Journal of Basic and Applied Engineering Research
Print ISSN: 2350-0077; Online ISSN: 2350-0255; Volume 2, Number 13; April-June, 2015 pp. 1110-1112
© Krishi Sanskriti Publications
http://www.krishisanskriti.org/jbaer.html

Comparison of Routing protocols in Vehicular Ad Hoc Networks

Kapil Sharma

Delhi Technological University
E-mail: kapil@ieee.org

Abstract—*Vehicular Ad Hoc Network (VANET) is a capable new technology and a class of mobile ad hoc network .VANET is diverse technology from others in mixture network architectures, node movement characteristics channel features such as short communication time, low packet delivery ratio, frequent link breakage, and quickly changed topology caused by high mobility and new application scenarios. In this paper we discuss the research challenge of routing in VANETs and survey recent routing protocols and related mobility models for VANETs.*

1. INTRODUCTION

VANET has its unique characteristics which pose many challenging research issues, such as data dissemination, data sharing, and security issues. ITS (Intelligent Transportation Systems) is the major application of VANETs. ITS includes a variety of applications such as co-operative traffic monitoring, control of traffic flows, blind crossing, prevention of collisions. Later, California PATH [1] and Chauffeur of EU [2] have also demonstrated the technique of coupling two or more vehicles together electronically to form a train. Recently, the European project Car TALK 2000 [3] tries to investigate problems related to the safe and comfortable driving based on inter-vehicle communications. Another important application for VANETs is providing Internet connectivity to vehicular nodes while on the move, so the users can download music, send emails, or play back-seat objective passenger games. However, simulation results showed that they suffer from poor performances because of the characteristics of fast vehicles movement; dynamic information exchange and relative high speed of mobile nodes are different from those of MANETs.

2. NETWORK ARCHITECTURES AND CHARACTERISTICS

VANETs may use fixed cellular gateways and WLAN access points at traffic intersections to connect to the Internet, gather traffic information or for routing purposes. VANETs can combine both cellular network and WLAN to form the networks so that a WLAN is used where an access point is available and a 3G connection otherwise. Table 1 depict that VANETs can be distinguished from other kinds of ad hoc networks. VANETs comprise of radio-enabled vehicles which act as mobile nodes as well as routers for other nodes.

Table 1 Characteristic of Vehicular Ad Hoc Network

Characteristics	Definitions
Highly dynamic topology	Due to high speed of movement between vehicles, the topology of VANETs is always changing. For example, assume that the wireless transmission range of each vehicle is 250 m, so that there is a link between two cars if the distance between them is less than 250 m. In the worst case, if two cars with the speed of 60 mph (25 m/sec) are driving in opposite directions, the link will last only for at most 10 sec.
Frequently disconnected network	Due to the same reason, the connectivity of the VANETs could also be changed frequently. Especially when the vehicle density is low, it has higher probability that the network is disconnected. one possible solution is to pre-deploy several relay nodes or access points along the road to keep the connectivity.
Interaction with on-board sensors	It is assumed that the nodes are equipped with on-board sensors to provide information which can be used to form communication links and for routing purposes. For example, GPS receivers are increasingly becoming common in cars which help to provide location information for routing purposes.
Various communications environments	VANETs are usually operated in two typical communications environments.In highway traffic scenarios, the environment is relatively simple and straightforward[8, 9].
Hard delay constraints	In some VANETs applications, the network does not require high data rates but has hard delay constraints. For example, in an automatic highway system, when brake event happens, the message should be transferred and arrived in a certain time to.

3. ROUTING PROTOCOLS

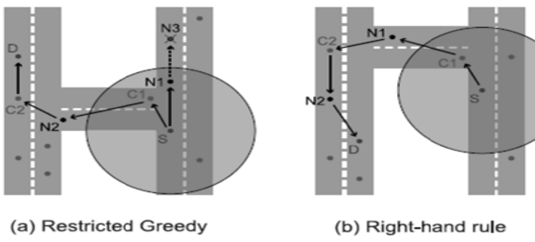
Ad Hoc Routing most ad hoc routing protocols are still applicable, such as AODV (Ad-hoc On-demand Distance

Vector) and DSR (Dynamic Source Routing). AODV and DSR are designed for general purpose mobile ad hoc networks and do not maintain routes unless they are needed. Hence, they can reduce overhead, especially in scenarios with a small number of network flows. However, VANET differs from MANET by its highly dynamic topology.

