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An Execution, Scrutiny and Collation on VANETs Routing Protocols

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Abstract*— *VANETs are termed as Vehicular Ad-hoc Networks, which are considered as one of the recent advances coming under the minor group of Mobile Ad-hoc Networks (MANETS). VANETs form an extemporaneous formation of wireless networks for data exchange in the sphere of vehicles. Due to self-formulating and adaptive nature of VANETs, that causes a numerous challenges like mobility issues, connectivity problems, security and privacy, which emerge to degrade its performance. One of the main threats is the routing protocol. There are several VANETs routing protocols, this proposed paper stipulate an implementation, analysis and comparison based on AODV and OLSR routing protocols under a city environment. To simulate the VANET scenario, requires two types of simulators: mobility simulator and network simulator. Here VANET MobiSim for generating the mobility files and Ns3 for checking the performance of routing protocols on the mobility files created by VANET MobiSim. The performance of both protocols can be analyzed and finally compared with the help of three criterions: packet-delivery-ratio, end-to-end delay and throughput. This paper arrives at a conclusion as AODV protocol is more effective than OLSR in inter-urban city scenarios.

Index Terms*— *VANETs, V2V, MANETs, AODV, OLSR, VANET MobiSim, Ns3 Simulator.

I. INTRODUCTION

Vehicular communication is a rising area of communications between the vehicles and also including the roadside communication infrastructure. The main motivation for this type of communication is safety and eliminating problems occurred by traffic collisions. One of the most recently added approach in vehicular communication is VANETs in the field of Intelligent Transport System (ITS), which is to achieve safety and productivity through this Intelligent Transportation, also integrates communication between mobile and fixed nodes [1]. VANETs are simply expanded as Vehicular Ad-Hoc Networks under the subdivision of Mobile Ad-hoc Networks (MANETs). MANETs are considered as the self-formulating and scattered infrastructure of mobile devices connected without wires. VANETs concept creates under the domain of vehicles or considered as a VANET CLOUD [2]. VANETs provide both of the Vehicle- To-Vehicle and Vehicle-To-Infrastructure environment, where each of the nodes has to be considered as the servers and clients which can exchange information and also share it. i.e., it comprises a wireless network where automobiles send and receive messages to each other with information about what they are doing. This data includes speed, location, and direction of travel, braking [3]. Mobility, connection between the nodes, co-operative communication, network topologies are the some of the main features of VANETs. Fig.1 gives a blueprint of VANET communication system.

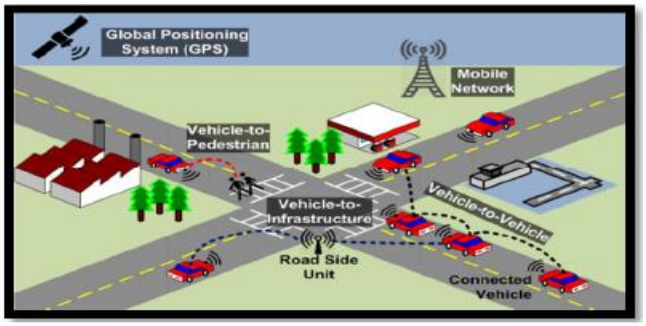

Fig.1: Blueprint of VANET Communication System

VANETs thus provide tremendous potential to improve vehicle and road safety, traffic efficiency, and convenience as well as comfort to both drivers and passengers. One of the main services is routing mechanisms. Due to the high mobility of nodes routing becomes more difficult [4]. A routing protocol governs the way that two communication entities exchange information; it includes the procedure in establishing a route, decision in forwarding, and action in maintaining the route or recovering from routing failure. The routing protocols depend on routing information, network structures and techniques and so on [5]. VANETs protocols reduce time consumption, overhead between the nodes, performance efficiency. There are several VANETs routing protocols, this proposed paper specifies an implementation, analysis and comparison based on AODV and OLSR routing protocols.

