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Performance and Evaluation of Routing Protocols for VANET using NS3

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Abstract: ***In past few years the communication between vehicles has gained a lot of importance. Vehicular Ad-hoc Network (VANET) is derived from Mobile Ad-Hoc Networks (MANET) which is a best approach for the vehicle to vehicle communication. The existing routing protocols of MANETS are not effectively applied in VANETs. Therefore, VANET supports a few routing protocols, and their performance is evaluated using simulation studies. In this paper, we mainly compare the performance of routing protocol such as DSDV, OLSR and AODV in VANETs using ns-3 simulation tool. With the consideration of parameters such as throughput, packet delivery ratio and overhead the performance of routing protocols for VANETs are discussed. The key challenge is to find the best routing protocol for VANET in both Grid and Random fashion by comparing the above mentioned parameters. The simulation results shows that the nodes arranged in Grid fashion has better communication among them compared to the nodes arranged in Random fashion.***
Keywords: Mobile ad-hoc network (MANET), Vehicular ad-hoc network (VANET), Routing protocols, ns-3 tool.

I. INTRODUCTION

[1] An ad hoc network is a wireless system of mobile nodes that cooperatively form a network. Every node in ad hoc network is responsible in routing information between its neighbours. When these nodes are free to move randomly and organize themselves arbitrarily we refer this as Mobile Ad Hoc Network (MANET). The evolution of traditional MANET is VANET. Vehicular ad-hoc networks (VANET) are created by applying the principles of mobile ad-hoc network (MANET) [7].VANET includes communication between moving vehicles on the roads. It is a special application of mobile ad-hoc network. This application is further divided into two classes. One class focuses on security application which is mainly used to solve traffic safety and the other is user application which is used to provide value added service. To improvise the safety of drivers and provide secure and comfortable driving environment, inter-vehicular communication is necessary to communicate through the message for different purposes. Destination Sequenced Distance Vector routing protocol (DSDV)[5] is a table-driven routing scheme for ad-hoc mobile networks based on Bellman-Ford algorithm. The main contribution of the algorithm was to solve the routing loop problem. [12]The Optimized Link State Routing protocol (OLSR) [3] is a proactive link-state routing protocol, which uses hello and topology control (TC) messages to discover and then disseminate link state information through the mobile ad-hoc network. Ad-hoc On-Demand Distance Vector (AODV)[3] protocol establishes routes to destination on demand and supports both unicast and multicast routing.

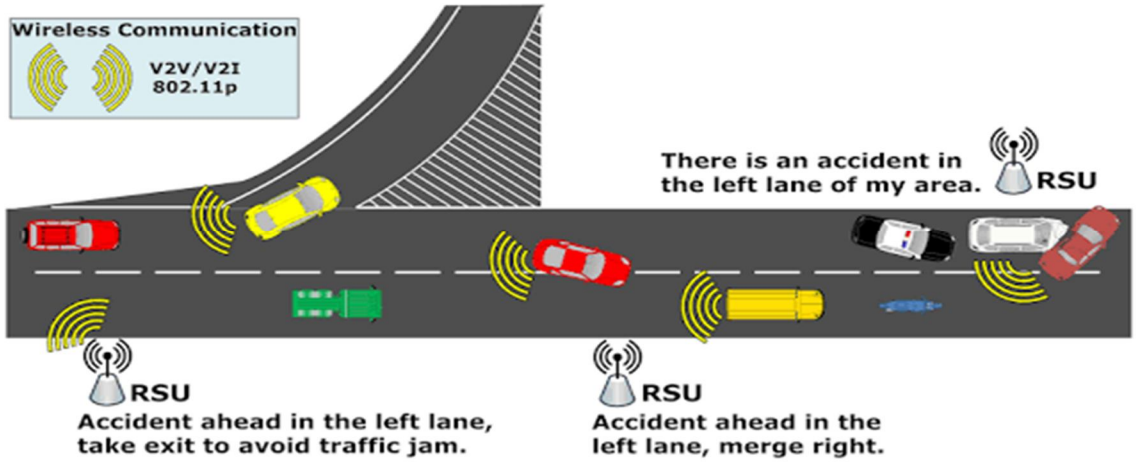

Fig1: Vehicular ad-hoc network (VANET) [16]

