Iraqi Journal of Computers, Communications, Control and Systems Engineering

Journal homepage: https://ijccce.uotechnology.edu.iq

New Traffic Control Based on VANETs Protocols Technique

Bushra Jaber M.Jawad

College of Administration and Economics, University of Kerbala, Karbala, Iraq
bushra.j@uokerbala.edu.iq

DOI: https://doi.org/10.33103/uot.ijccce.25.2.6

HIGHLIGHTS

- Evaluation of DSR, DSDV, and AODV routing protocols in VANETs.
- DSR outperforms other protocols in rural areas.
- AODV performs better in low-density network scenarios,

ARTICLE HISTORT

Received: 22/ April /2025

Revised: 30/ June /2025

Accepted: 31/ July /2025

Available online: 30/ October /2025

Keywords:
VANET network, Traffic control, VANETs Protocols, Urban Areas, Rural Areas.

ABSTRACT

An ad hoc network in a mobile system is known as a vehicular network. This application is useful in communication between the roadside and vehicle infrastructures. Nowadays, the deficiency and quality of transport classifications of smart transport systems are playing a vital and excessive role. This paper presents the examination of the traffic stream under VANET protocol methods. In the execution of luxury and safe vehicular ad hoc networks, the automobile must resolve inquiry information from other vehicles through multi-loop organizations. In case of the data move in vehicular ad hoc networks, it should have to aspect numerous disruptions because of a lot of related networks and flexibility. This paper's subsequent protocol is compared, and a study is performed on DSR, DSDV, and AODV. In both urban and rural areas, the preformation exists and is analyzed. The ID preformation is based on the basis of drop of data, density of vehicles, the delay of end-to-end loops, and throughput. The testing and analysis of obtained results from high-throughput DSR and low packet drop, which provide better results compared with DSDV and AODV in rural places. Additionally. The AODV provides better performance compared with the DSR environment of low densities

I. INTRODUCTION

The wireless technology is fast growing since last two decades for many applications and novel developments [1]. These human demands played great roles for researchers to achieve unique solution and effective costs [2]. The observable light communications, ad hoc network and sensors network are an example of wireless technology [3]. These technologies are used in engineering, networking, security, remote sensing, location tracking, and telecommunication [4]. The vehicular ad hoc networking shown in *Fig. 1* illustrate the architecture of VANETs fields with many components [5-7]. Different unit board information is transferred with very latest systems which used in this transportation design to provide high effective, safer, reliable, and friendly techniques as an intelligent system [6-10]. These technologies are used without altering and effecting the current systems and wide range of usages inside the automobile industrial, ecommerce, finance communications, and computer sciences [11-20]. To develop the security, transportation efficiency, and safety of transportation systems, the intelligent systems has been used [21-30]. Both of cars to highway side and vehicle to vehicle communications are included in vehicular ad hoc technologies which is considered as the furthermost important in the system of intelligent transportation as illustrated in *Fig. 2* [31-36] . In wireless systems and motorized technology vehicular ad hoc networks communications has become imperative field of researches. The objectives of VANET researches is to minimize the cost and profligate communications for information of passenger's safety and comforting [37-41].

