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Stochastic R-Tuple Estimation for Unicast Routing Protocol in VANET

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Abstract: Vehicular Ad hoc NETwork (VANET) is a latest technology that enables vehicles to communicate with infrastructure and with vehicle. It comes under the sub class of Mobile Ad hoc NETwork (MANET). In VANET all participating nodes are highly moving. VANET has two type of communication vehicle to infrastructure (V2I) and vehicle to vehicle (V2V). Each vehicle equipped with on board unit (OBUs) that gives the service of communicating with road side unit (RSUs). Main motivation behind VANET is to provide safety from accident and avoid the accident To manage the traffic VANETs play an important role for Intelligent Transportation Systems (ITS). VANET has high mobility compare to MANET. Due to high mobility, routing is biggest challenge. In this paper, reliability tuple estimation protocol (RTEP) is proposed for unicast routing protocol in VANET. R-Tuple plays a vital role in selecting reliable route between source and target vehicle. R-Tuple has three parameter range, direction and speed of the vehicle. Reliable route is selected based on these parameters.

Index terms: _VANET, Reliability Tuple, RTEP, Beacon message, position based protocol._

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I. INTRODUCTION

The creation of Vehicular Ad Hoc Networks (VANETs) is done by applying the principles of mobile ad hoc networks (MANETs) based on this it is conclude that when in domain of vehicles, principles of MANET are applied, then they form VANETs. Vehicular ad hoc networks (VANETs) are the special kind of Mobile ad hoc networks (MANETs) [6]. The VANET is a network of moving vehicles; the movement of vehicles is done at a relatively high speed that provides the facility to exchange traffic related information among vehicles in the network. To manage the traffic VANETs play an important role for Intelligent Transportation Systems (ITS). Two types of communication is there in VANET one is inter-vehicle Communication meaning is communication between vehicle to vehicle (V2V) and roadside to vehicle communication meaning is vehicles directly communicate to infrastructure (V2I). The VANETs main aim is to deliver the safe and exact information to the drivers and about the roads. The communication between source and destination is done in two ways are one hop communication and multi hop communication. In one hop communication the source vehicle does directly communication to the destination vehicle but multi hop uses the intermediate nodes to communicate from source vehicle to destination vehicle. The information can be of many types such as traffic contestant notification, emergency messages, peer to peer communication, and commercial application for advertising a few projects. VANET tries to add every participating Vehicle with a wireless router or node, it allows the vehicles around 100 to 300 meters of each other to attach and create a network with a wide range. Here each vehicle is connected with the wireless network and it uses the intermediate vehicle for forwarding the messages. The first networks that will join this technology are fire and police mobiles to interact with one another for the security purpose. This new technology to get more necessary information allows to monitoring an environment remotely. The responsibility of communication between the nodes is greater for the energy consumption when we compared it with monitoring and processing
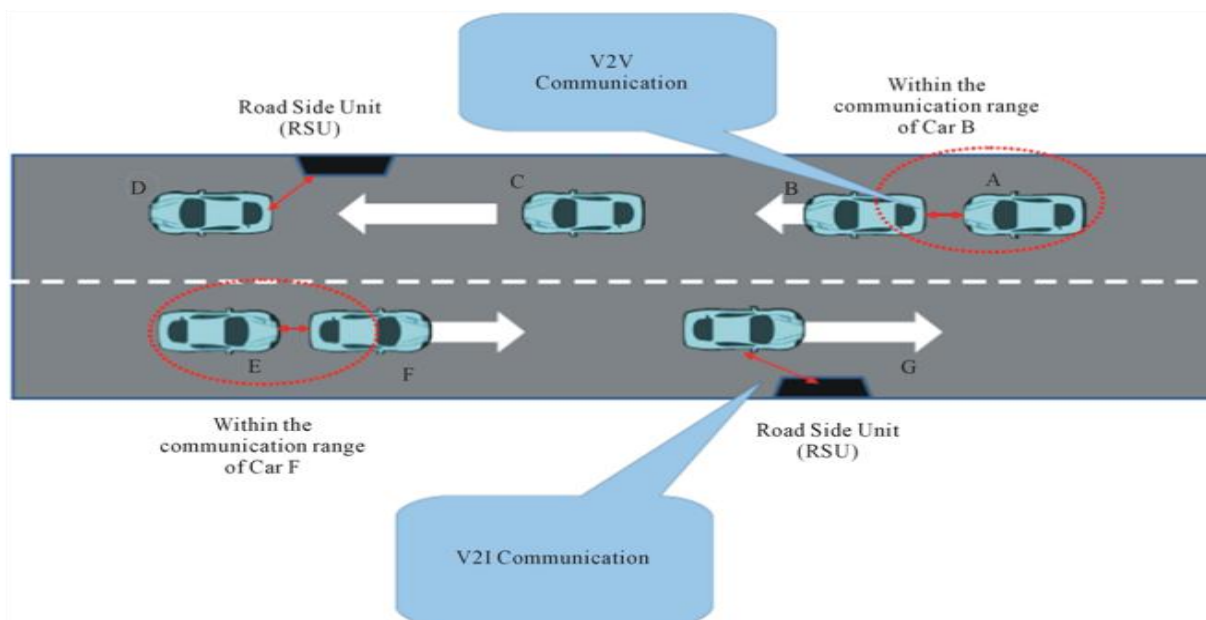
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Figure 1: A sample scenario of VANET.