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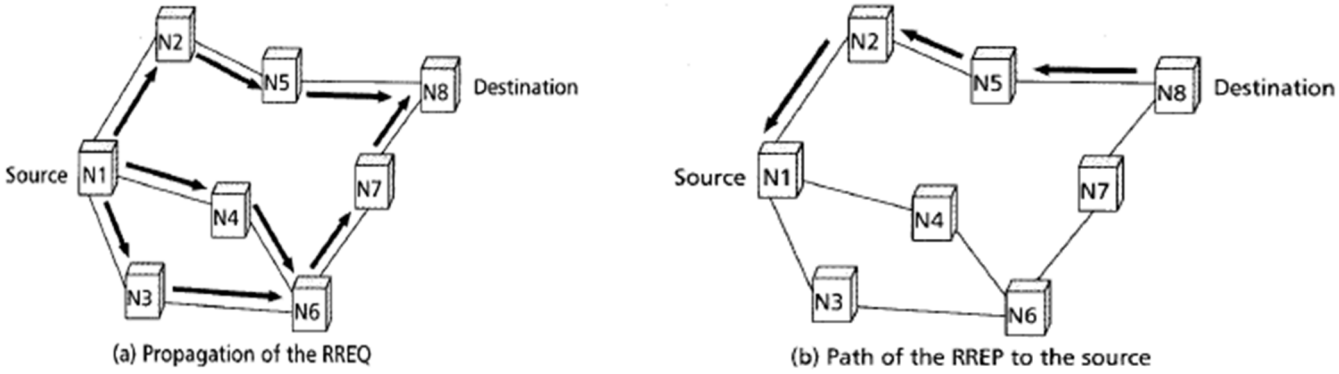
II. PROTOCOL INTRODUCTION

A. On-Demand Routing

AODV (On-demand distance vector routing)[3] is reactive routing protocol .This routing is based on routing requirements and routing responses. When the packet needs to be forwarded it to source node, it first finds out whether there is a valid route from the source node to destination, if not ten the routing lookup process is being performed. There are three basic protocol message types; they are RREQ message, RREP message and RRER message. The RREQ works as follows, when there is no route from the source node to the destination node, the route is thus being obtained by the broadcast of RREQ packets. The RREP works as follows, when the reply RREP message is received by source node within a certain period of time, now the routing is being completed and the data is ready to be forwarded. In routing maintenance process, the hello messages are being sent regularly to the neighbor node to keep in touch with each other, in case the hello message is not received, the link gets disconnected and to the source node the RRER message is being sent to notify.



B. Table Driven Routing

DSDV (The destination sequence distance vector protocol) [5] it is a proactive protocol which is an extension of the tradition DV protocol. DSDV has three main features they are 1: to each path add a sequence number 2: now each destination node will broadcast the increase number of even numbered sequences periodically 3: when it is found that the path to the destination node is broken, thee distance to the node is set to infinity and then the serial number of path is added to 1, once the path is fixed it then broadcasts the update packet to network the serial number is added to 1 and the packet is broadcasted.

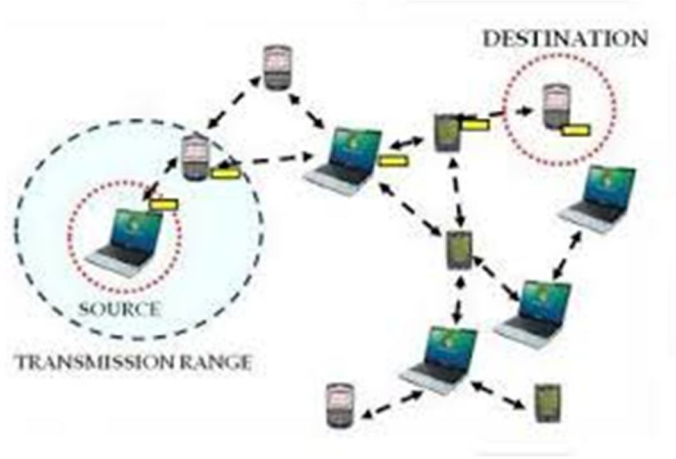


Fig2: Wireless connection between the nodes and transfer of data[12]

OLSR (The optimized link state routing protocol) [3] is a proactive protocol. OLSR is used for building neighbor tables and to broadcast Hello packets messages periodically. The mobile nodes make use of Dijikstra's algorithm in order to discover other nodes, routing apart from the existing network topology. The difference between OLSR and other protocol is MPR mechanism. In this the node will select a part of node as its own MRP in its neighbor nodes and all nodes are replaced by MRP to forward link state messages, due to which flooding is caused and reduced by routing overhead.

