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Enhanced Approach to Reduce Routing Overhead on VANET

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Abstract — ***The next generation VANET systems are denser and it supposed to handle high traffic rate as well as frequent interrupt in connection. It should consume less power and utilize bandwidth efficiently. At the same time, the VANET nodes must be simple, cheap, smaller in size and efficient enough to handle traffic. In addition to this, nodes use flooding mechanism in which it unconditionally floods data packets in all the directions. Which is going to increase routing overhead this paper presents results for routing overhead with different load conditions.***

Keywords- VANET Architecture, AODV, Routing Overhead

I. INTRODUCTION

A Vehicular Ad-Hoc network is a form of Mobile ad-hoc Networks, to provide communication among nearby vehicles and between vehicles and nearby fixed equipment i.e. roadside equipment. The main goal of VANET is providing safety and comfort for passengers. Each vehicle equipped with VANET device will be a node in the Ad-hoc network and can receive & relay other messages through the wireless network. Collision warning, Road signal arms and in place traffic view will give the driver essential tool to decide the best path along the way. VANET or Intelligent Vehicular Ad-Hoc Networking provides an intelligent way of using vehicular Networking. With the sharp increase of vehicles on roads in the recent years, driving becomes more challenging and dangerous. Roads are saturated; safety distance and reasonable speeds are hardly respected. The leading car manufacturer decided to jointly work with govt. agencies to develop solution aimed at helping drivers on the roads by anticipating hazardous events or bad traffic areas.
VANETs comprise of radio-enabled vehicles which act as mobile nodes as well as routers for other nodes. In addition to the similarities to ad hoc networks, such as short radio Transmission range, self-organization and self management, and low bandwidth, VANETs can be distinguished from other kinds of ad hoc networks as follows:

1.1 Highly Dynamic Topology:

Due to high speed of movement between vehicles, the topology of VANETs is always changing. For example, assume that the wireless transmission range of each vehicle is 250 m, so that there is a link between two cars if the distance between them is less than 250 m. In the worst case, if two cars with the speed of 60 *mph* (25 *m/sec*) are driving in opposite directions, the link will last only for at most 10 sec.

1.2 Frequently Disconnected Network:

Due to the same reason, the connectivity of the VANETs could also be changed frequently. Especially when the vehicle density is low, it has higher probability that the network is disconnected. In some applications, such as ubiquitous Internet access, the problem needs to be solved. However, one possible solution is to pre-deploy several relay nodes or access points along the road to keep the connectivity.

1.3 Sufficient Energy and Storage

A common characteristic of nodes in VANETs is that nodes have ample energy and computing power (including both storage and processing), since nodes are cars instead of small handheld devices.

1.4 Geographical Type of Communication

Compared to other networks that use Unicast or multicast where the communication end points are defined by ID or group ID, the VANETs often have a new type of communication which addresses geographical areas where packets need to be forwarded (*e.g.*, in safety driving applications).

1.5 Various Communications Environments:

VANETs are usually operated in two typical communications environments. In highway traffic scenarios, the environment is relatively simple and straightforward (*e.g.*, constrained one-dimensional movement); while in city conditions it becomes much more complex. The streets in a city are often separated by buildings, trees and other obstacles.

1.6 Hard Delay Constraints:

In some VANETs applications, the network does not require high data rates but has hard delay constraints. For example, in an automatic highway system, when brake event happens, the message should be transferred and arrived in a certain time to avoid car crash. In this kind of applications, instead of average delay, the maximum delay will be crucial.

II. VANET ARCHITECTURE

VANET may use fixed cellular gateways and WLAN/WIMAX access points at traffic intersection to connect to the internet, gather traffic information or for routing purposes. This network architecture is called pure cellular or WLAN. *[Fig.1]*

VANET can comprise both cellular network and WLAN to form a network. Stationary or fixed gateways around the roadside also provide connectivity to vehicles. In such a scenario all vehicles and road side devices form pure mobile ad-hoc networks. *[Fig. 2]*

Harris corner detector is a well-known interest key point detector due to its invariance to rotation, illuminations variation and image noise which has been proposed in 1988 However, Harris corner are not scale-invariant and several extension to Harris corner has been developed in order to be scale-invariant It is based on local auto-correlation function of a signal where local auto-correlation function measures the local changes of the signal with patches shifted by a small amount in different directions .

