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SURVEY: POSITION BASED ROUTING PROTOCOL FOR CITY ENVIRONMENT IN VANETS

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Abstract — *Recently VANETs have been most extensive topic for research due to its characteristic. In VANETs routing is a main challenging task due to network partitioning, high mobility and city environment characteristics. This characteristic of VANETs degrades the performance of routing protocol. Position based routing protocol is most suitable for highly dynamic and mobility network. In this paper we provide brief summary of different position based routing protocol. We focus on vehicle to vehicle communication based routing protocol in city environment. We discuss pros and cons of routing protocols. This study summarizes and compares all V2V routing protocol of city environment.*

Keywords- *VANET; Position based routing; V2V; GPSR; GSR; TFOR; GPCR;*

I. INTRODUCTION

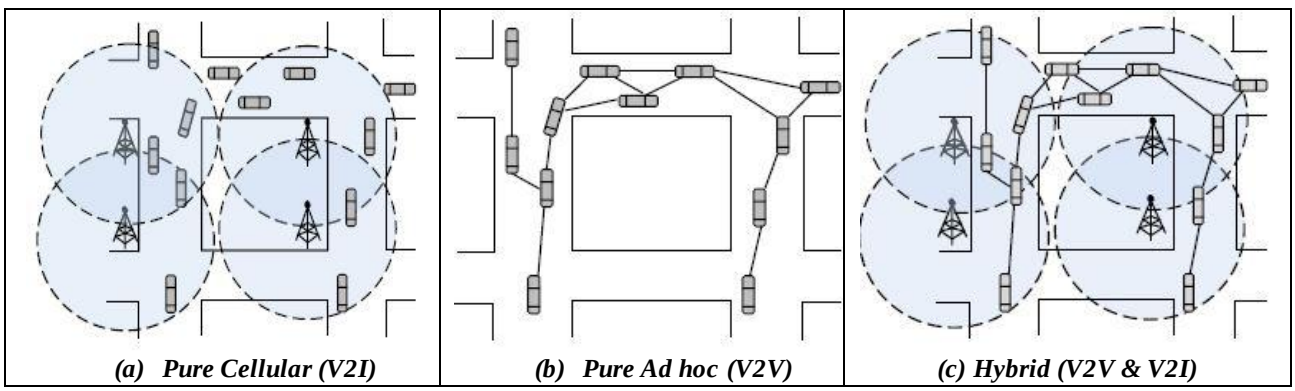
Vehicular ad hoc networks are kind of mobile ad hoc networks which are used to provide communications between vehicles [4]. VANETs are self-organized networks in which vehicles communicate with each other without using of infrastructure. IEEE 802 committee defined wireless communication standard, IEEE 802.11p, used for safety on the road and many other vehicular applications [5]. The Federal Communications Commission (FCC) has allocated 75 MHz of bandwidth, which operates on 5.9 GHz for short range communications between vehicle-to-vehicle communication (V2V) and vehicle-to-infrastructure communication (V2I)[4]. VANETs use dedicated short range communication (DSRC) for both V2V and V2I. The range of DSRC is 1000 m which is suitable for both V2V and V2I [5]. Vehicular communication is possible through either vehicle to vehicle (V2V) or vehicle to infrastructure (V2I) or both. The goal of VANETs is to build an intelligent transportation system (ITS). It supports a wide variety of applications including prevention of accidents, traffic flow control mechanisms, information services, real-time alternate route computations, and provision of Internet access to the vehicles on motion.

The rest of paper is organized as follow: Section 2 explains the architecture of vehicular network. Then we will explain the position based routing protocol for V2V in city environment in section 3. In section 4 we will summarizes and compares routing protocol and then finally we conclude the paper in section 5.

II. VANETs ARCHITECTURE

In VANET communication, information can be disseminated and collect through use of existing infrastructure or ad hoc network or by combination of both techniques. VANET can be classified into three categories (i) Pure Cellular (ii) Pure ad hoc (iii) Hybrid.

In Cellular based vehicular network are designed to support infotainment related applications, for example, downloading data, web browsing, getting latest news, parking information, and traffic information. Such type of network is called pure cellular or WLAN and is shown in Figure 1(a) Communication in such a network is based on vehicle-to-infrastructure paradigm. Vehicles communicate with existing infrastructure, for example, base station to disseminate or obtain useful information. Although, Cellular/WLAN-based networks support wide range of vehicular applications, they still suffer from one major drawback and that is the requirement of fixed infrastructure deployment.