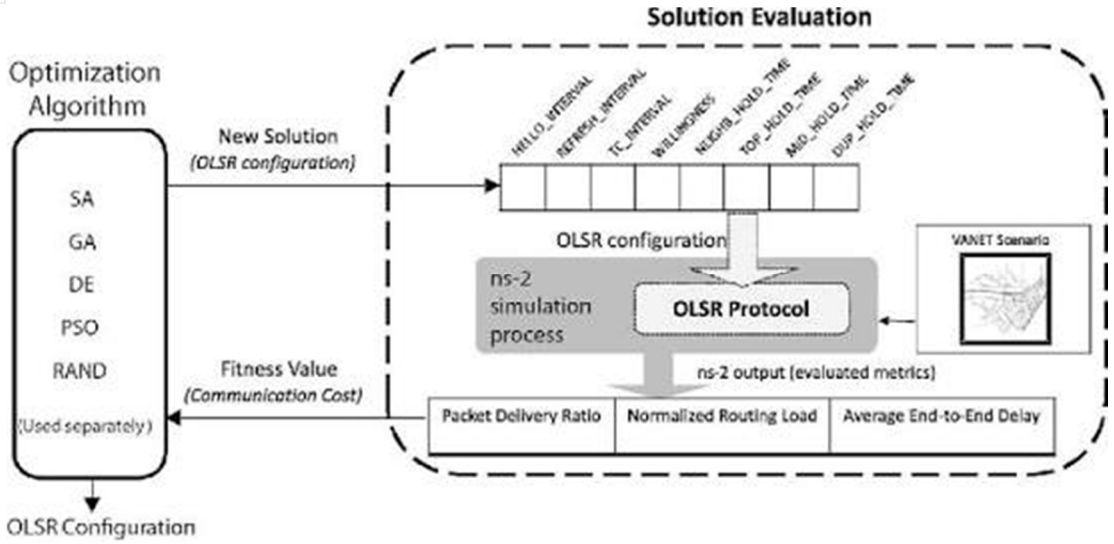


Fig3: OLSR Architecture [16]

III. SIMULATION PLATFORM

[1] Network Simulator Version 3 (NS3) is a discrete random event driven simulation. Network simulation is built using Python and C++ with scripting capability. This simulator features an integrated attribute based system to manage default and per-instance values for simulation parameters. It is a real simulation for subsequent application in engineering and its simulation results are closer to the real project.

A. NS3 Architecture

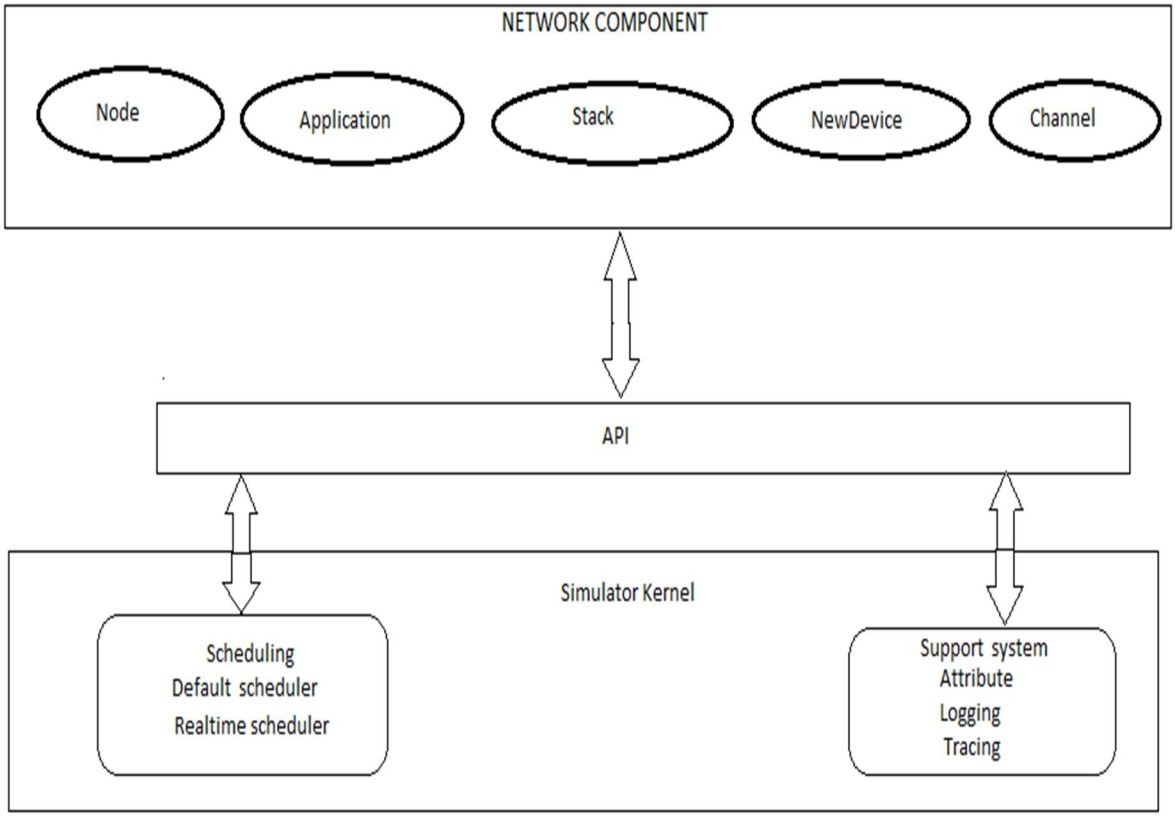


Fig4: Network Simulator-3 Architecture[16]

NS3 architecture has 5 types of network components namely Application, Node, Network Device, Topology Generator and Channel. In NS3 the basic computer devices are termed as nodes, which are described by Node Container class which provides a variety of methods for managing computer devices. Channel refers to the flow of data through media; network refers to the Internet to hardware and network card driver. The simulator kernel in NS3 mainly includes two core parts s i.e., time scheduling and support system. Time scheduling includes Real time scheduler and Default scheduler. The Support System includes Logging, Attribute and Tracing.

IV. PROBLEM STATEMENT

The comparison of three routing protocol namely AODV, DSDV and OLSR for VANETS was performed which was deployed in a Random Fashion. Various parameters such as throughput, packet delivery ratio and end-to-end delay were analysed using NS3. Further improvement on performance need to be worked on.

