Penerbit Akademia Baru

Journal of Advanced Review on Scientific Research
ISSN (online): 2289-7887 | Vol. 13, No.1. Pages 9-18, 2015

Survey on Running Environment of VANET Comparison with Routing Protocols

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Abstract – *Vehicular Ad hoc Network (VANET) is a promising technology, which provides the comfort applications and enjoyable drive on the road. To provide safety and accountable network Quality of Service (QoS) parameters, it is essential to design routing protocols in which support VANET environment. Mobile adhoc Network (MANET) offered effective protocols and some of MANET protocols has been used for VANET. On the other hand, due to a special kind of simulation stationary is not suitable to take in use the same protocols of MANET for VANET. In this problem, it is needed to survey on running environment of VANET and compare the routing protocols. This paper is twofold, first, it describes the running environment of VANET which consists of environment such as, component, network pattern, and applications, techniques such as, Broadcast, Geocast and Unicast, and routing protocols such as, routing strategy and forwarding strategy. Second, it describes the routing protocols which have been proposed for VANET. The primary contribution of this survey on new routing protocols and provide the comparison of the routing protocols. The limitation of each routing protocol for VANET is provided which can be implied to researchers to mitigate the challenges of VANET routing protocols. Furthermore the discussion of open area is present in this paper.*

Keywords: VANET, Routing Protocols, Broadcast, Geocast, Unicast

1.0 INTRODUCTION

Vehicular ad hoc network [23,32] has regulated the communication between vehicles, the networks without centralized infrastructure control are known as Ad hoc networks. Ad hoc Networks contain the group of wireless networks which based on multi hop radio transmitting. VANET have similarities with Mobile Ad Hoc Networks (MANETs) [29]. VANET become more advanced ad hoc network which deals with Intelligent Transportation System (ITS) based on wireless communication between vehicles to vehicles (V2V) Vehicle to Infrastructure (V2I) and vehicle to all (V2X) where Road Side Unit (RSUs) regulate the communication between V2V, V2I and V2X [16,21] based on IEEE 802.11p standard.

The main idea behind this communication is to provide real safety and security to all vehicles which contained safety and non-safety applications, the safety applications based on standard eight applications [35] which was introduced by the United States Department of Transportation (US-DoT), on the other hand non-safety applications were introduced to provide entertainment such as, multimedia applications, buy and sell applications related vehicular transportation which are administered by third party brokers [34]. This future generation increase in vehicle transportation and due to its accidents also increase, which is considered as harmful for human life. Based on these issues to reduce danger situations on

the road, the United States introduced Dedicated Short Range Communication [25], which enables wireless communication between vehicles with the help of On-Board Unit (OBU) [19] and RSUDSRC is basically IEEE 802.11a modified for low overhead task to 802.11p; which is under IEEE1609 of standards stating to Wireless Access in Vehicular Environments (WAVE).

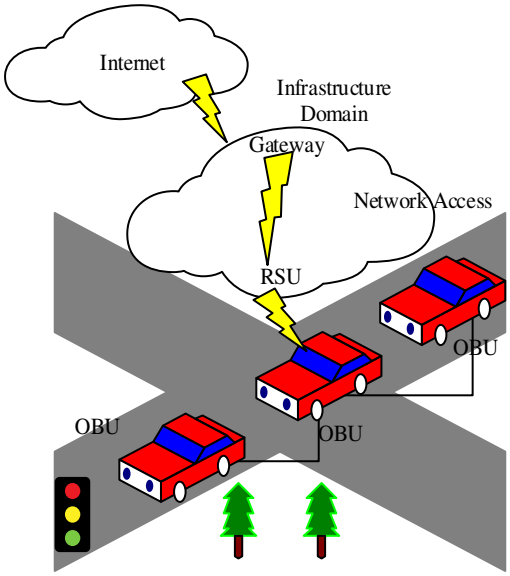

Figure 1: VANET Communication Environment describing V2V, OBU and RSU

The future generation communication between V2V, V2I, and V2X enables the investigation behind unexpected events such as collision, congestion, road condition, vehicle condition based on intelligent sensor devices which are embedded with each vehicle. This type of communication allows each vehicle to share useful information, alerts, parking lot availability, etc. based on sharing information and US-DoT applications can safe from accidents as well as provide comfortable drive on the road [5]. RSU enables the use of the Internet as well as connect through another server, which enables vehicles for communication purpose [11]. The detailed overview of vehicle's communication is shown in Figure 1, which describes the communication patter among vehicles. Work in this paper is organized as follows. We present the classification of running environment of VANET in section 2, section 3 discussed problems of routing in VANET, section 4 present the comparison of routing protocols which is present in Table 1. Finally, present the conclusion in the last section.

