Performance Enhancement of Routing Protocols for VANET With Variable Traffic Scenario

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Abstract: - Vehicular Ad-hoc Network (VANET) is a new network technology where the cars are used as mobile nodes to form a communication network. In VANET, routing protocols have a significant role in terms of the performance because they determine the way of sending and receiving packets between mobile nodes. In this paper, we examine and analyze the performance of Ad-hoc On-Demand (AODV), Ad-hoc On-demand Multipath Distance Vector (AOMDV) routing protocol using different speeds. The performance measurements; Packet Delivery Ratio, Residual Energy, Average End to End Delay and Average Throughput are examined with respect to 50 Speed and 100 Speed. The objective of this study is to find the best routing protocol over all circumstances. Based on our validated results, AOMDV performs the best among all evaluated protocols.

Keywords: AODV, AOMDV, VANET, Packet Delivery Ratio, Average End to End Delay, Throughput, Residual Energy, routing protocol, Network Simulator (NS2).

I. INTRODUCTION

The Vehicular Ad-hoc Network is a new network technology. VANETs support many applications that might assist drivers and achieve communications among the drivers successfully. Nowadays, there are two efficient types which are vehicle-to-vehicle communications or Inter-Vehicle Communications (IVC). VANETs allow vehicles to interact while they travel by using wireless devices that can make a dynamic network [2]. In VANETs, vehicles are represented as network nodes. Some vehicles are represented as senders and others are represented as receivers. Communications among vehicles are provided so that they transmit and receive information. Vehicles’ speed plays a key role in the connectivity range. So, usually VANETs in many implementations are signed up to one thousand meters. VANETs are used widely in many agencies. They are mainly used for the GPS navigation system along with toll tax and traffic messages, traffic management agencies, highway safety agencies, law enforcement agencies and emergency services [3].

ISSUES OF ROUTING IN VANETS:

Even though VANETs are capable of enabling many novel applications, the design of effective intervehicular communications remains as a challenge. The nodes in VANETs are themselves formed by vehicles with high mobility. Nodes in VANETs join and leave the network frequently, which results frequent path disruptions. The time varying vehicle density results in a rapid change in topology, which makes preserving a route a difficult task. This in turn, results in low throughput and high routing overhead. The well-known hidden terminal problem [4] affects the performance in VANETs causing low packet reception rate. Interference from the high-rise building induces problems such as routing loops and forwarding in wrong direction, which increases delay. The issue of temporary network fragmentation and the issue of broadcast storm [5] further complicate the design of routing protocols in VANETs. The routing protocols in VANETs should be capable of establishing the routes dynamically and maintaining the routes during the communication process.
They should be capable of discovering alternate routes quickly on-the-fly in the event of losing the path.

II. ROUTING PROTOCOLS IN VANET

Routing protocols - In [3], QoS routing protocols are classified chiefly by their: First one is uni-cast Routing Protocol, second one is multicast Routing Protocol. Different routing protocols try to solve the problem of routing in mobile ad hoc network in one way or the other. Unicast routing protocols and the multicast routing protocol are divided into proactive, reactive and hybrid routing protocol. gives a classification on routing protocol is based on uni-cast and multicast routing protocol. The Ad Hoc On-demand Distance Vector Routing (AODV) protocol [15] is a reactive unicast routing protocol for mobile ad hoc networks. As a reactive routing protocol, AODV only needs to maintain the routing information about the active paths. In AODV, routing information is maintained in routing tables at nodes. Every mobile node keeps a next-hop routing table, which contains the destinations to which it currently has a route. A routing table entry expires if it has not been used or reactivated for a pre-specified expiration time. Moreover, AODV adopts the destination sequence number technique used by DSDV in an on-demand way.

![Fig.1 VANET routing protocols classification](image)

3.1 Ad Hoc On Demand Distance Vector Routing- AODV

Ad Hoc On Demand Distance Vector Routing (AODV) an example of pure reactive routing protocol. AODV belongs to multihop type of reactive routing. AODV routing protocol works purely on demand basis when it is required by network, which is fulfilled by nodes within the network. Route discovery and route maintenance is also carried out on demand basis even if only two nodes need to communicate with each other. AODV cuts down the need of nodes in order to always remain active and to continuously update routing information at each node. In other words, AODV maintains and discovers routes only when there is a need of communication among different nodes. AODV uses an efficient method of routing that reduces network load by broadcasting route discovery mechanism and by dynamically updating routing information at each intermediate node. Change in topology and loop free routing is maintained by using most recent routing information lying among the intermediate node by utilizing Destination Sequence Numbers of DSDV.