To analyze the performance of MANET routing protocols in VANET, by using table driven routing protocols DSDV, OLSR and on-demand routing reactive AODV are used for analysis.

V. PROPOSED SYSTEM

The comparison between proactive and reactive protocols such as DSDV, AODV and OLSR is analyzed for Random and Grid fashion by evaluating the network parameters such as throughput, packet delivery ratio and overhead. By using the simulation tool NS3 we can show the simulation of nodes transferring data packets from source node to destination node. We also construct graph for the analysis of efficient protocol against the given network parameters above.

VI. SIMULATION ENVIRONMENT

For simulation of three routing protocols namely, AODV, DSDV and OLSR we make use of Ubantu16.4 with ns-3-dev environment.

Simulation scenario setting: set the communication range of nodes in the grid area of 5*5 in 250m, the packet size is 1024bytes, the transmission frequency is 5kbps, the number of vehicles has been increased from 20 to 25, in the simulation time of 100s were compared between the three kinds of routing protocols of network performance parameters. The simulation parameters in NS3 are shown in Table 1.

Parameter	Value
Scene	1000*1000
Channel	Wi fi channel
MAC Protocol	IEEE802.11p
Communication Distance	250m
Packet Size	1024bytes
Packet Transmission Frequency	5kbps
Routing Protocol	AODV, DSDV OLSR
Vehicles	10,15,25
Time	100s

A. Routing performance Introduction

1) Packet delivery ratio: Packet delivery ratio is the ratio of total number of packets received by the destination node and the

number of packets sent by the source node. The formula is shown in formula (1), in which P is the packet delivery rate, s is the number of data sent by the source node, and d is the number of data received by the destination node.

$$P=sd \quad (1)$$

2) Throughput: throughput gives the number of valid data a reporting system can transfer, is the ratio of effective data transmission successful data reported in the number of bits and the total transmission time. The formula is shown in formula (2), where th is the throughput, p is the number of routing packets received by the receiving node, and t is the total time spent.

$$Th=(pt \times 8) \times 1000 \quad (2)$$

3) Overhead: Overhead refers to the processing time required by the system software, which includes the operating system and any utility that supports application programs.

VII. SYSTEM DESIGN

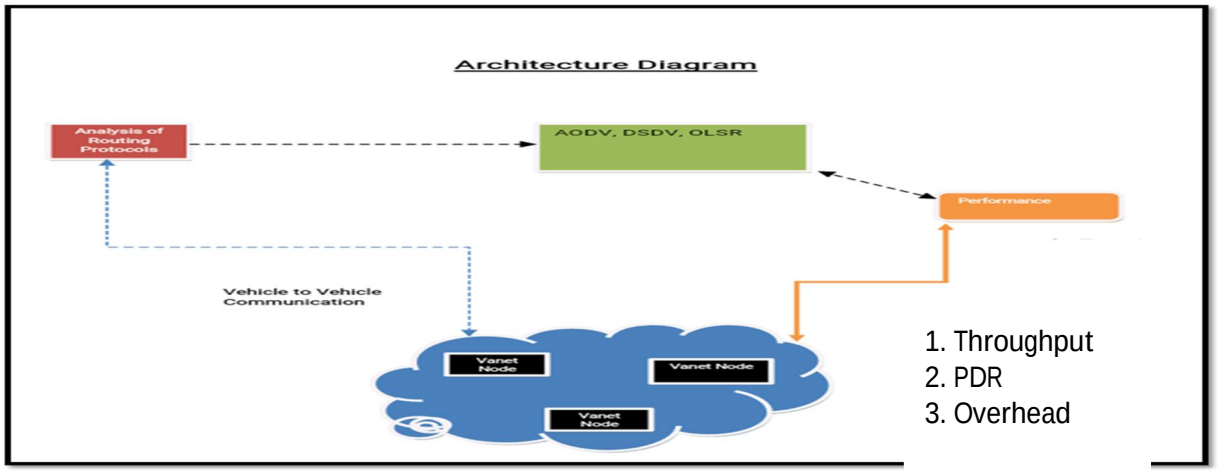
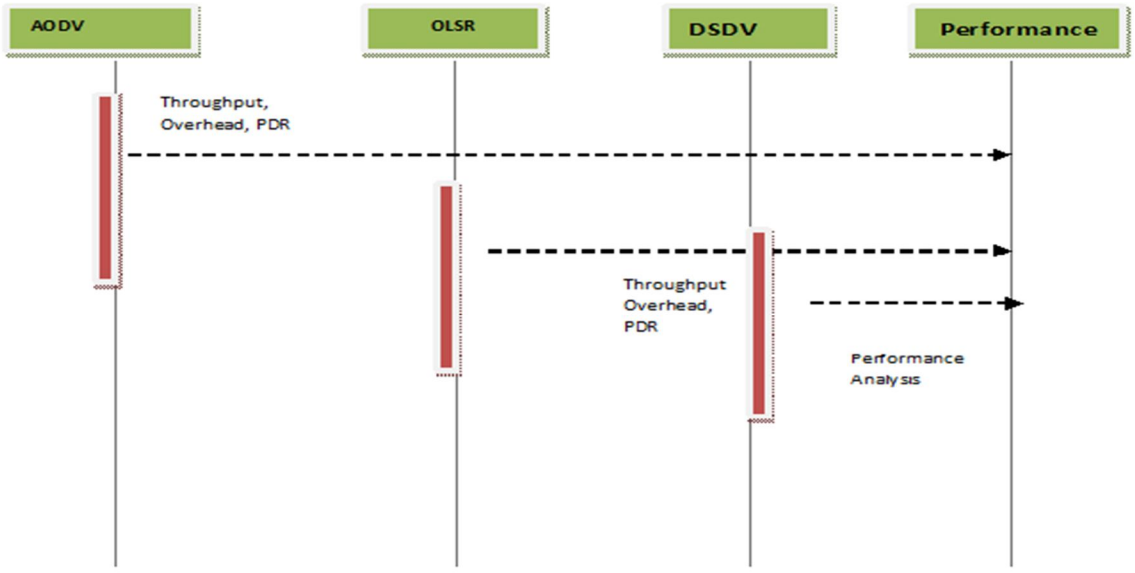


