Middle-East Journal of Scientific Research 20 (12): 2113-2116, 2014
ISSN 1990-9233

DOI: 10.5829/idosi.mejsr.2014.20.12.21100

Comparison of Topology Based Protocols of Vehicular Ad hoc Network

Dalya Khalid Sheet, Abdul Hanan Abdullah,
Ahmed Nazar Hassan and Kashif Naseer Qureshi

Faculty of Computing, University Teknologi Malaysia,
81310 Skudai, Johor Bahru, Malaysia

Abstract: Vehicular Ad hoc network is a new and most useful technology for transportation services. Still this technology has been facing various issues and challenges. One of the major challenges is efficient routing between vehicles for solving the disconnectivity, delay, obstacles and high mobility issues in highway and metropolitan areas. Many types of protocols working for routing and play their significant role in different angels. The topology-based protocols are one of the major categories in routing taxonomy. In this paper, we compare popular topology based routing protocols and their comparison with each other.

Key words: Vehicular · Topology · Mobility · Routing

INTRODUCTION

Recently the roads have been congested because of traffic and high mobility [1]. The intelligent transportation system has various applications to overcome these issues in metropolitan and highway environment [2]. These applications have been working for accident detection, emergencies and for controlling the traffic. The intelligent transportation system is heterogeneous and different technologies play their role. One of the boosting technology is vehicular Ad hoc networks came as a sub class of mobile Ad hoc networks. In this type of networking, make communication enable between vehicles without permanent infrastructure. The VANET technology has unique characteristics when we compare with other technologies especially with its main class MANET. The dissimilar devices working for communication between vehicles such as special on board units equipped with wireless sensors and applications with radio range. Many protocols are working for sending or receiving the data packets from one vehicle node to the destination node. History of protocols started from mobile Ad hoc networks, the researchers tested many MANET protocols in the vehicular environment but they were not much suitable for VANET environment such as DSDV, OLSR, DSR. The three type of communication in VANET the pure Ad hoc, cellular and hybrid. In the first type of network, the vehicles communicate with each other without any permanent infrastructure with the help of their own range and equipped devices in the vehicles. The cellular type is communication between vehicles through base station or access point which is installed on the road side or in junctions. The last type of network is a combination of both technologies cellular and Ad hoc [3]. The different protocols for both environments have been proposed and many authors divided these protocols into different categories. They are divided into topology based, position and cluster based. In this paper, we discuss some popular topology based protocols and compare these protocols with each other. Our paper is divided into three sections, in the first section, we discuss some challenges of VANET in the context of routing, the second section our discussion based on topology based routing protocols and in last section we compare topology based routing protocols and test some popular protocols in simulation.

Routing Challenges of VANET: The nature of vehicular environment is dynamic and self-configuring and because of vehicle speed that is highly mobile. The vehicle nodes are possibly predictable and location of vehicles is realistic in VANET. The one of the main challenge is connectivity because of high mobility [4]. The network

Corresponding Author: Dalya Khalid Sheet, Faculty of Computing, University Teknologi Malaysia,
81310 Skudai, Johor Bahru, Malaysia.

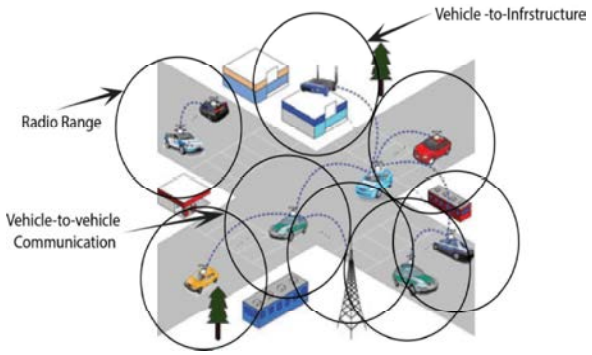

Fig. 1: VANET Communication

topology change frequently and that is the cause of small range diameter of vehicles the network is dense and sparse [5]. Another challenge is driver behavior reacting with data. Below we briefly discuss some major challenges in detail.

In VANET many wireless access standards used for connectivity and provide an air interface for communication such as 2, 2.5, 3G cellular technologies. These technologies are providing reliable security, capacity and bandwidth but in VANET case they have problems of bandwidth, latency and high cost makes it impossible to use a s a main communication in VANET. The IEEE 802.11 standard based wireless technologies are working in VANET [6]. These standards provide wireless communication between the vehicle to vehicle and with infrastructure. The radio communication range is 1000 meters; it is opera table in 200 Km/h speed. The recently these wireless access standards are working combine such as GSM/HSCSD/GPRS and UMTS (3G) with 60 GHz band. However, the combination of different interfaces in a single system makes high redundancy and increase flexibility and cause of poor performance in applications.