3.2 Ad Hoc On Demand Multipath Distance Vector Routing- AOMDV

The AOMDV routing protocol is an extension of AODV. It is a reactive (on-demand) routing protocol as compared to proactive OLSR protocol. Thus the route is calculated only when needed not in advance as in OLSR protocol. Like AODV it also involves two methods: route discovery and
route maintenance. But it is multi-path routing protocol as compared to single path based AODV protocol. Therefore, it is suitable for highly dynamic ad-hoc networks like vehicular ad-hoc networks where network partitioning and route breakdown occur very frequently. For dealing with such network scenario AOMDV protocol determines multiple paths during the procedure of route discovery. As a result in case of link failure in the network there is no need to find the new route every time due to availability of other routes while the AODV protocol require an additional burden related with the route discovery procedure to be invoked every time to find the new route whenever route breaks causing a delay in data transfer. So AOMDV is said to be an improved form of AODV routing protocol.

Ad-hoc on-demand Multipath Distance Vector Routing (AOMDV) protocol is an extension of AODV protocol. AOMDV protocol defines multi-paths when it is used to search of the route discovery. Thus, it is unnecessary to find a new route every time when the link failure of the network happened. AOMDV protocol has two components; computation of multiple loop-free paths, and computation of disjoint paths. Therefore, the AOMDV protocol reduces the routing overhead and it allows only accepting alternate routes with lower hop counts [1].

III. IMPLEMENTATION

In this section, we analyze the performance of the two routing protocols; AODV and AOMDV for both 50 Speed and 100 speed. In this analysis, we consider the following measured parameters: Packet Delivery Ratio, Residual Energy, Average End to End Delay, and Average Throughput with respect to speed or different packet size.

A. Packet Delivery Ratio:

Comparative performance analysis of different routing protocol has been performed with increasing number of mobile nodes where all nodes are moving with a speed of 10 m/sec. The simulations results in Figure 2 and figure 3 shows. It is the ratio of actual packets delivered to total packets sent. Packet Delivery Fraction calculation Formula:

\[
\text{Packet Delivery Fraction} = \frac{\text{Total No. of Packet Receive}}{\text{Total No. Packet Send}}
\]

![Result of PDR in 50speed](image_url)

*Fig.2 Packet Delivery Ratio in 50Speed*
B. End to End delay
This is the average delay between the sending of the data packet by the source and its receipt at the corresponding receiver. This includes all the delays caused during route acquisition, buffering and processing at intermediate nodes.

Figure 3 Packet Delivery Ratio in 10 Speed

Figure 5 End to End Delay in 50 Speed

End to End Delay calculation Formula:

E2E Delay = Receiving Time – Sending Time

Figure 5 End to End Delay in 100 Speed
C. Residual Energy
It is the total amount of remaining energy by the nodes after the completion of Communication or simulation. If a node is having 100% energy initially and having 70% energy after the simulation than the energy consumption by that node is 30%. The unit of it will be in Joules. Residual Energy calculation Formula:

\[ \text{Residual Energy} = \text{Total Energy} - \text{Consume Energy} \]

![Figure 6 Residual Energy in 50 Speed]

![Figure 7 Residual Energy in 100 Speed]

D. Throughput
Throughput is the rate of successful message delivery over a communication channel. It is usually measured in kilobits (kilobit/s or kbps). Residual Energy calculation Formula:

\[ \text{Throughput} = \frac{\text{Total No. of Successfully Received Packet}}{\text{Total Simulation Time}} \]
IV. CONCLUSION

In this paper, we examined and analyzed the performance of AODV and AOMDV routing protocols. We considered the 50 Speed and 100 Speed as the controlled parameters in our experiments to determine the best routing protocol. In our simulation, two protocols for the measured parameter; Packet Delivery Ratio, Average End to End Delay, Throughput, Residual Energy, AOMDV and AODV. Design of efficient routing protocols for VANET is one of the major challenges to be addressed in order to leverage the benefits of the VANET technology to day-today life. Performance of routing protocol for VANETs depends drastically on the mobility of nodes, vehicular density and several external factors such as driving environment. It also depends on the use of appropriate mobility model and propagation model. The protocol should perform well in both dense and sparse traffic conditions either in city or highways seamlessly. A universal routing solution for all VANETs application scenarios may not be viable; we need to design specific routing protocol and mobility model to fulfill the specific QoS requirements of each application.

REFERENCES