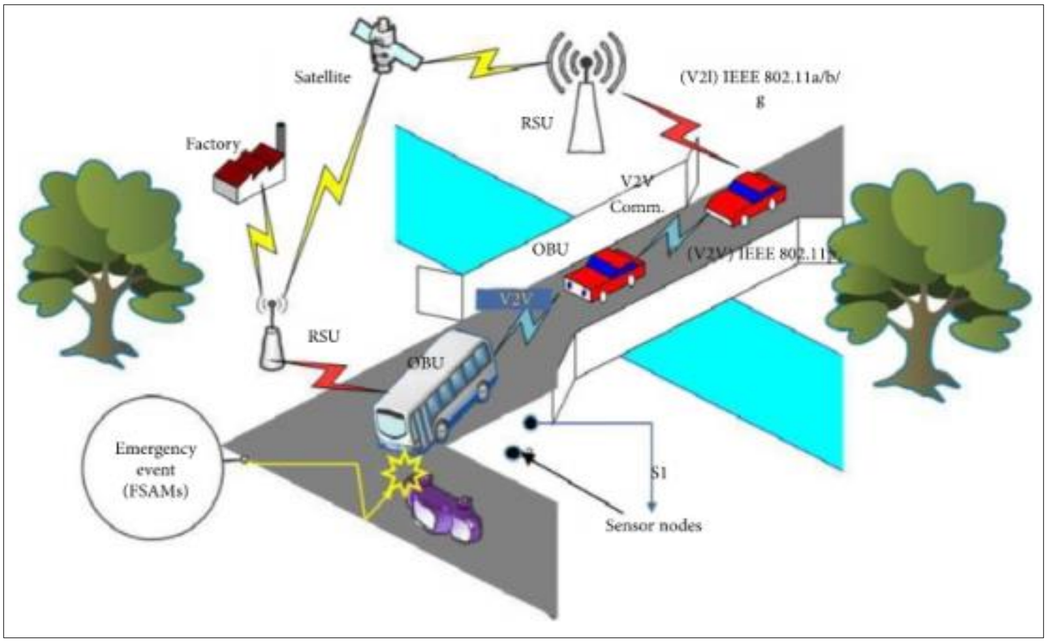

FIG. 1. VANETS ARRANGEMENT FIELDS.

The VANETs are a stimulated researches fields for industry of networking and studies which gives the researchers new concept of networking. That mean the VANETs known as vehicular ad hoc that could develop the comfortable of passenger with guarantee minimum collision in the vehicles. It's an emerging field for research about this idea in corporate academic sectors which is determined by wireless networks. As the wireless systems are developed intensive researches and being led on VANET, it is wanted to the vehicle and should be prepared with GPS technology. Hence, this will support and help in data sharing in case of the vehicular ad hoc is introduced. Therefore, this information in network sharing and configuration pathway that established before. In the ad hoc network, many challenge and difficulty could face as in energy utilizes, bandwidth limitation, security, scalability, and network performances. Different parameters are used in this work such as data drop, delay, density, and throughput to test the networks performance

FIG. 2. INFRASTRUCTURES OF VEHICULAR.

.

II. RELATED WORK

Several studies have focused on comparing the performance of different routing protocols, including proactive, reactive, hybrid, and geographic-based approaches. Protocols such as Ad Hoc On-Demand Distance Vector (AODV), Destination Sequenced Distance Vector (DSDV), and Dynamic Source Routing (DSR) have been extensively analyzed under different mobility scenarios and network sizes. For example, research has shown that AODV typically offers high packet delivery ratios and throughput in dynamic environments, whereas DSDV tends to have lower end-to-end delay but struggles with scalability. DSR has also demonstrated superior throughput in certain cases due to its efficient route caching mechanism. In VANET environments, which exhibit even higher mobility than traditional MANETs, studies have explored protocols like Ad Hoc On-Demand Multipath Distance Vector (AOMDV), Zone Routing Protocol (ZRP), and GPSR (a geographic routing protocol). These protocols are evaluated using simulation tools such as NS-2, NS-3, SUMO, and MOVE to emulate real-world traffic conditions. Results generally highlight that multipath and hybrid protocols like AOMDV and ZRP perform better in maintaining reliable communication despite frequent topology changes. Additionally, proactive protocols such as Optimized Link State Routing (OLSR) have shown robustness in dense networks, albeit at the cost of increased control overhead. These comparative studies contribute significantly to understanding the trade-offs between routing efficiency, delay, scalability, and overhead, guiding the selection of suitable protocols for specific network conditions and applications.

In [42], three routing rules which are based on on-demand protocol (AODV, AOMDV and DSR), constantly updated DSDV, location-based GPSR are considered. Some trials changed the number of nodes and the speed with which they moved, sometimes simply to add to the confusion. To understand the mess, we tracked end-to-end delay, throughput, the routing paperwork workload and how many packets made it to where. To put it another way, we were looking for the protocol that appeared least misarable in a given traffic situation.

This research investigates the performance of three routing protocols for VANET in Pekanbarus, Indonesia. Once-popular Destination-Sequenced Distance-Vector (DSDV) against the more dynamic Ad hoc On-Demand Multipath Distance-Vector (AOMDV) and the Zone Routing Protocol (ZRP). Packet delivery, delay, throughput, collisions, and drop rates serve as evaluation parameters. Simulations throw in variable node densities (100, 250, 600, even a tight 700 vehicles) each with transmission ranges (250, 500, or a 1km). Results indicate that AOMDV outperforms the other protocols in terms of packet delivery ratio and throughput across all scenarios, while DSDV and ZRP excel in end-to-end delay and routing overhead, respectively. The findings suggest that AOMDV is the most suitable routing protocol for enhancing communication efficiency in VANET applications, providing a foundation for future implementations in urban traffic management systems.[43]

AODV protocol, DSDV protocol and DSR protocol with five nodes density are selected in this paper. Available for every protocol in terms of certain parameters such as (throughput, packet delivery ratio, and end- to- end delay). These simulators let users run VANET and build real time traffic model of simulation. For this paper had worked with tools(SUMO, MOVE and NS-2) and simulations were generated, graphs were plotted and analysed using Trace-graph. From results DSR performs much efficient as compared to AODV and DSDV in the throughput. Although DSDV has the smallest average end to end delay, it is not the optimal algorithms. From the above, we can sum up that each strategy has its advantages and disadvantages, making it more appropriate to a particular scenario than other scenarios.[44]

