iJRASET
International Journal For Research in Applied Science and Engineering Technology



INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 **Issue:** IV **Month of publication:** April 2021

DOI: https://doi.org/10.22214/ijraset.2021.33715

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International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue IV Apr 2021- Available at www.ijraset.com

Performance Evaluation of Vehicular Ad-Hoc Network based on Proactive and Reactive Routing Protocols

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Abstract: ***The city and highways are more accident zone and the number of vehicles on the road were most congested areas. Today, advances in wireless networks have led to the essence of a new type of network called Vehicle Networks. Vehicular Ad-hoc Network is an emanate sub-class of MANET. This technique was used by infrastructure developers to develop new processes that increase the safety and comfort of drivers and passengers. This type of network evolves as part of Intelligent Transport Systems to bring a significant improvement of the performance to the transport system. The big challenge for VANET is to design more routing protocols that are suitable for efficiently routing packets to the final destination. Despite the high speed of vehicle position and direction of navigation, frequent disconnection and highly variable topology. SUMO and NS3 were simulation tools applied to real city street maps and then OSM was separate from the map. The proactive and reactive routing protocols are AODV, DSDV and OLSR with the execution of routing techniques is being evaluated based on Quality of Service (QoS) parameters namely, packet delivery ratio, throughput and average end-to-end delay.***
Keywords: VANET, SUMO, NS-3, WAVE, ITS, Routing protocols.

I. INTRODUCTION

Vehicle Ad-hoc Networks (VANET) is an important role of the intelligent transportation system for the communication between moving vehicles information exchanges to other vehicles in era to avoid collisions and traffic on the roads. The emergency vehicle is time consumes highly at the roadside traffics and it affect the destination and delayed the particular areas of road side injuries. The wireless communication had a Mobile Ad-hoc Network and it is a sub category of Vehicular Ad-hoc Network [1] transport networks are expected to utilize various advanced wireless technologies such as Dedicated to Short-Range Communications (DSRC), which is an enhanced version of WAVE (IEEE802.11p) technology suitable for VANET environments. It was important for a brief history of wireless communications [2] area since 1864, James Clerk Maxwell develops and expresses his opinion on the ubiquity of electromagnetic waves. Despite, end of the year 1887, Hertz further improved the concept of wireless technology. Times of India (TOI) and WHO reported in the newspaper on the year 2014 and most of people death in Mumbai-Pune highway accidents up to the level of 81.5% [3]. But, preventable accident and emergency period congestion of information exchanging on popular safety application with the help of Network transportation system to quick and rapid solution from the enhanced VANET scenarios. Hence, vehicles are increased in the modern days and the traffic jam on roads were produces the emissions of CO_2.

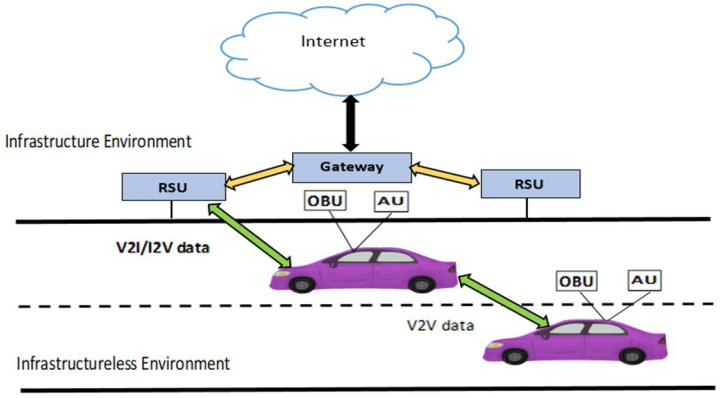


Fig. 1. Structure of VANET [2] [4]

