

Routing Protocol with Quality Optimization for Vehicular Ad Hoc Networks

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ABSTRACT: Vehicular Ad Hoc Networks(VANET) technology is immensely used in communication between vehicles to vehicles(V2V) and vehicles to Road Side Units(V2R) due to its wide usage in safety and non-safety applications. VANET technology is implemented in high mobility vehicles in urban vehicular areas for increasing safety and security. There are different types of routing protocols that are available for faster communication but most of them only tend to work when the traffic of vehicles is low to moderate. Due to high mobility of vehicles the main concern in networks is of quality. Whether the routing protocol can achieve maximum throughput of network and reduce the end-to-end(E2E) packet delay in transmission or not is a challenging issue. In order to overcome such issue, the proposed protocol uses two quality metrics which are implemented in high density vehicular ad hoc networks in urban areas. These two metrics, network throughput and end-to-end time delay ratios are optimized and the packet is delivered safely.

KEYWORDS: V2V, V2R, E2E, network throughput, high mobility

I. INTRODUCTION

Implementation of Vehicular Ad Hoc networks(VANETs) in traffic maintenance have improved immensely due to its wide range of message passing in an easy way. In VANETs vehicles are considered as nodes and communication is done similar to mobile communication in MANETs. VANET technology is implemented in a set of vehicles of having communicating capabilities that are moving on the road. There are two types of communication in VANETs. They are vehicle to vehicle communication(V2V) where both vehicles exchange messages. Other type is of vehicle to infrastructure, where infrastructure can be considered as Road Side Unit(RSU) [1] which exchange message with the moving vehicle and vice-versa. There will be high mobility as the vehicles in VANETs move with high velocity and the time they spend in particular network is very low. In urban areas, there are many challenging issues such as the mobility of vehicles will be high in day time rather than night, in such cases the traffic maintenance and counting number of vehicles on road segments will vary and is very complicated. Another issue may be due to road connection, buildings and pathways which will be complex to select routing path. The high density and high velocity of vehicles makes the routing protocol loses its quality most of the time. The network throughput may decrease and the end-to-end packet receiving will be delayed. To examine and to increase the quality of routing protocol of proposed work. Quality optimized routing mechanism is implemented and executed in urban areas with high vehicular density.

II. RELATED WORK

Many routing protocols are designed to implement VANETs in more easy and secure way. One of the most important one is greedy parameter stateless routing for wireless networks (GPSR) [2]. GPSR makes use of greedy forwarding decisions for wireless datagram networks which takes into account of router positions and destination of packets. It enables perimeter routing to overcome local maximum problem. GPSR does not accurately work in urban areas with high mobility.

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GSR [3] uses dijkstras algorithm to combine street maps and computes the shortest paths between source and destination, which are represented as sequence of intersections. Another similar type routing protocol is A-STAR [4] which is also uses street maps. In this protocol bus routes are taken to identify junctions which have high connectivity and then from that point packets are forwarded.

When there is low traffic is there then MDDV [5] is used which have geographical area knowledge and all the details regarding traffic. The traffic is taken as static and packet forwarding is done. GYTAR [6] is a routing protocol which have traffic density information and by using this weights that are assigned to road segments. Packets are forwarded to road segments which have high weights and are near to destination.

IGRP [7] routing protocol will have different location servers which stores topology of network and generates routes with high connectivity of network. This routing protocol have quality of service constraints such as packet delay, number of hops and other things.

iCAR [8] makes decisions based on average message passing delay for better routing paths. It does not take paths with dense vehicular topology and high volumes of data packets are carried forward on low density network paths. In [9] an approach is made to make routes which will be stable for longer periods of time by taking cross-layering. Distance between two vehicles are taken and link residual time is calculated which represents for how much time the link between the vehicles can be stable. Link residual time can also be combined with other quality metrics such as end-to-end delay and packet loss ratio. SCRIP [10] is a routing protocol which selects the routing paths which have less end-to-end delay. It is used in urban vehicular networks with low to medium traffic.

III. PROPOSED WORK

Quality of Service(QoS) is one of most challenging issues in VANETs. In this proposed system two QoS metrics are taken into consideration. They are network throughput and average time delay for packet transmission. The proposed system is based on the selection of hop from opposite side of source vehicle because ongoing vehicles might have huge gaps between them. When there is gap then vehicle to vehicle links may not remain for longer periods of time causing link breakage which results in packet delay. The two QoS metrics used in proposed work are explained as below.

A. Motivational Scenario

The routing mechanism is developed by taking the scenario as depicted in below figure. In fig. 1(a) [11] there are two lanes, lane W and lane E that are opposite in transit. The vehicles V_1 and V_3 are moving in west side and vehicle V_2 is moving in east side. Let us take the source transmitting vehicle as V_2 and C_1 , C_2 , C_3 are its transmission ranges for hop selection. Vehicle to vehicle communication(V2V) cannot occur in lane E as there are no neighbor vehicles.

