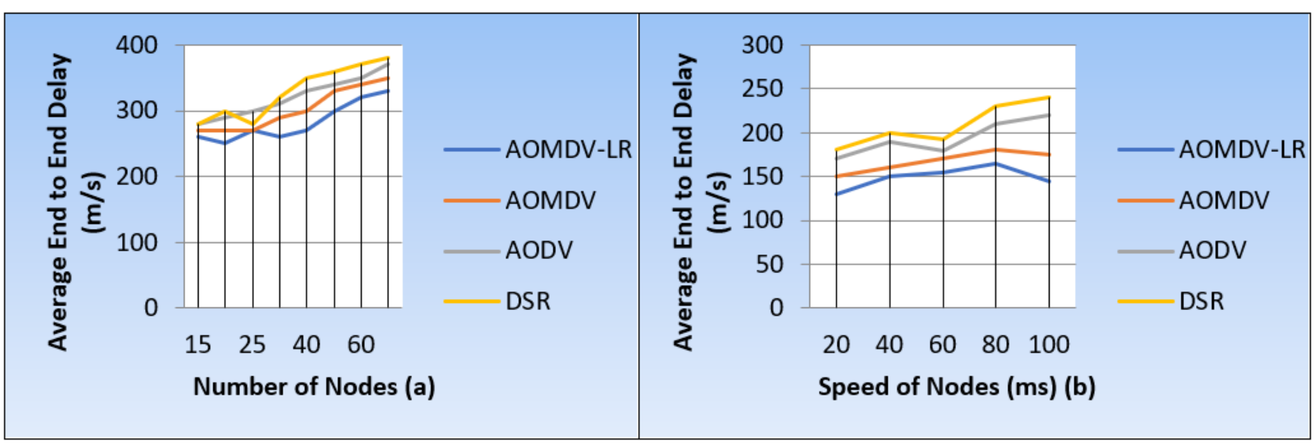

Fig 2. Average end to end delay measurement by varying number of nodes and speed of nodes

3.2 Normalized routing load

Given as outbound routing packets sent from source to destination in the network. It's far calculated by dividing the whole variety of routing packets sent (consists of forwarded routing packets as nicely) by using the entire number of facts packets acquired.

$$NRL = \frac{\sum_{i=1}^{n} Ts_i}{\sum_{i=1}^{n} Tr_i} * 100$$

Where NRL=Ts/Tr, Ts= Total Packet sent, Tr= Total Packet received. Figure 3 (a,b) evaluates the performance comparison of DSR, AODV, AOMDV and AOMDV-LR routing protocols, and by changing the values of node number and node speed normalized measure the routing load applied. DSR, AODV and AOMDV face a higher load because this approach of retransmitting dropped packets causes the packets to stay longer in the network. Because the DSR maintains route caching procedures, it also sees more loads on the network to forward packets from the source to the destination. Additionally, since AOMDV-LR uses a local repair approach, the total distance from origin to destination is subtracted, making this protocol less subject to network load. AOMDV-LR stays on the network the shortest because it has no chance to resend dropped packets. Therefore, this protocol has less network load.

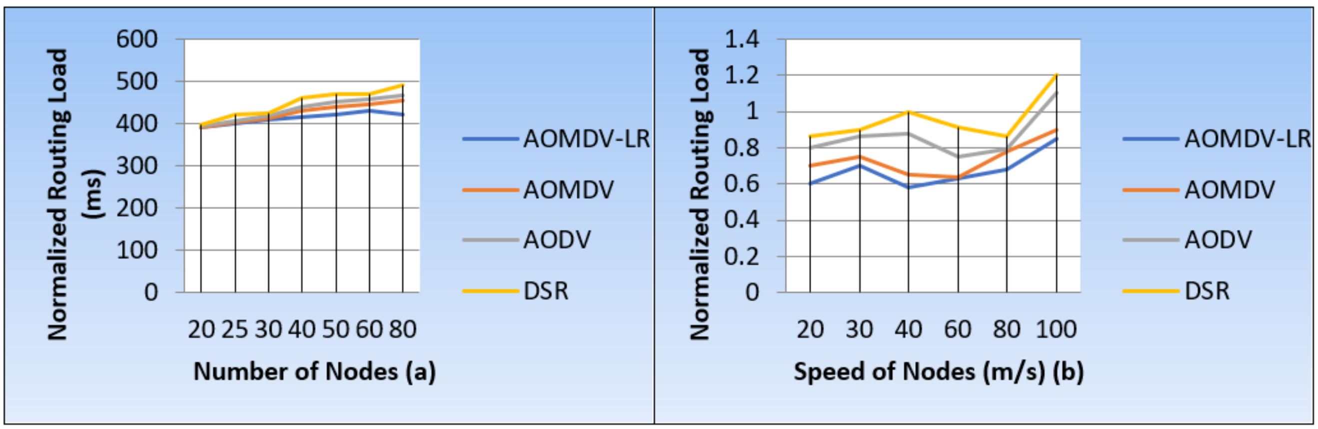

Fig 3. Averagenormalized load measurement by varying number of nodes and speed of nodes