The paper highlights the performance comparison of the protocols (reactive and proactive) of AODV, DSR, and DSDV over various in "throughput, control overhead, packet delivery ratio, and average end-to-end delay". Simulations showed that various routing protocols may either be optimized for (VANET)295 connectivity and throughput. Additionally, the evaluations also demonstrate the effect of sizes for the network and routing protocol on "packet loss, packet delivery ratio, average end-to-end delay, and overhead transmission".[45]

The performance of three well-known routing protocols in mobile ad hoc networks (MANETs) are compared. DSDV, OLSR, and AODV. NS-3 simulation tool is used , the protocols are compared based on key performance metrics such as throughput, end-to-end delay, and packet delivery ratio (PDR) under varying network conditions, from varying node densities to varying mobility. Results indicate that AODV always guarantees the maximum PDR and throughput, especially in mobile scenarios, and also lower end-to-end delay compared to both OLSR and DSDV. OLSR, being proactive, is suitable for highly dense networks but generates more overhead. Conversely, ease of design in DSDV limits its scalability and stability and hence degrades in highly mobile networks. They give good insight into the pros and cons of every protocol, which makes it easy to make effective routing strategy decisions for various MANET applications.[46]

III. MATERIALS AND METHODS

Usually, the WAVE is considered as developing standards in wireless communications which is in short range known access of wireless to ad hoc network or so called DSRC. These methods support all data transformation between the infrastructure and vehicles. The WAVE/DSRC played vital roles in wireless networking by provide high data rate, low delay, and high mobilities. The DSRC is known as facility variety from short to intermediate in order to retain vehicles to vehicles communicated processing and useful with small zone which is required fast data transfer and less delay. For the IEEE released standard include IEEE802 P16091.1, 2,4, it is used as source director and explain the services and interfaces of WAVE resources managing applications and data formatting. It is providing instant access with many applications to another network designer. For medium access controlling of protocol layers, the WAVE load used the IEEE802.11P. For one controller channel and association share, WAVE use transporter intelligence numerous contact protocols or crash escaping CSMA/CA as protocol of intermediate contact. The protocol of VANET directing is a major routing protocol in vehicular ad hoc networks based on position, Geo routing, cluster routing, and broad routing [20]. The VANET node move arbitrarily without activities restriction which is unlike MANETs because of multiple rout VANET has flexible and complex topologies when the drivers are moved. In this paper, proactive protocols and reactive protocols are discussed and investigated by using link information Table I to find the networks with package data forwarding routing topologies which are categorized as follow:

A. **Protocol of proactive rout:** The protocol of table-driven rout is also called proactive rout protocol which is used in movable ad hoc networking contact of available node in order to support consistent rout data in the rout table. In addition, the Destination-Sequenced Distance-Vector Routing DSDV, Optimized Link State Routing OLSR, and FSLS are another kind of proactive protocol. Based on Bellman Ford algorithm, the DSDV is table determined rout protocols which is practice in vehicular ad hoc networks. Fundamentally, every vehicle shares the pathway data table to their national's vehicle. These national's vehicle usage an incremental package with complete dump packets to keep their rout tables up to dating. Meaning that, the full dumping packets consist data of each participate vehicle in vehicular ad hoc network, whilst, incremental packets consist newest up-dating in the vehicle locations subsequently of previous full dumps packets. In the tables, the pathways are christened with up to dates entrance, where the positions of node are fewer variable DSDV which is consider as respectable choice for these networks.

B. **Protocol of reactive rout**: as on demand rout protocol, the reactive rout is known with not destination nodes and reachable in this routing detection processing. The RREQ could be used and routing request come with RREP to initiate the rout reaction packet as well. In this method, less overhead could find in reactive rout protocol.

TABLE I. PARAMETERS AND SIMULATION MODEL

Parameters	Specifications
Channel type	Wireless channel
MAC protocols	802.11P
Mobility Mode	Random way point
Channel Model	Two ray ground
Protocols	DSR, DSDV, and AODV

Every vehicle consists of rout information in ad hoc distance vector protocol AODV to receive salutation for table entrance classification updating. When the table values are not use in definite time, this will be erased, while when the rout is disconnecting between vehicle to other vehicle RERR packets could forward. Therefore, the vehicle rout may update in table efficiency. In VANET, the dynamic source rout DSR is used to initiate on demand rout protocols base on link state rout. In case of the vehicle require to transfer data to another vehicles, firstly sent rout detection request to the vehicles. The rout detection sending vehicle by employee a rout request packets in the networks and another vehicle forward rout reaction by update their name as a sender. Earlier to routing requests messages spreading, the destination vehicle nodes have rout to vehicle and route request letter is unicast to the source bulge. When the path request package is not receiving the correspondent's nodes detections of routing up to the terminus's nodes. Usually, two kinds of simulators are used in vehicular ad hoc network. In this paper the hybrid simulator is used as so called ESTINET to provide facility for traffic simulator and network simulations. These technologies are latest techniques used on over the word based on novel kernel designed approaches.