Fig5: System Design

In the above diagram it shows the architecture of the proposed system. Vehicles are considered as nodes, and are deployed and it is made vehicle to vehicle communication. While communicating with v2v the routing protocols like AODV, DSDV and OLSR is analysed for better routing.

VIII. IMPLEMENTATION



The performance of these protocols are analysed and compared using three parameters such as packet delivery ratio, throughput and overhead. From the sequence diagram above we observe that, the results showed OLSR is more efficient than DSDV and AODV for throughput, and AODV is more efficient than other two routing protocols for packet delivery ratio (PDR). As per the result observation overhead is same for all the three routing protocols.

A. Network Module

This module consists of following steps:

1) *Setting up Wireless Network Topology:* This includes environmental settings, node configuration, and topology creation.
2) *Setting the MAC protocol:* Each and every node in the network topology will be assigned to operate with 802.11 protocols.
3) *Identifying the neighbors:* In order to identify the neighbors for a particular node Euclidian distance concept is used.
4) *Specifying the data transmission through single and multi-hop:* From which node the data has to be sent and which node must receive the data will be specified. Also how much amount of data has to be sent along with the time interval of sending the data will be specified.
5) *Specifying the simulation start time and end time:* In NS3 the entire transaction takes place within fraction of seconds. The transaction can be viewed through the NAM window at any time. For this the simulation start time and end time will be specified.

IX. RESULT ANALYSIS AND DISCUSSIONS

A. Computations For Grid

Routing Protocols	PDF (%)	Throughput (kbps)	Overhead
AODV	0.1569	733.00 3	1 in load
DSDV	0.1528	713.809	1 in load
OLSR	0.1271	767.595	1 in load

B. Computations For Random

Routing Protocols	PDF (%)	Throughput (kbps)	Overhead
AODV	0.4162	295.94	3 in load
DSDV	0.4015	285.545	3 in load
OLSR	0.3575	254.239	3 in load

1) *Throughput Grid*

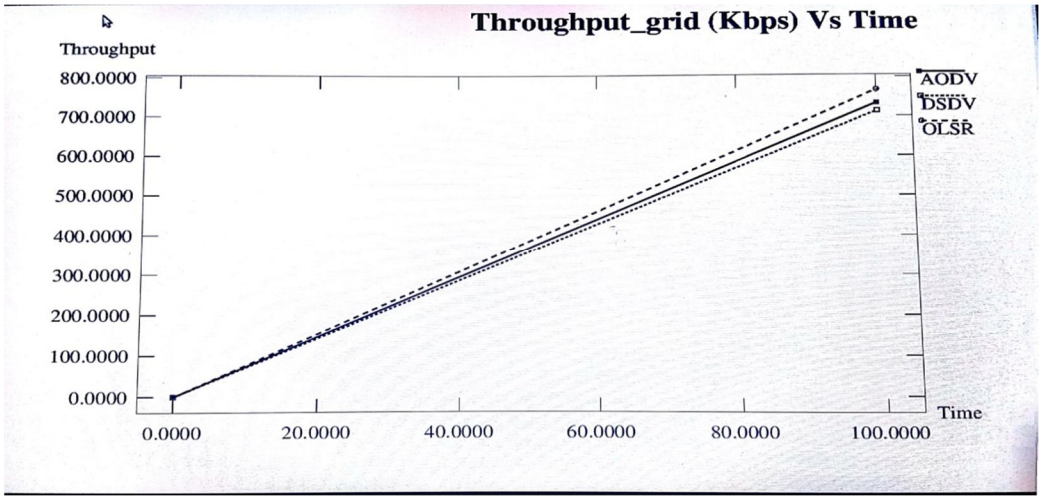


Fig8: Throughput grid (Kbps) vs. Time

The above graph speaks about Throughput in grid topology versus time, where throughput is taken on y-axis and is measured in terms of Kbps and time is taken on x-axis. This graph specifies that OLSR has the highest value compared to AODV and DSDV. Hence this proves that OLSR is more efficient for throughput in grid topology.

