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An Ethical Survey on Non-Delay Tolerant Routing Protocols for VANET

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Abstract— Intelligent Transportation system is a potential system which uses Vehicular Ad hoc Networks (VANET) with internet for its safety driven applications. VANET is infrastructure less and the vehicles form a self-structured network. During data forwarding, the vehicles undergo congestion which is a vital issue related to VANET. To overcome this the data has to be propagated in a particular path in optimized fashion . Routing protocols play a vital role for the propagation of data among nodes. This paper reveals the general idea of position routing protocols with much emphasize on Non delay routing protocols. Various parameters such as packet delivery ratio , end to end delay , throughput and cost were analyzed using hybrid NDTN routing protocols. It also focuses on various aspects of VANET like architecture, an overview of routing protocols, position based routing protocols, classification and related works contributed by various researchers.

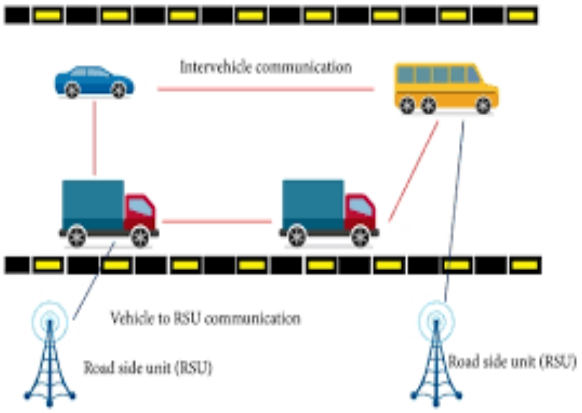
Keywords— Beacon,Overlay,End to End delay, Packet Delivery Ratio

I. INTRODUCTION

Nowadays the vehicles on the road face many problems such as an accident, traffic congestion, link failure[1]. A Survey reveals that for every minute about 16 die in the road due to the accident. Hence a traffic safety measure to be imparted to the driver. As the automobile industry has inbuilt wireless devices and GPS devices, the communication has become more reliable and easy. Apart from this, the VANET provides a wider knowledge to make the vehicles talk to each other about current traffic and relative movement of vehicles. Vehicular Ad Hoc Network(VANET) is a network of vehicles which considers vehicles as network nodes. The features such as self organization, self healing and auto configuration plays a vital role in VANET. Vanet is a remarkable area for research analysis and development. A Vehicular adhoc network is a generic communication which can be applied to smart transportation systems. VANET provides a well organized connectivity all over the vehicles. As the position of the vehicle changes frequently VANET implements the fusion network architecture. It uses WLAN and a 3G connection for its communication. Intelligent Transportation System is incorporated inorder to ensure safety. The other important application of VANET is Infotainment application which is used for multimedia data dissemination between nodes. Today there is an enormous increase in mobility of vehicles. As a result the traffic congestion of vehicles occurs which leads to blockade of road. To overcome congestion vehicular Adhoc Network routing protocol come into existence. Vehicular network topology is heterogeneous. The topology in VANET varies from dense topology to sparse topology. The subsequent sections include VANET architecture, classification of routing protocols and study of related works.

II.VANET ARCHITECTURE

The VANET environment [2] barters information between vehicles in motion, underlying fixed structure, strollers with personal devices. Dedicated Short Range Communications (DSRC), Wireless Access in Vehicular Environment (WAVE) and Wi-Fi are various communication standards used between vehicle for rapid data transmission. The best interface should be chosen by the vehicle in order to transfer data with other nodes or location servers. Various protocols are successively instigated at the lower communication layers. For instance, during data dissemination the Logic Link Control sub layer mediates as interfacing layer between the network layer and the link layer. Considering heterogeneity in the vehicular adhoc environment, it is appropriate that applications be relatively agnostic to the core medium-access communication framework in order to let a speedy task force and incremental deployment of VANET applications and technologies. For the incremental deployment of the diversified vehicular wireless environment and heterogeneous devices, an uncertain middle-ware layer is implemented. This layer provides information from multiple sources, allowing heterogeneous devices to be supported over different communication protocols.



Generally VANET communication is divided into Vehicle to Vehicle (V2V) , Vehicle to Infrastructure (V2I) and uses a unique taxonomy of wireless access called Wireless Access for Vehicular Environment(WAVE) and Dedicated Short range communication signal (DSRC).The V2V communicates data among themselves whereas in V2I road side units actively participate during data transmission. The units which are required for data propagation in VANET are Road Side Unit, On Board Unit and Application Unit. The Road side units or Provider renders an application service. An On Board Unit attached to Vehicle consists of memory device, resource command processor (RPC) and user interface. With the help of on board unit the application unit which is connected to the vehicle executes the applications catered by the provider.