2.0 CLASSIFICATION OF RUNNING ENVIRONMENT OF VANET

The current routing protocols of Mobile Adhoc Network (MANETs) are considered in the environment of VANETs on the other hand, these protocols might not openly enables due to the different simulation stationary of VANETs in different simulators such as OMNeT++, Ns2/3 etc. The performance of vehicular network routing protocols dependable on an unlimited level on many internal and external influences. The protocols must perform well in

city and highway scenario as well as intelligent factors are needed to control the congestion and provide accurate information regarding any event.

A classification, which described the key qualities for instance, VANET environment which consists component, network pattern, and applications. The techniques discussed about Broadcast, Geocast, and Unicast. Finally, routing protocols consist of routing strategy and forwarding strategy in a vehicular environment shown in Fig. 2.

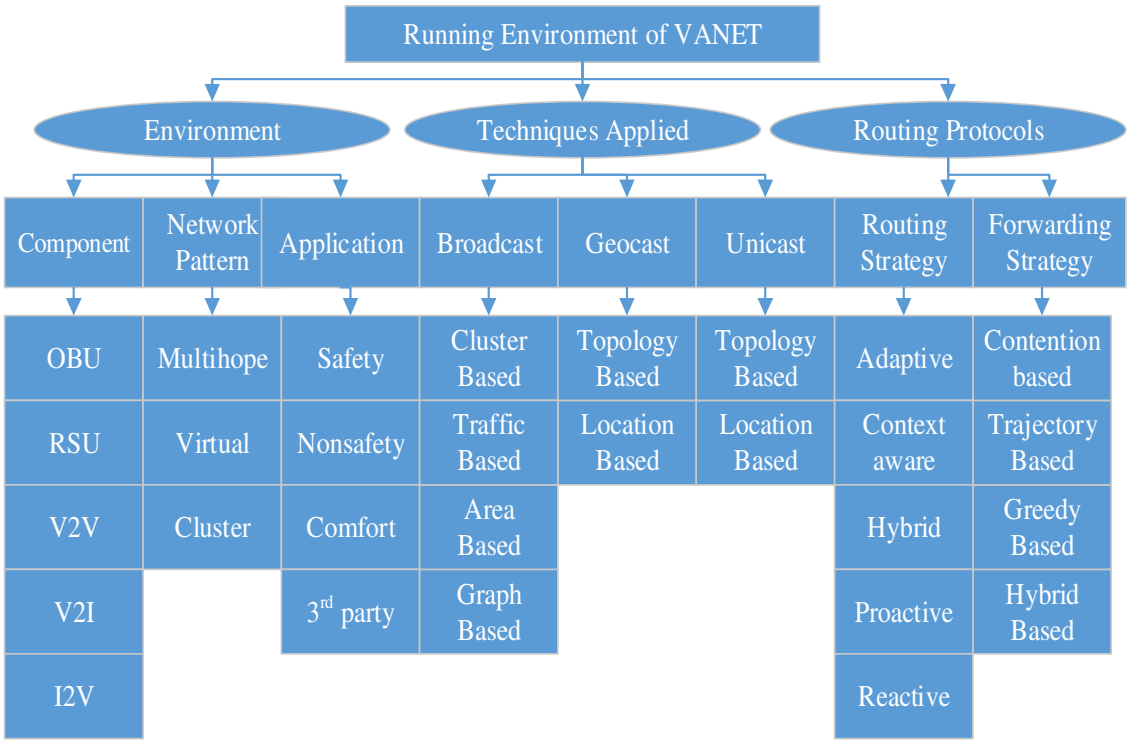

Figure 2: Classification of Running Environment of VANET

The design for VANETs can be either of clean cellular/WLAN or clean ad hoc or hybrid designs. Vehicular communication can stream in a multihop manner, in this pattern the packet exchange among multiple following vehicles in the network to the required destination [14]. On the other hand, in virtual backbone designs few of the vehicles choose form a backbone, in this pattern, it stored the information regarding the destination of the dynamically altering vehicles [4]. In general, routing protocols are categorized such as Unicast, Broadcast, Multicast, and Geocast furthermore the detailed study of present routing protocols can get in [13,18,28,36].