(a) Pure Cellular (V2I) *(b) Pure Ad hoc (V2V)* *(c) Hybrid (V2V & V2I)*

Figure 1. VANET Network Architecture [2]

This problem is solved by ad hoc networks where information is propagated without the requirement of specialized infrastructure as shown in Figure 1(b). This type of network is often called vehicular ad hoc network (VANETs) and is based on vehicle-to vehicle communication. Vehicular ad hoc networks are self-organized network where packet is delivered by multi-hop fashion. Although, ad hoc net- works do not require fixed infrastructure support but vehicles limited transmission range and high mobility causes rapid topology changes. Such rapid topological change not only causes network partitioning but also leads to partitioning and routing link failures. Figure 1(c) shows the hybrid architecture; a combination of cellular and ad hoc networks. Pure ad hoc net- work suffers from network partitioning and mobility.

III. POSITION BASED ROUTING PROTOCOLS

There are many routing protocols proposed among them position based routing protocol is mainly suitable for VANETs. In position based routing protocol whenever source node communicates with the destination node using their geographical position. In this routing protocol position of source and destination can find using the Global Position System (GPS) and location services. Using position of vehicle sending information become easy. When source node want to send data packet find the position of destination node, if destination node is within transmission range of source node then directly send data packet. If destination node is node not in transmission range of source node then source node finds the neighbor node which is nearest to destination. Source node broadcast beacon message to its neighbor node with in transmission range, neighbor node send the reply message containing position of node. Source node contains the table of one hop neighbor node. Using one hop neighbor information source can send data packet to destination. Position based routing protocol are design for city environment and highway environment. Many position based routing protocol are proposed for V2V & V2I communication. Some of them traffic aware routing protocol. In position based routing protocol neglecting of traffic flow can degrade the perfo rmance in delivery ratio and hop count and end to end delay. Classification of position base routing protocol is shown in Figure 2.

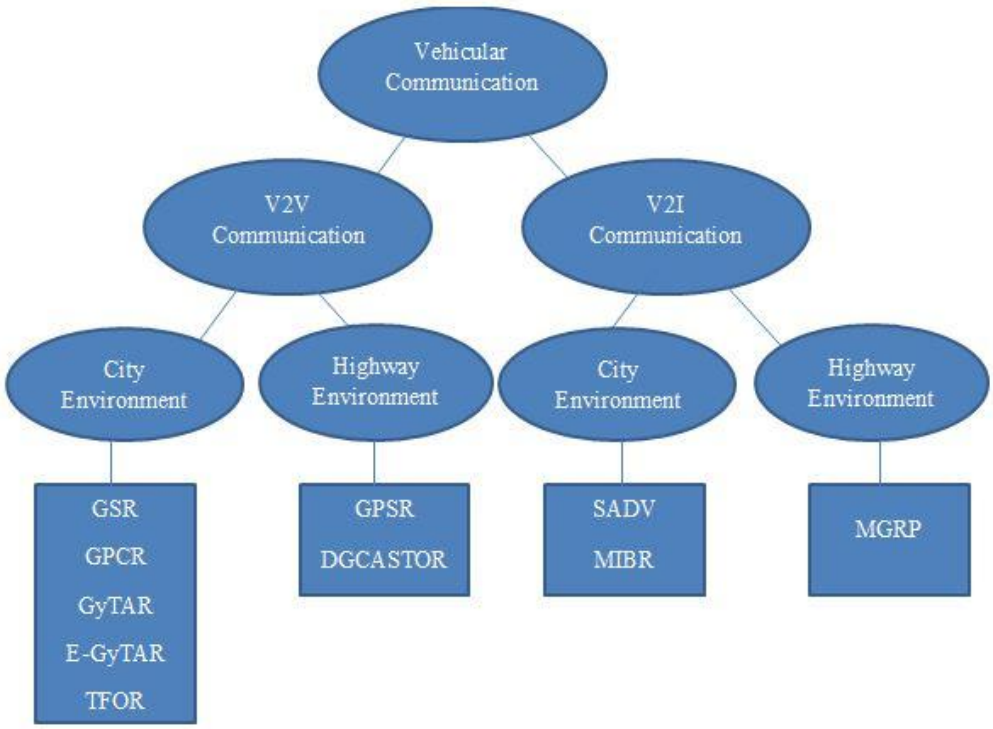


Figure 2. Classification of Position Base Routing Protocol[1]

In this paper we discuss the position based routing protocol that is based on V2V communication and mainly they are designed for city environments. We also discuss first position based routing protocol that is GPSR routing protocol, it is designed for highway environment.

