International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Impact Factor (2012): 3.358

Analysis of Road Vehicle Density Based VANET Routing Protocol in City Environments using QualNet

Amita Jaiswal[1], Arun Kumar Shukla[2]

[1] Teaching Associate, Department of Computer Science & I.T., SSET, Shepherd School of Engineering & Technology, Allahabad, U.P, India

[2]Assistant Professor, Department of Computer Science & I.T., SSET, Shepherd School of Engineering & Technology, Allahabad, U.P, India

Abstract: ***During the last few years, continuous progresses in wireless communications have opened new research fields in computer networking, aimed at extending data networks connectivity to environments where wired solutions are impracticable. Among these, vehicular traffic is attracting a growing attention from both academia and industry, due to the amount and importance of the related applications, ranging from road safety to traffic control, up to mobile entertainment. Vehicular Ad-hoc Networks (VANETs) are self-organized networks built up from moving vehicles, and are part of the broader class of Mobile Ad-hoc Networks (MANETs). Because of their peculiar characteristics, Vanets require the definition of specific networking techniques, whose feasibility and performance are usually tested by means of simulation. In this paper, we have evaluated the road vehicle density based Vanet routing protocol in city environment where each vehicle computes the vehicle density of the road to which it belongs by using beacon messages and the road information table. Based on the real-time road vehicle density information, each vehicle establishes a reliable route for packet delivery. Finally, the performance of this routing mechanism is evaluated through QualNet 5.0 and it is observed that this routing mechanism performs well in terms of packet delivery and throughput.***

Keywords: Vanet, Routing Protocol, ITS, Vehicle Density, City Environment

1. Introduction

Absence of road traffic safety takes a toll of precious human lives and poses a dire threat to our environment as well as also increases environmental pollution and energy waste. Recent advancement in wireless technologies and the significant rate of loss due to road accidents necessitate the evolution of an intelligent transportation system. The report of National Highway Traffic Safety Administration (NHTSA) shows that 6.3 million police reported traffic road accidents, which caused 43,000 fatalities and more than 1.2 million injuries every year in the 25 European Union States. [2]

With a view to increasing safety and improving the present road condition VANET comes into play in recent times. Introduction of VANET will significantly reduce the traffic congestion and vehicle accidents, which is the current issue throughout the world. VANET has emerged as one of the central focus of interest for research for the last decades. Vehicular ad hoc network is a special type of wireless ad hoc network, which has the property of high node mobility and fast topology changes.

Vanet is the core of Intelligent transportation system (ITS). ITS refers to the effort of adding information and communications technology to vehicles and transport system, in order to reduce the fuel consumption, vehicle wear out, transportation time and improve the safety, performance and efficiency.

Figure 1: Communication of vehicle in Vanet

Previous studies show that many of the existing VANET routing protocols are based on geographical routing protocols for MANET.

VANET routing protocols such as CAR and A-STAR is based on GPSR, but have not considered the road vehicle density. Therefore, they perform very poorly when there are roads with low vehicle density. [3]

The selection of routing methodology totally depends on the nature of the communication network. Furthermore, researchers state that since VANET requires critical safety related information to be quickly and reliably delivered to its users, it is important to design a VANET routing protocol to satisfy the requirement.

Further in Section2, we discuss the previous work done on Vanet routing protocols. In Section 3, we will discuss about the estimation models for the evaluation of how to measure the road traffic density information in real time using Qualnet 5.0. The simulation results and the performance analysis are presented in Section 4.Finally, the conclusions are summarized in Section 5.

Previous studies show that many of the existing VANET routing protocols are based on geographical routing protocols for MANET.

VANET routing protocols such as CAR and A-STAR is based on GPSR, but have not considered the road vehicle density. Therefore, they perform very poorly when there are roads with low vehicle density. [3]

The selection of routing methodology totally depends on the nature of the communication network. Furthermore, researchers state that since VANET requires critical safety related information to be quickly and reliably delivered to its users, it is important to design a VANET routing protocol to satisfy the requirement.

Further in Section2, we discuss the previous work done on Vanet routing protocols. In Section 3, we will discuss about the estimation models for the evaluation of how to measure the road traffic density information in real time using Qualnet 5.0. The simulation results and the performance analysis are presented in Section 4.Finally, the conclusions are summarized in Section 5.

PrabhakarRanjan*et al.* discussed the comparative study of VANET and MANET routing protocols. They compared AODV, DSR and ZRP routing protocols in MANET and the performance metrics is based on average jitter, end-to-end delay, throughputs and hop-count.

Vegni and Little (2010) and **Berlin and Anand (2012)** propose hierarchical architectures, in which vehicles communicate information to road-side infrastructure units, which in turn communicate information to other infrastructure units.

Da Li *et al*. proposed a distance based broadcast protocol called Efficient Directional Broadcast (EDB) which is composed of two parts viz. directional broadcast on the road and directional broadcast at the intersection. At the intersection, a directional repeater is installed which is used to forward the message to vehicles on the different road segments incident to the intersection of different directions. It has many advantages including long transmission range, space reuse, low redundancy and collisions.

