

COMPARISON OF POSITION BASED ROUTING PROTOCOLS IN VANET

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Abstract — Now a day large number of vehicles moving on the road it make difficulty in driving so the percentage of casualties is increased day by day. Mostly, accident happens due to incomplete information of road conditions including traffic signals, speed, and neighbor vehicles location. A new kind of ad hoc network is emerging these days known as VANET (vehicular ad hoc network). VANET have main two types of communication vehicle to vehicle (V2V) and vehicle to infrastructure (V2I). One of the major challenges of VANET is routing the packet in effective and efficient manner. In this paper we studied the different position based routing protocols based on vehicle to vehicle communication and their comparisons.

Keywords- VANET; Position based routing; V2V; V2I; TDR;

I. INTRODUCTION

VANETs (Vehicular ad hoc networks) are classified application of mobile ad hoc network (MANET), which are used to provide communication between vehicles. VANETs are self-organized network in which vehicle communicate with each other without using any predefine infrastructure. VANETs support many applications such as traffic and safety application, entertainment application etc. There are two type of communication in VANETs, vehicle to vehicle (V2V) and vehicle to infrastructure (V2I). In vehicle to vehicle communication vehicles can communicate with each other directly using OBU (On Board Unit) shown in figure1. In vehicle to infrastructure communication vehicles can communicate with fixed equipment next to the road, it referred as RSU (Road Side Unit) shown in figure2.

VANETs have many characteristics such as predictable mobility, providing safe driving, no power consumption, rapid changes in network topology, large scale network, and high computation ability.

There are many issues and challenges in VANETs such as signal fading, bandwidth limitation, security and privacy, connectivity and routing protocol. In this paper we will discuss main challenges of VANETs is routing protocol. We presents different routing protocol based on vehicle to vehicle communication designed for both city and highway environment in next sections.

The rest of paper is organized as follow. Section 2 explains the applications of VANETS. Then we will explain different routing protocol of vehicular network in section3. In section 4 we will explain the position based routing protocol for V2V in city environment and highway environment. Then we will summarize and compares routing proto col in section 5 and then finally we conclude the paper in section 6.

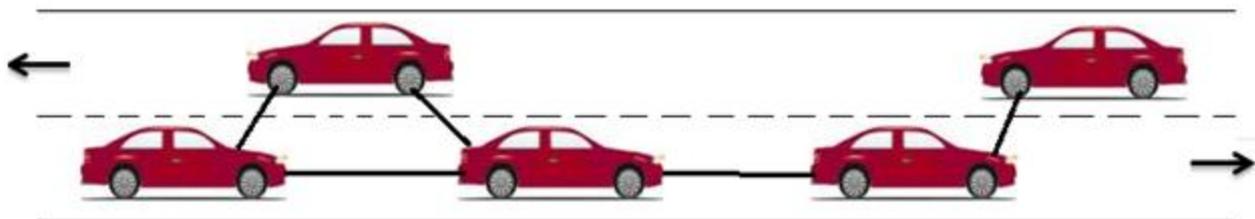


Figure 1. V2V Communication

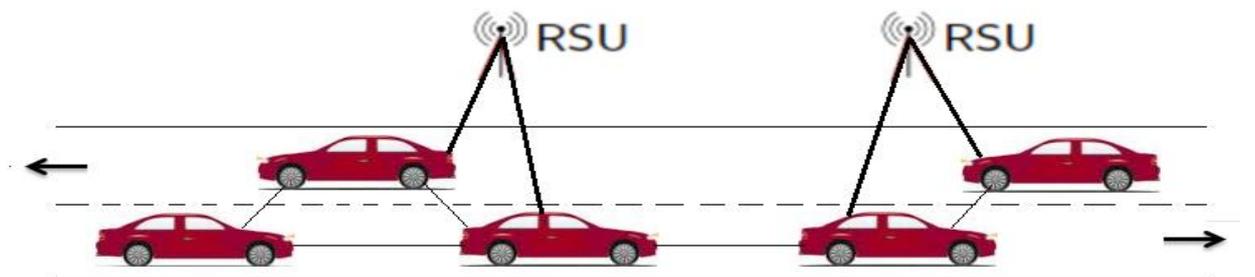


Figure 2. V2I Communication

II. APPLICATION OF VANETS

The RSU can be treated as an access point or router or even a buffer point which can store data and provide data when needed. All data on the RSUs are uploaded or downloaded by vehicles [10]. A classification of applications is also done by as vehicle to vehicle applications, vehicle to Infrastructure applications, vehicle to Home applications and Routing based applications [10]. Based on the type above communication the applications of VANETS classified into following categories:

- 1) Safety oriented
- 2) Commercial oriented
- 3) Convenience oriented and
- 4) Productive Applications

1) **Safety oriented Applications [10]:** Safety applications include monitoring of the surrounding road, approaching vehicles, surface of the road, road curves etc. The Road safety applications can be classified as:

- Real-time traffic
- Co-operative Message Transfer:
- Post-Crash Notification
- Road Hazard Control Notification
- Cooperative Collision Warning
- Traffic Vigilance