A.APPLICATIONS

Typically, VANET applications are categorized as safety, transport efficiency, and information/ entertainment applications. Examples for each category are:

- Cooperative forward collision warning .
- Assist the driver during the green phase in traffic signal and provide an optimal speed advisory
- Remote wireless diagnosis
- Internet of Vehicles used for passengers convenience and security during traveling which uses sensors or other devices for data collection.

III.ROUTING PROTOCOLS

Routing [3]is the process of forwarding data from source to destination by means of multi hop transmission. During data transmission the data packet has to be relayed from source to destination by adjusting the path in case of link failure. A mechanism should be used to log the details of the link. VANET uses a high speed data delivery which contrasts from the other types of the network which uses a constant speed during the mobility. Communication link failure is a major challenge which is solved by designing a efficient routing protocols.

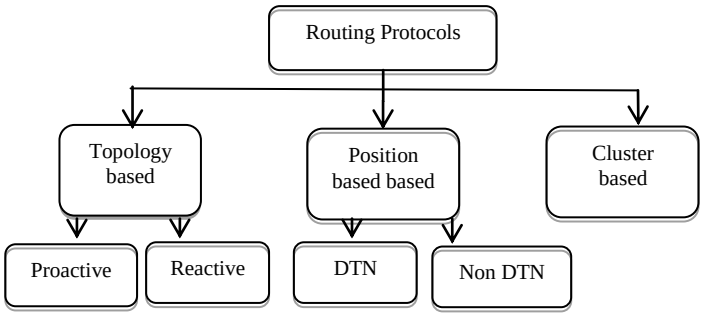


Fig 1.Classification of Routing protocols

Routing protocols are broadly classified into three types[4]. They are Topology based , Position based and Cluster based routing protocols as shown in fig.1 . Link information is mainly needed in order to transfer data in the network. Reactive and Proactive routing are major classifications in topology based routing protocol. In Cluster based routing protocol entire geographic area is divided into clusters in which the vehicles that are proximate together form a group. The cluster is represented by cluster head which is responsible for intra and inters cluster communication. Among the three routing protocols position based is considered to be efficient due to the location servers, GPS. There are several variants in position based routing protocols which follows various routing techniques for its data propagation. Routing protocol in VANET must cope up with the following challenges,

- Highly dynamic: Since VANET exists in the communication range due to its mobility.
- Network Partitions: The traffic is sparse in rural areas and hence creates a partition.
- Energy Sensitive transmissions: A high priority safety warning message should be relayed as soon as possible.

A.POSITION BASED ROUTING PROTOCOLS:

In position based routing [5] the data route forwarding by a node is primarily decided based on the location of packets destination and the position of the node's one hop neighbors. Global positioning system (GPS) which is a position determining service along with every node decides its position and the position of the neighboring node. The node determines the location of its neighbor inside the radio range of the current node. Position based routing protocol based on the strategy that routing path has to be selected based on the location. The location information of the nodes are monitored by Global Positioning System(GPS).The method uses the location of the source node, next hop node and the destination node where the data has to be forwarded. The packet is delivered to the destination from the source node by the following procedure.

Initially, the path for forwarding the packet is selected using Dijikstra's algorithm which computes the shortest path for data delivery. Secondly, the Link Estimation Time (LET) is

calculated in order to measure the link availability in a network. It is based on position, Direction and availability of the vehicle. Thirdly, the data is forwarded using greedy forwarding strategy. Finally, due to the absence of the neighboring node during data transmission, there is a chance of breakage in links which has to be recovered and forwarded.

B. CLASSIFICATION OF NETWORKS

Position based routing protocols are further divided into Delay Tolerant networks and Non Delay Tolerant networks(DTN) as shown in Table 1.

	Delay Tolerant	Non Delay Tolerant
Mechanism	Store and forward	Carry and forward
Forwarding strategy	Store the data till it gets a feasible node.	Aims to transmit the data from source to destination as soon as possible.
Protocols	VADD,Geopps ,Geo DTN.	GPSR, GSR, A-STAR, GPCR, CAR, GyTAR, LOUVRE,CBF
Limitations	Storage ,Delay, limited resources, disconnection and security.	High mobility of vehicles, obstacles in routing.

