Pros and Cons: Various Routing Protocols based on VANET's: A Survey

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ABSTRACT

Vehicular ad hoc network (VANET) is advance form of mobile ad hoc network. In VANET, vehicles communicate with each other. It can be vehicle to vehicle V2V or vehicle to infrastructure V2I communication. VANET applications can be categories into two parts, safety applications and user applications. In this paper, our main focus is on safety applications. VANET have various challenges like frequent topology change and short lifetime duration. To deal with these challenges, VANET require efficient routing protocols. In this paper, pros and cons of various routing protocols will be discussed. VANET is very much similar to MANET but the main difference between them is highly dynamic topology of VANET.

Keywords

V2V, V2I, VANET, Routing, DSDV, AODV, STAR, OLSR, DSR, ZRP, GPRS, GSR, A-STAR.

1. INTRODUCTION

VANET stand for vehicular ad hoc network, it is subclass of mobile ad hoc network. VANET is self-organized and self configured network. In this, vehicles act as nodes, which are used to send, receive and route the data. In this, nodes itself perform the routing operation to forward the data from one vehicle to another by using multi-hop concept. It can be of two types 1) vehicle to vehicle communication (V2V) 2) vehicle to infrastructure communication (V2I).

VANET applications [5] can be categories into safety applications and user applications. User applications like internet access, weather information, entertainment etc. By using safety applications, security is provided on roads. Human life is very much affected from accidents on roads. To provide security to humans during driving is very important today. By using VANET, important information is provided to drivers (to provide security to them). By using this, traffic can be easily managed. It is very interesting topic for research purpose. It faces various challenges like mobility, security, short lifetime duration for communication. To handle these challenges, various routing protocols are used to increase the lifetime, security and how to deal with mobility. Both VANET and MANET have some same characteristics like both are mobile network, both can be deployed without any infrastructure and both use the nodes as a network router to forward the packet, does not require any central entity. But there are some characteristics which differentiate both [4]. In VANET, topology is very frequently changed as compare to MANET because vehicles speeds are high so they change the location very frequently. This is very big challenge in VANET, for this we require more stable and robust routing protocols. Limitations in MANET, low storage space, low battery and processing power but these are not in VANET.

VANET have sufficient battery power and storage space. Because of high mobility VANET face challenges in routing protocols. Communication environment can also affect the routing protocols in VANET. Two type of networks, sparse network and dense network. In dense network, building, trees and other object act as an obstacle. In sparse network like highways, these obstacles are absent. So both networks require different routing protocols.
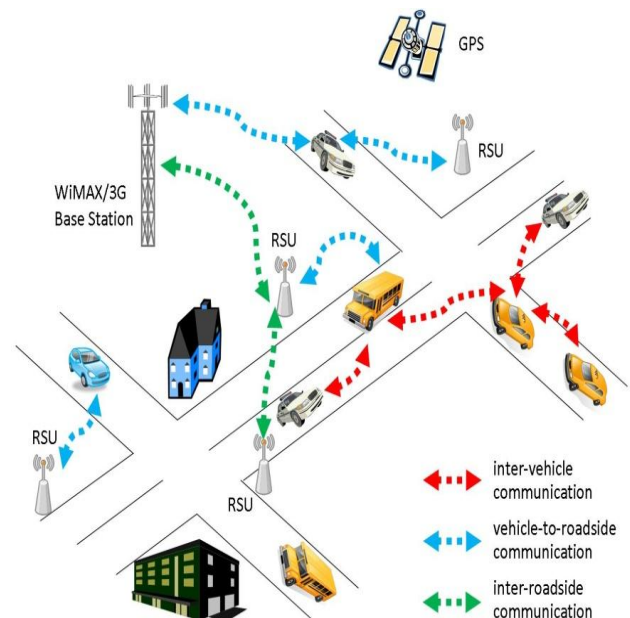
2. ROUTING PROTOCOLS

In VANET, two basic type of routing protocols are used: position based routing protocols and topology based routing protocols. Topology based routing protocol can be further divided into three subcategories: proactive/table driven, reactive/on-demand and hybrid routing protocol. In topology based routing protocol, link's information are used to send data packets from source node to destination node. In position based routing protocol, it doesn't require any link's information like previous one. It uses the geographical position (through GPS) of nodes to send data. It doesn't maintain any routing table. It uses information from GPS for routing.