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The impact of sudden changes in global warming and climate changes it affect humans and animals were caused some diseases and environmental risks. Hence, safely use the renewable energy resources with the help of creating natural energies such as water, solar, and wind energy. The development of solar bikes, cars and other vehicles to safe guard nature and save the earth from pollutions. But the application is very useful with the Intelligent Transportation System (ITS) emerging of Vehicular Ad-hoc Network. VANET basic structure in the Figure 1 shown above, that the communication system classified into three ways are [3]

1) Vehicle-To-Vehicle Communication System (V2V)
2) Vehicle-To-Infrastructure Communication System (V2I)
3) Inter-Vehicle Communication System (IVC)

Vehicular ad-hoc network was the main function of transmission for safety, ensure and protect the traffic collision management application, and it helps the Internet of things with a global positioning system to take the direction of navigation at road of lane and road junctions vehicular information passes through the road side vehicles in the infrastructure of vehicular environment.

A. VANET Application

The application of Internet of Things (IoT) as its main objective was to safety of human beings and animals with the important thoughts that flow it as urban and roads in the particular way of most accidents and traffic congestion and some rural areas are without lights and obstacles to sudden and effective accidents on the road are avoided to improve the application of advanced techniques to assist with GPS and satellite in the vehicle.

These VANET applications can be categorized as shown in Figure 2.

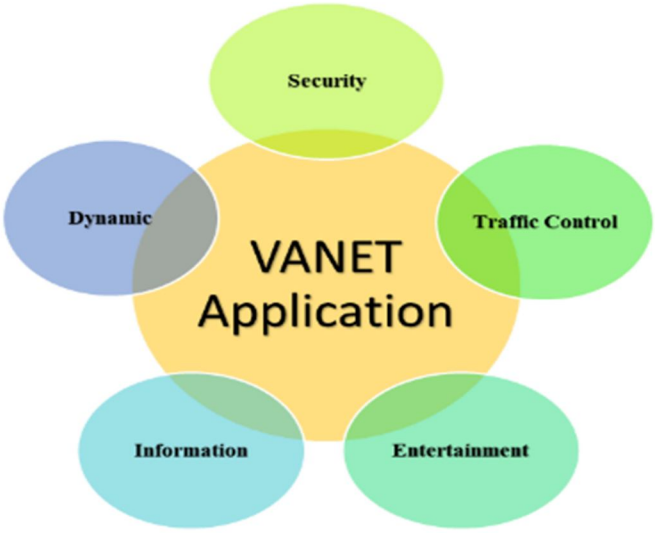


Fig. 2: VANET Application

II. RELATED WORK

Seth, A. D., and Ankit Khare (2014) [9] was examined vehicular ad-hoc networks emerged as a novelty from the MANET's crucial network environment are various mobility models with node position and speed. There are two routing links such as DSR and DDSR at source based on on-demand protocols for the destination in the two important phases are route discovery and route maintenance of dynamic source routing. The RSUs for highway scenarios with the simulation of trace metrics at delay distinction of the performance metrics tools. Therefore, after simulation results analyzed the trace metrics are evaluated by the DSR. DSR is a delay time graph 1 was high and DDSR is a delay time graph 2 was less. Finally, the result indicates that DDSR was much better than the DSR protocols.

Daya Sagar Bara, and Krishna Kumar Jha (2015) [10] was proposed real-time traffic analyzed to vehicular ad-hoc networks with advanced application of a novelty intelligent transportation system. Wireless Access in Vehicular Environments (WAVE) described a Dedicated Short Range Communication (DSRC) and then the methodology for the two steps, that is, the first is a traffic simulator with the main purpose of mathematical modeling and computer software worked with SUMO. Compared to the various protocols such as Ad-hoc On-Demand Distance Vector (AODV) is much higher efficiency in PDR and Dynamic Source Routing (DSR) in higher performance of average end-to-end delay in the simulation results.

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Amina, B., and E. Mohamed (2018) [5], studied the vehicular ad-hoc network based on the routing protocols implement by the AODV, DSDV, OLSR, GPSR, and GPCR. Quality of Service (QoS) metrics performance and measured by the throughput, PDR, average end-to-end delay and overhead. Finally, OLSR can be designed the best for this scenario in terms of PDR and throughput. GPSR and GPCR are the best routes in case of overhead and average end-to-end delay. The AODV was greater control of the overhead because it transmits a large number of control message packets to maintain the route. Among these investigators, he relied on the tool presented in this article and it was useful to researchers and students in this field.