2) Pdf Grid

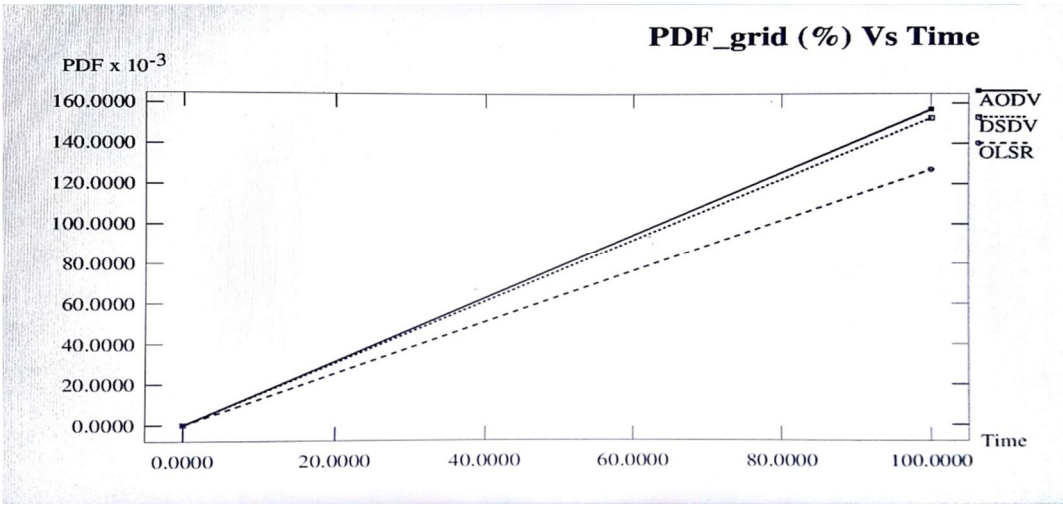


Fig9: PDF grid (%) vs. Time

The above graph speaks about Packet delivery ratio in grid topology versus time. Where PDF is taken on y-axis and measured in terms of (%) and time is taken on x-axis. This graph indicates that AODV has the highest value compared to DSDV and OLSR. Hence, as a result AODV is more efficient for packet delivery ratio in grid topology.

3) Overhead Grid

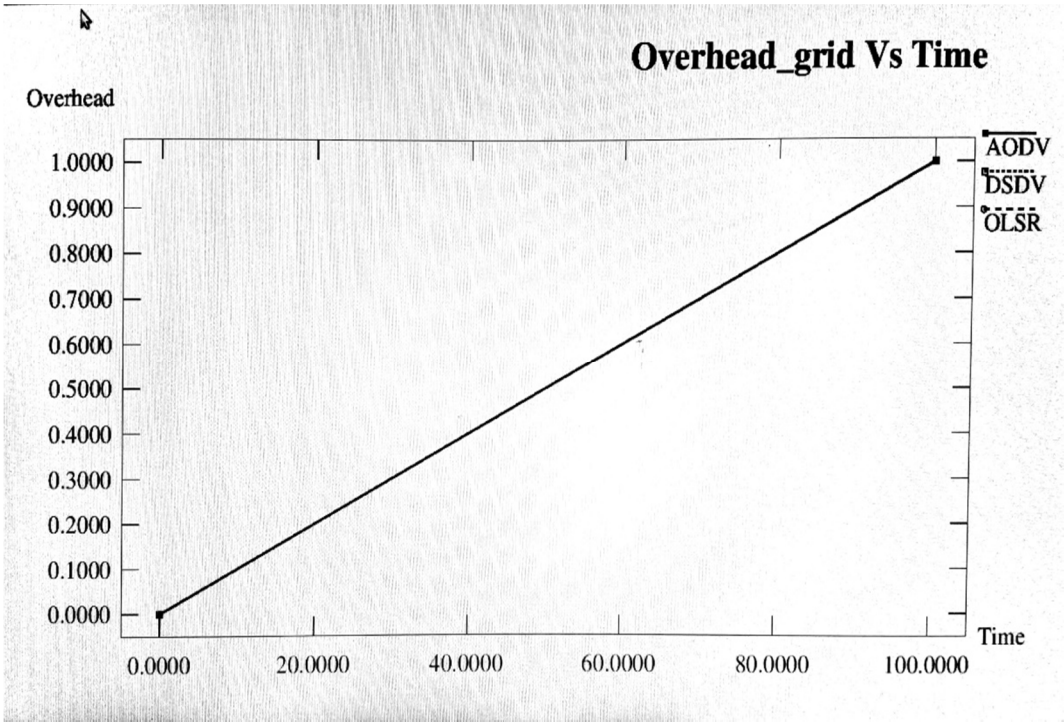


Fig9: Overhead grid vs. Time

The above graph speaks about the parameter, Overhead in grid topology versus time where overhead is taken on y-axis and time is taken on x-axis. Since all the protocols holds the same value for overhead. Any of these protocols can be used for computing overhead.