The essential objective of this paper is to assess AODV and OLSR VANET routing protocol in realistic city traffic environment. The simulation and performance can be analyzed with the help of two simulators such as VANET MobiSim for providing the mobility files and Ns3 which is a network simulator for evaluating the performance of the routing protocols. The completion can be criticizing with three aspects: packet-delivery ratio, end-to-end delay and throughput. The outlast section of this paper is catalogued as follows: In Section II, briefly explains some related works and overall background details of the AODV and OLSR routing protocols, while Section III, shortly depicts the criterion used in the simulation. In Section IV, presently the simulation and scenario setup, while Section V, discusses the execution, scrutiny and collation about these two protocols with the selected parameters.

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Finally, Section VI draws some concluding remarks and also gives an outline for some future works.

II. Related Works And Backgrounds

A. Related Work

Numerous researches have been declared by analyzing the performance of different VANETs routing protocols with distinct mobility models or patterns and performance criterions. One of the earliest extensive researches was done by Maninder Singh *et al.* [6]. This survey executes performance analyze between AODV, OLSR, GRP by using OPNET simulator and also specifies some basic metrics that were accepted for further studies in wireless networks. A paper by Aleksandr Huhtonen [2], forwards a brief idea about the AODV and OLSR ad-hoc routing protocols. One more study with same protocols under an urban environment by Christian Bonnet *et al.* [7], understood the distinct mobility scenarios and network behaviours and tested the performance of the routing protocols. Also a survey by Thakore Mitesh [8], describes the comparison between AODV and OLSR routing protocols with the help of the network simulation tools such as OPNET and NS-2. A paper by Twinkle Makwana et al. [9], gave an outline of the Ns3 network simulator for testing the performance of routing protocols on the mobility files.

According to the several developments began with different scenario-based testing, it is quiet accessible that distinct scenarios make to change the protocol performance. So we have focus more on sensible node-to-node or node-to-environment connections. This type of application became a serious factor in the VANETs atmosphere. The recent review have been formulates by Imran Khan et al. [10], forwards the performance evaluation of AODV and OLSR in highly fading vehicular ad-hoc network environments. They founded a particular network topology and the position of the distinct nodes. The implementation can be done in NS-2 platform. However, to the finest observation, no assessment or realizations have been organized in between the VANETs routing protocols: AODV and OLSR under intra urban structures by using the VANET MobiSim mobility simulator, the network performance and comparison can be found by arranging the setup of Ns3 simulator.

B. Background

A crucial task in VANETs environment is to find, maintains and use better routes for communication. VANETs routing protocol considered as a syntactic or typical mechanism, which controls, co-ordinates and communicates in between the vehicular networks about the topology, link states to find best routes [11]. In our network describes two routing protocols: AODV and OLSR. Each of these protocol used in this inter urban scenario. According to our literature work, the routing protocols can be splits up into two, on the support of the topological information. They are named as Reactive (On-Demand) and Proactive (Table-Driven) routing protocols[12].

Reactive routing protocols determine the best routes by initiating route finding process with the help of flooding methods; hence there is a chance to occur overhead. By discovering the targets, got idea about the routes and thus communication can be easily possible [3]. AODV routing protocol belongs to this category. Proactive are those protocols continuously alter information about the routing tables even if also no communication is going on, with the benefits of the routing tables routes between the nodes can be readily available. OLSR routing protocol comes under this class. Fig.2 furnishes the overall sense about this paper.

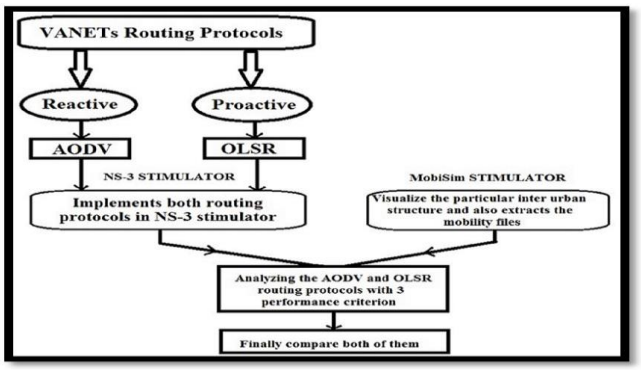

Fig.2: Flowchart about the plan

For the performance comparison, assessment can be done with AODV and OLSR routing protocols. In this section, shortly discuss about both protocols; for detailed information readers could also refer RFC [3561], RFC [3626] for AODV and OLSR routing protocols respectively.