Ashwini et.al, (2018) [6] was proposed proactive and reactive routing protocols based on on-demand and table-driven routing protocols such as DSDV, AODV, and OLSR. Therefore, the schedule consists of the real-time schedule and the default scheduler. It is compatible with the system consisting of logging, attributes, and tracking. The performance measured by the parameters designed for the position of grid and random on the nodes is compared with the results of simulation to more efficiently.

Rajneesh Kumar, and Brajesh Kumar Singh (2019) [7] was explained the different techniques of novel route establishment by big challenges of vehicular ad-hoc networks. Then previously developed routing approaches enhanced by comparison anatomy of novelty proposed algorithm with performance evaluated by two routing protocols such as DSDV and AODV in terms of definite parameters are only two components analyzed in throughput and packet loss. Reactive protocols are computationally high throughput and packet loss is less computational for AODV with much better efficiency. A comparative analysis of AODV is high throughput and DSDV is less to perform based on simulation results.

Deepshika Reddy et.al, (2020) [8] was proposed to genre communication aspects in VANETs are three ways with in terms of Vehicle to Vehicle, Vehicle to Infrastructure and Hybrid engineering. Comparison with various protocols and various scenarios from the performance of the metrics analyzed by the good put, the Mac Physical overhead, and the packet delivery ratio for Basic Safety Messages (BSM) estimated by the OLSR and AODV protocols result was received along with simulation and graphs.

III. TOPOLOGY BASED ROUTING PROTOCOLS

As discussed upon, the classification of different protocols briefly elaborated to the dynamic topology based on routing protocols, techniques were used the best performance to realize the metrics and simulation from the routing protocols are mainly classified into two or more types namely as proactive and reactive routing protocols. These are classified into denoted given below represented by the VANET Routing Protocols shown in Figure 3.

