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A Study on Ad-hoc Routing Protocols for its Suitability in Vehicular Ad-hoc Networks

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Abstract: ***Vehicular Ad-hoc network (VANET) a type of Ad-hoc network is a new technology that has evolved recently and is widely finding application in areas such as traffic and road safety, payment collection, tourist guiding information and natural hazards. In VANET environment, routing should be focused, as it is essential for life safety applications. The information should be broadcasted to all the entities in the network with the help of routing protocols. By taking into account the VANET characteristics and its applications, the existing routing protocols of ad-hoc network are discussed and analyzed for its suitability in VANET environment.***

Keywords: Ad-hoc, VANET, AODV, DSDV, DSR, GSR, TORA, ZRP, GPSR, PBR, FSR, OSLR.

I. INTRODUCTION

Ad-hoc Network is an emerging technology which is an autonomous collection of wireless mobile nodes that are self configured to form a network environment without any infrastructure establishment. Ad-hoc network can form a spontaneous network either momentarily or permanently. The information transmitted by a mobile node will be received by all other nodes within its transmission range due to its wireless connectivity and omni-directional antennae. Due to the limited transmission capability of the network, the nodes cannot directly communicate with each other but they exchange information through multi-hop communication. They transmit the packets to other nodes across the network without access points and any infrastructure establishment.

An ad-hoc routing protocol is a standard, that controls the routing path of the packets between the mobile nodes so that the information will be communicated to the specified destination without fail. As the nodes in an ad-hoc network can join and leave the network anytime, it is difficult to predict the routing path.

The development in ad-hoc networks is liable for developing protocols and components to enable ad-hoc networking between mobile nodes. Ad-hoc networks using mobile devices face additional problems due to hardware limitations. The complexities in routing lead to active research in the routing areas of ad-hoc network particularly in a VANET scenario.

Vehicular Ad-hoc Network (VANET) is an evolving technology in Ad-hoc networks. Each node in the network may be either a vehicle or Road Side Unit (RSU) which is equipped with the necessary communication facility. An electronic device placed inside each vehicle will provide Ad-hoc network connectivity for the vehicles. Each vehicle equipped with the device will be a node in the network and can receive and relay other's messages through the wireless network.

This paper is organized as follows: Section II provides an introduction on Vehicular Ad-hoc Network. Section III discusses the VANET characteristics and its Applications. Section IV discusses the various types of Ad-hoc routing protocols. And the paper concludes in Section V.

II. VEHICULAR AD-HOC NETWORKS

Vehicular Ad hoc Networks (VANET) is a type of Ad-hoc Network which is spontaneously formed between moving vehicles. In VANET, vehicles act as nodes which can exchange information between each other without any network infrastructure establishment. Vehicular Communication is envisioned of Intelligent Transportation systems (ITS) in which vehicles can communicate with each other through Inter Vehicle Communication (IVC) as well as with the Road Side Units (RSU) and vehicles through Roadside to Vehicle Communication (RVC).

In order to participate in the network, a vehicle should possess in-built display with keypad, sensor, digital map and Global Positioning Systems (GPS). The sensor is powered by vehicle's battery and is used to sense the happenings in the surrounding such as congestion, road maintenance, traffic jam and if needed the information will be communicated to the nearby vehicles and Road Side Unit (RSU). RSU also stores the data of the vehicle passing through in the memory installed in the unit. The vehicles in the network have high mobility, and hence they enter and leave the network dynamically. Figure 1 shows a sample Vehicular Ad hoc Network.

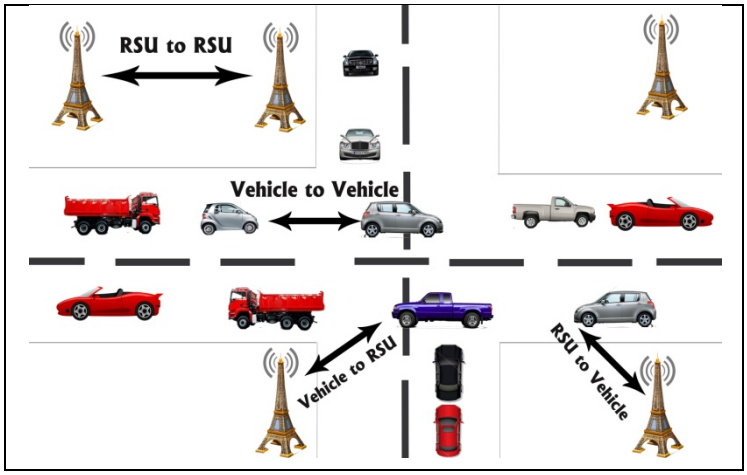

Figure 1: Vehicular Ad-hoc Network

Distant vehicles in the network can communicate through intermediate vehicles and nearby fixed Road Side Unit (RSU). RSU can also communicate with the nearby RSU to share the information. Although VANET is a type of MANET, the mobility pattern of VANET nodes is predefined as they move on specific paths and not in random direction. As the mobility pattern of VANET nodes is predictable, the limitation on storage capacity and high processing power does not exist [1].