Table 1.Classification of PBR

Non Delay Tolerant Network :

NDTN uses carry and forward approach which forwards data packet which are nearer to destination nodes. Whenever no neighboring node is found other than the self node , the forwarding strategy fails. Hence the node is said to be in the local maximum. The NDTN protocols are used to recover from the problem. This section focuses on various NDTN protocols further classified into Beacons and Beaconless routing protocols is shown in Fig 2.

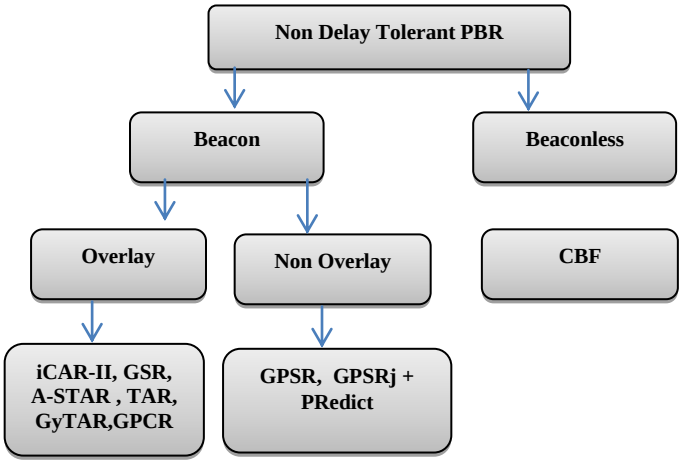


Fig 2.Classification of NDTN

Beacon

The management frames which contain all basic information about a network in IEEE 802.11 Wireless LAN is called as beacons. These frames are sent periodically in order to prove its persistence in the network. This also synchronizes the service set members. The beaconing routing protocol collects the information from one hop or double hop neighbors with the help of Beacon messages. The anchor nodes and the optimal neighbor nodes which are closer to destination nodes are identified.

The beacon routing protocols are further classified into non-Overlay and Overlay techniques.

Overlay Routing

The nodes are connected either by virtual or logical links.in an overlay networks. These links constitute a path by the physical links in the network .It is tedious to select a path at the junctions which has several crossroads. Hence the overlay routing protocol uses several methods to select forwarding nodes at the junction. The NDTN overlay protocols are iCARii, GSR, A-STAR,TAR, GyTAR ,GPCR.

Non Overlay Routing

The Greedy forwarding strategy is used in order to forward the packet to its neighboring node nearer to the destination. The data forwarding fails if there is no other node which is nearer to the destination other than the self node. When there is no such node then it has reached the local maximum and has attained the maximum progress. Routing protocols have their own recovery technique to deal with such link failure. GPSR, GPSRJ+Predict are some of the overlay based NDTN protocol.

Non Beacon

The management or control frames are not needed for proactive data transmission. The control is delegated to all neighboring nodes which decide whether to forward oncoming packet to the next node. The distributed timer based contention process selects the probable forwarder which suppresses other valid forwarders. The last hop's distance to the destination is compared with the receivers of the broadcast data. The progression of the data forwarding is quicker when there is a large difference and shorter the timer. Contention Based Forwarding (CBF) protocol is the only Non beacon routing protocol.

IV.STUDY OF RELATED WORKS

GPSR+Predict

Zinab Squalli hussaini[6] in his work has formulated the algorithm for enhancement of GPSR protocol known as GPSR+Predict. In this algorithm, the future position of all nodes is estimated in advance prior to data delivery. The protocol has achieved maximum throughput, lower cost and low end to end delivery ratio.

FGWSO-TAR

According to Deepak Rewadaka [7] et al and Dharmapal Doye et al , the Tar protocol find route using Data route and lightweight urban scenarios. The proposed protocol is intended to measure the distribution and density of the vehicle. The study reveals that TAR adopts less routing overhead , less traffic density and delay time. FGWSO-TAR is an efficient optimized protocol which provides an optimal path for every vehicle in the roadway with minimal delay and distance. The autoregressive model is being implemented for optimization.

GyTAR

Moez Jerbi et al [8] stated that an improved greedy routing protocol (GyTAR) utilizes the road traffic density information and mobility prediction which includes direction and speed to route data. GyTAR achieves the highest packet delivery ratio during data forwarding since no pre established routes are required. The way is resolved dynamically following vehicle density and urban condition qualities.

CLWPR:

The Cross Layer Weighted position based routing protocol proposed by Konstantinos Katsaros[9] .It transmits data based on node reliability . Analytic hierarchy process(AHP) is combined with multiple decision criteria which is used for fast forwarding mechanism. The comparison is done with the ETSI, GyTAR which increases the Packet Delivery Ratio by 40% with cost of increase in End to End Delivery Ratio. The packet Delivery Ratio is still more increased due to caching using Cross layer information.