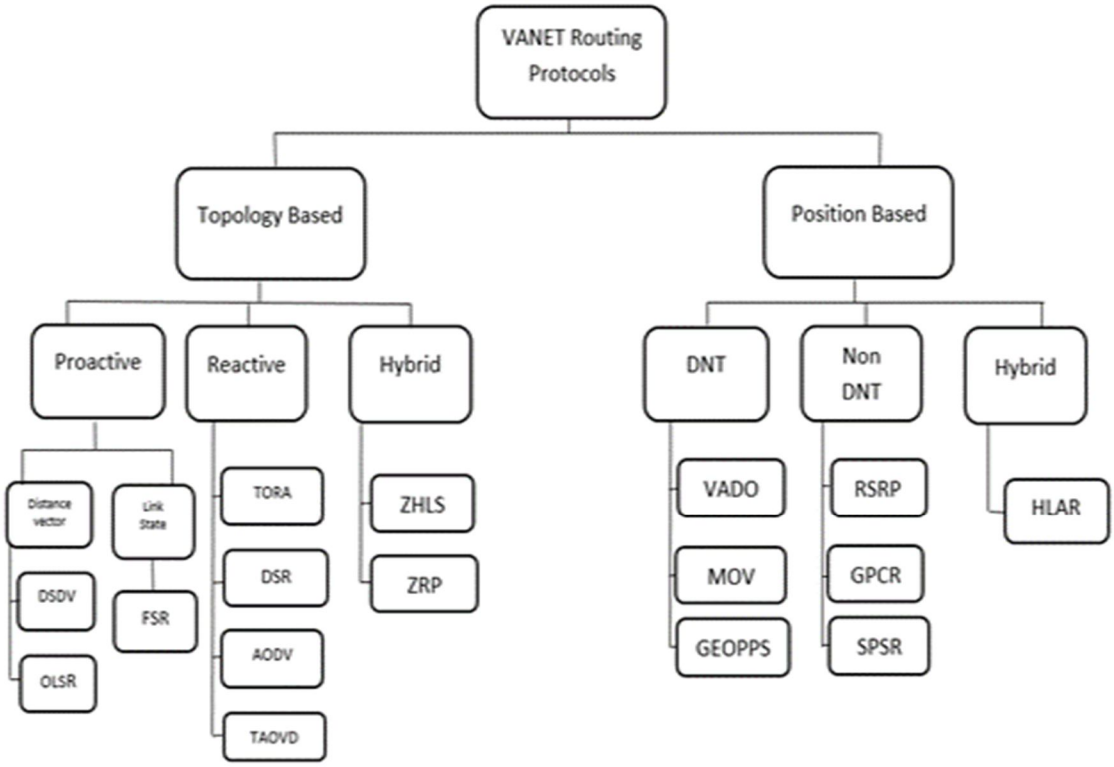


Fig. 3: VANET Routing Protocols

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A. Proactive Routing Protocols

In this proactive protocols till it learn from the topology network of the topological information exchanging to the network nodes, there is a need for a route to the destination such that the route sharing information is available immediately. Proactive protocols are called as table-driven routing protocols and also distance vector routing techniques.

1) *Destination Sequenced Distance-Vector Routing Protocols (DSDV):* DSDV is a proactive routing protocol described the Bellman-Ford routing algorithm and it was developed by C. Perkins and P. Bhagwat in 1994 [11] [12] [13], the networks in this each mobile nodes on routing table at the set of all available destinations to count the hops of each, every table entry is noted the sequence order with originated by the destination node. Incase routing table maintaining the information at the network for topology and updated to the periodic transmission.

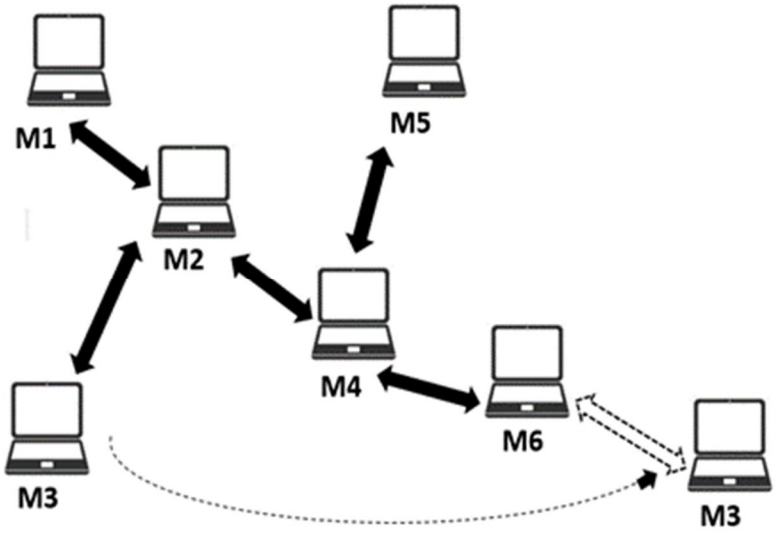


Fig. 4: DSDV Routing Protocols

Hence, the full dump are used in such an event, they updating the route packets are sequence order assign to the transmitter for update the route information in the route packets is the highest sequence order was needs to higher order means recent update packets and each nodes expect time interval and transmit the message to the neighbors. So that the recent information was best router of a destination and it informs to the neighbors. Figure 4, described in the DSDV Protocols [11] [12] [13]

2) *Optimized Link State Routing Protocols (OLSR):* The link state algorithm is a table-driven and proactive routing protocol, entire links from mobile nodes to network topology in the multi-hop links with the metrics of the sequence number at routing table information exchanges to the packets are delivered to the neighbor nodes [11] [14] [15]. OLSR is a multipoint relay and also selectors will reduce the size of control packet on the particular node for the link of subset neighboring nodes and select the multipoint relay in terms of alternating all the links in the network. The link state routing was flooding to each node that received the packet and again transmit and that received the packets.