III. CHARACTERISTIC AND APPLICATIONS OF VANET

Vehicular Ad-hoc Network has specific characteristics which have to be taken into account while building the architecture. Vehicles can provide continuous power to their computing and communication devices. Vehicles may join and leave the network at any time and much more frequently. For Ad-hoc deployments, the network cannot depend on a single vehicle for packet forwarding because the duration of the vehicle's cooperation depends on its destination and its direction of travel.

As stated in [2], VANETs comprise of radio-enabled vehicles which act as mobile nodes as well as routers for other nodes. In addition to the similarities to Ad-hoc networks, such as short radio transmission range, self-organization, self management, and low bandwidth, VANETs can be distinguished from other kinds of Ad- hoc networks as follows:

- High dynamic topology
- Frequent disconnection of network
- Sufficient energy and storage
- Mobility modeling and prediction

- Interaction with on-board sensors
- No confidentiality for safety information [3]
- Central authority
- Power consumption [4]

VANET communications (IVC and RVC) can be used for number of extremely diverse latent applications with extremely diverse requirements. The major classes of applications possible in VANET are driver assisted applications and commercial applications. The most important VANET applications are listed below.

Driver Assisted Applications

Driver assisted applications will monitor the surrounding area, approaching vehicles, and lane switching in the road. Some of the driver assisted applications are as follows:

- Vision Enhancement[5]
- Traffic Control
- Collision Warning
- Cooperative Driving
- Lane change Assistance
- Emergency Recovery
- Natural hazards like ice, fog etc.,
- Speed Limit Warning

Commercial Applications:

Commercial applications will provide the driver/passenger with the entertainment and web services. Some of them are as follows:

- Electronic Toll Collection.
- Locating places
- Travel and Tourism information
- Internet, Multimedia and games

IV. Routing Protocols of Ad-Hoc Networks

Routing Protocols for an ad-hoc network can be complicated because the nodes can move haphazardly and can also unite or depart the network randomly. The high effervescent behavior of the nodes in ad-hoc network results in relentless and indecisive changes of network communication, which also adds complexity to launch the routing path among the nodes. Routing protocols aims to establish the route, forwards the packets, maintains and updates the routes and recovers from failures.

The following observation has to be considered while routing is performed in Ad-hoc Networks [6].

- Traditional Routing algorithms cannot be used for ad-hoc networks since they have highly dynamic topology.

- Centralized approaches will not work effectively, because it needs long time to collect the current status and disseminate them.
- Information from lower layers concerning connectivity or interference can help routing algorithms to find a good path.
- Many nodes need routing capabilities, to forward the packets to other nodes.
- Ad-hoc network is connectionless, and hence it is not possible to maintain a connection in a fast changing environment and the nodes have to make local decisions for forwarding the packets to the destination.

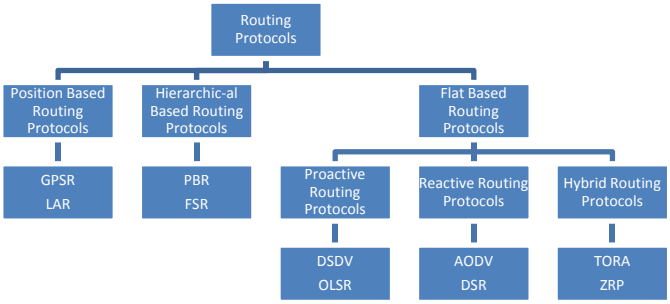

Figure 2: Classification of Routing Protocols

Routing protocol can be classified based on the Cast Property as Unicast, Broadcast and Multicast or based on the Network Structure (Figure 2) as Position-based routing, Hierarchical-based routing, and Flat-based routing.