1. Ad-hoc On-demand Distance Vector (AODV)

In AODV, it starts with a routing process and then data traffic information delivered from source node to destination. Thus the source announces a Route Request (RREQ) packet to neighbouring nodes, which doesn't know the information about active routes for the requested destination node [13]. Thus they forward the packets to their neighbour ones until an active route is fixed or maximal number of hops is achieved. When an intermediate node understands about the active route to the requested target, then it sends back a Route Reply (RREP) packet to the source node. Finally, source gets this reply thus establishes the route between source and target. Fig.3 displays an idea about AODV.

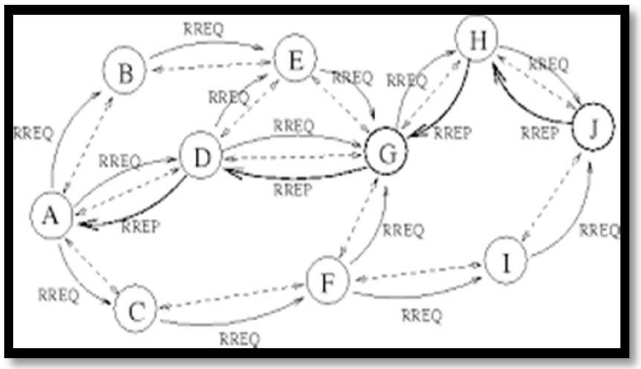

Fig: 3: Idea about an AODV protocol

2. Optimized Link State Routing (OLSR)

In OLSR, each node repeatedly organizes and retains the set of neighbours that can be attained in 1-hop and 2-hops. Related to this, an appropriate MPR algorithm reduces the number of active relays needed to cover all 2-hops neighbours. Such relays are termed as Multi-Point Relays (MPR) [11]. A node forwards a packet only if it has been selected as MPR by the sender node.

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In order to create and maintains its routing tables, this protocol repeatedly transmits link state details over MPR backbone [5]. Thus an active route is to be obtained at each node to reach any destinations in the network. Fig.4 specifies the outline of MPR in OLSR protocol.

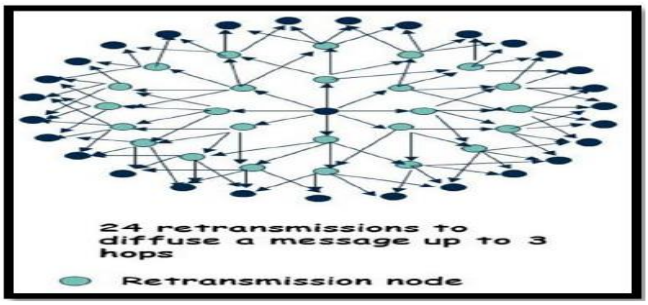

Fig.4: Outline of MPR in OLSR routing protocol

III. CRITERION FOR PERFORMANCE TESTING

There are different categories of metrics used for comparing the VANETs routing protocols. This work discusses mainly three criterions, defines as follows.

1. Packet Delivery Ratio (PDR)

It is defined as the ratio of the number of data packets that are successfully secured by the target to the entire data packets that are delivered by the origin or source at Constant Bit Rate (CBR).

PDR= Σ Number of Secured Data Packets
Σ Number of Delivered Data Packets

2. End-To-End Delay

It depicts overall delay, from the creation of packets from the source node until packets are achieved by the target node.

EED=Σ (Packet Arrival time-Packet delivered time)
Total number of connection pairs

3. Throughput

It is measured as the number of packets successfully transmitted to their end target point at unit time.

Throughput =Number of packets send
Time taken

IV. DESIGNING OF SIMULATORS AND SCENARIO

A. Scenario Features

The simulation work should attempts a network atmosphere as same as that of the real world one. As a result of this idea, a particular inter urban scenario has to be taken for assessing the simulation performance. In this scenario the acceleration of the vehicle node considered as a uniform speed of 20Km/hr. this environment is specified as a city area, which consists of several intersection points [9]. Each of the vehicle nodes has movement to the definite directions. Some nodes cause offence, then that nodes in the particular lane should get the message to change or move to other lane. Vehicular nodes communicate according to the emergency situations like node collisions, traffic problems and so on [7].Otherwise there is no need to improve the performance arguments. Here the process of effective routing mechanisms in between the nodes can be done in all directions whenever needed. Table 1 shows the summarized contents of the simulation parameters.