3.0 PROBLEMS OF ROUTING IN VANETS

Due to enabling plenty of non-safety applications of VANET, the deployment as well as implementation of significant inter- vehicular communications triggers plenty of issues. Vehicles in VANETs are flexible to leave and join at any time and it's frequently process in its communication with high mobility resultant regular path disturbances.

The time consuming vehicle density overall sum-up in a prompt variation in topology, which creates to maintaining a route a difficult task. One the other hand, due to decrease in throughput as well as, high routing overhead. It is studied that hidden terminal issue [2] disturbs the performance in VANETs triggering low packet reception rate. Due to Interfering by the city area such as big buildings brings problems, for instance, routing loops and sending in incorrect direction, which rises delay to destination. Short term connectivity of the network division and the problem of the transmission stream [37]. On the other hand it is too complicated the strategy of routing protocols in VANETs.

The vehicles are leaving and joining network undefined time the routing protocols in VANETs must be accomplished by creating the routes dynamically as well as upholding the routes at the time of communication. It must be proficient of discovering alternative routes without time consuming in the occurrence of losing the path. Most of safety application based on quick transmission warning messages and demanding to get message from source to destination with no delay. It is implied that it must be improved in routing algorithms which must recognize peak paths to avoid delay in routing protocols as well as routes within a network needed to avoid congestion.

Thus, annoying challenge is to implement routing protocols to solve above mentioned problems as well as to enable the communication with no delay and with no overhead. Hence it is important for an ideal network should not transmit data with in delay and organize the network with reliable routing algorithms which must provide accurate communication without the overhead.

4.0 COMPARISON OF ROUTING PROTOCOLS

Alrajeh, et al. [3] a secure routing protocol was proposed which is based on a crosslayer approach and energy-harvesting appliance with spread cluster-based security contrivance. In this technique QoS parameters are replaced among cross layers to certify effective usage of the energy. It is observed that this technique performed well in many other scenarios as well as mitigate the aggressive security attacks when the network in a prone environment. However, the packet acknowledgement could not be used in case high routing overheads and still suffer high packet loss.

Barekatain, et al. [6] GREENIE was proposed, which considered the essential for engaging an effective routing protocol to reflect the effects of participant's mobility is unavoidable. It was designed and calculated an effective hybrid routing protocol for packet distribution which proficiently routes data over on the participant's mobility. Hence it is observed that influence of GREENIE on the observed video quality furthermore, it significantly overtakes other routing protocols the main reason behind it that effectively received total number of packets, and other QoS parameters.

Bernsen, & D. Manivannan [7] designed an effective routing protocol for vehicular environment, namely Reliable intervehicular Routing (RIVER). RIVER employs an undirected graph which signifies the neighboring roads, outline, in this technique vertices of the graph points at which road curve or cross, and the graph ends signify the road sections among the vertices.

Unterschütz, S., et al. [33] was familiarized CometOS, which is defined as component-based, extensible, tiny operating system for ad hoc network environment. It presents the simulation

by use an OMNeT++ simulator it enables a different platform running of protocols on OMNeT++ and reserve limited platforms. The simulation of this work contained 93 nodes, and evaluate the QoS parameters.

Paul, B., et al. [27] a research carried out which identified the advantages and disadvantages that can be utilized in order to develop and improve new routing protocols. Therefore, this research has presented pros and cons Inter vehicle communication VANET routing protocols. A priority routing protocol was proposed in [31] for vehicular network, based on message types. This technique emphasis primarily on a safety warning application which considered to provide the non-danger distributed manner for drivers, it computes the QoS parameters along with the overall MAC delay, overall message reception, collision, overall message distribution distance.

Hui, L., eta al. [15] proposed an algorithm based on node density, residual energy, and location information on the whole network cluster head election and the auxiliary cluster head election in the cluster. Compared with the classic LEACH protocol, based on simulation, it is observed that this technique improved in the protocol, the cluster head is more evenly distributed, more reasonable number of cluster heads, reducing the energy consumption of the node and extend the lifetime of the whole network.