B. Reactive Routing Protocols

In this reactive based on-demand driven routing protocols, are the protocols process of implementing routes to the destination for needed at on-demand. The part of dialog is query reply with reactive routing on the ad-hoc networks. The various types of on-demand protocols are given below [11],

1) *Ad-hoc on-Demand Distance Vector Routing Protocols (AODV):* The routing protocols are unstable methods that respective manner, it will halt or improvement of DSDV. But the reactive protocols are called known as AODV, it alternative to the proactive routing protocols. The creative route based on demand, the number of transmissions to minimize it has not wrapper of the destination sequenced distance vector. So, it was any demand from the originating node to send a packet to the destination, it is the transmission of the route request (RREQ) packet [11] [16]. In this process streaming to the failure notification reaches the source node. The information received from the source it efficiency decided to again initiate the route discovery phase.

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IV. PROPOSED AND EXPERIMENTAL METHODOLOGY

The sumo is an open-source and streaming multi-modal traffic simulator package designed to handle large networks. SUMO is developed by the German Aerospace in this open-source application in 2001, which is the research goal of this sumo simulator with traffic forecast, traffic light estimation, route selection, and car communication for sharing vehicle information on the open road in the purpose to extract area on the digital card wizard for the application.

Construct to traffic generator scenario in sumo with steps to given below

1) *Step 1:* The Simulation of Urban Mobility model (SUMO) installed the package and then select the python file for osmwebWizard.py to chosen are automatic opened the browser with the link are file://home/vi/sumo/tools/webwizard/index.html.
2) *Step 2:* OpenStreetMap (OSM) are displayed the E-Map and viewed the generate scenario.
3) *Step 3:* Digital world map to the select it manually choose and dragged the particularly selected area.
4) *Step 4:* The generate scenario through vehicles to chosen and simulation time to given seconds on run time executed the time generate and next select the left side and right side of drive chosen to apply it.
5) *Step 5:* Open the terminal and chosen the file saved in the locator to apply the name of osm.sumocfg-sumo to generate traffic simulator.
6) *Step 6:* osm.sumocfg-sumo are apply it automatically opened the traffic generate scenario of data reported on the simulation time, longitude, parameter and execution of fixed time run simulation are generate to save the file in the locator.

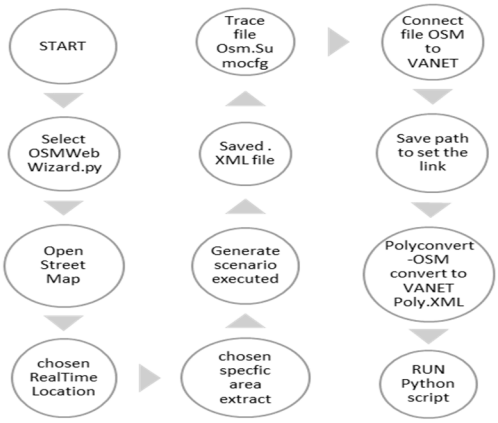


Fig. 5: Flow Chart of Simulation of Urban Mobility (SUMO) Using Open Street Map (OSM)

V. EXPERIMENTAL WORK

In this simulated environment that the osm.sumocfg to the file extracts with the traffic control generator and sumo tools executed to run the simulation of real world map of the simulated application of vehicle movement, speed, duration, delay time and waste of time generate scenario to show the figure 6, graphical viewer of the traffic simulator given below. The osm.poly.xml file to generate the graphical user interface with the traffic scenario on executed to run the simulation and completed the vehicle movement, generate automatic saved file to store the xml format. The sumo configuration and convert the file name into change the rename with vanet.xml to the saved file and then fixed path to network simulator with configure to path name save to the routing protocols in the trace path to explore with a script and to run it as the simulation of routing protocols.