Position-Based Routing: vehicular nodes in a network can make use of position information in routing decisions, such algorithms still have some challenges to overcome. Most position based routing algorithms base forwarding decisions on location information. For example, greedy routing always forwards the packet to the node that is geographically closest to the destination. GPSR (Greedy Perimeter Stateless Routing) is one of the best known position-based protocols in literature. Fig. 1 shows comparison between restricted greedy routing and. Right-hand rule routing.

3.1 Greedy routing vs. Restricted greedy routing in the area of a junction

Source S wants to forward the packet to the destination D. If a regular greedy forwarding is used, the packet will be forwarded beyond the junction (Coordinator C1) to N1, and then it will be lead to a local minimum at N3. But by forwarding the packet to coordinator C1, an alternative path to the destination can be found without getting stuck in a local minimum.



(a) Restricted Greedy (b) Right-hand rule

Fig. 1: Restricted greedy routing vs. Right-hand rule

Right-hand rule is used to decide which street the packet should follow in the repair strategy of GPCR: Node S is the local minimum since no other nodes is closer to the destination D than itself. The packet is routed to the first coordinator C1. Node C1 receives the packet and decides which street the packet should follow by the right-hand rule. It chooses the street that is the next one counter-clock wise from the street the packet has arrived on.

3.2 Cluster-Based Routing

In cluster-based routing, a virtual network infrastructure must be created through the clustering of nodes in order to provide scalability. Fig. 2 shows VANETs. Each cluster can have a cluster head, which is responsible for intra- and inter-cluster coordination in the network management functions. Nodes inside a cluster communicate via direct links.

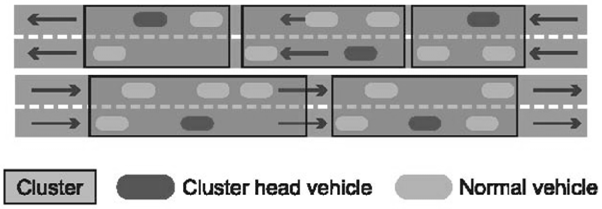


Fig. 2: Cluster-Based Routing

3.3 Broadcast Routing

The simplest way to implement a broadcast service is flooding in which each node re-broadcasts messages to all of its neighbours except the one it got this message from. Flooding guarantees the message will eventually reach all nodes in the network. Flooding performs relatively well for a limited small number of nodes and is easy to be implemented. But when the number of nodes in the network increases, the performance drops quickly. The bandwidth requested for one broadcast message transmission can increase exponentially.

3.4 Geocast Routing

Routing is basically a location-based multicast routing. The objective of a geocast routing is to deliver the packet from a source node to all other nodes with a specified geographical region (Zone of Relevance, ZOR). Many VANET applications will benefit from geocast routing. For example, a vehicle identifies itself as crashed by vehicular sensors that detect events like airbag ignition, then it can report the accident instantly to nearby vehicles. Vehicles outside the ZOR are not alerted to avoid unnecessary and hasty reactions

4. MOBILITY MODEL

In this section, we will briefly review the mobility model§ used by VANET routing protocols. A realistic mobility model is not only very important for getting accurate results in routing performance evaluation but also a necessary component to predict the next positions of vehicles and make smarter route decisions in many VANET routing protocols. Table 2 shows the comparison of 9 different protocols using different simulators.

Table 2: Comparison of routing protocols

Routing Protocols	Routing Type	Position Information?	Hierarchical Structure?
PRAODV/PRAODV-M [5]	Unicast	Route-Selection (lifetime prediction)	No
GSR[6]	Unicast	Packet Forwarding	No
GPCR [7]	Unicast	Packet Forwarding	No
A-STAR [8]	Unicast	Packet Forwarding	No
LORA_CBF	Unicast	Packet Forwarding	Yes
Msg Dis Protcl [10]	Geocast	Packet Forwarding	No
IVG [11]	Geocast	Packet Forwarding	No
Cached Geocast [12]	Geocast	Packet Forwarding	No
AOMDV	Unicast	Route-Req-Forwarding	No