Table I. SimulationParameters

Parameter	Specification
Network Simulator	Ns3-3.21 Version
Mobility Simulator	VANET MobiSim
Routing Protocols	AODV, OLSR
Scenario	1, Inter Urban Scenario
Number Of Nodes	15
Simulation Area	4Km X 4Km
Total Time	300s
Node Speed	20Km/Hr
Propagation Model	ITU-R-1411
PHY/MAC Protocol	IEEE 802.11p
Transport Protocol	UDP
Channel Data Rate	2048bps

B. Mobility Simulator

VANET MobiSim is used as the mobility simulator in this work. This simulation is modelled for express the better way to construct, plan or serve the transformation systems. Fig.5 conveys the idea about intercity scenario used in the simulation.

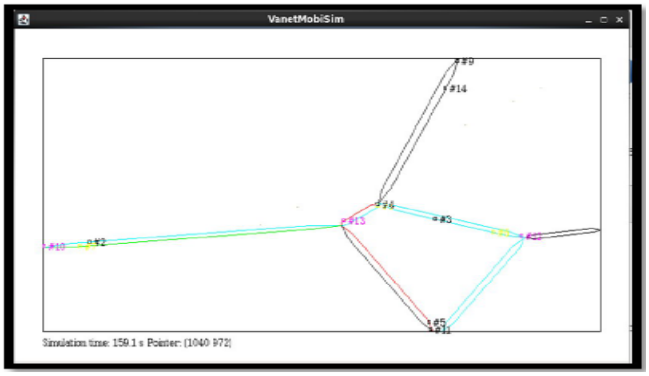

Fig.5: Inter-urban city Scenario

It is a wide source traffic simulation package which includes net import and demand modelling schemas. This helps to done many research works related to vehicular communications. VANET MobiSim forwards the framework of continuous and discrete movement of vehicle nodes, multi-lane streets with lane changing, managing the networks with a few edges, network wide density, and so on [10]. The colour line in the above figure represents different lanes of the road and each nodes act as the vehicles.

C. Network Simulator

Here Ns3-3.21 version treats as the network simulator. This is used to evaluate the network protocols related to the communication between the vehicles [12]. A broad range of network applications, protocols, and also help the users to analyze the complex structures of networks, by this type of simulators. Ns3 illustrates as a discrete network simulator and open source software which succeeds or extends from the Ns2 simulator [11]. The motivation of this simulator is to formulate a free simulation background for networking studies.Mobility.data, Flowmonitor, Gnuplot; these are the three core elements that are used for evaluating the performance.

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The Mobility.data is supports to extract the output file from VANET MobiSim. Flowmonitor is used to measure the QoS factors [3]. And finally, Gnuplot granted the idea to plot the graphs.

With the guidance of NetAnim aspect, helps to visualize the simulation of nodes. Fig.6 shows the simulation of AODV VANETs routing protocol and Fig.7 displays the simulation of OLSR VANETs routing protocol using NetAnim in Ns3. Simulation can be obtain while executing the code of both VANETs routing protocols.