The routing issues in VANET gain a lot of attention during last years, because the environment of network is totally different and protocols unsuitable. The frequent network partitioning requires unique approaches for successful data delivery. Many approaches proposed such as carry and forward, greedy, perimeter. In the first approach is a combination of three routing algorithms opportunistic, trajectory, geographic forwarding. The opportunistic approach is used for forwarding the packet whenever find an opportunity in network. This approach is suitable in broadcasting environment, but it is not good if the target is a single node. The trajectory approach is use road layout and geographical position of nodes but problematic with dead road [5].

Topology Based Routing Protocols: The link information is used to forward the packet between the source node to destination node. The topology based routing protocols are further divided into three categories, table drive (proactive), on demand (reactive) reactive and hybrid (proactive, reactive). The first category function is maintaining the latest information in routing tables about nodes in the network. Whenever the network topology change all nodes update the information with each other [7]. But utilizing some of bandwidth in the network. The second category is about sending route request message to other nodes until founding and time to leave expires. In this kind of approach, the traffic is less because of information exchange on demand. These type of protocols takes time for the discovery process in the network during sending the data packets between source and destination [8]. The third category is a combination of both categories reactive and proactive. Below we discuss some popular routing protocols and compare with each other.

RBVT-P (Road Based using Vehicular Traffic Proactive): It is a proactive topology based routing protocol and periodically maintains a network topology. The protocol use traffic information such as connected road segments and intersections as a real time graph for shortest path. The algorithm includes four steps discovery, maintenance, topology dissemination and route computation [9]. In the discovery the connectivity packet [10] contains real time traffic information for discovered road based network topology. In the topology, dissemination steps the discovery information store in route update (RU) packet and forward to all nodes. In computation step, the shortest path find and when route is established the data is forwarded and then maintenance starts through intermediate nodes. The protocol working well in many vehicles present on the road and performance is poor with fewer vehicles on the roads.

AODV (Ad hoc on Demand Distance Vector): AODV [11] is a popular topology and on demand protocol. The function of the protocol is establishing connection between source and destination with the help of broadcasting a route request for their neighbors. In the request packet contains IP addresses of source and target node and sequence number, hop counts in the form of a routing table. When this packet find the destination through intermediate nodes, the destination node acknowledges to the source about route. The other nodes

Table 1: Features of topology based routing protocols

Protocols	Traffic Awareness	Forwarding strategy	Positioning system required	Infrastructure Required1	Communication Environment
ZRP	NO	Multi Hop	NO	NO	Urban
AODV	NO	Multi Hop	NO	NO	Urban
RBVT-P	Yes	Multi Hop	YES	NO	Urban,Highway

between source and destination update the routing information if there is new route request generated from source. After this process, the route is maintained through periodically hello messages. Due to high mobility many time the route breaks and the process stop and consuming of network resources due to broadcasting hello messages are another problem.

ZRP (Zone Routing Protocol): The protocol [12] is hybrid in nature because use both categories reactive and proactive. In this protocol, the network is divided into different zones. The routing zones are local region of routes of the network and protocol configured a particular network through adjustment of a single parameter. Every node is maintaining the routing information, which is within its zone. For this, the protocol use a proactive approach and for discovering routes to the destination, the flooding based query use. This is a flexible approach for discovering and maintaining routes in the network. The route discovery is based on reactive and querying is based on proactive technique.

Simulation Results of Protocols: For simulation results, we use NS-2 simulator with sumo mobility model, which is a popular and standard simulation environment. The mobility model we use is a random waypoint model with the size of 500m x 500m with 20 vehicles nodes. In our simulation scenario, all nodes are moving and randomly change the source and destinations. Because we need continuous change in the topology, below the table shows some parameters for the simulation.

Packet Delivery Ratio: Fig. 2 Shows the comparison of three protocols based on packet delivery in the network. The AODV protocol in our simulation overall performs better. The RBVT-P and ZRP drop packets during route discovery but compare to ZRP the RBVT-P performance is better.

End-to-End Delay: Fig. 3 shows the graph about end-to-end delay. The average packet delay is based on the numbers of nodes waiting in a queue when protocol tries to find a valid route to the destination. The AODV and RBVT-P show poor delay because working on typical shortest path. ZRP is better because the protocol working in zones and discovery is fast.