A- Scenario of Urban Area: In grid areas, scenario of 80 cars are recognized as on-board unit allocation data between road side unit RSU and between each other as illustrated in *Fig. 3*. As on-board unit, the nodes are shown behaviours of cars moving in the network to test the performances of each protocols. Through the calculation of cars communication performances between road side and vehicles, the cars make vehicular ad hoc networks. Table II shows the random way point of the vehicles in mobile mode. These nodes of the model are permitted to transfer and found their terminus. The determination of vehicle movements is achieved by new algorithms.

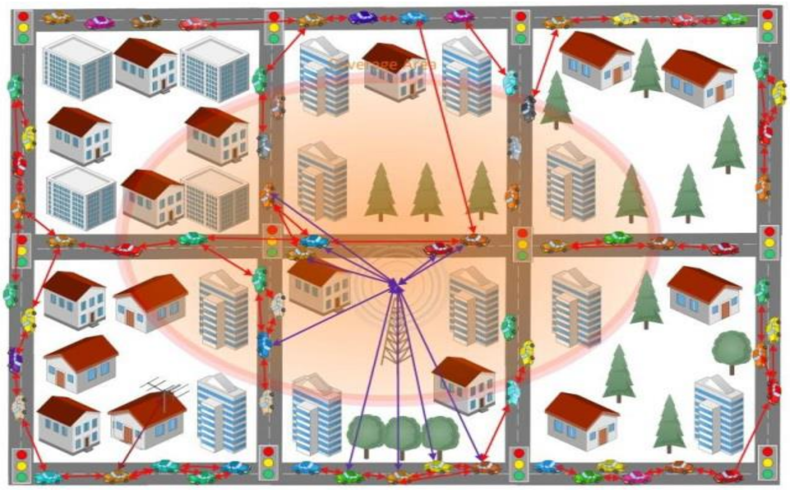

FIG. 3. URBAN AREA GRID SCENARIO.

TABLE II. URBAN SCENARIO SIMULATION PARAMETERS

Parameters	Specifications
Vehicle Numbers	80
Time of simulation	90 m
Speed of vehicle	10 m/s
Bandwidth of the channel	6 Mbps
Transport protocols	UDP
Power of transmitter	28 bm

B- The Scenario of Rural Areas

Fig. 4 illustrate the country areas grid situation with 15 on-boards unit sharing information between respectively additional and with roads sides unit. The network performance of vehicular ad hoc provide cars movements to check the protocol behaviors as shown in Table III.

TABLE III. RURAL SCENARIO SIMULATION PARAMETERS

Parameters	Specifications
Vehicle Numbers	80
Time of simulation	50 m
Speed of vehicle	10 m/s
Bandwidth of the channel	6 Mbps
Transport protocols	UDP
Power of transmitter	28 dbm

FIG. 4. RURAL AREA SCENARIO.

IV. RESULTS AND DISCUSSIONS

Under the parameters used in Table I and Table II, the performances of rout protocol are illustrating in graph use diverse parameter. The metric consideration and time axis are represented in this graph as shown in *Fig. 5*. From this graph, one could observe that the urban scenario throughput using dynamic rout protocols is better than AODV and DSDV. When the speed of the cars is increased with many connections to the road side, the performance of distance vectors is decreased with high DSDV performance. For the rural area's scenarios, the throughput illustrated in *Fig. 6* explain clearly that the DSR throughput is more than all other techniques. While, the throughput of DSDV techniques is lower than all other methods and AODV throughput is middle of both other methods. The dynamic sources of routing protocols have more efficient performance than AODV and DSDV in the packets drops in urban and rural areas. *Fig. 7* shows the 20 and 10 packets dropping in town scenario and fewer than 50 packet drops in country scenarios. The passes time ration in DSR is

decreased and the packet dropping rate are increased in rural scenarios. For AODV package droplet proportion is continue from 100 to 400 packet.