III. CHARACTERISTICS

3.1 Highly dynamic topology

The topology formed by VANET is always changing as vehicles are moving at high speed .on highways, vehicles are not moving at constant speed.

3.2 Frequently Disconnected Networks

The highly dynamic topology results in frequently disconnected network since the link between two vehicles can quickly disappear while the two nodes are transmitting information. The problem is future worsened by varying node density where there are different frequency of nodes for different roads and highways. A robust routing protocol is hence needed to recognize the frequent disconnectivity.

3.3 Pattern Mobility

Vehicles follow a trail or certain mobility pattern which is a function of underlying roads, the traffic lights, the speed limits traffic conditions and driving behaviours of driver, because of particular mobility Pattern, evaluation of VANET routing protocols only makes sense from traces obtained from pattern

3.4 Unlimited battery power and storage

The nodes in VANET are not subject to power and storage limitations as in sensor networks, another class of ad hoc network where nodes are mostly static. Nodes are assumed to have ample energy and computing power and hence the optimizing duty cycle is not as relevant it is in sensor network.

IV. VANET CATEGORIES

Wireless ad hoc networks have the characteristic to be infrastructure-less and do not depend on fixed infrastructure for communication and dissemination of information. The architecture of VANET consists three categories: pure cellular/WLAN, pure ad hoc and hybrid

4.1 WLAN / Cellular

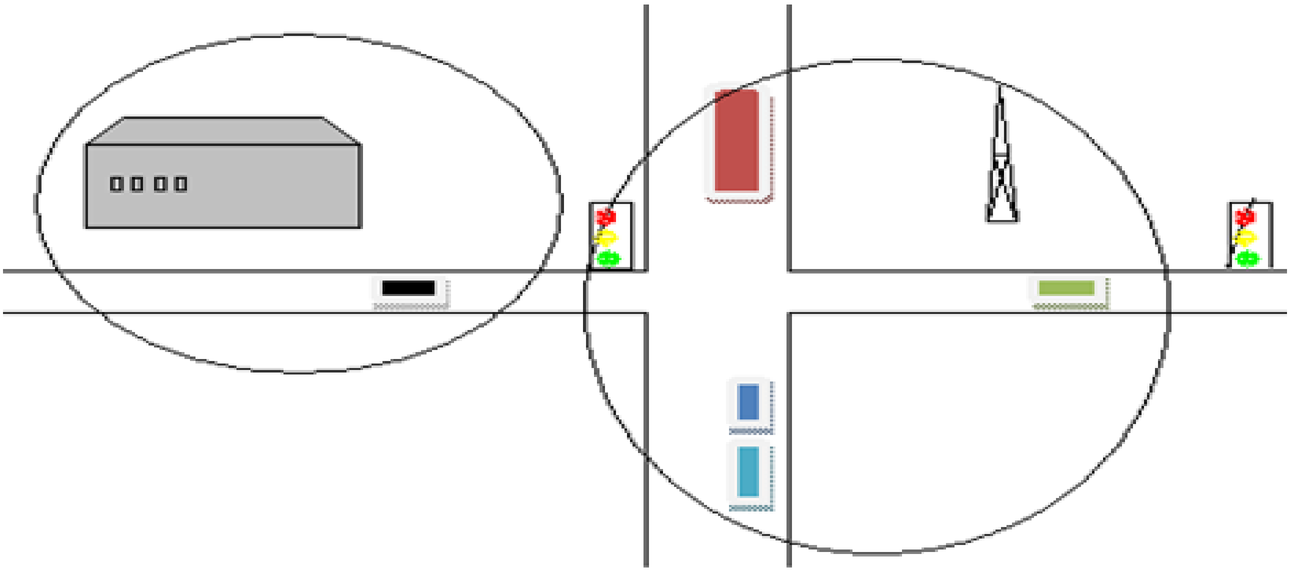

Fig.1: WLAN / Cellular [2]