Luo,et al. [19] studied a scheme in which each node is offered to maintain more than one route to assigned or required destination. Therefore, upon common route failure, the sender is able to use the alternative route, based on this technique the QoS parameters can be enhanced. In [20] designed a table-less position based routing technique which suitable for low power data centric wireless sensor networks. This technique is distributed, using the greedy forwarding scheme, and undependable on nearby information. Therefore, it observed that accurate delivery, long life of the network. [10] has been examined the routing protocol problem which consists of twofold significant situations for VANET Manhattan and the Freeway. This protocol known as Two-level Trajectory Based Routing (TTBR). Thus, this technique is needed Peer Servers and Grid subdivision of the space. This protocol presents the simulation and examined the results which discussed the enhancements and scalability presented by TTBR in evaluation with other adhoc network's protocols namely; AODV and GPSR. Based on simulation this technique examined the Overhead and Packet Delivery Ratio.

Abedi, et al. [1] implemented a new modified version of AODV as MANET routing protocol to make it applicable in VANET network. In this implementation it was used the direction as the key parameter to choose the next hop during a route discovery stage. On the other hand, the position was the second used parameter in the next hop selection. Chen, et al. [9] HarpiaGrid proposed which is a reliable grid-based routing protocol for vehicular environment. It applied in vehicle navigators to develop geographically logical routing paths, efficiently exchange the route discovery network overhead with irrelevant calculation time. Furthermore, its taking benefit of the information providing by gridded geographic data, broadcasts is prepared more effective. On the other hand, in the route maintenance, a fault-tolerance process is considered to mitigate dead paths.

Jing, F., et al. [17] proposed the adversarial impact of route choosing policy for the mobile network environment. The absence of universal viewpoint might increase congestion and overall resultant in harm of the local traffic. This routing protocol consists of controls the route selection policy in the reflection of the dynamic network situation. It is observed from

simulation of this work is offering good packet delivery ratio and low overhead ratio by examined with other protocols.

Table 1: Comparison of Routing Protocols

Protocol	Tools	Performance Evaluation		Strengths	Limitation
		Energy	Delay		
(Luo,et al. 2010) [19]	NS-2		√	All source node keeps an alternate route to the destination In presence of broken route so alternative route used to broadcast packets	This process needed huge cache to keep alternative routes
(Hui, L., eta al., 2010) [15]	OMNeT++	√		Cluster head is more evenly distributed, more reasonable number of cluster heads, reducing the energy consumption of the node and extend the lifetime of the whole network	Considered only for the distribution of the remaining energy of the node may not be optimal, may be the cluster head node number is too small and unevenly distributed
(Alrajeh, et al., 2013) [3]	NS-2	√	√	Improved QoS lifetime of the network less consumed the network energy compared with HEED and LEACH in the presence of attack	Packet acknowledgement could not be used in case high routing overheads and high packet loss
(Barekatain, et al., 2013) [6]	OMNeT++		√	Executes routing in the MAC layer in the purposes of the internet protocol layer with no additional change	It does not consider energy parameter
(Bernsen, & D. Manivannan, 2012) [7]	Dependable ne-ss Calculation		√	Efficiently distribute dependability data by recognizing the edge eavesdropped weighted routes	Reply must return before the vehicle move away
(Unterschütz, S., et al., 2012) [33]	OMNeT++		√	CometOS adopts concepts of OMNeT++ and allows platform independent protocol development. Higher level protocol implementations can be executed within the simulation environment itself as well as on resource-restricted hardware	The released software provides no comm. Protocols And a generic configuration of modules is missing yet
(Paul, B., et al., 2011) [27]	OMNet++	√		This Protocol suitable / good for inter vehicle comm.	PBR – DV is not done
(Suthaputchakun, C., & Sun, Z. 2011) [31]	OMNeT++		√	PRP attains for messages, prioritization and maximum dissemination distance in completely distributed situation	Less reliability and security were not considered
(Madani, et al., 2010)	OMNeT++	√	√	Accurate delivery, long life of the network, a method based on	Insufficient compression and