A. Position-based or Geographical Routing protocols

Position-based or geographical routing protocols use geographic positioning information instead of using network address to choose the next hop neighbors. Nodes that are within the communicating range are formed as neighbors, which are recognized by sending beacons periodically. Examples of Position-based routing are Greedy Perimeter Stateless Routing (GPSR)[7], Location Aided Routing (LAR)[8].

B. Hierarchical Based Routing protocols

The routing depends on the hierarchical level where a node resides. Hierarchical routing has multiple layers of nodes where each layer has its own routing function to be performed. Examples of Position-based routing are Fisheye State Routing [9] , Global State Routing[10].

C. Flat Based Routing Protocols

In Flat-Based routing protocols or Topology-Based Routing Protocols, each node typically plays the same role which collaborates to perform the route discovery task. Flat-based routing protocols can be classified into three categories based on how the routing information is obtained and preserved by the mobile nodes as follows.

1. Proactive routing protocols.
2. Reactive routing protocols.
3. Hybrid routing protocols.

1) Proactive routing protocols

A Proactive routing protocol also known as “table-driven” routing protocol in which the mobile nodes in the ad-hoc network incessantly determine the routes to all accessible nodes and try to preserve the reliable up-to-date routing information. It maintains the route by using a periodic update process. In this type of routing, the control packets are broadcasted to all the

nodes in order to maintain the paths between each pair of the nodes. A table indicating the next hop neighbor towards the destination is constructed. In proactive routing, a mobile node proactively updates the state of the network and maintains the route. Examples of Proactive Routing protocols are Destination Sequenced Distance Vector Routing (DSDV)[11], Optimized Link State Routing Protocol(OLSR)[12].

2) Reactive Routing Protocols

In Reactive routing protocols which are known as on-demand routing protocols the routing paths are searched only when needed. It maintains only the active routes and hence reduces the network traffic. This type of protocols finds a route on demand by flooding the request packets in discovering the routes to the destination. Route discovery stops when either a route has been found or when no route is available. Examples of Reactive Protocols includes Ad hoc on Demand Distance Vector (AODV)[13], Dynamic Source Routing (DSR)[14].

3) Hybrid routing Protocols

Hybrid routing protocols combines the advantages of both proactive and reactive protocols. The route is initially established with proactive property and then it floods reactively. Examples of hybrid routing protocols are Temporary Ordered Routing Algorithm (TORA)[15], Zone Routing Protocol (ZRP)[16]. A comparative study of the considered Ad-hoc routing protocols is summarized in Table I.

As VANET is a type of Ad-hoc Network, the routing Protocols of Ad-hoc network will be suitable for VANET also. As VANET posses some unique characteristics as stated in Section III, the existing routing protocols can be suitably modified so that the ad-hoc routing protocols finds application in VANET environment also.

The main applications of VANET is Location based services like locating missing vehicles, locating fuel station and tourist guiding information which can be achieved using any position based routing protocols. As the information in VANET is critical for life safety applications, the timely receipt of traffic information is essential. The following characteristics of reactive protocols are very much essential for VANET environment also.

- It computes the route on demand before sending the information.
- Overhead is less as it maintains only small tables.
- Consumes less bandwidth
- On route failure, the error route is broadcasted to erase the invalid path.

While developing an efficient routing protocol for Vehicular environment based on its characteristics and applications, Position based routing protocols and Topology Based routing protocols best suits the growing needs of VANET.

TABLE I
COMPARISON OF VARIOUS AD-HOC ROUTING PROTOCOLS

Routing Protocol	Type	Route Discovery	Network Topology	Route Forwarding Method	Route Failure
GPSR	Position Based routing	Link State	Hierarchical Location Based	Heuristic Method	If a neighbour has failed or gone out-of-range, it deletes the neighbor from its table.
LAR	Position Based Routing	On Demand Location Based	Flat	Heuristic Method	Error route is sent to the source to erase the broken path.
FSR	Hierarchical Based Proactive routing Protocol	Link State Computes periodically	Hierarchical	Wireless Multihop	Deletes the neighbor from its link state list and update the neighbor table which provides more up-to-date routing information.