2) **Commercial Applications [10]:** Commercial applications will provide the driver with the entertainment and services as internet access, streaming audio and video. The Commercial applications can be classified as:

- Remote Vehicle Personalization/ Diagnostics
- Internet access
- Digital map downloading
- Real Time Video Relay
- Value-added advertisement

3) **Convenience Applications [10]:** Convenience application mainly deals in traffic management with a goal to enhance traffic efficiency by boosting the degree of convenience for drivers. The Convenience applications can be classified as:

- Route Diversions
- Electronic Toll Collection
- Parking Availability
- Active Prediction

4) **Productive Applications [10]:** We are intentionally calling it productive as this application is additional with the above mentioned applications. The Productive applications can be classified as:

- Environmental Benefits
- Time Utilization
- Fuel Saving

III. DIFFERENT TYPE OF ROUTING PROTOCOLS

Routing protocols for VANETS are mainly classified in two different categories according to their position accusation and the route update method [2]. They are follows:

A. Topology Based Routing Protocols

In topology based routing protocol uses available information about all links that reside in the network to forward the data packet from source to destination. These can be classified into three categories: Proactive Routing Protocol, Reactive routing Protocol and Hybrid routing protocol. Basically in Proactive routing protocol chooses the route path which usually depends on shortest path algorithm. It is also called table driven protocol, all nodes have neighbor table, so that route discovery is not required. Example of proactive routing protocol are OLSR [12], DSDV[13]. In Reactive routing protocol routing path is determine on based of requirement. It is called on demand routing protocol. When source node want to send data packet that time route discovery is done. There are many reactive routing protocols have been developed like Dynamic supply Routing (DSR) [14], Temporally Ordered Routing Protocol (TORA) [15] and Ad hoc On-demand Distance Vector Routing (AODV) [16]. In Hybrid routing protocol it uses both table maintenance and on demand route discovery. Advantages of topology based routing protocol are as It surely provide route between source node to destination node, It can send unicast, multi cast and broad cast message, less resources are required, few

bandwidth consumption. Disadvantage is more overhead, sometimes it cannot discover the complete path because of high mobility of vehicles, unnecessary flooding.

B. Broadcast Based Routing Protocols

In this routing protocol the data packet floods over the entire network. All nodes receive the data packet which is on the transmission range of source node. Whenever the destination node is outside the transmission range of source node that time this protocol is used [2]. There are mainly used for safety application like traffic jam warning, accident warning, road conditions, emergency warning etc. Advantages delivery of data packet is guarantee, minimize the overhead. Disadvantages Large bandwidth uses, many replicated packet reaches to the node [2].

C. Cluster Based Routing Protocols

In this protocol various vehicles have similar characteristic like direction, velocity, speed etc. are grouped together make a clusters in whole network. Cluster head manage the cluster. If vehicle want to send data in same cluster then it directly sends to destination node. If destination node is in another cluster then source send data packet to cluster head and cluster head forward packet to another cluster head and reach to destination. Advantage it has good scalability for large network. Disadvantages overhead increases, more delay [2].

D. Geo Cast Based Routing Protocols

In this routing protocol land is divided into zones. If the node is in the same zone, data packet forwarding is done using ZOR (Zone of Relevance). If the node belongs to another ZOR, Communication done by using zone of forwarding (ZOF). ZOF have responsibility to forward the data packet from source node to destination node. It Reduce the overhead and network congestion, Reliable packet delivery. Disadvantage is end to end delay increase [2].

E. Position Based Routing Protocols

In this protocol, whenever source node wants to communicate with destination node, its uses geographical position of node. Source finds its position using Global Positioning System (GPS). Source node finds the position of destination using location services. When source node find the neighbor node to send data packet, neighbor node finds using sending beacon message. in this protocol no need of route discovery procedure and maintenance. Advantages more suitable in VANETs, it provides good performance, no need of route discovery, lowest processing overhead. Disadvantages it needs GPS, Location server sometime goes into deadlock state.

IV. POSITION BASED ROUTING PROTOCOLS

In this paper we classified routing protocol based on the communication environment. Mostly VANET communication is classified into two categories: City environment routing protocols and highway environment routing protocols.

4.1 City Environment Routing Protocols

Mainly in City have a lot of streets, which may intersect with each other called as junctions. In city have many obstacles like building, trees etc. That may raise difficulty in receiving signal due to radio propagations. Following are the most common VANET position based routing protocol proposed for city environment.

A. Geographic Source Routing (GSR)

GSR is first position based routing protocol designed for city environment to overcome the disadvantages of GPSR. It uses position based routing with topological knowledge of network. In GSR, Source node uses static map of street to find shortest path toward the destination via Dijkstra shortest path algorithm. Drawback of GSR is that the shortest path is not optimal path because it does not consider no. of vehicle on street [5].