VANETs have several features such as scalability, dynamic network topology, road restrictions and high mobility. The applications of VANETS are used to alert the drivers from traffic jams, situation of the road to avoid accidents[11]. It is also be used to broadcast attentive messages to the drivers of back vehicles to avoid back end accident on highways.
VANET is growing technologies because they justify, newly, the attention of the academic institutions and the industry. The vehicular communications (VC) happen in the centre of various initiatives of the research that increase the security and the effectiveness of transportation systems, for example, acknowledgments of the ambient situations (snow, fire etc.), traffic in the road conditions (emergency, construction sites, or congestion).

II.   RELATED WORK

Yong Xiang a,Zheng Liu b [3]presented a geographic stateless VANET unicast routing protocol for VANET(GeoSVR). In GeoSVR the use of optimal forwarding path is to solve issues related to local maximum and sparse connectivity by given road type estimation. In previous the restricted forwarding algorithm is used to find the next hop in a restricted range for reducing the packet loss which is caused by unreliable wireless channel.

Sivakumaret al [6] explained about a new unicast stable routing protocol (SRP). In VANETs SRP is used to route packets from source vehicle to the destination vehicle. The main proposed work of this protocol is design a metric which is called as Reliability Index. Between each link and route reliability Index is there. Based on the RI and the number of forwarded vehicles possible route is there with respect to source vehicle. To send the messages from source to the destination vehicles the best route is selected. In case of occurring the disconnection in the active route then we select the next route which is best in the Sorted Route Table.

When disconnection occurs this reduces the overhead packets to find a new route. The throughput of the broadcast will also increase.

N.V. Dharani Kumari [1] proposed an AHP mechanism which combines multiple decision criteria into a single evaluating function for improving the routing protocol over a number of metrics. The influence of several routing metrics are the link lifetime, node status and node density on forwarding decision , predictable mobility is activated in a organized structure to make an effective geographical forwarding decision.

P.A. Sumayya, P.S. Shefeena [5] designed a VANET based system for broadcasting information related to traffic inside the network. This system has the responsibility to broadcasting the information the drivers about the things happening within the communication range. For extending the range of emergency warnings messages and to balance the previous traffic signals methods for pre-empting the traffic light. This is the easy method is presented it is for implementing the tool for deploying On Board Unit (OBU) with VANETs and they also presented the SMARTDRIVE app. This is the application for the rapid progress of VANET.

According to Omar Sami Oubbati, Abderrahmane Lakas[4]   for supporting the ad hoc routing between UAVs and VANET in addition toUAVs themselves they presented the UVAR protocol and its extension. The main focus of the UVAR protocol is on urban vehicular background. The main aim of this is to enhance the performance of routing which is based on road traffic in the ground. In this they presented set containing two protocols are one is UVAR-S for air-to-air communication and another is for UVAR-G for ground-to-air communication.

Jia Li and Ping Wang [2] proposed two schemes on GPSR. The first scheme is proposed to for introducing the

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coefficient of dependence (CoD) concept. The CoD concept considers the factors affecting factors the beacon interval to set the position update interval dynamically, where the including factors are distance between sender and potential receiver, frequency of data messages delivered by vehicles, number of cars about and degree of matching the driving trend of the neighbor vehicle with the predicated message forward direction.

III.   PROPOSED WORK

In this paper R-Tuple is introduced and it estimates through the beacon message. There two main part of proposed work R-Tuple and beacon messages.

a) Reliability Tuple:

To measure the reliability of node between source and target vehicle R-Tuple is proposed. Range, direction and speed are the parameters of R-Tuple. RT vector metric has been used to choose the best path between source and destination. RT vector of a communication link has been represented as stated below:

$$RT(i,j) = \{ r, d, s \}$$

Where

i- Origin Vehicle(Source vehicle)
j- Target Vehicle.
r- Range of Vehicle.
d- Direction of Vehicle.
s- Speed of Vehicle.