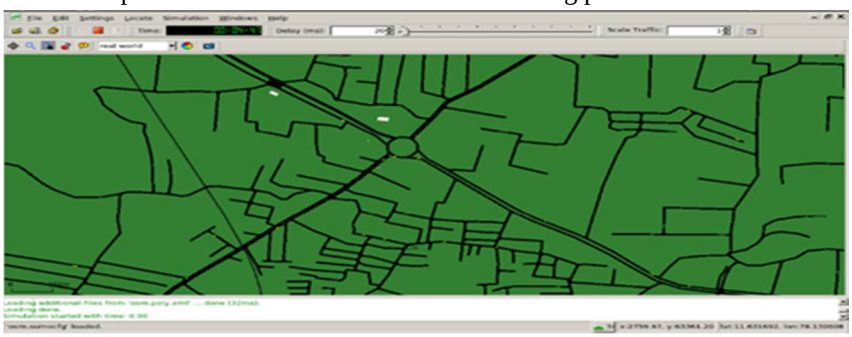


Fig. 6: Graphical Viewer of Traffic Simulator Using Sumo

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Table 1: Simulation Parameter for VANET

Simulation Parameter	Value
Routing Protocols	AODV, DSDV, OLSR
Simulation Area	300*1500meters
Mobility Model	Random Waypoint Model
Number of Nodes	130 Nodes
Radio Propagation Model	Two Ray Ground
Mac protocol	IEEE 802.11p
Transmission Power	20dBm
Transmission Range	145m
Speed	20m/s
Simulation Time	30.01sec
Channel	Wi-Fi channel
Packet size	64bytes

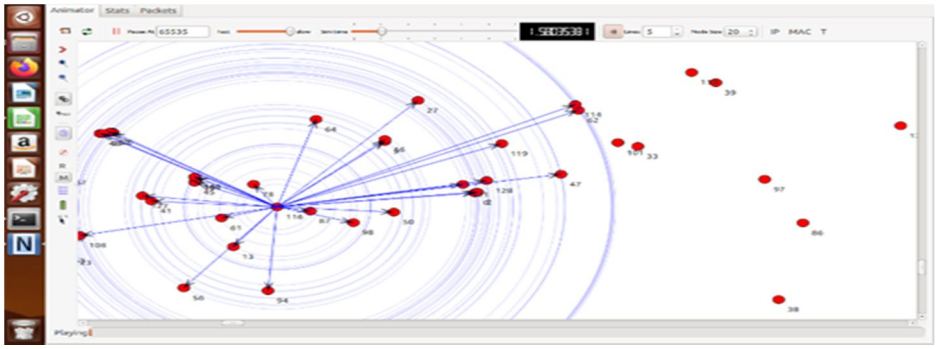


Fig. 7: Net Animation Playing the Nodes Movement Simulation of VANET Routing Protocols

VI. RESULT AND DISCUSSION

The performance of simulation protocols related to the three parameters consist of
The three parameters of the metrics relating to routing techniques on the Quality of Service (QoS) were used in all the parameter and terms indicate with the traffic controller in the network and this was used in the method mainly measured the metrics of a realistic performance.

A. Packet Delivery Ratio (PDR)

PDR is the total number of bits received and transmitted to the source and destination with the percentage measurements to the simulation, by the PDR formula given below,

$$PDR = \frac{Packet\ Received}{Packet\ transmitted} * 100$$

With the Packet Delivery Ratio equal to the total number of packets received by the total number of packets transmitted and percentage of the successfully transmitted the data with the performance is evaluation by the routing protocols.

B. Throughput

Throughput is a kilobits per seconds (Kbps) to measure the total number of bits are transferred to the network simulation and the evaluation of the throughput formula are given below,

$$Throughput = \frac{No.of\ Received\ packets}{Total\ Simulation\ Time} \times Packet\ Size$$

Maximum throughput of the routing protocols is the best performance of successfully routed for the network simulation.