4.2 Pure Ad-Hoc

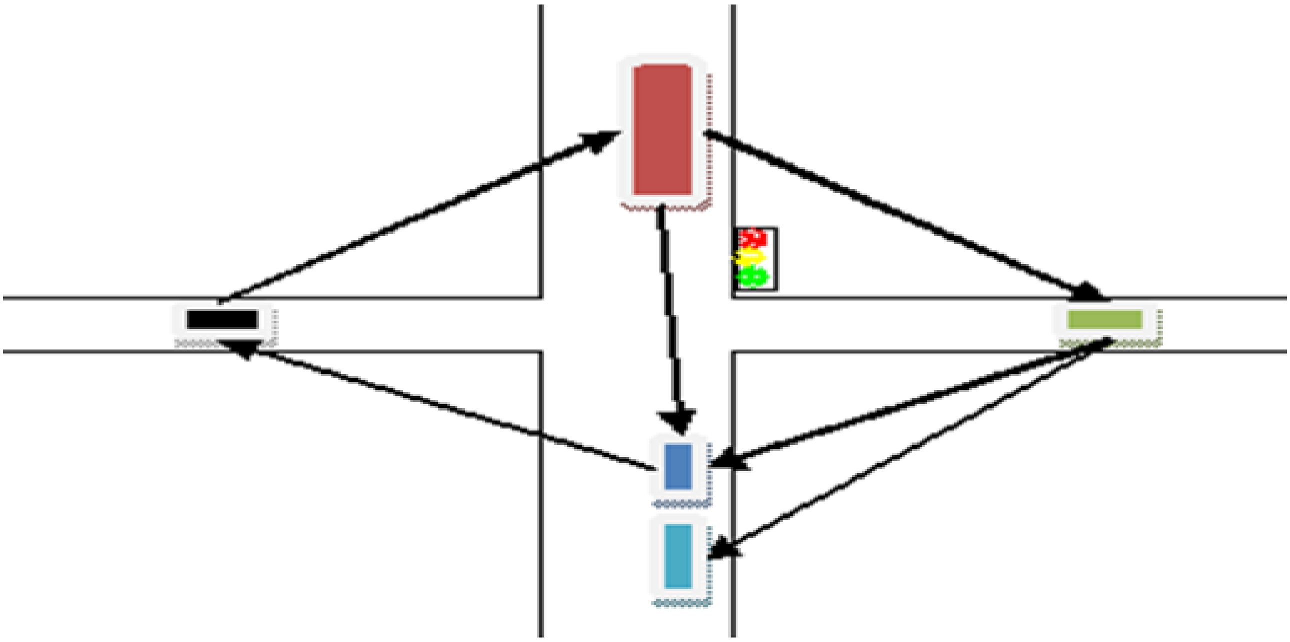

Fig. 2 : Pure Ad-Hoc[2]

4.3 Hybrid

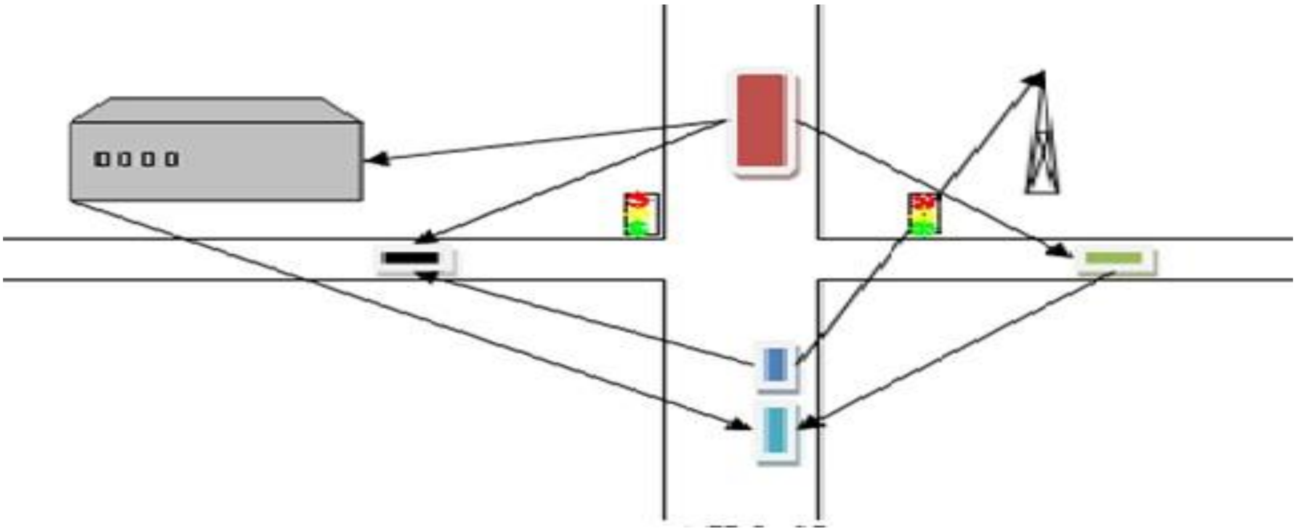

Fig. 3: Hybrid [2]