Routing Protocols	Network Simulator	Simulation Scenario
PRAODV/PRAODV-M [5]	NS2	Simple highway model (20km segment only)
GSR[6]	NS2	Real city model
GPCR [7]	NS2	Real city model
A-STAR [8]	NS2	Grid city model
LORA_CBF	OPNET	Simple circle and square road
Msg Dis Protcl [10]	Own	Simple highway model (10 km long)
IVG [11]	Glomosim	Simple highway model (10 km long, 100/200 nodes)
Cached Geocast [12]	NS2	Quadratic network (size from 1 km to 4km)
AOMDV	NS2	Simple highway model

5. CONCLUSION

In this article, we discuss the challenges of designing routing protocols in VANETs and survey several routing protocols recently proposed for VANETs. In general, position-based routing and geocasting are more promising than other routing protocols for VANETs because of the geographical constrains. However, the performance of a routing protocol in VANETs depends heavily on the mobility model, the driving environment, the vehicular density, and many other facts. Therefore, having a universal routing solution for all VANETs application scenarios or a standard evaluation criterion for routing protocols in VANETs is extremely hard.

REFERENCES

[1] J.K. Hedrick, M. Tomizuka, and P. Varaiya, “Control issues in automated highway systems,” IEEE Control Systems Magazine, vol. 14, no. 6, pp. 21–32, Dec. 1994.

[2] O. Gehring and H. Fritz, “Practical results of a longitudinal control concept for truck platooning with vehicle to vehicle communication,” in Proceedings of the 1st IEEE Conference on Intelligent Transportation System (ITSC’97), pp. 117–122, Oct. 1997.

[3] D. Reichardt, M. Miglietta, L. Moretti, P. Morsink, and W. Schulz, “Cartalk 2000—safe and comfortable driving based upon inter-vehicle communication,” in Proceedings of the IEEE Intelligent Vehicle Symposium (IV02), 2002.

[4] “Car-to-car communication consortium,” http://www.car-to-car.org.

[5] V. Namboodiri, M. Agarwal, and L. Gao, “A study on the feasibility of mobile gateways for vehicular ad-hoc networks,” in Proceedings of the First International Workshop on Vehicular Ad Hoc Networks, pp. 66–75, 2004.

[6] C. Lochert, H. Hartenstein, J. Tian, D. Herrmann, H. Füßler, and M. Mauve, “A routing strategy for vehicular ad hoc networks in city environments,” in Proceedings of IEEE Intelligent Vehicles Symposium (IV2003), pp. 156–161, June 2003.

[7] C. Lochert, M. Mauve, H. Füßler, and H. Hartenstein, “Geographic routing in city scenarios,” ACM SIGMOBILE Mobile Computing and Communications Review (MC2R), vol. 9, no. 1, pp. 69–72, Jan. 2005.

[8] G. Liu, B.-S. Lee, B.-C. Seet, C.H. Foh, K.J. Wong, and K.-K. Lee, “A routing strategy for metropolis vehicular communications,” in International Conference on Information Networking (ICOIN), pp. 134–143, 2004.

[9] H. Füßler, M. Mauve, H. Hartenstein, M. Kasemann, and D. Vollmer, “Locationbased routing for vehicular ad-hoc networks,” ACM SIGMOBILE Mobile Computing and Communications Review (MC2R), vol. 7, no. 1, pp. 47–49, Jan. 2003.

[10] L. Briesemeister, L. Schäfers, and G. Hommel, “Disseminating messages among highly mobile hosts based on inter-vehicle communication,” in Proceedings of the IEEE Intelligent Vehicles Symposium, pp. 522–527, 2000.

[11] A. Bachir and A. Benslimane, “A multicast protocol in ad hoc networks intervehicle geocast,” in Proceedings of the 57th IEEE Semiannual Vehicular Technology Conference, vol. 4, pp. 2456–2460, 2003.

[12] C. Maihöfer and R. Eberhardt, “Geocast in vehicular environments: Caching and transmission range control for improved efficiency,” in Proceedings of IEEE Intelligent Vehicles Symposium (IV), pp. 951–956, 2004.