B. Greedy Perimeter Coordinator Routing (GPCR)

The Main Concept of GPCR is to take advantages of streets and junctions form a natural planner graph, without using any external information, it is map independent routing techniques. GPCR work in two parts: Restricted Greedy forwarding and Repair Strategy. In restricted greedy forwarding packet should always be forward to a node on junction instead of transmitting across the junction. Node that is located in the area of junction select as coordinators. In repair strategy consist two parts: on each junction it has to be decided which street packet should follow next and in between junction greedy routing use to select the next junction. GPCR also neglect traffic flow between the junctions [6].

C. Directional Greedy Routing Protocol (DGRP)

Directional greedy routing protocol is position based routing protocol that uses direction of vehicle that is moving toward the destination. By choosing the node moving toward the destination with greedy forwarding method reduces the number of hops. DGR uses location services to get position of vehicle and also assume its velocity and direction. In DGR source node select the node which moves toward the destination and is closest to destination node. DGR uses two

forwarding strategies: position first forwarding and directional first forwarding. Drawback of DGR is forwarding node does not compute the new position of neighbor node [11].

D. Predicted Directional Greedy Routing Protocol (PDGRP)

Predicated Directional Greedy routing protocol is an upgraded version of DGR which is based on same assumption as DGR. In PDGRP, weight score is calculated based on packet carrier, its current neighbors and also its possible future neighbor in very near. Forwarding node maintains 2-hop neighbor node information. Before forwarding packet, forwarding node consult with its neighbor node and also compute new predicted position of all its neighbor and then after select a node whose one-hop neighbor is moving toward the destination and closest to the destination [7].

E. Three Dimension Oriented Routing Protocol (TDR)

In this paper [3] authors represent novel routing protocol Three-dimensional scenario oriented Routing (TDR) protocol. TDR is position-based routing protocol for vehicular ad hoc network. It is first protocol that can be work in 3D scenario and this protocol give solution for routing issues in 3D scenarios. In TDR establishes a route hop by hop and transmits packets as far as possible to the optimal immediate neighbor node which is located on the same plane with the current forwarding node. TDR protocol consists two parts: Temporary destination and Process of data transmission [3]. This protocol also considers the Road Mode, Intersection mode, Intra-layer Transmission pattern and Interlayer Transmission pattern [3].

4.2 Highway Environment Routing Protocols

In highway have one way or two-way with single or multiple lanes. VANET routing protocol in highway have partially connected network, which have low node density and high mobility. Following are the most suitable routing protocol for highway scenario.

A. Greedy Perimeter Stateless Routing for Wireless Networks (GPSR)

This is first position based routing protocol designed for highway scenario. In GPSR, there is not route discovery mechanism, Node only know the geographical position of their neighbor nodes through beaconing. GPSR have two mechanism greedy forwarding and perimeter forwarding. GPSR uses greedy method if source node finds the neighbor node which is nearest to destination; if neighbor node not found in transmission range that time uses perimeter method for recovery. GPSR is best suitable for highway. GPSR does not suit the city environment [4].

B. Distributed Vehicular Broadcast protocol (DVCAST)

In DVCAST all the vehicles use a flag variable to confirm the redundancy of packets. It is utilizes information of restricted topology, by employing the cyclic ‘hello’ messages for sending the information. The DVCAST protocol segments the vehicles into three types such as: Well connected, sparsely connected and totally disconnected neighborhood [8].

C. Dynamic Time Stable Geo cast Routing (DTSG)

The primary objective of this protocol is to function even on networks with meager concentration. It vigorously regulates the protocol based on the concentration of network density and the speed of vehicles for improved performance. It constitutes two phases: Pre-stable: The pre-stable phase assists the message to be circulated within the region and Stable period: stable-period transitional node, employs store and forward method for a predefined time within the region[9].

V. COMPARISON OF POSITION BASED ROUTING PROTOCOLS

Table 1. Comparison of Position based Routing Protocols

Protocols	Scenario	Forwarding strategy	Recovery strategy	Realistic Traffic flow	Digital Map required	Location services required	Predictive
GSR	City	Greedy	Carry & Forwarding	YES	YES	YES	NO
GPCR	City	Restricted Greedy	Carry & Forwarding	YES	YES	YES	NO
DGRP	City	Greedy	Carry & Forwarding	YES	YES	YES	YES
PDGRP	City	Greedy	Carry & Forwarding	YES	YES	YES	YES
TDR	City	Greedy	Perimeter	YES	NO	NO	NO

GPSR	Highway	Greedy	Perimeter	YES	NO	YES	NO
DVCAST	Highway	Multi-hop	Carry & Forwarding	YES	NO	NO	NO
DTSG	Highway	Multi-hop	Carry & Forwarding	YES	NO	NO	NO

VI CONCLUSION

Routing is most challenging issues of VANETs, because of dynamic network and high mobility. Position based routing protocols are most suited to high mobility and dynamic network. Position of the vehicle is one of the most important information in routing. Position based routing protocol need information of about physical location of other vehicles. In this paper we present the briefly survey of position based routing protocol for vehicle to vehicle communication. This paper presents different routing protocol operable in city environment as well as highway environment. We also present other categories routing protocol. We have also present TDR protocol that is first 3D dimension routing protocol for city environment.

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