V. ROUTING PROTOCOLS

The routing protocol of VANETs fall into two major categories of topology-based and position-based routing. There are many advantages and disadvantages of these routing protocols. The detailed coverage of relevant routing protocols and their impact on overall VANET architecture is incomplete without knowledge of VANET applications

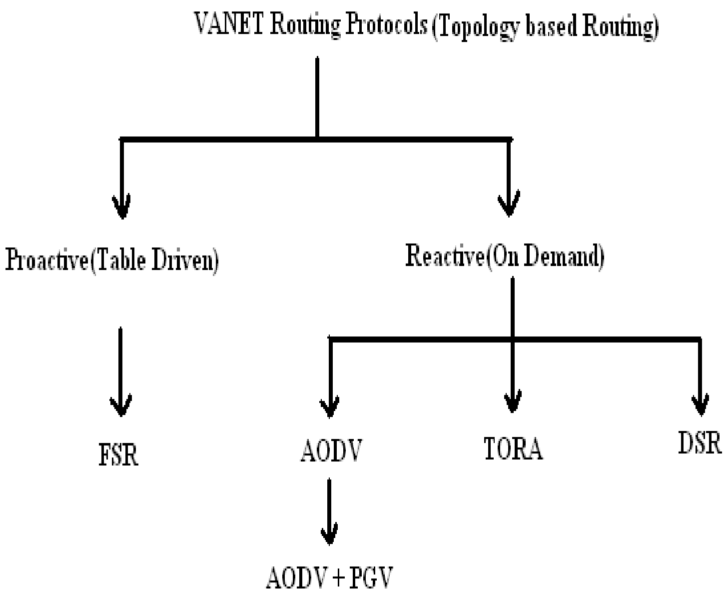

Fig. 4: Classification of VANET Routing Protocols [1]

5.1 Fisheye State Routing(FSR)

This is an efficient link state routing that maintains a topology map at each node and propagates link state update with only immediate neighbors not the entire network furthermore the link state information is broadcast in different frequencies for different entities depends on their hope distance to the current node. Entries that are closer are broadcasted with larger frequency. The routing gets corrected as packets approach progressively closer to the destination due to the reduction in broadcast overhead.

5.2 AODV (Ad Hoc On Demand Distance Vector **Routing)**

In this routing upon receipt of broadcast query (RREQ) nodes record the address of the node sending the query in their routing table or the previous hop and is called backward learning. Upon arriving at the destination, a reply packet (RREP) is then sent through the complete path obtained from backward learning to the source.et each step of the path the node records its previous hop and establishes the forward path from the source.

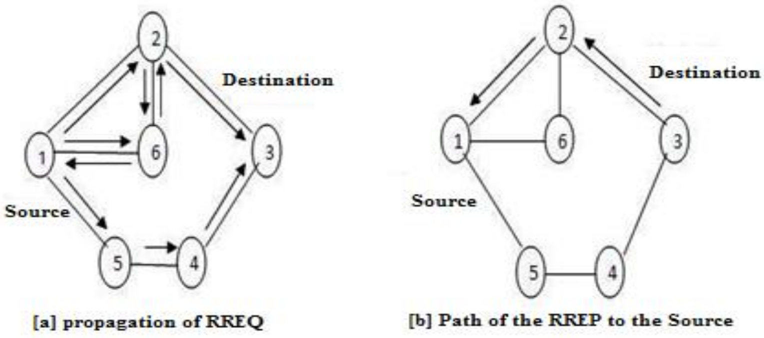

Figure 5: AODV [1]