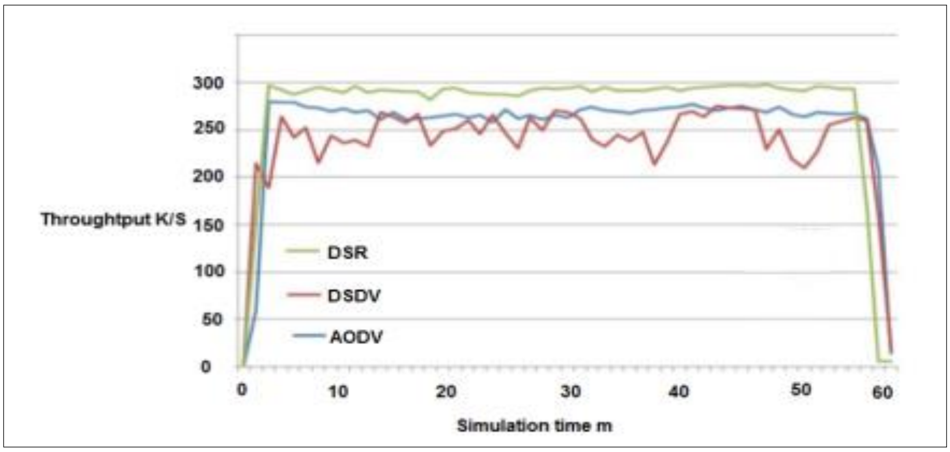

FIG. 5. URBAN SCENARIOS THROUGHPUT PERFORMANCES.

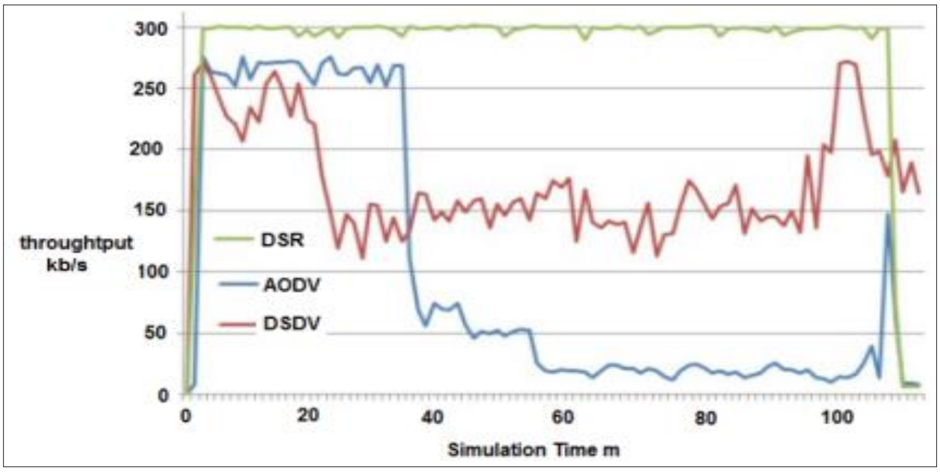

FIG. 6. RURAL SCENARIO THROUGHPUT.

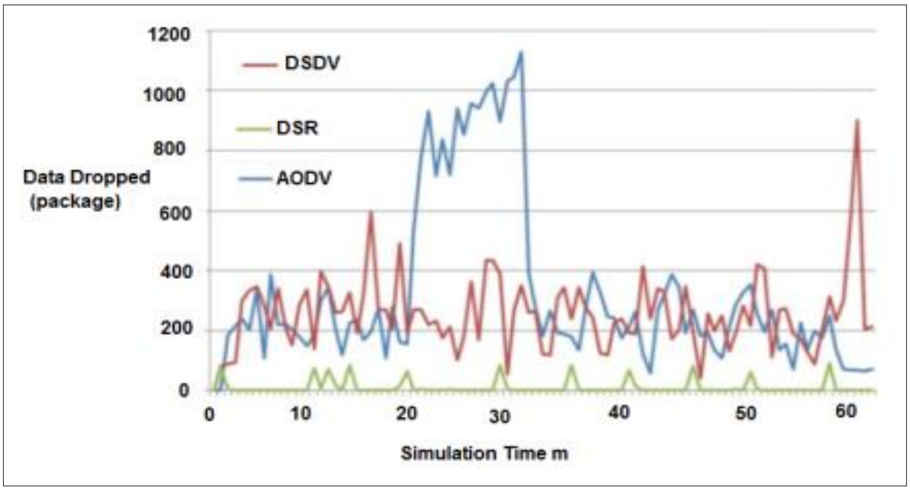

FIG. 7. URBAN SCENARIO PACKET DROPPING.