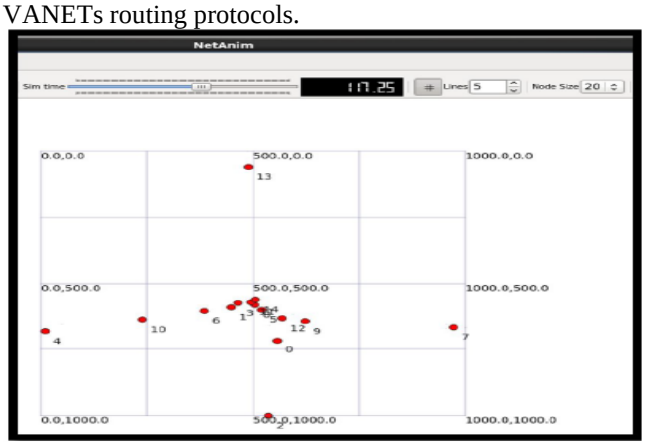

Fig.6: Simulation of AODV Routing Protocol

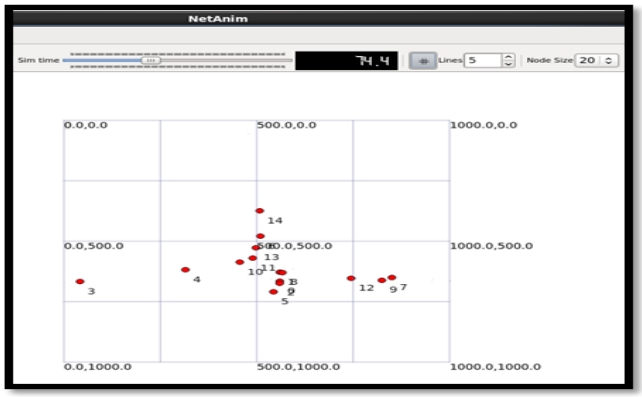

Fig.7: Simulation of OLSR Routing Protocol

V. SCRUTINY AND COLLATION RESULTS

A. Scrutiny Outcome

In this section, discusses and evaluate about the results of the simulation step of VANET routing protocols, begins with an analysis of packet delivery ratio, end-to-end delay and finally throughput in the particular inter urban network scenario.

1. Packet Delivery Ratio of AODV and OLSR

As confirming to the Fig: 8 and Fig: 9, which demonstrate the graphs plotted for AODV and OLSR, using the metric PDR with respect to timing factor. The PDR can be analyzed with 15 vehicle nodes in 300bits/sec. We can see that timing parameter depends on the value of PDR. Hence PDR values are severely affects the performance of both protocols.

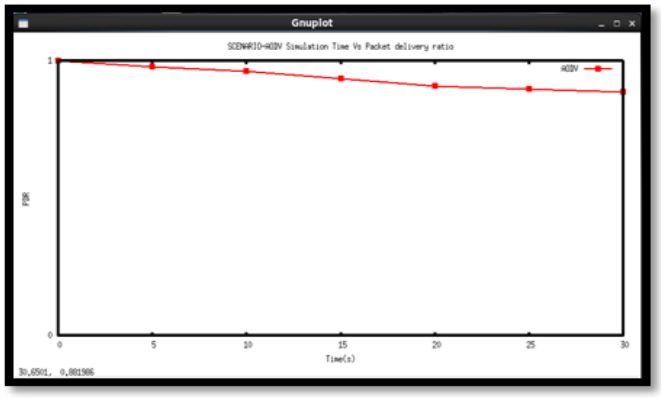

Fig.8: PDR of AODV Routing Protocol

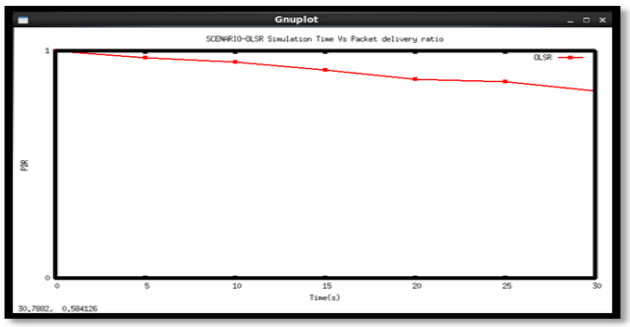

Fig.9: PDR of OLSR Routing Protocol

2. End-To-End Delay of AODV and OLSR

From the graphs Fig: 10 and Fig: 11, which draws the End-To-End Delay parameter with respect to the timing factor, to represent both AODV and OLSR routing protocols. Here also graph plotted with the help of the simulation criterions.