3.3 Average Throughput

Average throughput is the ratio of the volume relationship between range, volume, the amount of packets received at the destination, and the number of packets sent by the source. This performance analysis parameter measures the protocol's reliability, effectiveness.

$$ATP = \frac{\sum_{i=1}^{n} Dr_i}{\sum_{i=1}^{n} Ds_i} * 100$$

Where ATP is packet delivery quantitative relation, Dsi is information packet sent and Dri is information packet received. Figure 4 (a,b) focuses on the performance comparison of AODV DSR, AODV, AOMDV and AOMDV-LR routing protocols, varying values of the number of nodes and speed of nodes to calculate the average throughput. For retransmission of packets, AODV and AOMDV have the ability to detect alternate paths, which is essential in case of packet loss. AOMDV and AODV can send the maximum number of packets compared to other routing protocols, so it is clear that has the highest throughput. AOMDV-LR uses local repair forwarding, so the source node knows the locations and destinations of its neighbors. Therefore, this method subtracts a total distance of from the origin to the intended destination. This is why AOMDV-LR has a higher throughput than DSR, AODV and AOMDV routing protocols. In DSR, the route cache is maintained by the source node that sends the packet. Therefore, DSR takes hours to send a packet and cannot deliver any more. AODV has the lowest throughput because it does not have the ability to resend dropped packets. Therefore, packet forwarding is much less than other routing protocols.

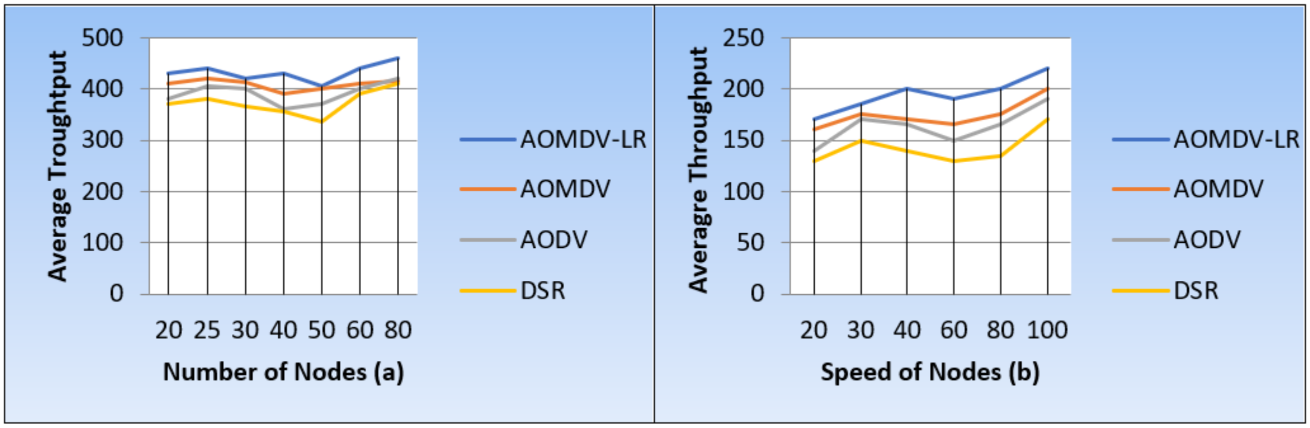

Fig 4. Averagethroughput measurement by varying number of nodes and speed of nodes

3.4 Packet loss rate

Packet rate is the difference between the range of information packets sent and data packets received within a network.

$$PLR = \frac{\sum_{i=1}^{n} Ds_i - \sum_{i=1}^{n} Dr_i}{\sum_{i=1}^{n} Ds_i} * 100$$

Where PLR is the packet rate, Dsi is the transmitted information packets, and Dri is the received information packets. Figure 5 (a,b) shows the total packet loss rate for the routing protocols DSR, AODV, AOMDV and AOMDV-LR. Packet loss can occur in a variety of situations, such as dropped connections, corrupted packets, and frozen bandwidth. From this figure, we can see that DSR has the highest packet loss rate. This is because DSR has difficulty repairing broken connections and many packets are dropped. AODV also has the highest packet loss rate. AOMDV and AOMDV-LR have significant packet loss rates. From the figure, we can see that AOMDV-LR has the lowest packet loss rate. This is because when a link failure occurs, a route error (RREP) is sent to the processing node and the packet uses multiple paths to reach its destination along with the local repair mechanism.