A. Greedy Perimeter Stateless Routing (GPSR)

In GPSR authors proposed novel routing protocol that is based on position of vehicle, in GPSR protocol position is find using GPS (Global Positioning System), position of neighbor node will find using the beacon message, and sender vehicle can find the distance of destination node using the location services like GLS, RLS, and HLS [1]. GPSR send data packet to its neighbor node which is nearest to the destination. It uses the single hop information which store in sender table. GPSR work in two parts (i) Greedy Forwarding (ii) Perimeter Forwarding, in greedy forwarding method vehicle send the data packet to neighbor node which is nearest to the destination. If neighbor node not found in

transmission range that time greedy method fails, Perimeter forwarding use in recovery strategies. In perimeter uses right hand rule for finding the neighbor node, sends data to its neighbor node and again that process repeat still the greedy forwarding phase will not start again [10]. Figure 3 shows greedy forwarding strategy, in which source node S send data packet to a node closest to the destination 'D', in this case 'S' sends packet to 'B'. In Figure 4 shows perimeter forwarding strategy in which node 'A' cannot find the closest node to destination 'D'. So it will use right hand rule principle and forward packet to its neighbor node 'B', again 'B' forward packet to 'C' still greedy forward phase not start.

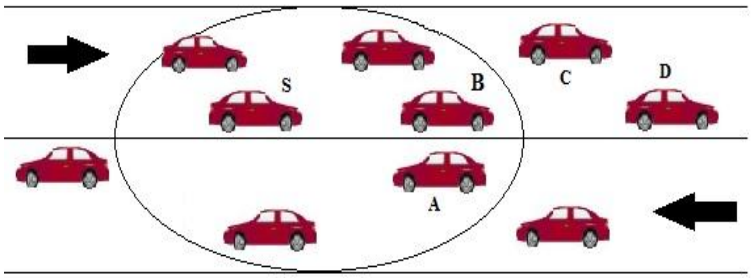


Figure 3. Forwarding Strategies in GPSR

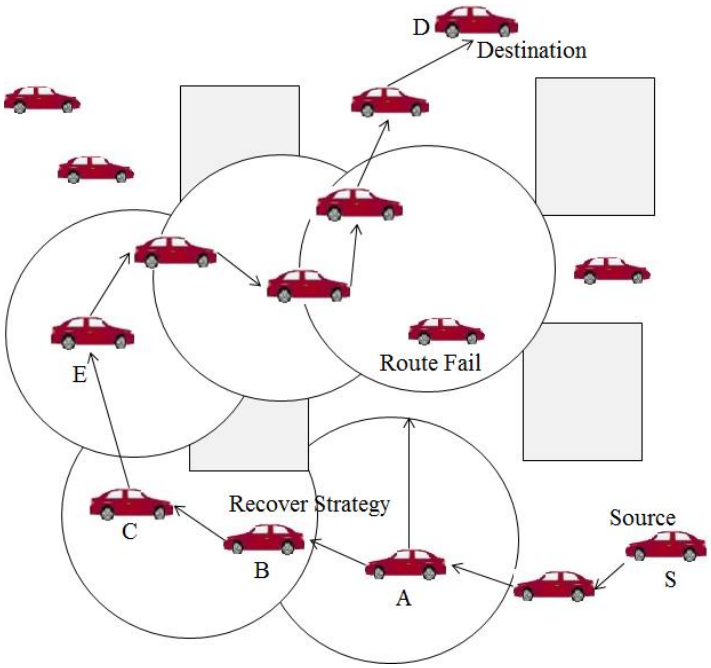


Figure 4. Recovery Strategy in GPSR

B. Anchor based Street and Traffic Aware Routing (A-STAR)

Anchor based street and traffic aware routing is designed for city environment. This protocol removes the drawback of GSR by considering vehicular traffic of the street. A-STAR is traffic aware: the traffic on the road determines whether the anchor point of the road will be considered in the shortest path. A-START routes based on two kinds of overlaid maps: a statically rated map and a dynamically rated map. A statically rated map is graph that displays bus routes that imply stable amount of traffic flow [12].