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C. End-To-End Delay (E2E)

This metric shows the general delay, from the packet broadcast of application agent to the sender node until the receipt of packet by the relevance representative at the destination node. It can be calculated by dividing the sum of all the time differences between sending and receiving packages. In delay, the average low end-to-end delay in the network is a good indicator of the performance of the routing protocol.

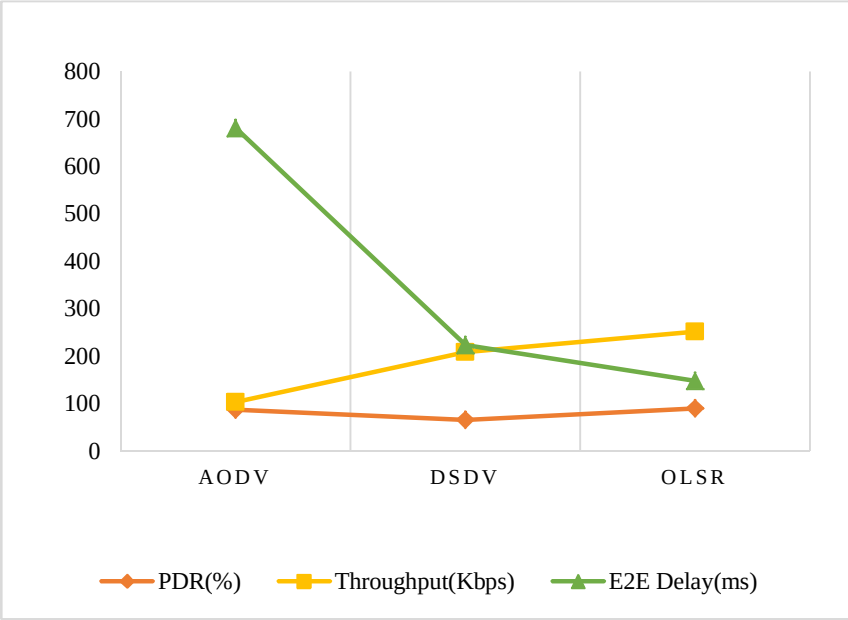


Fig. 8: Performance Evaluation of AODV, DSDV and OLSR Routing Protocols

VII. CONCLUSION

The wireless technology in the future enhanced for all over the country developed and people can use for their daily purpose is a fixed form of communication system benefit in communicating between devices for various purposes. The present study attempts to investigate some important aspects of wireless technology that are being used as a part of these days. There was a milestone in routing protocols within vehicular ad-hoc networks at the heart of intelligent transportation systems for the backbone of proposed wireless access in the vehicle environment. It has been implementing the simulation of Urban Mobility (SUMO) model utilizing the route path establishing to improve the traffic management with the generate scenario, and then the three routing protocols are compared to the metrics performed with the result analyzing the net animation for the node movement of packets transfer to the vehicular network. Hence, the protocols of performance metrics analyzing the throughput of the Optimized Link State Routing (OLSR) is compared to various protocols are better performance in this simulation of the result is highest than the DSDV and AODV. The packet delivery ratio is the best protocols enhanced by the metrics of this result analysis are Optimized Link State Routing (OLSR) is the best performance in the higher PDR than the other protocols are certain AODV is the second better evaluation to the DSDV, and it is compared to the two protocols are evaluated with the lesser performance from the packet delivery ratio. The End-to-End delay analyzing the best performance of the routing protocols are lesser time mounted with the OLSR and also compared the other routing are lesser evaluated to the protocols. Overall performance of analysis was measured in this techniques of proactive routing protocols is one of the best performance model in OLSR is better than the DSDV and AODV.

Our further, research of the improvement and enhancement of routing protocols also the development of various metrics. Vehicular Ad-hoc Networks are highly motivated and sophisticated technologies for the period of daily life, traffic measures, prevent congestion and accidents. So most of the maximum researchers under taken the research in this field of vehicles is a specific computer's innovation in navigation technology.