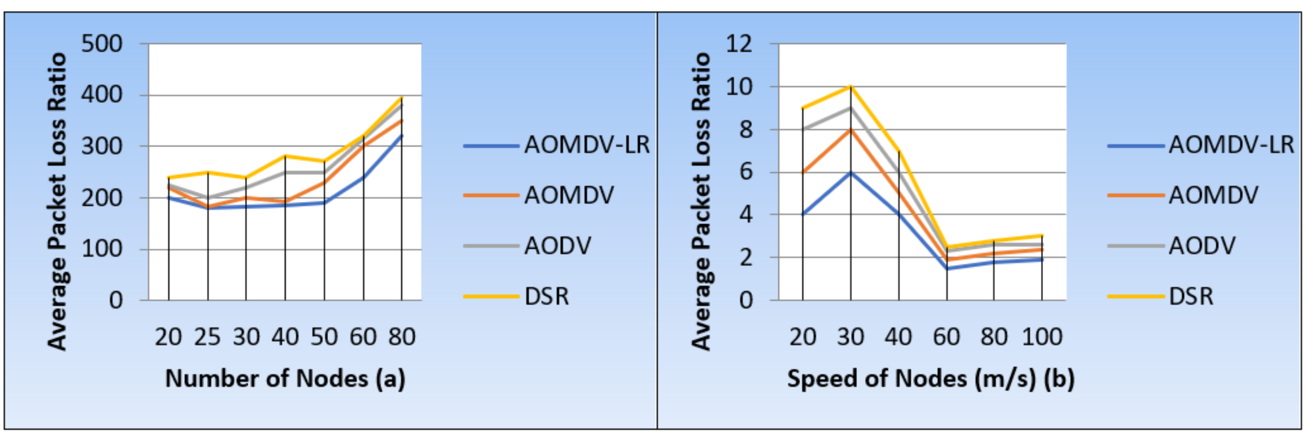

Fig 5. Averagepacket loss ratio measurement by varying number of nodes and speed of nodes

When the number nodes and node mobility is increased the better End to End delay is achieved by using AOMDV and high average throughput and minimum packet loss is achieved by using AOMDV-LR. Simulation results prove that AOMDV-LR performs better in areas of high traffic density compared to DSR, AODV and AOMDV protocols.

Table 2. Summarized Result

Protocols Used	Parameters Used	For numbers of Nodes	For speed of Nodes
DSR AODV AOMDV AOMDV-LR	End-to-end average delay	AOMDV	AOMDV
	Normalized routing load	AOMDV	AOMDV
	Average throughput	AOMDV-LR	AOMDV-LR
	Packet loss rate	AOMDV-LR	AOMDV-LR

4 Conclusion

Topology-based routing protocols are most used in vehicle communications. In this study, we examine the impact of various simulation parameters on three categories (proactive, reactive, and hybrid) of routing protocols (of DSR, AODV, AOMDV and AOMDVLR) for optimal simulation results. The drawback of DSR and AODV is that both protocols do not have mechanism to repair route locally. The connection setup delay is higher than in table- driven protocols. AOMDV provides alternate path for fault maintenance but does not repair route locally. AOMDV-LR has better outcomes in terms of End to End delay, Routing Overhead, Throughput and Packet loss Ratio. Simulation results show that the end-to-end average delay is the lowest, but the packet loss rate is higher for his DSR. DSR also has the lowest average throughput, but puts fewer loads on the network. AOMDV-LR has the highest throughput and low packet loss rate, but faces high load and average end-to-end delay on the network. Our experiments show that AOMDV tends to have lower packet loss rates. A particular routing protocol can be selected depending on the importance of parameters in a particular scenario. Finally, considering delay and normalized routing load, we conclude that AOMDV is useful. AOMDV-LR is recommended when considering throughput and packet loss rate for evaluation. Simulation results prove that AOMDV-LR performs better in areas of high traffic density compared to DSR, AODV and AOMDV protocols. The AOMDV-LR protocol improves overall network performance by providing maximum throughput and minimum end-to-end latency. Energy consumption is an important issue to measure performance metric of VANETs, but is temporally not evaluated in this review paper. In future work, simulated result of recently introduced protocols that support energy preservation of VANET nodes will be compared with AOMDV-LR and other recently introduced fault tolerance routing protocols.

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