GSR	Hierarchical Based routing Protocol	Periodically broadcast the topology table to its neighbours	Hierarchical	Wireless Multihop	Does not flood the link state packets. Every node maintains the link state by the information received from neighbouring nodes and exchanges with its neighbours only.
AODV	Topology Based Reactive routing Protocol	On Demand	Flat	Wireless Multihop	The error route is broadcasted to erase the invalid path.
DSR	Topology Based Reactive routing Protocol	On Demand	Flat	Wireless Multihop	Error route is sent to the source to erase the broken path.
DSDV	Topology Based Proactive routing Protocol	Computes periodically	Flat	Wireless Multihop	Flooding the updated route throughout the network.
OLSR	Topology Based Proactive routing Protocol	Computes periodically	Flat	Wireless Multihop	Computes an alternative route immediately using the information stored in the neighbor.
TORA	Topology Based Hybrid routing Protocol	On Demand	Flat	Wireless Multihop	Error route will be recovered if there is no alternative path.
ZRP	Topology Based Hybrid routing Protocol	Hybrid	Flat	Wireless Multihop	Updates the tables of the node within the range and send the error route to the source.

V. CONCLUSION

This paper gives a detailed overview of VANET applications and its characteristics. From the details of the research carried out in vehicular ad-hoc network, it is observed that VANET has inherited its maximum features from ad-hoc networks. Hence the choice of the routing protocols for VANET can be decided based on the existing Ad-hoc Routing Protocols.

While developing an efficient routing protocol for Vehicular Ad-hoc Networks based on its characteristics and applications, the position based routing protocols and the topology based routing protocols best suits the need. Further the comparison of various Ad-hoc routing protocols clearly states that though these protocols are suitable for VANET, it has to be modified to adhere to the unique characteristics of Vehicular Ad-hoc Network.

References

1. S aira Gillani, Imran Khan, Shahid Qureshi and Amir Qayyum, “Vehicular Ad Hoc Network (VANET): Enabling Secure and Efficient Transportation System”, Technical Journal, University of Engineering and Technology, Taxila, Vol. 13, 2008.
2. Fan Li, Yu Wang “ Routing in Vehicular Ad Hoc Networks: A Survey”.
3. Emanuel Fonscca and Andreas Festag “A Survey of Existing approaches for Secure Ad Hoc Routing and their Applicability to VANETS”.
4. Ioannis Broustis and Michalis Faloutsos “Routing in Vehicular Networks: Feasibility, Security and modeling Issues”
5. Kamini Rakeshkumar “VANET Parameters and Applications: A Review “GJCST Computing Classification” Global Journal of Computer Science and Technology ,Vol 10, issue 7 ver 1.0 pp 72 September 2010.
6. “Mobile Communications”, Pearson Education, Second Edition, Jochen Schiller, 2011
7. Brad Karp, “GPSR: Greedy Perimeter Stateless Routing for Wireless Networks”, Harvard University / ACIRI,H. T. Kung, Harvard University, MobiCom 2000
8. Y.-B. Ko and N. H. Vaidya, ”Location-aided routing(LAR) in mobile ad hoc networks”, in ACM/IEEE International Conference on Mobile Computing and Networking (Mobicom98), 1998, pages 66-75.
9. M Gerla, X. Hong, G. Pei. Fisheye State Routing Protocol (FSR) for Ad Hoc Networks, IETF Draft, 2001. http://www.ietf.org/internet-drafts/draft-ietfmanet-fsr-02.txt
10. Tsu-Wei Chen and Mario Gerla,” Global State Routing: A New Routing Scheme for Ad-hoc Wireless Networks” Proc. IEEE ICC'98, 5 pages. http://www.ics.uci.edu/~atm/adhoc/paper-collection/gerla-gsr-icc98.pdf
11. C.E Perkins, P. Bhagwat, “Highly Dynamic Destination- Sequenced Distance Vector routing (DSDV) for mobile computers”, in proceedings in SIGCOMM ’94 Conference on Communications Architectures, Protocols and Applications, August 1994, pp 234-244.
12. Jiri Hosek, Karol Molnar; “Investigation on OLSRRouting Protocol Efficiency”, Recent Advances inComputers, Communications”, Applied Social Science andMathematics, ISBN: 978-1-61804-030-5, PP: 147 – 153.
13. C.Perkins, E. Belding-Royer, S.Das, “Ad hoc On-Demand Distance Vector(AODV) routing”, RFC 3561,July 2003.
14. D.B Johnson and D.A Maltz, “ Dynamic source Routing in ad hoc Networks,” Mobile Computing, ed T.Imielinski and H. Korth, Kluwer Academic Publishers, 1996,pp 153-181.
15. http://tools.ietf.org/html/draft-ietf-manet-tora-spec-04
16. Nicklas Beijar,” Zone Routing Protocol (ZRP)”,Networking Laboratory, Helsinki University of Technology,P.O. Box 3000, FIN-02015 HUT, Finland. Nicklas.Beijar@hut.fi