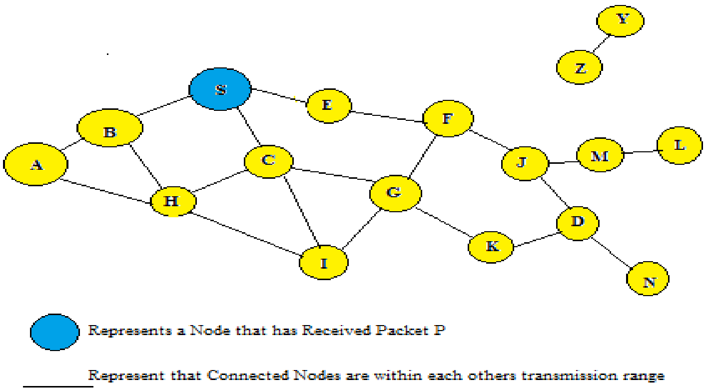

Figure 6: AODV Mechanism [2]

VI. SIMULATORS

6.1 SUMO (Simulation of Urban Mobility)

SUMO is an open source, highly portable, microscopic road traffic simulation package designed to handle large road networks. Its main features include collision free vehicle movement, different vehicle types, single vehicle routing, multi-lane streets with lane changing, junction-based right-of-way rules, hierarchy of junction types, an open GL Graphical User Interface(GUI), and dynamic routing. SUMO can manage large environments, i.e., 10,000 streets, and it can import many network formats such as Visum , VISSIM , or XML-Descriptions. Thus, by combining SUMO and open streetmap.org , we can simulate traffic in different locations of the globe. However, since SUMO is a pure traffic generator, its generated traces cannot be directly used by the available network simulators, which is a serious shortcoming.

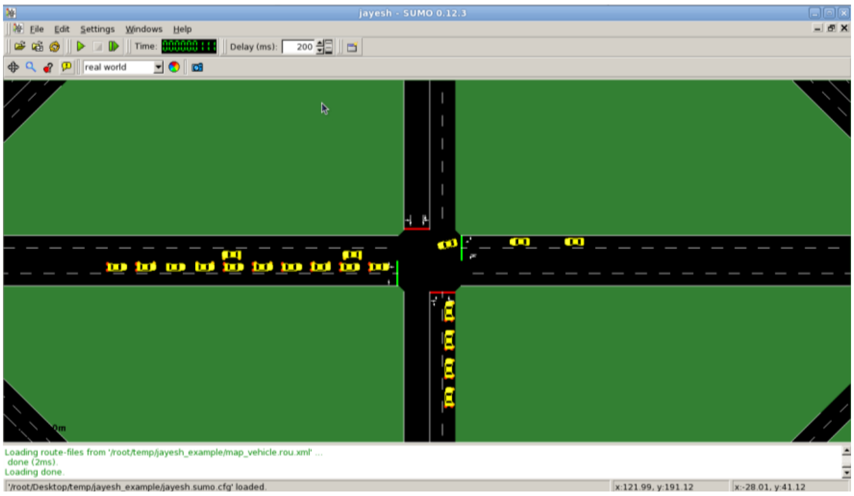

Fig. 7 SUMO Layout

6.2 NS-2

NS-2 is a discrete event simulator developed by the VINT project research group at the University of California at Berkeley. The simulator was extended by the Monarch research group at Carnegie Mellon University to include: (a) node mobility, (b) a realistic physical layer with a radio propagation model, (c) radio network interfaces, and (d) the IEEE 802.11 Medium Access Control (MAC) protocol using the Distributed Coordination Function(DCF).
However, the NS-2 distribution code had some significant shortcomings both in the overall architecture and the modeling details of the IEEE 802.11 MAC and PHY modules. The PHY is a full featured generic module capable of supporting any single channel frame based communications system. The key features include cumulative Signal to Interference plus Noise Ratio (SINR) computation, preamble and Physical Layer Convergence Procedure (PLCP) header processing and capture, and frame body capture. The MAC now accurately models the basic IEEE802.11Carrier sense multiple access with collision avoidance (CSMA/CA) mechanism, as required for credible simulation studies.