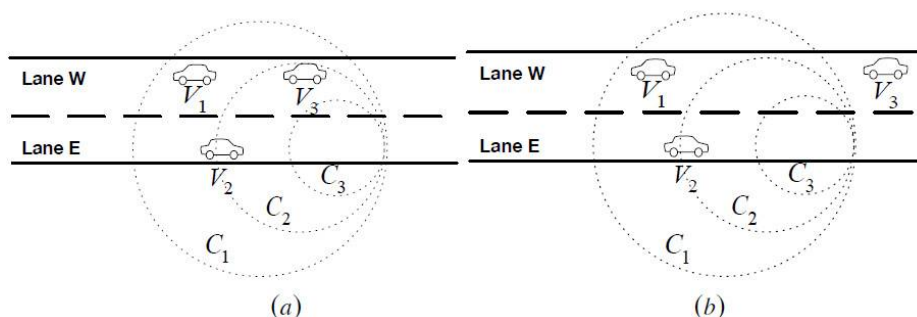


Fig. 1(a) Transmission ranges (C_1 , C_2 , C_3) of source vehicle(V_2). 1(b) Time delay and throughput trade off

So selection of hop from opposite lane is taken. In fig. 1(b) The vehicle on lane E is ready to transmit the packet on to lane W and it has two receiver vehicles V_1 and V_3 . Here transmission range plays an important role. If vehicle V_2 selects vehicle V_1 as receiver then the link time will be very short as it moves out of the transmission range quickly. So,

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vehicle V_2 selects the vehicle V_3 which lasts longer. The receiver which can be best in delay time and network throughput is selected. Based on the observations the proposed work is implemented in phases as below.

Phase 1: Initially the vehicle V_2 checks the density of vehicles present in its smaller range (C_1). Based on that it decides the radius of remaining transmission ranges, C_2 and C_3 in this case.

Phase 2: The vehicle V_2 sends a Request-to-Broadcast (RTB) message to all the vehicles within its range.

Phase 3: In this phase, each vehicle in vehicle V_2 range receives the message that is transmitted by V_2 . They check the message and see whether they are eligible to forward the packet to destination or not. If they are eligible they send back message saying they are Clear-to-Broadcast (CTB), if not, they discard the packet they received.

Phase 4: As soon as V_2 receives a reply CTB message then it transmits the packet along with destination id and location.

Different applications in VANETs have different quality requirements. Some may require minimum network throughput while delay is more and vice versa. So, an optimized mechanism is proposed here by taking an average of packet transmission delay time and network throughput. This proposed work is experimented in NS2 simulator and the result is taken on end-to-end transmit delay and network throughput.

IV. PERFORMANCE RESULTS

The proposed mechanism is executed in network simulator 2(NS2). The following fig. 2 represents the transmission of packets from source to neighbor vehicles. After they receive the message they check whether they are eligible or not and then they send CTB message if yes and discard if no.

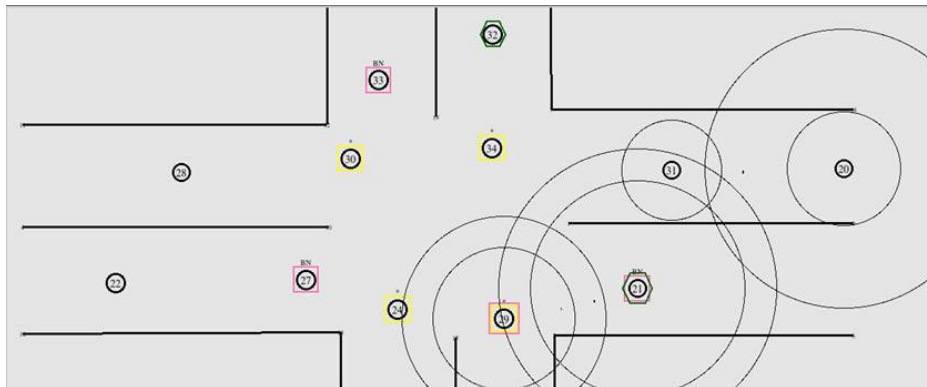


Fig. 2 Transmission ranges of different vehicles that receive message from source

In the above figure 2, each and every vehicle receives the message so that the best one that can provide QoS metrics can be found. This mechanism will improve safety of packet delivery.

To check the maximum throughput of network the simulation is done and the packet delivery ratio is noted. Experimental results show that the proposed mechanism maximize the network throughput and increases the packet delivery ratio as the time increases.

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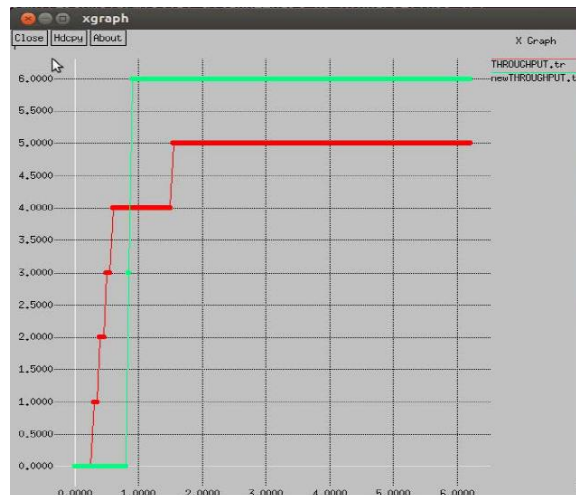


Fig. 3 network throughput

As experimented the results are shown in fig. 3 showing the network throughput increase while transferring the data packets. As time increases the data packets transmission also considerably increases.



Fig. 4 E2E delay graph

E2E delay is most important factor for any routing protocol as it determines the quality of network route. Here in fig. 4 E2E delay graph is represented where the proposed work is compared with GPSR and the proposed work reduces the E2E delay and outperforms the existing one. In the proposed mechanism, the delay time for packet delivery is reduced.

V. CONCLUSION

In the proposed mechanism QoS metrics, network throughput and end-to-end delay is taken into consideration and implemented in the network path selection for packet transfer. Experimental results show that the proposed work is better than previous quality controlled routing protocols. By using quality metrics maximum utilization of network is done along with low delay in packet transmission. This simulation is done on network paths with high vehicular density in urban areas where quality is a prior object. Faster communication with more quality is represented in proposed mechanism.

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