2.1 Topology based routing protocols

It uses the link's information to send data packet from source node to destination node. It can be further divided into three types:

2.1.1 Proactive routing protocols

In this each node maintain a table in which all information related to connected nodes is available. Whenever any changes occur in network topology, each node will update its routing table. To find the path from source to destination, it uses the shortest path Algorithm. Various types of proactive routing protocols are: DSDV, OLSR, STAR and FSR.

2.1.1.1 DSDV

It stands for destination sequenced distance vector [1] [11]. It uses the bellman-ford algorithm. It forward two type packets: full dump and incremental. All the routing information is send in full dump packet and all the updates information is send in incremental packet.

Pros:

- It provides loop free routing protocol.

- No route discovery is required because it is already stored in background.

Cons:

-In VANET, network topology change very frequently. So, number of incremental packets will also increase. This will increases the overhead in the network.

2.1.1.2 OLSR

It stands for optimized link state routing [2] [8]. In this, whenever any change in the topology occur, MPR (multipoint relay) are responsible to generate and forward the topology information to selected nodes.

Pros:

-In broadcast scenario, reduce the number of retransmission of packets.

Cons:

-In OLSR, large amount of bandwidth and CPU power is required to compute the optimal path.

2.1.1.3 STAR

It stands for source tree adaptive routing [12]. In this no need to send update messages to whole network whenever any change in the network topology. Update message is send when any event occurs in network.

Pros:

-It is suitable for large scale area.

-It reduces the overhead of messages on the network by eliminating the unnecessary updates.

Cons:

-It requires large storage space and processing to maintain the tree of whole network.

2.1.2 Reactive routing protocols

Reactive or on-demand routing protocols are used to overcome the overhead that are present in proactive routing protocol. In this, routes are discovered only for those nodes that are active. For discovering the route from source to destination, it requires RREQ and RREP. Source node will send the Route Request (RREQ), when it wants to send the message to particular destination node. Then source node will wait for the Route Reply (RREP), if reply will came in particular time period. It will start communication by assuming that the path is available. If it does not receive any reply in particular time period, it will assume the path is not available.

Packet can route from source to destination in two ways: through source routing and hop by hop routing. In source routing, routing information is present in data packet. In this, no need to update the intermediate nodes. In hop by hop routing, only next hop and destination address is present in data packet. Hop by hop routing is more suitable in large scale area because if link between source and destination will break, hop will automatic find another way to forward the packet to destination. Various reactive routing protocols:

2.1.2.1 AODV

It stands for Ad Hoc on Demand Distance Vector [2] [9]. In this, if source node wants to communicate with destination node, it will broadcast the RREQ (route request) to neighboring node and wait for the RREP (route reply) for a specific time period. No need to update each and every routing table in network. Only active nodes are required up-to-date. If any link failure in the route, then all other active nodes will be updated that this link is no more available and remove this link from your routing table.

Pros:

-It can be used in large scale area.

-If link failure occurs, all other active nodes will remove that link from table.

-It uses Up-to-date routing information from source to destination by using destination sequence number.

-It reduces the route redundancy.

Cons:

-It consumes extra bandwidth.

2.1.2.2 DSR

It stands for dynamic source routing [8] [11]. It performs two operations route discovery and route maintenance. In route discovery, it will discover the route from source to destination. If node finds more than one way to reach at same destination, it will store that information. In case if one route is break then it can use other route, no need to again discover new route.

Pros:

-No need to update nodes periodically.

-In this node can save more than route from the same destination, if one route is fail, then use alternative route to reach at destination. No need to discover new route.

Cons:

-In high mobility it does not perform well.

-packet loss is high.

2.1.3 Hybrid routing protocols

It is combination of both reactive and proactive routing protocol. ZRP [3] [7] stand for hybrid routing protocol. In this network is divided into zones. Radius or size of the zone is predefined, it basically depend upon the strength of signal, power etc. when source node and destination node are in same zone that is intra-zone routing protocol. In this, proactive routing is used to discover and to maintain the route. If source and destination are in different zones then that is inter-zone routing protocol. In this, reactive routing protocol is used.