Table IV. Showes the comparative analysis for selected protocols with different environments. Performance metrics include Packet Delivery Ratio, Throughput and End-to-End Delay

TABLE IV. COMPARATIVE ANALYSIS ROUTING PROTOCOLS IN VANETS

Scenario	**Metric**	**AODV**	**DSR**	**DSDV**	**Dynamic Protocol *(Our Study)***
Urban - Throughput	Data delivery efficiency	Moderate: variable performance with network size and density (Ahmed et al., 2024), (Mahdi et al., 2021), (Quadri et al., 2025)	Good: highest throughput in urban settings (Mahdi et al., 2021),	Moderate to low, declines under dense scenarios (Ahmed et al., 2024), (Quadri et al., 2025)	**Highest overall throughput in urban environments (Fig. 5)**
Rural - Throughput	Data delivery efficiency	Moderate: middle-ground results (Mahdi et al., 2021), [(Thakre & Awaya, 2024)]	Best throughput in rural areas (Mahdi et al., 2021), [(Ema et al., 2019)]	Poor performance in sparse rural settings (Ahmed et al., 2024), (Mahdi et al., 2021)	**Top performer in rural throughput (Fig. 6)**

Urban - Packet Drops	Network reliability	Packet loss rises from 100 to 400 packets	Lower than AODV; increases at high speed	High drop rate	**Lowest: only 10–20 packets dropped**
Rural - Packet Drops	Network reliability	Moderate; worse than DSR	Increased drops with speed	High; slightly better than DSR in rural cases	**< 50 packets dropped in rural areas**
End-to-End Delay	Latency	Moderate: improves in dynamic settings (Ahmed et al., 2024), (Mahdi et al., 2021), [(Quadri et al., 2025)]	High delay in rural and low-speed settings [(Ema et al., 2019)], [(Sari et al., 2020)]	**Lowest delay** overall (Ahmed et al., 2024), (Mahdi et al., 2021), [(Sari et al., 2020)]	**delay is minimize**
Packet Delivery Ratio (PDR)	Delivery success	High PDR in dense scenarios [(Mahdi et al., 2021)], [(Thakre & Awaya, 2024)], [(Quadri et al., 2025)]	Best overall PDR [(Mahdi et al., 2021)], [(Ema et al., 2019)]	Lower PDR in high-mobility settings [(Ahmed et al., 2024)], [(Sari et al., 2020)]	**Better PDR than AODV & DSDV across environments**

As shown in Comparative Table IV, Protocol DSR performs best in terms of throughput and packet delivery, particularly in mixed rural and urban environments, confirming its strength in low to moderate mobility conditions. AODV exhibits consistent and balanced performance, making it a preferred choice in high-mobility, high-density environments. DSDV, while fast in route setup, struggles with scalability and adapts poorly to dynamic environments, though it excels in delay-sensitive applications due to its low end-to-end delay.

V. CONCLUSIONS

This paper investigates and examines the proactive and reactive routing protocols under microscopic mobility modeling, with a comparison being made. Important performance and characteristics of these protocols under a vehicular ad hoc network. The results exhibited that the reactive protocols are better than other protocols due to an efficient pathway detection mechanism and route maintenance with minimum periodic broadcast, which is found in nearly all reactive routing protocols. The performance analysis also shows that the DSDV end-to-end delay is minimized to achieve the main requirements in all real-time systems. This minimization of delay is because the characteristics of drive approaches tables with little drawback, represented in producing an overhead problem. In future work, the researchers should focus on minimizing this overhead over time.

REFERENCES

[1] F. Abbas, & Z. Khan, A novel low-latency V2V resource allocation scheme based on cellular V2X [communications. IEEE Transactions on Intelligent Transportation Systems, . (2018). 20(6), 2185-2197.
[2] La Vinh, A.Cavalli Security attacks and solutions in vehicular ad hoc networks: a survey. International Journal on Ad Hoc Networking Systems (2014) 4: 630-645.
[3] D. Diyan Routing and Security in Vehicular Networking. IJCSI International Journal of Computer Science Issues 3: 712-718 (2013).
[4] A Burde, S. Pingat Next Generation Vehicular Traffic Management Using VANET Technology. International Journal of Computer Science and Information Technologies(2013) 4: 715-720.
[5] S. Zeadally, R. Hunt , Y. Chen, A. Irwin, A .Hassan Vehicular Ad Hoc Networks (VANETS): Status. Results and Challenges.Telecommunication Systems (2010). 50: 217-241.
[6] M. Lee and T. Atkison, (2021) VANET Applications: Past, present, and future. Veh. Commun., 28: 1–44.
[7] SA. Abed Comparative Analysis of TCP-Protocol Operation Algorithms in Self-Similar Traffic. Journal of Communications and Network (2013) 5: 1-9.
[8] B. Umar , R.Waqas Issues of Routing in VANET(2010).
[9] T. AG Ranjeesh, T. Sunil. Comparative Performance Analysis of DSDV, AODV and DSR Routing Protocols in MANET using NS2. International Conference on Advances in Computer Engineering (2010) 330-333.