DAPBR

Anant Ram et al[10] has conceived a protocol which observes the neighborhood in the direction of destination and selects the forwarder based on density and mobility. A better lifetime is achieved when compared with GPSR. In case of the selection of next forwarder is based on density parameter. Therefore reduces the probability of occurrences of void region and hence average delay is expected to reduce. As the vehicle density increases the probability of occurrence of void region reduces, inorder to increase the packet Delivery ratio.

AFMADR

GenLi et al[11] has proposed adaptive additive fuzzy weighting approach.The protocol assigns the fuzzy scores of candidate vehicles by comparing their real time attributes. The simulation results has proved that the algorithm has attained the highest delivery ratio and lowest delay.

IDTAR

[12]IDTAR considers both distance and real time vehicle density information to route data in VANET.It is designed for smart cities.The performance analysis and evaluation conducted within various city scenarios and and the simulated results reveals that IDTAR performs better than GSR, GyTAR, A-STAR in terms of PDR and data packet end to end delay. Hence legacy protocols have been analysed and concluded that the highest PDR which is 4.4% greater than GSR,1.9% than GyTAR and 2.6% than A-STAR.IDTAR achieves the lowest E2E delay with improvement of 99.3% lower than GSR,99.0% than GyTAR and 38.9% than A-STAR.

A-STAR

Balasubramani et al [13] has proposed that A-Star calculates the anchor path for transmitting packets in Non DTN network . The dynamical maps identifies the path using traffic awareness inorder to find out the bus routes in urban scenario and are also used to measure the latest traffic information.

APBR

Neha goel et al[14] has proposed that Acute based Position based routing protocol uses restricted greedy forwarding to transfer the data packet at intersections. This protocol has used carry and forwarding strategy for recovering data.

iCAR-II

Nizar Alsharif [15] in his study revealed that iCAR-II which uses multi hop vehicular applications accompanied with mobile data off loading and internet based services. It provides a connectivity awareness for routing packets and hence it update the location servers with real time information. It is envisioned to provide a guaranteed connectivity and minimal delivery delay.

Ivd-CAR

Ahmed Nazar Hassan[16] in his work has stated that Ivd – CAR employs connectivity aware data dissemination. Cooperative Localization and Geometry based localization are the two localization techniques are used to find the position of the neighboring vehicle while the GPS is unable to locate the server . Standard Deviation of real time Inter Vehicular Distance of a forwarding path enables IVD CAR to significantly reduce the hop count. Due to the accuracy in calculation ,it reduces the probability of path disconnection with high delivery ratio.

IDLAR

[17]It is found that all nodes are randomly distributed when the transmission range remains same. The neighboring nodes are those within the transmission range and are identified with the help of GPS servers. In ID-LAR protocol, the request zone is divided into number of sub zones. This algorithm finds the next best forwarding node during the data propagation phase. This protocol has analyzed the next forwarder node selection, the expected distance, average number of hops and expected distance between source and destination nodes. The performance study of IDLAR is

compared with D-LAR and Simulation result shows significant improvement in the performance parameters such as packet delivery ratio, end-to-end delay.

TOPOCBF

According to Michele Rondinone , Javier Gozalvez et al[18] TOPOCBF is a new contention based forwarding protocol which uses multi hop connectivity estimated using DIRCoD technique for selecting the routing paths. It is compared with GyTAR and various parameters are analyzed. The research findings has revealed that average packet delivery ratio is 75.85%, average overhead .98% and minimal end to end delay.

PPRP

Raj K Jaiswal [19] in his contribution had stated that PPRP is designed which forwards the packets using greedy forwarding with predicted location id using Kalman Filter. Location prediction is done effectively by Kalman filter. The performances such as average delay and PDR have been improved which act as a background to use Kalman Filter(KF). It is observed that location prediction using KF improves the PDR and average delay compared to CLWPR.

In Table 2 the mechanism and limitations of various protocols have been analysed. In Table 3 performance parameters and the tools for implementation have been classified for the reviewed protocols.