If source vehicle communicates directly to the target vehicle then value of 'r' will be 1, for multi vehicle value is 0. In multi vehicle communication 'd' has three value 1, 11, and 0. if vehicle in same direction the value is '1'. if vehicle in towards direction then value is 11 and 0 for opposite direction. Speed 's' has two values 1 and vehicle's own speed, if vehicle reply 1 then vehicle is in same speed else it gives own value

Parameter	Values	Description
Range	1	vehicle in communication range.
	0	Out of range.
Direction	1	Same direction.
	11	Towards direction.
	0	Opposite direction.
Speed	1	For same speed.
	0	For different speed.

Table1. Showing assigned value of RT.

Range is calculated by sending beacon messages to neighbor vehicles if vehicle reply within the threshold time then vehicle in range. Information of speed and direction is attached with beacon message for calculating speed and direction of neighbor vehicle. With the help of beacon messages R-Tuple is estimated.

b) Beacon Message Frame

Beacon frame is the management frames which comes in IEEE 802.11[9] based on WLANs. Beacon message Frame is also known by the name is 'hello' packet, these frame are small in size. Access point (AP) transmit beacon frame periodically to neighbour node.
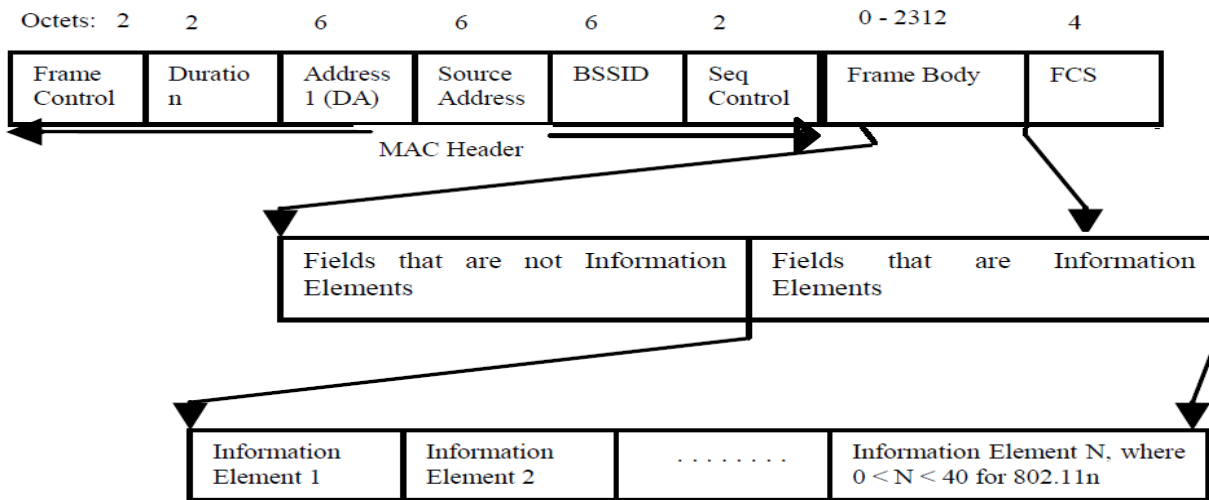
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Figure 2: Beacon frame format

Beacon includes 24 octets for MAC header, 0 to 2312 octets for Frame Body, and 4 octets for Check Sequence (FCS). The Frame Body is a field which contain two field non informational fiels and informational field. Non Informational field is mandatory. In information field, additional field is embed according to need.

Fields that used for embed additional information in beacon frame

i) SSID Field.

How to use of SSID field for carrying additional information in beacon was originally proposed by R Chandra et al [11]. It includes probe request, response, probe association and re association. Element id for SSID is '0' and maximum limit is 32 character. Main advantage of SSID is there no need of modification of kernel at client device.

ii) BSSID Field.

Size of this field is fixed to 6 octet, it shows the currently used MAC address by station in AP. It helps to identifying uniquely BSS. It doesn't carry large information due to limited size.

iii) Information Element (IE) Field.

802.11 provide the facility of carry non standard or 'vendor specific information' in Information Element field (IE) of beacon frame. Id of this field is ELEMENT ID 221, it always present in last of frame body and it carries up to 253 octet information. Figure 3, shows the general structure of the Information Element (IE) Field
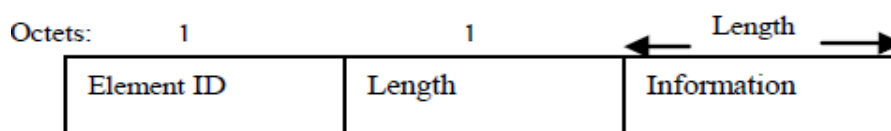

Figure 3: Structure of Information Element

Three fields contain information about the element of beacon frame and length of the first two fields.The length of the fields is fixed to 1 octet.