Pros:

-It combines the advantages of both proactive and reactive to make efficient routing protocol.

Cons:

-It is not suitable for highly mobile network, where network topology changes very frequently.

-In this, zone size is predefined and fixed. It cannot change after implementation.

-zone size is problem in this.

2.2 Position based Routing Protocols

In these protocols, nodes don't require to maintain the route information to forward data from source to destination. Each node uses the GPS to find the locations of destination, source and other neighboring nodes. Position based routing is more suitable as compare to topology based routing in VANET environment. Position based routing also face various problems like in tunnel GPS doesn't work properly and many more. It follows carry and forward technique to forward the data to destination.

2.2.1 GPSR

It stands for Greedy perimeter stateless routing [1] [10]. In this each node has information about its current geographic position and also the neighboring nodes position. It forwards the packet to nearest node toward destination. It is also known as greedy algorithm because it follows the nearest path to forward packet from Source to destination. In this, it first uses the greedy algorithm to forward the packet if it does not work then it use perimeter forwarding.

Pros:

-It is suitable for highways.

-It uses the greedy technique to forward packet.

Cons:

-It does not perform well in city environment where radio obstacle involves very much.

-If GPS fail, it does not able to perform.

2.2.2 GSR

It stands for geographic source routing [4]. It is used to overcome the problem that is present in GPRS. GPRS does not perform well in city scenario because of lots of obstacles like building shadow, trees and many more. GSR uses the topology information and position information to forward the data packet from source to destination. It uses the Dijkstra algorithm to find the shortest path between source and destination.

Pros:

-It is more scalable as compare to AODV.

-It is more suitable for city scenario.

-Packet delivery ratio is better.

Cons:

-Packet delivery ratio in sparse network is not well.

-Routing overhead increases in GSR.

2.2.3 A-STAR

It stands for Anchor-Based Street and Traffic Aware Routing [4]. It is used to overcome the problem that arises in GPRS and GSR. Working of A-STAR is very much similar with GSR. Only the differences between both are, in A-STAR, it

uses the actual traffic awareness to calculate the topology information that is not available in GSR.

Pros:

-It is suitable for city scenario as well in sparse network where traffic density is low.

Cons:

-Packet delivery ratio in A-STAR is low as compare to GSR.

Below is comparison between different-different routing protocols.

Table 1: Comparison of Topology Based Routing:

Parameters	Reactive routing	Proactive routing	Hybrid routing
Routing	Flat	Flat/ hierarchy	Hierarchy
Routing overhead is	Low	High	Medium
Latency	High	Low	Inside the zone is low
Scalability	Designed for small network, up to 100 nodes	>100 nodes	Designed for large network, >1000 nodes
Periodic updates are	No	Yes	Inside the zone, yes
Mobility support	Route maintenance	Periodic update	Combination of both
Routing information availability	Information is available when required	Always available	Combination of both
Control traffic	Low	High	Lower than both
Storage requirement	Depend upon no of route maintenance	Higher	Depend upon the size of zones.

Table 2 : Comparison of Position Based Routing:

parameters	GPSR	GSR	A-STAR
Packet delivery ratio	low	high	medium
scenario	highway	city	both

3. CONCLUSION

In this paper, pros and cons of various VANET routing protocols are described. The main challenges in VANET are mobility, packet delay, and packet loss. In this, topology changing very frequently due to which efficient routing protocols are required which are more robust and give efficient output. In this paper, various routing protocols are discussed. It can be position based routing or topology based. These routing protocols can be compared on the bases of various parameters like packet delivery ratio, end to end delay and throughput. Comparison between different routing protocol is shown in table 1 and table 2. In VANET, various terms are present that can affect the routing protocol like mobility, environment, velocity, link duration etc. But mobility is the main term that affects the routing protocol very much. In VANET, environment also effects the routing. In sparse network, traffic density is less, more number of obstacle are present. So, this network requires different protocol as compare to dense network in which obstacle are less. Due to these challenges and environment effect, VANET require a more efficient and robust routing protocol. Future scope is hybrid routing is a combination of proactive and reactive routing but it does not perform well in highly mobile network like in VANET.

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