VIII. ACKNOWLEDGEMENT

It is a pleasure to pay my sincere thanks to the University Grants Commission, New Delhi for supporting with “UGC-SAP II” to do my research work.

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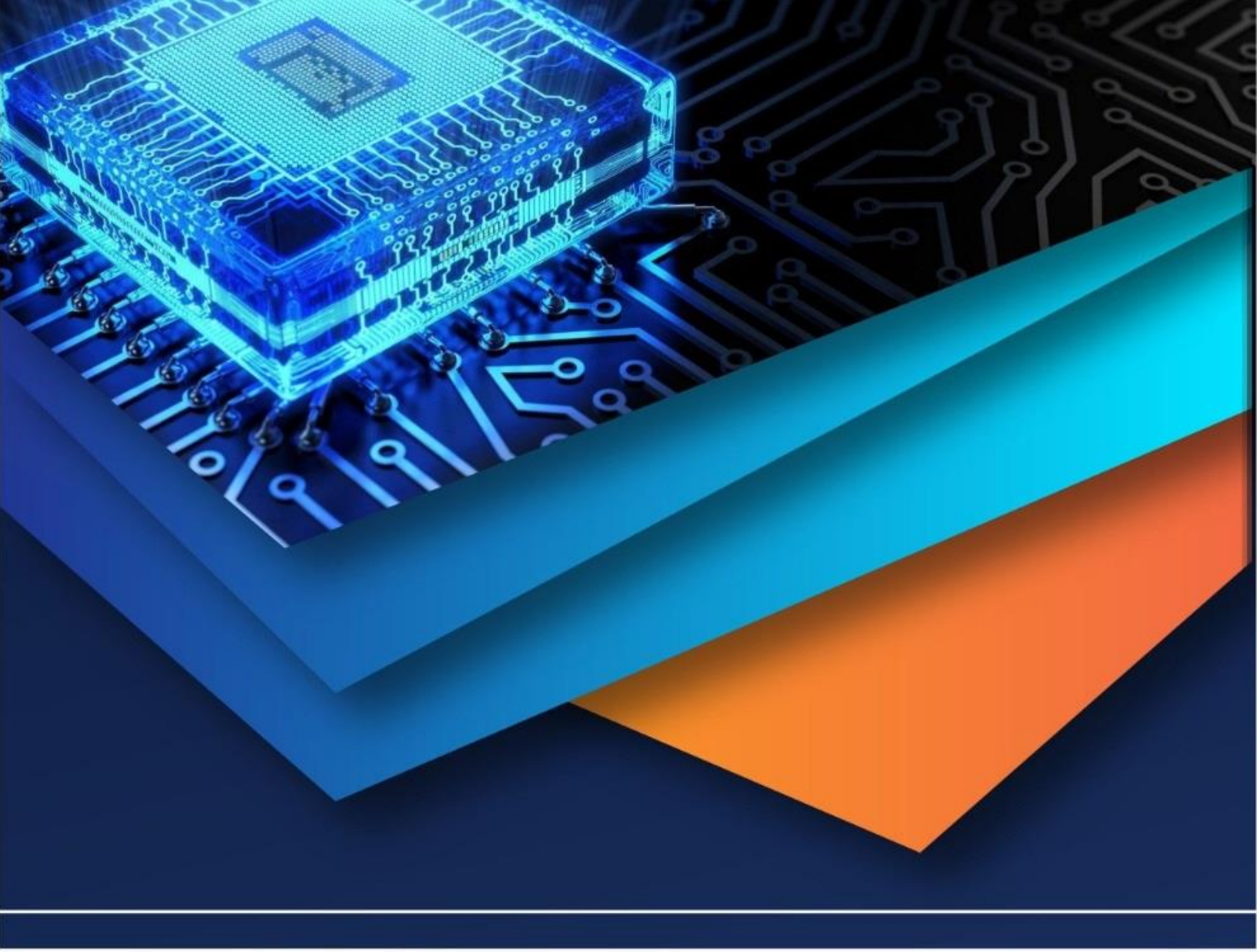
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