C. Geographic routing in City Scenarios (GPCR)

GPCR is map independent routing techniques, GPCR is to take advantage of the fact that street and junction from a natural planar graph, without using any global or external information such as static maps [8]. GPCR consist of two phase (i) restricted greedy Forwarding (ii) repair strategy [8]. In restricted greedy forwarding packet always forward to vehicle on junction instead of forwarding packet across a junction. Vehicle located in area of junction selected as coordinator, coordinator broadcast its role with position, if forward vehicle is not located on junction that time packet carried out by the vehicle still the next junction came. Authors introduced a novel recovery strategy divide into two parts (i) each junction decide packet should follow the which line (ii) routing between two junction done by greedy

forwarding. Drawback of GPCR is neglect the traffic flow between two junctions [8]. As shown in Figure 5 node *A* would forward packets to node *B* which locates on the junction even though the radio range on node *A* can be covers node *C*.

D. Greedy Perimeter Urban Routing (GPUR)

In greedy forwarding method node choose neighbor node which is nearest to the destination, similar to the transfer node in transmission range, it may create issues of selecting junctions and numerous modification in traffic in cities. So to solve these issues GPUR is proposed.

The GPUR select a relay node depending on information about the features of the roads, which is identical to GPCR. On the other hand, contrasting to the GPCR, the GPUR chooses a relay node from nodes with 2-hop neighbors to minimize the routing error issues and the prospect of local maxima in cities as depicted [11]. GPUR sends intermittent beacon messages to approximate the occurrence of 2-hop neighbors amongst all the relay candidates. The isochronal beacon messages are employed to appraise the existence of 2-hop neighbors, which leads to severe delay in transmission. Moreover the GPUR also fail to determine the local maximum problem [11].

E. An improved vehicular ad hoc routing protocol for city environments (GyTAR)

Authors proposed inter-vehicle ad hoc routing protocol called improved Greedy Traffic Aware Routing protocol suitable for city environments [7]. GyTAR have two parts (i) dynamic junction selection (ii) forwarding packet between two junctions using an improved greedy strategy shown in Figure 6. GyTAR choose junction dynamically and one by one, it consider both traffic variation and distance to the destination. When choosing next junction a vehicle see the position of neighbor junction using digital map. A score is given to each junction considering the traffic density and the curvemetric distance destination [7]. Highest score junction is the nearest to the destination vehicles. Once the destination junction is decided, improve greedy forwarding strategy is used to forward data packet between two successive junctions. For that all packet are marked the location of the next junction, each vehicle maintains a neighbor table which contain position, velocity and direction of each neighbor vehicle are recorded [7].once improved greedy methods fails recovery strategy is required. GyTAR uses carry and forward method, in which forwarding vehicle carry the packets until the next junction [7].

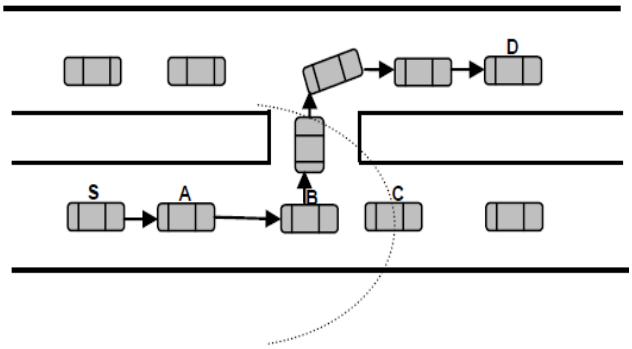


Figure 5. GPCR routing along junctions[2]

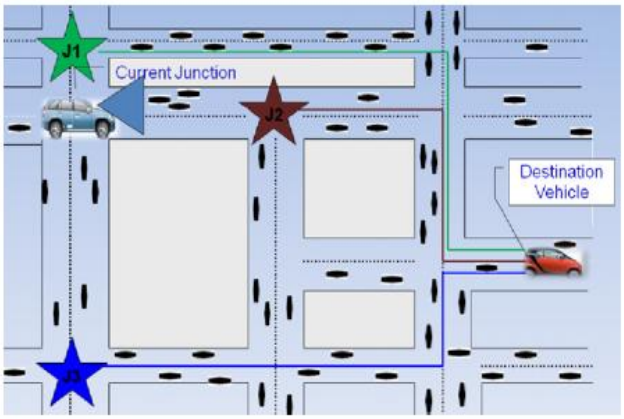


Figure 6. GyTAR junction selection mechanism[1]