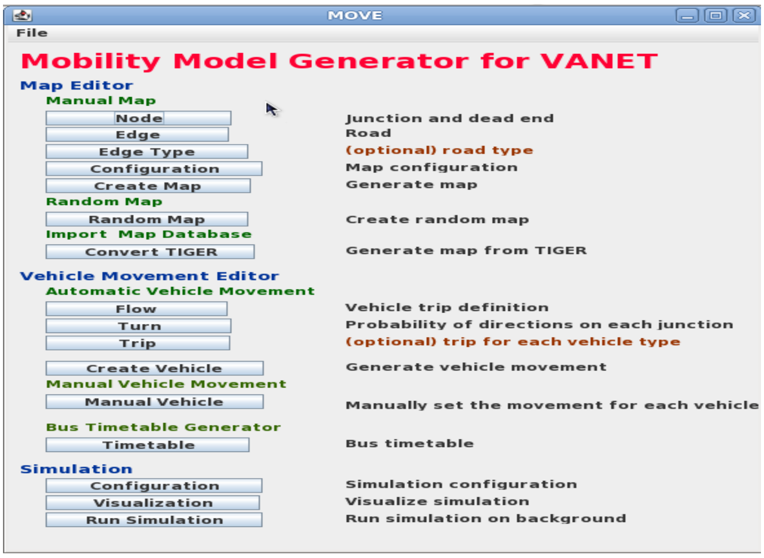

Fig. 8 MOVE Mobility Model Generator

VII. SIMULATION RESULTS

Table 1. Results

	NUMBER OF NODES			
	25	**50**	**75**	**100**

E2E DELAY	1062.65	1119.61	1373.16	1416.36
ROUTING OVERHEAD	6827	27031	92418	253477
THROUGHPUT	433.91	402.82	364.86	267.51

Table 1. Conclude that as number of nodes increases E2E delay is linearly increased, simultaneously Routing overhead is also increased with number of nodes, at the same time Throughput decreases as the number of nodes increases.

7.1 END TO END DELAY

End to End delay can be calculated by dividing the time difference between every TCP packets sent and received, to the total number of TCP packets received. For the better performance of the protocol end to end delay must be a slower as possible.
As we can see from the graph that as number of vehicle increase networks tries to generate more number of connection. To generate more number of connections route request and route reply mechanism of protocol is used. As vehicle move in other direction as well as lanes are different we are having end to end delay increased

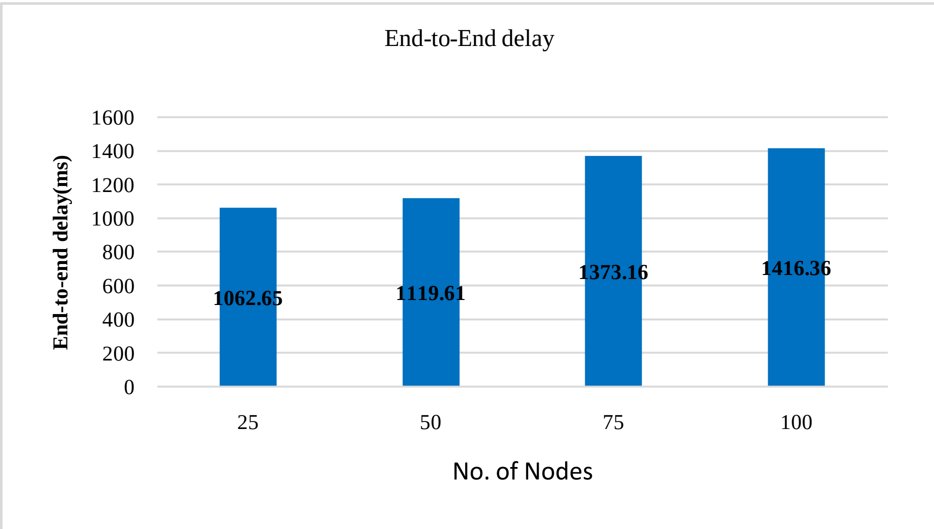

Fig 9. End-to-End Delay

7.2 ROUTING OVERHEAD

All the routing packets no matter broadcasting or unicasting per -hop should be count once. Routing overhead means the total number of routing packets, counted once per hop.

From graph 10. we can say as number of vehicle are increase in the network more number of routing packets will be flood as per basic functionality of protocol which works basis on route request and route reply packets. More number of vehicle will generate more number of traffic eventually more collision and many more routing packets. Routing overhead is harmful for network and we are going to reduce this impact which intern helps the network to become better.