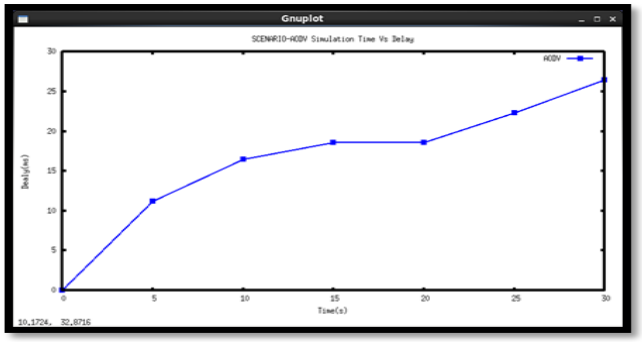

Fig.10: End-To-End Delay of AODV Routing Protocol

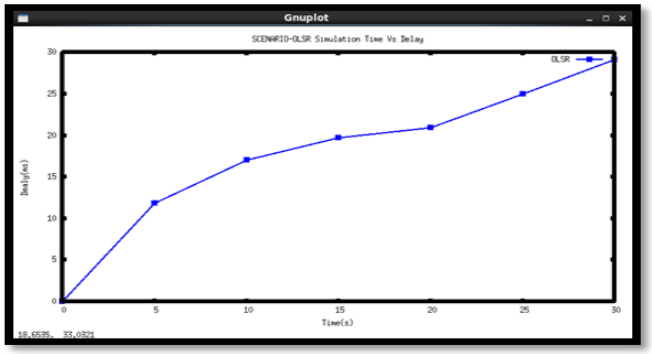

Fig.11: End-To-End Delay of OLSR Routing Protocol

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3. Throughput of AODV and OLSR

With the reference of final metric throughput, that also plot against the timing factor. Here Fig: 12 and Fig: 13 represent the throughput of AODV and OLSR routing protocols.

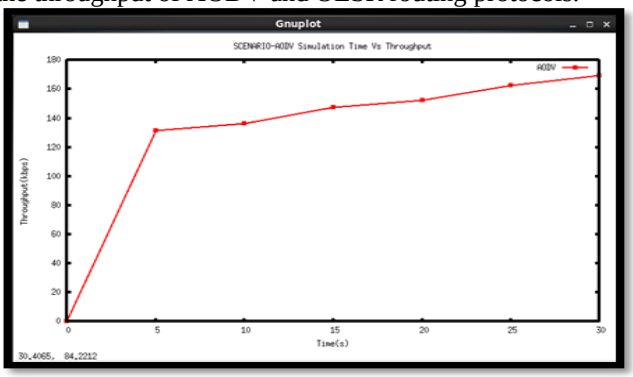

Fig.12: Throughput of AODV Routing Protocol

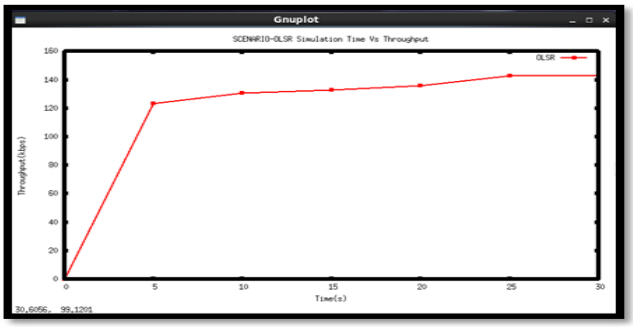

Fig.13: Throughput of AODV Routing Protocol

B. Collation Results

These results are obtained under the inter-urban scenario with constant speed of the vehicle nodes. From Fig: 14, Fig: 15 and Fig: 16 give the descriptive idea about the collation view of the performance metrics of AODV and OLSR routing protocols. The speed of the vehicle is 20Km/hr in uniform nature. The vehicles can move on all possible directions, with the designing AODV and OLSR routing approaches. In Fig: 14, we can observed that PDR ratio is high in AODV protocol compared to the OLSR, i.e. The data packets send from source vehicle node to receive by the destination vehicle node at right time with less variations.

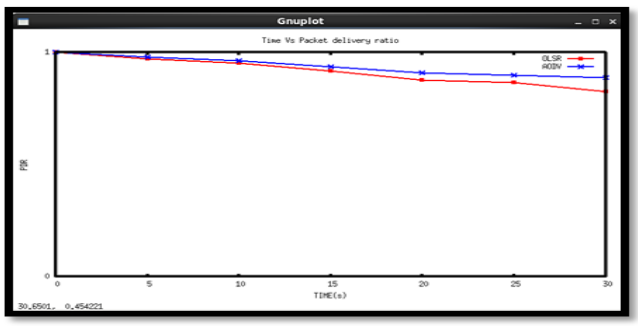

Fig.14: PDR vs. Time of AODV and OLSR

By analyzing Fig: 15, is sure that the end-to-end delay of AODV is minor as related to OLSR. With the explanation of a city scenario, OLSR routing protocol causes delay in delivery or receiving the data packets; sometimes crashes can be occur because city scenario is not considered as a complex one. AODV which has a delay of 15ms and that of OLSR has 23ms. The end-to-end delay doesn't change with increase in number of vehicle nodes, it only increase the number of intermediate nodes.