F. Enhanced junction selection mechanism for routing protocol in VANETs (E-GyTAR)

This paper is design for city environment and it consider the real time city environment configuration with bi-directional and multi-lane roads [6]. It takes vehicles speed and direction to select the junction and route the data packet. In E-GyTAR junction are selected dynamically, in which considering the number of vehicle moving toward the destination, junction with highest score selected as next junction. Position of destination vehicles can be finding using GLS [6]. This protocol uses Infrastructure free traffic information system to find the traffic density [6], IFTIS form a cell between two junctions, it divides the road length into cells. Cells formed in such way that each vehicle belongs to the one of the cell. Center of cell have small circles and that lead the vehicle as a cell leader, this vehicle collect the information of cell and send to the end point of road. Packet forwarding between to junction is done using improved greedy forwarding method, neighbor table is maintained which record the direction, velocity, speed of vehicle. E-GyTAR uses carry and forward method to recover from local maximum problem. E-GyTAR gives higher packet delivery ratio and lower end to end delay than GyTAR [6].

G. Traffic Flow Oriented Routing Protocol for VANTEs (TFOR)

In this paper authors represent a novel position-based routing protocol for vehicular ad hoc network to enhance traffic safety and traffic organization and facilitate driving through a smart transportation system [3]. It considers a real-

time city based scenario with multi-lane and bi-directional roads. It chooses best junctions which have high traffic flows to forward the data packets. Two working phases (i) the new junction selection mechanism (ii) routing between the junctions is based on two-hop neighbor information. This protocol selects the junction dynamically considering both directional and non-directional traffic flow density. Sending vehicle node uses a digital map to find the location of neighbor junction. It determines the curvemetric distance from each neighbor junction to the destination vehicle [3]. It chooses the junction with maximum score as a next junction. This protocol uses the infrastructure-free traffic information system (IFTIS) [5] to calculate traffic density between two junctions [3]. In this paper road is divided into small cells of fixed size. The vehicles into the same cell form a group. The cell size is equivalent to the vehicle's transmission range that is around 250 m. The cells superimpose in such a way that each vehicle belongs to at least one of the cells [5]. Vehicle that is nearest to the cell's center is select as the group leader. Group leader generates and updates the cell density packet(CDP), it will contain the number of vehicle moving towards the destination, number of vehicle moving opposite to the destination, road id, cell id, time, cell center position. This protocol is based on two-hop neighbor information, the forwarding node uses two hop neighbor table and greedy forwarding to send data packet to its neighbor to the neighbor's neighbor that is closest to destination. TFOR uses the carry-and-forward technique to recover from the local optimum situation [3].

IV. COMPARISON OF VANET ROUTING PROTOCOL

TABLE 1.COMPARISON OF VANET POSITION BASED ROUTING PROTOCOL

Protocols	Scenario	Hop Count	Forwarding strategy	Recovery strategy	Realistic Traffic flow	Digital Map required	Location services required	Predictive
GPSR	Highway	Single Hop	Greedy	Perimeter	YES	NO	YES	NO
GSR	City	Single Hop	Greedy	Carry & Forwarding	YES	YES	YES	NO
A-STAR	City	Single Hop	Greedy	Carry & Forwarding	YES	NO	YES	NO
GPCR	City	Single Hop	Restricted Greedy	Carry & Forwarding	YES	YES	YES	NO
GPUR	City	Two Hop	Restricted Greedy	Carry & Forwarding	YES	YES	YES	NO
GyTAR	City	Single Hop	Improved Greedy	Carry & Forwarding	YES	YES	YES	YES
E-GyTAR	City	Single Hop	Improved Greedy	Carry & Forwarding	YES	YES	YES	YES
TFOR	City	Two Hop	Improved Greedy	Carry & Forwarding	YES	YES	YES	YES

V. CONCLUSION

Routing is major challenging issues for VANET. This paper discuss various Position based routing protocol designed for Vehicle to vehicle communication in city environment. However it is difficult to designing a routing protocol that is suitable for all VANET applications. Therefore review of various positions based routing protocol was carried out. The performance of VANET routing protocol depends on various parameter like mobility, hop-count, and recovery strategy and so on. Therefore this paper had carried out an extensive survey and compare different position based routing protocol designed for vehicle to vehicle in city environment. Even though there is not any single protocol that is suitable for all VANET application, all this routing protocols are suitable with its own communication environment.

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