IV. PROPOSED ALGORITHMS

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In VANETs there is need of robust routing protocol that work efficiently in frequently disconnection environment due to heavy mobility and dynamic topology. RTEP (R-Tuple Estimation Routing Protocol) is proposed for efficient routing in distributed disconnection environment to achieve high packet delivery ratio. RTEP has two phase finding all routes phase and filter route phase. For finding the routes and selecting appropriate route two control message is used

ROUTE_REQ and ROUTE_REPLY. Working procedure of RTEP is:

   i. *Find all possible routes.*
   ii. *Broadcast beacon message to each route that carries additional information.*
   iii. *Filter routes based on R-Tuple parameters.*
   iv. *Select the best route.*
   v. *Forward packet through selected route.*

a) Route request

Suppose Vs and Vt are the source vehicle and target vehicle.

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i. *Set R // available routes table*
ii. *Broadcast ROUTE_REQ (Vs,Vt) message.*
iii. *If R= Φ //no route available.*
iv. *Broadcast again.*
v. *Until R≠ Φ.*
  else
  store route and forward.
vi. *end if.*

When the route request beacon message is broadcasted to all neighbor vehicles and the destination vehicle repliesto the route request message as route reply message that contains the additional information.

b) Reply of route request

After receive the route request vehicle (Vi) checks.
i. *If Vi=Vt*
ii. *Send ROUTE_REPLY (Vs,Vt).*
iii. *Else*
iv. *R=Vi // add vehicle to set R.*
v. *Vi=Vs.*
vi. *End if*
vii. *Broadcast ROUTE_REQ (Vs,Vt) message.*
viii. *Repeat step i to iv.*

If a vehicle Vi have more than one route, all information contain in route reply message of Vi and this result is stored in Reliability Table (R). This table is filtered based on R-Tuple parameters. R table helps in choosing the best route.From figure 4, possible paths from source and destination vehicles are shown.

According to the figure4, red vehicle is source vehicle and the green vehicle is target vehicle, In traditional routing protocol considers all possible path for routing the packet but in VANET scenario vehicle moves in different directions with different speed, there is no guarantee of efficient routing. To make efficient routing it is necessary to filter all possible path based on range, speed and direction of the participating vehicle in the VANET.Where V12 is the source vehicle and V4 is the target vehicle. As we seen in figure 2, two paths are not in the same direction and other paths are in the same direction. If selected path is not in the same direction then very less possibility of forwarding message to the target node. If the speed of all vehicles is same then routing is possible.
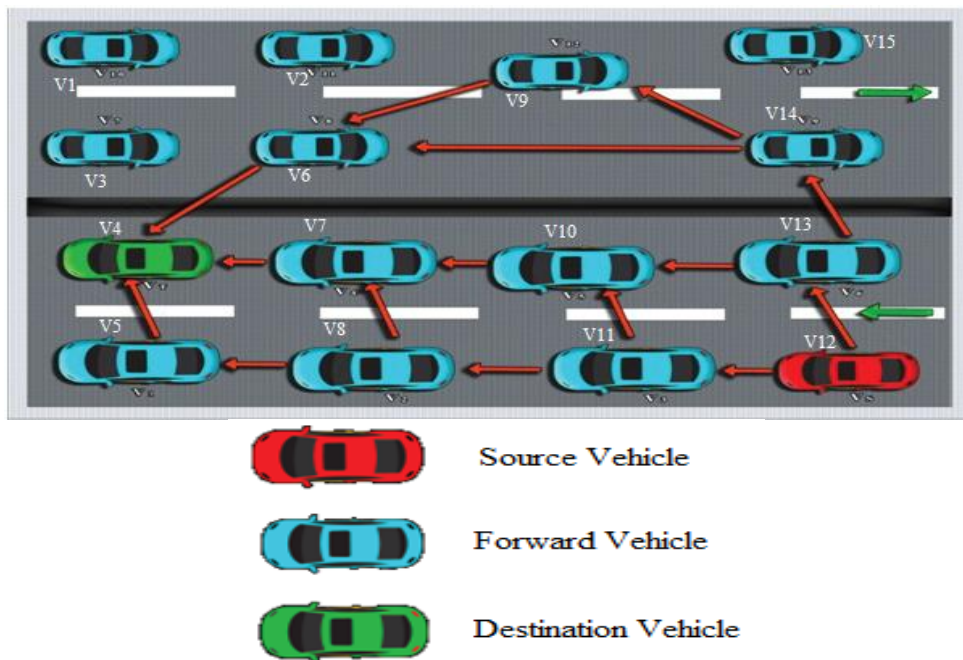

Figure 4: Highway scenario of VANET

This paper mainly focuses on filtering the all possible path by using R-Tuple metric.