Alvin Sebastian *et al.* developed a protocol which uses a context-aware strategy that identifies the endangered vehicles and is able to deliver the warning messages efficiently in various road traffic scenarios.

Hyun Yu et al (2013) proposed a stable routing protocol for vehicles in urban environment which is based on the real-time road vehicle density information in order to provide fast and reliable message delivery so that it can adapt to the dynamic vehicular urban environment. In the proposed mechanism, each vehicle computes the real-time traffic density of the road to which it belongs from the beacon messages sent by vehicles on the opposite lane and its road information table.

After focusing on the above research works, we have evaluated an approach which helps each vehicle to compute the vehicle density of the road to which it belongs by using beacon messages and the road information table. Based on the real-time road vehicle density information, each vehicle establishes a reliable route for packet delivery in the city environment. All this work has been shown with the help of QualNet 5.0 simulator tool.

2. VANET Routing in the City Environment

In this section, we describe the VANET routing protocol which is applicable in the city environment having high vehicle density. Since this routing protocol uses the real-time road density information as a routing metric, it is essential to acquire the up-to-date road traffic density information. It is assumed that all vehicles are equipped with GPS but are not provided with preloaded global traffic information.

obtained via centralized servers. Indeed, there are a plethora of services that provide real-time traffic information on the web. These services are based on traffic estimations by use of traffic cameras or even Wi-Fi devices. However, these services only provide a coarse-grained estimate of the traffic density. For example, the services that use traffic cameras can provide the traffic information on the roads that have the traffic cameras installed.

Furthermore, the real traffic measurements show that the vehicle distribution on roads follows the exponential distribution, and this may significantly impact the performance of routing in vehicular networks. Therefore, we propose a simple but effective method to acquire the real-time traffic density [5]

The road traffic density should account for all vehicles currently residing on every lane of the road. A naive approach to accomplish this is for each vehicle to simply transmit beacons to its neighbours, but the vehicle may not be aware of the vehicles outside of the broadcast transmission range even if it is on the same road. We use a smarter method to overcome this; each vehicle periodically transmits beacons that contain its direction of movement and the total number of reverse cars (TRC) in addition to its own identifier and position. By using this TRC information, each vehicle estimates the number of vehicles in the forward direction that is, moving in the same direction as itself, as well as the reverse direction, that is, moving in the opposite direction. The beacon message format is given in Figure 2.

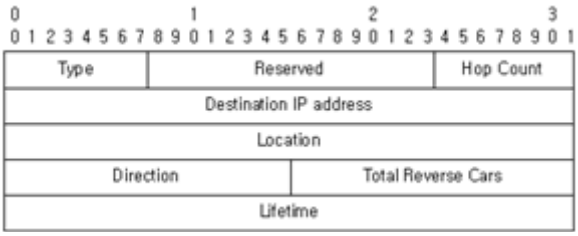

Figure2: The beacon message format

The beacon message has the location, the direction, and the TRC fields. The location field is the current geographical position of the vehicle acquired by the GPS, and the direction field is the movement direction in terms of the azimuth angle (0 to 359 degrees) of the vehicle. The TRC field is the number of the vehicles moving on the opposite-direction lane of the same road. Each vehicle also maintains the road information (RI) to store the road vehicle density computed from the information in beacons. This is later used in the proposed routing scheme as a routing metric. The RI is created when the vehicle enters the road and is updated upon receiving a beacon from a vehicle moving in the opposite direction.

3. Performance Evaluation Using Qualnet as a Simulation Tool

The simulation is emulation of reality using mathematical model. A simulation model allows examining system behaviour under different scenarios in virtual computational world. It can be used to identify bottleneck in a progress, provide a safe and relatively very cheap solution to evaluate the side effects and to optimize the performance of the system before transferring them to real world.

A network simulation tool is a piece of software that predicts the behaviour of communication network. It is a software program that imitates the working of computer networks. Network simulation tools serve a variety of needs. Network simulators are relatively fast and cost effective as compare to the cost and time involved in setting up an entire test bed containing multiple networked computers, routers and data links. They allow researchers to create and test the scenarios that might be particularly difficult or expensive to emulate using real hardware. Network simulation tool are particularly useful in allowing researches to test new routing protocols for networking or change to existing protocols in a controlled and reproducible environment. There are many types of network simulator like NS2, MOVE, SUMO, OPNET, OMNET++, NetSim,QualNetetc are being used by the researchers these days. We have used QualNet 5.0 network simulation tool for our evaluation.

4. Results

For the estimation of vehicle to roadside (V2R) communication over VANET, a framework named as QualNet Virtual Internetworking (QVI) was made which considers the architecture of city environment over vehicular network where vehicle density is high, as was discussed in chapter three. Now, following the second phase of framework, execution of the scenario takes place to get the result of different metrics. After executing the scenarios, the network information was recorded and the values and statistics were collected according to the GPSR and RVDVR routing protocols and the third phase of framework includes comparison analysis of the scenario.