4) Throughput Random

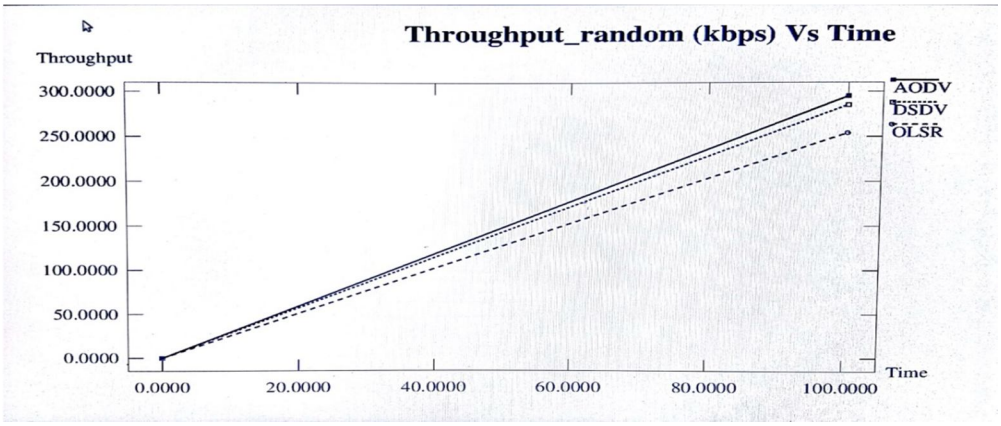


Fig11: Throughput random (kbps) vs. Time

The above graph speaks about Throughput in random topology versus time, where throughput is taken on y-axis and is measured in terms of Kbps and time is taken on x-axis. This graph specifies that OLSR has the highest value compared to AODV and DSDV. Hence this proves that OLSR is more efficient for throughput in random topology.

5) pdf Random

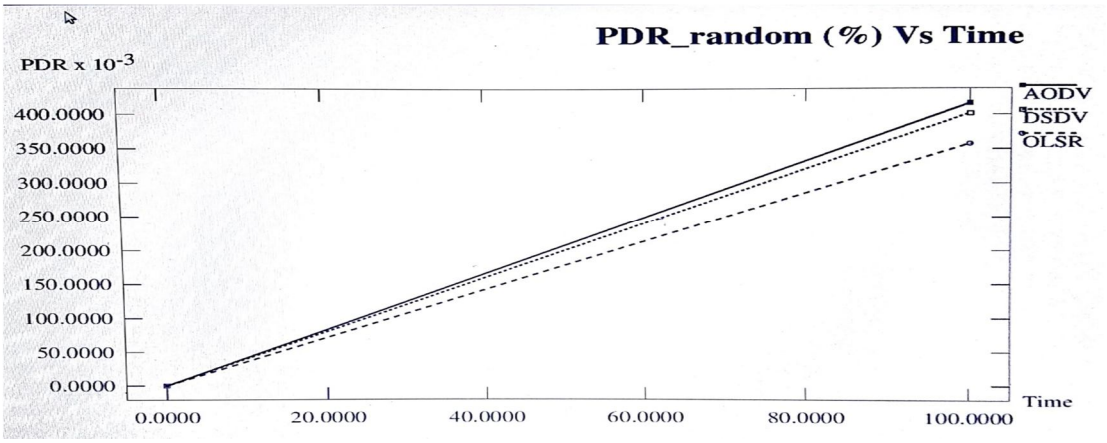


Fig11: PDR random (%) vs. Time

The above graph speaks about Packet delivery ratio in random topology versus time. Where PDF is taken on y-axis and measured in terms of (%) and time is taken on x-axis. This graph indicates that AODV has the highest value compared to DSDV and OLSR. Hence, as a result AODV is more efficient for packet delivery ratio in random topology.

6) Overhead Random

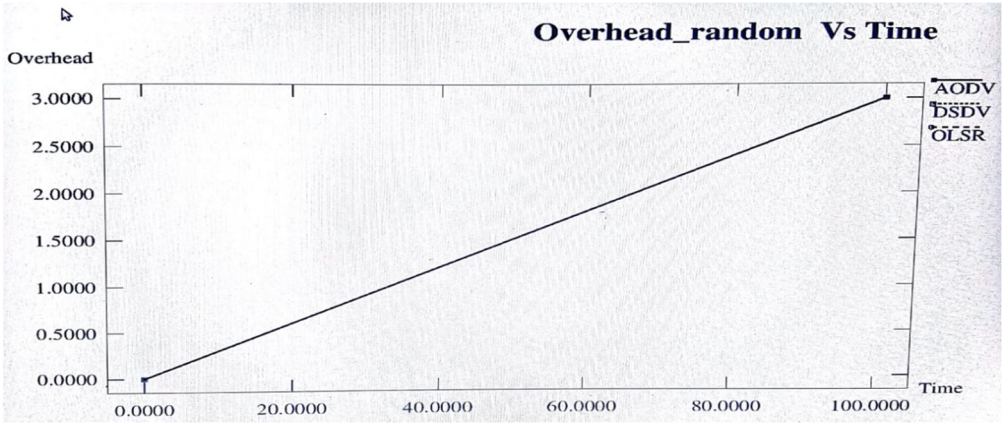


Fig12: Overhead random vs. Time

The above graph speaks about the parameter, Overhead in random topology versus time where overhead is taken on y-axis and time is taken on x-axis. Since all the protocols holds the same value for overhead. Any of these protocols can be used for computing overhead.