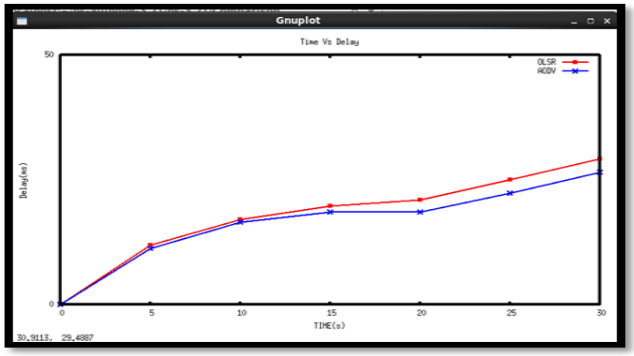

Fig.15: End-To-End Delay vs. Time of AODV and OLSR

Final criterion is throughput, which defines the ratio of packets send from the source vehicle to time taken. From Fig: 16 it is confirmed that the throughput of AODV is higher than that of OLSR routing protocol. At first, the throughputs of both protocols are steady increases, but later it causes slight variations. As a information from the below figure, states that throughput of AODV is 140bps and that of OLSR is 130bps. From this comparative result we can conclude that the AODV vehicular routing protocol is more suitable in inter-urban scenario or a smaller network. But OLSR is used in highway scenario with complex network topologies. Table II summarize the comparison of AODV and OLSR VANET routing protocols.

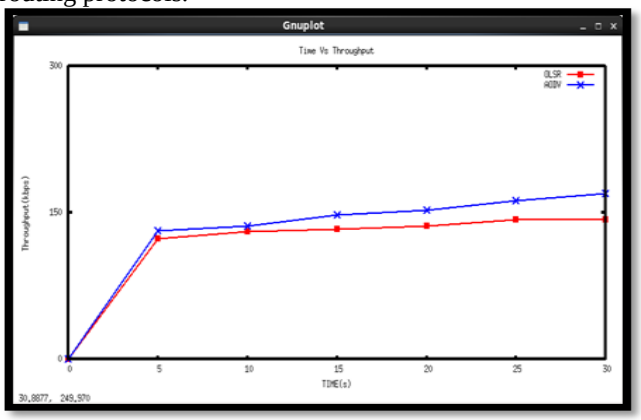

Fig.16: Throughput vs. Time of AODV and OLSR

TABLE II. Comparison of AODV and OLSR

Protocol	AODV	OLSR
PDR	High	Low
End-To-End Delay	Low	High
Throughput	High	Low
Type	Reactive	Proactive
Protocol Suite	Simple Networks	Complex Networks
Outcome	Suitable for networking area with less and moderate load with minimum speed mobility	Having least performance in routing under city scenario. Hence it is well suited for highway scenarios

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VI. CONCLUSION AND FUTURE WORKS

There are so many available standard routing protocols are beneficial and practicable in vehicular ad-hoc networks. But there is need to find the better one in appropriate situations. This paper intent to build a practical scenario simulation with the cooperation of a mobility simulator and the outcome of this simulator is then used in network simulator to check the performance collation of AODV and OLSR VANET routing protocols. This work is proposed to design a simple inter-urban city scenario. The main goal is to research the function of the two protocols and criticize their performance with the key criterions like packet delivery ratio, end-to-end delay and throughput. From our detailed comparative study, it is clear that AODV VANET routing protocol is feasible for simple networks like city scenarios and that of OLSR is more suited for highly traffic complex networks like highway atmospheres.

The upcoming or future work can done by evaluating different scenarios with distinct types of vehicles with the involvement of clustering routing protocols and also analyze their performance by newly set of metrics like routing overhead, topology change, traffic quantity, error rates, jitter and so on.

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