[10] A. NC, Sinem, O. Ozkasap. Vehicle Mobility and Communication Channel Models for Realistic and Efficient Highway VANET Simulation. IEEE Transactions on Vehicular Technology (2015) 64: 248-262.

[11] M. Aazam & E. N. Huh, E-HAMC: Leveraging Fog computing for emergency alert service. In 2015 IEEE International Conference on Pervasive Computing and Communication Workshops (PerCom Workshops) (2015, March). (pp. 518-523). IEEE.

[12] F. Abbas, & Z. Khan, A novel low-latency V2V resource allocation scheme based on cellular V2X communications. IEEE Transactions on Intelligent Transportation Systems, (2018). 20(6), 2185-2197.

[13] I. A .Abbasi, & A. Shahid Khan A review of vehicle to vehicle communication protocols for VANETs in the urban enviro nment. *Future Internet*, (2018). 10(2), 14.

[14] A.Abuashour & M. Kadoch, Performance improvement of cluster-based routing protocol in VANET. IEEE Access, (2017). 5, 15354-15371.

[15] Z. Afzal, & M. Kumar, Security of Vehicular Ad-Hoc Networks (VANET): A survey. In Journal of Physics: Conference Series(2020, January). (Vol. 1427, No. 1, p. 012015). IOP Publishing.

[16] M.Agiwal, A.Roy & N.Saxena Next generation 5G wireless networks: A comprehensive survey. IEEE Communications Surveys & Tutorials, (2016). 18(3), 1617-1655.

[17] N.Akhtar, S. Ergen C., & O.Ozkasap. Vehicle mobility and communication channel models for realistic and efficient highway VANET simulation. IEEE Transactions on Vehicular Technology, 2014). 64(1), 248-262.

[18] H. Al Najada, & I. Mahgoub Anticipation and alert system of congestion and accidents in VANET using Big Data analysis for Intelligent Transportation Systems. In 2016 IEEE Symposium Series on Computational Intelligence (SSCI) (2016, December). (pp. 1-8). IEEE.

[19] A. Ali, I. Phillips & H.Yang *Evaluating VANET routing in urban environments*. In 2016 39th International Conference on Telecommunications and Signal Processing (TSP) (2016, June). (pp. 60-63). IEEE.

[20] M.Alsabaan, W. Alasmary, A. Albasir, &K. Naik Vehicular networks for a greener environment: A survey. IEEE Communications Surveys & Tutorials, (2012). 15(3), 1372-1388.

[21] K.AwanM., M.Nadeem, A.Sadiq S.,A. Alghushami, A. Khan & K.Rabie Smart Handoff Technique for Internet of Vehicles Communication using Dynamic Edge-Backup Node. *Electronics*(2020)., 9(3), 524.

[22] A.Bazzi, G. Cecchini, A. Zanella, &B. Masini M. (2018). Study of the Impact of PHY and MAC Parameters in 3GPP C-V2V Mode 4. IEEE Access, (2018). 6, 71685-71698.

[23] A. Bazzi, B. Masini M., A. Zanella & I. Thibault On the performance of IEEE 802.11 p and LTE-V2V for the cooperative awareness of connected vehicles. IEEE Transactions on Vehicular Technology, (2017). 66(11), 10419-10432.

[24] M. Boban, A. Kousaridas, K. Manolakis, J. Eichinger & W. Xu Connected roads of the future: Use cases, requirements, and design considerations for vehicle-to-everything communications. IEEE vehicular technology magazine, (2018). 13(3), 110-123.

[25] A. Boukerche & E. Robson Vehicular cloud computing: Architectures, applications, and mobility. Computer networks, (2018). 135, 171-189.

[26] S.Brown & A. Mickelson A decision framework for choosing telecommunication technologies in limited-resource settings. *Future Internet*, (2018) 10(1), 8.

[27] G. Cecchini, A. Bazzi, B. Masini & A. Zanella LTEV2Vsim: An LTE-V2V simulator for the investigation of resource allocation for cooperative awareness. In 2017 5th IEEE International Conference on Models and Technologies for Intelligent Transportation Systems (MT-ITS) (2017, June). (pp. 80-85). IEEE.

[28] N. K. Chaubey Security analysis of vehicular ad hoc networks (VANETs): a comprehensive study. International Journal of Security and Its Applications, (2016). 10(5), 261-274.