X. CONCLUSION

The proactive and reactive protocols which include AODV, DSDV and OLSR of VANET are being analysed. The communication between the vehicles is simulated by NS3. The performance of these protocols are analysed and compared using three parameters such as packet delivery ratio, throughput and overhead. The long-time communication between the vehicles is limited because of the high mobility of the nodes in vehicular networks. By simulating, the results showed that OLSR is more efficient than DSDV and AODV for throughput, and AODV is more efficient than other two routing protocols for packet delivery ratio (PDR). As per the result observation overhead is same for all the three routing protocols. Hence as a result grid positioning of nodes gave better efficiency in communication than compared to random positioning of the nodes. The future work should be carried out with respect to the other parameters to have betterment in the communication.

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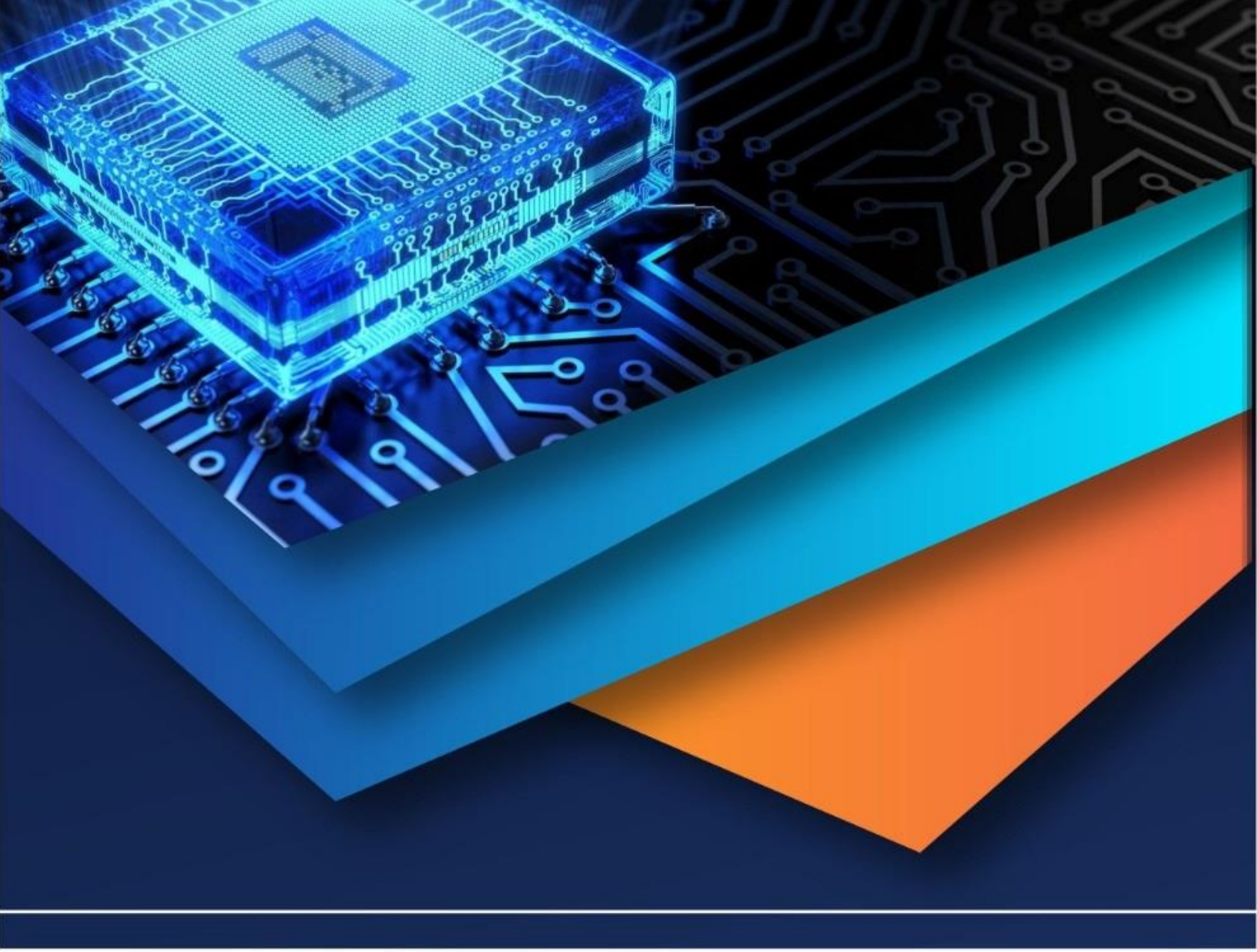

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