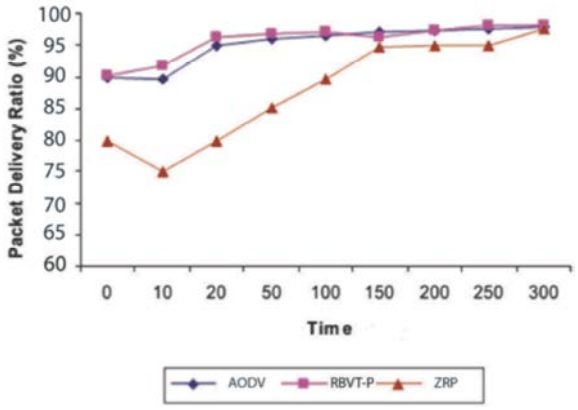

Fig. 2: The Packet Delivery Ratio

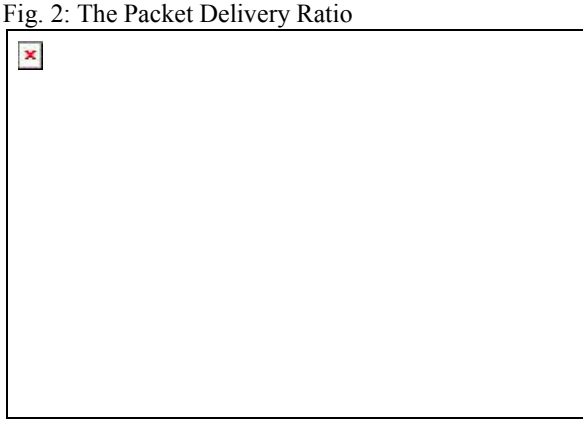

Fig. 3: End-to-End Delay

Table 2: Parameters for simulation

Parameter	Value
Protocol	AODV,ZRP,RBVT-P
Time	250 sec
Area	500 m x500 m
Radio range	250 m
Node movement	Random waypoint
Traffic type	CBR (UDP)
Bandwidth	2 Mbps

CONCLUSION

The VANET has received boosting research attention and have active projects. Various protocols have been proposed for efficient routing in different environments like metropolitan and highway. The routing protocols are depending on different schemes such as topology, position, clustering, beacon or baconless and still need enhancement to overcome many challenges.

The VANET is a dynamic and highly mobile network because of the speed and has different challenges. We simulated three most popular routing protocols in NS2 simulation and through results; we generated the graphs and check the overall results. The AODV protocol is best in packet delivery compare with ZRP and RBVT-P and on the other hand the ZRP is better in the end to end delay. Through this comparison, researchers easily find the results and check one good protocol is not better in all metrics.

REFERENCES

1. Härri, J., *et al.*, 2006. VanetMobiSim: generating realistic mobility patterns for VANETs, in Proceedings of the 3rd international workshop on Vehicular ad hoc Networks, pp: 96-97.
2. Qureshi, K.N. and A.H. Abdullah, 2013. A Survey on Intelligent Transportation Systems, Middle East Journal of Scientific Research, pp: 15.
3. Schoch, E., *et al*., 2008. Communication patterns in VANETs, Communications Magazine, IEEE, 46: 119-125.
4. Jaap, S., *et al*., 2005. "Evaluation of routing protocols for vehicular ad hoc networks in typical road traffic scenarios, Proc of the 11th EUNICE Open European Summer School on Networked Applications, pp: 584-602.
5. Yousefi, S., *et al.*, 2006. "Vehicular ad hoc networks (VANETs): challenges and perspectives, in ITS Telecommunications Proceedings, 6th International Conference on, pp: 761-766.
6. Eichler, S., 2007. Performance evaluation of the IEEE 802.11 p WAVE communication standard, in Vehicular Technology Conference, VTC- Fall. IEEE 66th pp: 2199-2203.
7. Lee, K.C., *et al*., 2009. Survey of routing protocols in vehicular ad hoc networks, Advances in Vehicular Ad-Hoc Networks: Developments and Challenges, IGI Global, pp: 21.
8. Qureshi K.N. and H. Abdullah, 2013. Topology Based Routing Protocols for Vanet and Their Comparison with Manet, Journal of Theoretical and Applied Information Technology, pp: 58.
9. Kulkarni S.A. and G.R. Rao, 2010. Vehicular ad hoc network mobility models applied for reinforcement learning routing algorithm, in Contemporary Computing, ed: Springer, pp: 230-240.
10. Pettifor, A.E., *et al*., 2008. Keep them in school: the importance of education as a protective factor against HIV infection among young South African women, International Journal of Epidemiology, 37: 1266-1273.
11. Chakeres, I.D. and E.M. Belding-Royer, 2004. AODV routing protocol implementation design, in Distributed Computing Systems Workshops, Proceedings. 24th International Conference on, pp: 698-703.
12. Haas, Z.J. *et al*., 2002. The zone routing protocol (ZRP) for ad hoc networks,