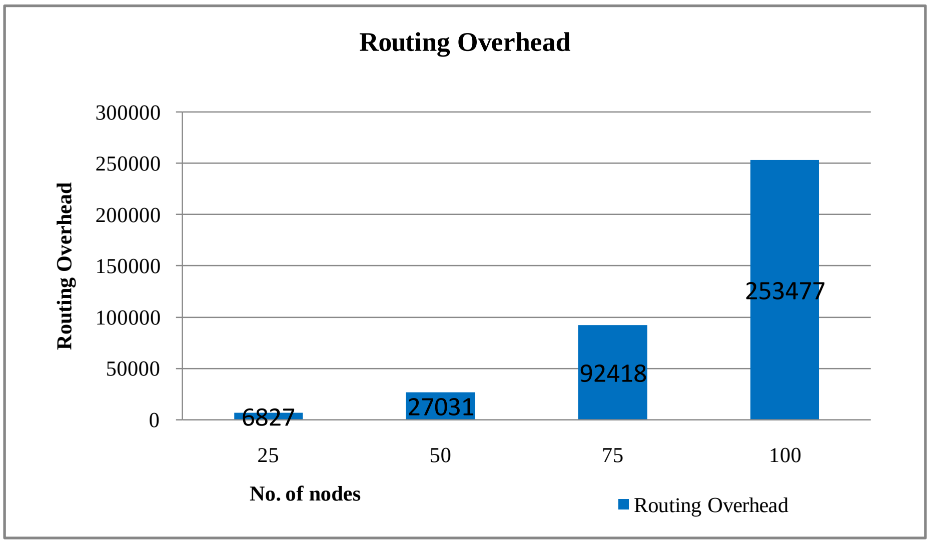

Fig. 10 Routing Overhead

7.3 THROUGHPUT

The ratio of the total amount of data that reaches a receiver from a sender to the time it takes for the receiver to get the last packet is referred to as throughput. It is expressed in bits per second or packets per second.

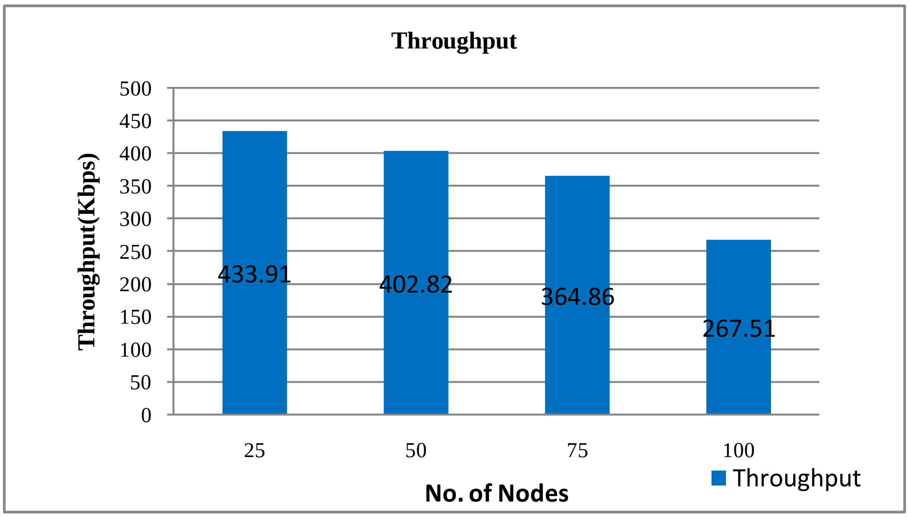

Fig. 11. Throughput

From graph 11. we can say that as number of vehicle increase in the network more connection will be built and congestion will increase which intern create more collision which reduce throughput of network.

VIII. CONCLUSION

We have done detail literature survey on vehicular ad hoc network, routing protocol used in ADHOC network, mobility model of ad hoc network and traffic characteristic of vehicular ad hoc network. We have found SUMO, MOVE and NS-2.34 appropriate to complete our objective.

We have done simulation of AODV protocol in NS-2.34. Our simulation results have been evaluated in terms of throughput, end to end delay, routing overhead. We have create mobility files from SUMO and traffic files from cbrgen utility of NS-2.34.Our simulation result suggest that as number of vehicle increase in network throughput of network decrease because link failure and congestion created by routing packets.

We would like to propose method through which we can decrease network overhead which has been created by routing packets. If we are able to detect unnecessary and redundant packets then we can drop them in intermediate path which intern help to other vehicles to reduce computation and forwarding and help network to become efficient.

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