[29] L. Chen & C. Englund. Every second counts: integrating edge computing and service-oriented architecture for automatic emergency management. Journal of Advanced Transportation, Volume 2018, Article ID 7592926. https://doi.org/10.1155/2018/7592926.

[30] D. Nguyen, H. P., & R. Zoltán The current security challenges of vehicle communication in the future transportation system. In 2018 IEEE 16th International Symposium on Intelligent Systems and Informatics (SISY) (2018, September). (pp. 000161-000166). IEEE.

[31] T.S. Darwish &K.A. BakarFog based intelligent transportation big data analytics in the internet of vehicles environment: motivations, architecture, challenges, and critical issues. IEEE Access, (2018). 6, 15679-15701.

[32] M. A. Ferrag , L. Maglaras, A. Argyriou, D. Kosmanos & H. Janicke Security for 4G and 5G cellular networks: A survey of existing authentication and privacy-preserving schemes. Journal of Network and Computer Applications, 2018 101, 55-82.

[33] M. Gonzalez-Martín, M. Sepulcre, R. Molina-Masegosa, & J. Gozalvez, Analytical models of the performance of C-V2X mode 4 vehicular communications. IEEE Transactions on Vehicular Technology, 2018 68(2), 1155-1166.

[34] C. Guo, D. Li, G. Zhang & M. Zhai Real-time path planning in urban area via vanet-assisted traffic information sharing. IEEE Transactions on Vehicular Technology,2018 67(7), 5635-5649.

[35] A. Haider & S.H. Hwang Adaptive transmit power control algorithm for sensing-based semi-persistent scheduling in C-V2X mode 4 communication. Electronics, (2019). 8(8), 846.

[36] A. Srivastava, A. Prakash, and R. Tripathi, "Location based routing protocols in VANET: Issues and existing solutions," Veh. Commun., vol. 23, p. 100231, 2020, doi: 10.1016/j.vehcom.2020.100231.

[37] A. Haider, R.S. Sinha & S.H. Hwang Investigation of Open-Loop Transmit Power Control Parameters for Homogeneous and Heterogeneous Small-Cell Uplinks. ETRI Journal, (2018). 40(1), 51-60.

[38] R. Hussain, F. Hussain & S. Zeadally Integration of VANET and 5G Security: A review of design and implementation issues. Future Generation Computer Systems,2019 101, 843-864.

[39] W. Jaballah B., M. Conti &C. Lal, *A survey on software defined VANETs: benefits, challenges, and future direction*s. arXiv preprint arXiv: (2019). 1904.04577.

[40] Y. Jeon, S. Kuk, & H. Kim, Reducing message collisions in sensing-based semi-persistent scheduling (SPS) by using reselection lookaheads in cellular V2X. Sensors, 2018 18(12), 4388.

[41] J. Jeong (2019). IP Wireless Access in Vehicular Environments (IPWAVE): Problem Statement and Use Cases. IETF Draft, draft-ietf-ipwave-vehicular-networking 2019 -07.

[42] R. R. Ema, M. F. Ahmed, M. H. Ahmed, and T. Islam, "Effect of number of nodes and speed of nodes on performance of DSDV, AODV, AOMDV, DSR and GPSR routing protocols in VANET," 2019 10th Int. Conf. Comput. Commun. Netw. Technol. ICCCNT 2019, pp. 1–6, 2019, doi: 10.1109/ICCCNT45670.2019.8944844.

[43] E. Safrianti, L. O. Sari, and F. Saputri, "Performance Analysis Of DSDV, AOMDV and ZRP Routing Protocols Application Simulation In Pekanbaru Vehicular Ad Hoc Network (VANET)," Bul. Pos dan Telekomun., vol. 18, no. 2, pp. 127–144, 2020, doi: 10.17933/bpostel.2020.180204.

[44] H. F. Mahdi, M. S. Abood, and M. M. Hamdi, "Performance evaluation for vehicular ad-hoc networks based routing protocols," Bull. Electr. Eng. Informatics, vol. 10, no. 2, pp. 1080–1091, 2021, doi: 10.11591/EEI.V10I2.2943.

[45] A. W. K. Al-Nasir And F. S. Mubarek, "Aodv, Dsdv, And Dsr Protocols Of Routing: A Comparative Study In Vanets Using Network Simulator-2," Samarra J. Pure Appl. Sci., Vol. 6, No. 1, Pp. 211–222, 2024, Doi: 10.54153/Sjpas.2024.V6i1.662.

[46] S. A. Quadri And R. M. Gaikwad, "Computer Scienceresearch Paperavailable Online At Comparative Evaluation of Aodv , Olsr , And Dsdv Routing Protocol Performance In Manet Using Ns-3," Vol. 16, No. 2, 2024.