The result shows that the RVDVR protocol achieves higher packet delivery ratio than GPSR in all cases because RVDVR forwards packets to stable routes by considering the road vehicle density. The following graphs show the comparison of RVDVR with GPSR protocols in the city environment with high vehicle density for vehicle to roadside communication. The following graph shows the comparison of the Road Vehicle Density Based Vanet Protocol with GPSR, a geographical based routing protocol for MANET environment with vehicle to roadside communication for Total Packets sent

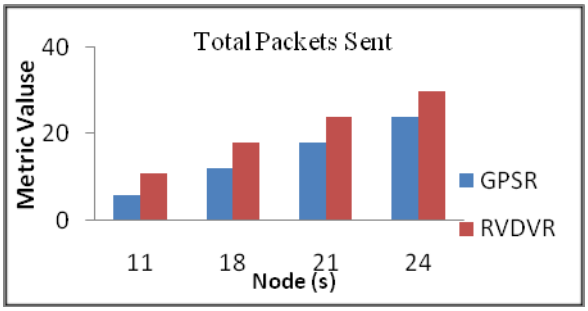

Figure 3: Comparison of GPSR and RVDVR in city

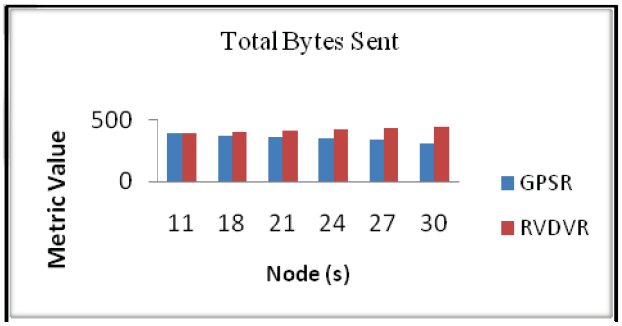

Figure 4: Comparison of GPSR and RVDVR in city environment with vehicle to roadside communication for Total Bytes sent

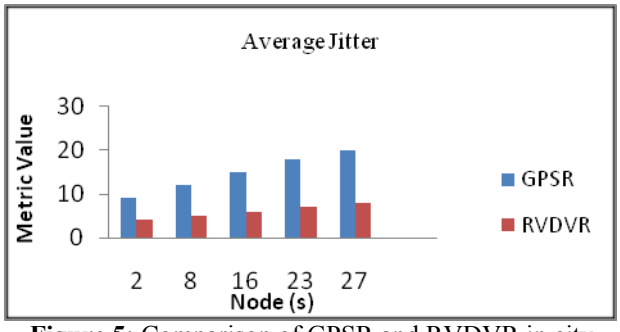

Figure 5: Comparison of GPSR and RVDVR in city environment with vehicle to roadside communication for Average Jitter

By comparing Road Vehicle Density Based Vanet Routing Protocol (RVDVR) with GPSR, it is clear that RVDVR performs well in Vanet architecture, where the vehicle density is high as compared to highway environment, in terms of packets and bytes sent by the CBR client and and

CBR server. Even this protocol has low average jitter or latency rate as compared to GPSR.

5. Conclusion

The VANET which is an essential technology in the ITS has some disadvantages such as short time for link connection and high packet loss ratio. Therefore, routing protocols that provide stable routes are required. In order to evaluate the performance of the RVDVR routing mechanism, it is being compared with GPSR through QualNet 5.0 based simulations and showed that RVDVR outperforms GPSR in terms of delivery success rate and routing overhead.

With QualNet there are various advantages over other simulation platforms like easy-to-use and clear user interface, support for distributed computing, sophisticated animation capabilities, extensive possibilities for analysing scenario, shipped with a lot helpful documentation and tons of example scenarios.

Finally, it has been realised that on the basis of VANET architecture and environment, protocols should be more powerful to deal with problems related to traffic etc.

From a networking point of view, in terms of vehicles and speed distribution, queuing dynamics and presence and size of clusters may heavily affect the connectivity of VANET architecture and consequently, the performance of ad-hoc network protocols. It is a part of future work to investigate the actual impact of these traffic generating conditions on a vehicular network, so as to understand which factors must be considered and which can be neglected for a confident VANETs simulation study.

References

[1] Bohm A., Jonsson M., "Position-based data traffic prioritization in safety-critical, real-time vehicle-to-infrastructure communication," Proc. IEEE ICC Workshops 2009, pp. 1-6, 2009.
[2] C. Lochert, H. Hartenstein, J.Tian, H. Fussler, D. Hermann, and M. Mauve, "A Routing Strategy for Vehicular Ad Hoc Networks in City Environments", Proc. IEEE Intelligent Vehicles Symposium, 2003.
[3] Chih-Hsun Chou, Kuo-FengSsu, "Geographic Forwarding With Dead- End Reduction in Mobile Ad Hoc Networks" IEEE Transactions on Vehicular Technology, vol.57, 2008.
[4] QualNet Network Simulator. http://www.scalable-networks.com/.
[5] Hyun Yu, JoonYoo (2013) “A VANET Routing based on the Real- time Road Vehicle Density in the City Environment”, ICUFN 2013.