Routeid	RT value	No.of forwarded vehicle
1	V12-V11-V8-V5-V4.	3
2	V12-V13-V10-V7-V4.	3
3	V12-V11-V10-V7-V4.	3

4	V12-V13-V14-V9-V6-V4	4
5	V12-V13-V14-V6-V4	3

Table2. Showing sample value of RT.

Above are the all possible available routes. After filtering by RTEP routes is:

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| Routeid	RT value	No.of forwarded vehicle
1	V12-V11-V8-V5-V4.	3
2	V12-V13-V10-V7-V4.	3
3	V12-V11-V10-V7-V4.	3

Table3. Showing value of RT after filter

V CONCLUSION

In this paper, RTEP protocol is proposed for efficient routing. R-Tuple (RT) is used for choosing the best route between two nodes. Beacon message is used in RT estimation. by RT it easy to find and filter routes in VANET. To overcome the problem of selecting a reliable route between the source and target vehicle it RTEP plays major role. The main focus of RTEP is filter routes based on the direction of the vehicle. A vehicle moving in opposite direction means there is very less chance of forwarding message source to target vehicle due to dynamic topology. The packet delivery ratio of the RTEP is high, compared to other protocols like AODV, DSR, and DSDV. The future work is to enhance performance by applying some other techniques. Prediction based technique if apply in future for RT then RTEP may give the better result.
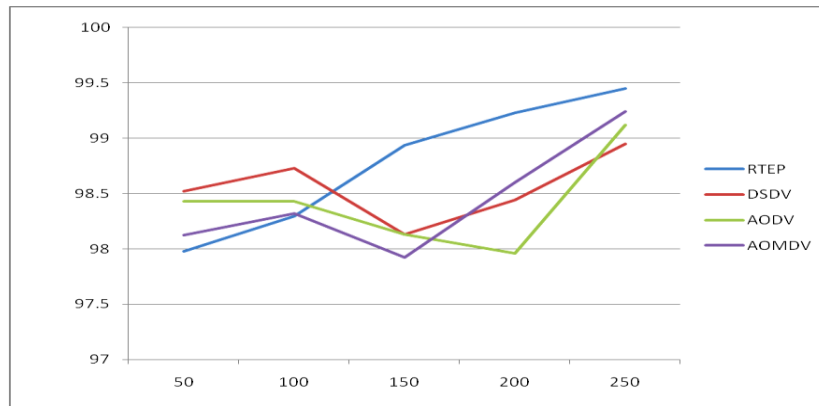
Fig5: PDR Comparison graph.
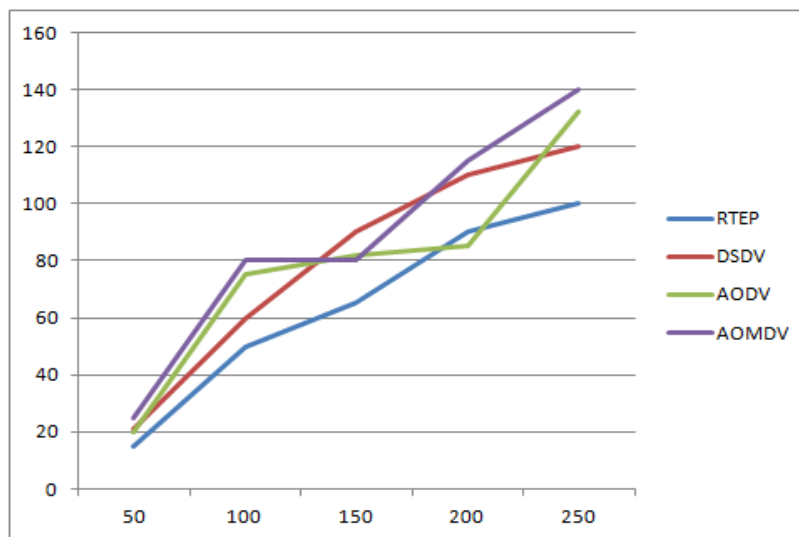
Fig6: End-To-End Delay Comparison graph

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