[20]				route of end-to-end delay	evaluation results with similar class are not provided
(De Rango, et al., 2009) [10]	NS-2		√	Enhancements a presented by TTBR by comparison with routing protocols, namely; AODV and GPSR, results shows the satisfactory performance than AODV with high speed and high density	Energy performance was not evaluated
(Abedi, et al., 2008) [1]	GloMoSim		√	Establish more stable routes with high mobility nodes, observed overhead route in AODV is less than DAODV	Reduction of routes caused less overhead. Moreover, the movement parameter was not considered
(Chen, et al., 2008) [9]	SUMO	√	√	Global data, broadcasts made more effective, trace back and create a new grid forwarding route, provides excellent fault-tolerance ability.	Insignificant computation time
(Jing, F., et al., 2007) [17]	OMNeT++	√	√	Provide alternate loading condition. Routing policy used in the presence of low and high traffic load, and the selective policy is used in case moderate level	Incapable for several traffic situations of each node at the same time
(Sommer, C., et al., 2008) [30]	OMNeT++ & SUMO		√	Provides essential tools to achieve a bidirectional coupling	Complicated simulation system

Sommer, C., et al. [30] is studied the need for bidirectional link of the network by simulation and road traffic micro simulation for valuing such protocols. The modified mobility module, which describes all effort of vehicles, impacts the consequence of simulations to an unlimited compact. This study is done by the network simulator OMNeT++ and the road traffic simulator SUMO.

5.0 OPENAREA

It has seen that the researchers have succeeded much unlimited growth on vehicular communication. On the other hand, based on literature review, it has seen that until now some of panic issues have facing to regulate VANET communication which is needed to mitigate by develop the tools and techniques or algorithms to overcome these issues. Such as the issues related vehicular communication, vehicular security, vehicular applications, stimulation of the vehicular environment etc. [22]. The challenges are facing in VANET present in Table-2.

6.0 CONCLUSIONS

It is examined that the routing protocols such as, Unicast, Geocast and Broadcast are challenging problems to regulate the VANET at the network layer. This survey examined the existing Unicast, Geocast, and Broadcast running environments for VANET. The unicast

running environment, fragmented into minimum delay, hence delay is not acceptable in VANET environment due to fast moving vehicles.

Table 2: VANET challenges

Requirements	Description
Routing Protocols	Based on literature review, it is observed that plenty of researchers proposed a verity of protocols and presented the simulation results and their parameters, while the protocols for instance, Cognitive MAC for VANET (CMV) and Greedy Traffic aware (GyTAR) are considered as the serious issue to develop the greatest routing protocols which can provides accurate VANET communication along with greatest mobility of vehicles and high active topology.
General Standards	IEEE802.11 is assumed as a general standard, while this standard might not overcome the necessity of robust network from Denial of Service (DoS), on the other hand, the present MAC QoS parameters of the IEEE802.11p has not competently deployed for a possible huge number of vehicles (M. Faezipour, et al., 2012) [22]. The overall sum-up that developers in this area should look forward on possible standard for VANET to improve its usage.
Mobility	Mobility is the custom for VANET which creates the topology adjustment rapidly. Moreover, the mobility designs of vehicles on the road reveal robust links [8]. On the other hand, the authors [24] has been implied the awareness about mobility that responsibility as a key role in VANET protocol development.
Supportive Communication	O. Altintas, et al., 2014 [26] it is assumed the VANET communication can be achieved through mobile computing cloud (MCC), on the other hand, [22] the authors proposed a broadband cloud in VANET. Overall sum-up is that the collaboration among the clouds for vehicular and clouds for internet in the environment of vehicular administration for applications is bringing a serious issue to developers.
Security	F. Kargl, et al., 2011 [12] implied verity of clarifications which observed the important problems and the typical design of infrastructure less networks still depend on certificates. The certificates hold signature of each vehicle. For instance key-distribution assumed great solution for VANET security, on the other hand, key-distribution has some issues, for instance various vehicular industries and disclose the vehicle privacy [8]. Moreover, the transaction of the VANET security observed a serious issue in the attributes of productivity.

Furthermore, in Multicast and Geocast protocols for VANETs also needed to improve based on less delay, less overhead of the network, and must be satisfied the accurate packet delivery guarantee. The approach of multicast in VANETs to delivering multicast data packets from source vehicle to all multicast vehicles. On the other hand, the approach of Geocast in VANET to delivering Geocast data packets from a source vehicle to situated in a specific geographic region. While the approach of broadcast running environment in VANETs is based on single hop and multi hop. It implies to the researcher on this topic that the development of routing protocols for VANETs should be considered with less delay in communication and less overhead in communication of city and highway scenario.

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