Table.2 Strategy of Routing protocols

Protocol	References	Mechanism	Limitations
GPSR+ Predict	[6]	Uses node movement information to increase the performance of the network by estimating the future position of all vehicles	Used only in static configuration mode
TAR	[7]	Routing is Data Route and Lightweight scenarios	Sensitive to dynamic topology changes
GyTAR	[8]	GyTAR is a new intersection-based geographical routing protocol. Junction Selection, Forwarding data between two junctions	Real time inferences on road density not considered
CLWPR	[9]	There is no route discovery before the actual data dissemination, just selection of the next hop according to minimal weight.	As carry and forward mechanism is used it is well suited for sparse scenarios.
DAPBR	[10]	Observes the neighborhood in the direction of destination based on Density and mobility	Envisioned only on flat network
AFMADR	[11]	Fuzzy weight assignment and highest fuzzy set utility score is chosen as target for next transmission Highest PDR,Low E2E Delay,Less forwarding hops	Delivery ratio may be increased by using buses as carriers
IDTAR	[12]	It considers both distance and real time vehicle density in intersections and is traffic aware routing	Security and trust not ensured
A-STAR	[13]	Anchor path is selected by Street maps, Traffic awareness , Dijikstra's least weight algorithm	Routing path is not optimal because the route follows the anchor path which causes large delays
APBR	[14]	It uses restricted greedy to transfer a data packet at intersections and for recovery carry and forwarding strategy will be used	Study on different locations are not emphasized
iCAR-II	[15]	Enables Multi hop vehicular applications as well as mobile data offloading and Internet Based Services.	Higher cost in case of RSU deployment
Ivd-CAR	[16]	Cooperative Localization (CL),Geometry based Localization (GL),Standard Deviation for estimating connectivity ,Segment hop vehicle	Parameter such as density of vehicles not considered
IDLAR	[17]	Use the map topology and the vehicles density to efficiently select the adequate junctions that data packets cross to reach the destination	Study of real-time road densities have not been inferred from observing hello transmitted packets and vehicle movement patterns
TOPOCBF	[18]	Dynamically selects forwarding paths based on their capability to route packets between anchor	Routing and dissemination schemes with store, carry and forward capabilities are not

		points	considered
PPRP	[19]	Forwards the packets using greedy forwarding with predicted location id using Kalman Filter	Heterogeneous traffic, highway traffic and with different size of data packet are not taken into account.

Table. 3.Performance Evaluation of Routing protocols

Protocol	Non Overlay/ Overlay	Beacon/ Beaconless	Algorithm Compared	Packet Delivery Ratio	End to End delay	Throughput	Tools Used
GPSR+Predict	Non overlay	Beacon	GPSR	Average	Average	Average	NS2,Mobisim
FGWSO-TAR	Overlay	Beacon	TAR	High	Low	High	MATLAB
GyTAR	Overlay	Beacon	LAR,DSR	Average	Average	Average	QualNET
CLWPR	Overlay	Beacon	GPSR	Average	Low	High	NS3
DAPBR	Overlay	Beacon	GPSR	High	Low	High	NS2,SUMO
AFMADR	Overlay	Beacon	GPSR, GSR, GeOpps	High	Low	High	NS2,SUMO
IDTAR	Overlay	Beacon	GyTAR , A-STAR-SR, GSR	High	Low	High	NS2
A-STAR	Overlay	Beacon	GPSR	Average	Average	Average	Open street map editor,NS2, SUMO
APBR	Non Overlay	Beacon	GPSR	High	Low	High	NS2
iCAR-II	Overlay	Beacon	GyTAR, GPSR,GSR	High	Low	High	MATLAB,SUMO
Ivd-CAR	Overlay	Beacon	A-CAR,CSR	High	Low	High	NS2
IDLAR	Overlay	Beacon	D-LAR,LAR	High	Low	High	MATLAB
TOPOCBF	-	Beaconless	GyTAR	High	Low	High	SUMO
PPRP	Overlay	Beacon	CLWPR	High	Low	High	NS3,VANET MobiSIM

V. FUTURE TRENDS AND CHALLENGES.

Now the communication in the entire world is through internet. Traditional VANET is used for small and homogenous network . The emerging technology Internet of vehicles has been deployed in smart vehicles (IOV).IOV is a heterogeneous network which uses human, vehicle and things. Hence the interaction between three is known as Swarm computing which integrates the entire environment whereas individual model uses interaction between the individual attribute.

The concept of IOV involves activation and maintenance of IOV. The research issues which are identified are

- Routing problems in network
- Collision detection
- Processing information from heterogeneous network.

VI. CONCLUSION

In this survey we have analyzed some of the state of art and hybrid Non Delay Tolerant protocols. Several performance metrics such as Packet delivery ratio, end to end delay, throughput have been analyzed. The simulation tools used for various protocols were also revealed. In particular the current research challenges in the field of Internet of Vehicles (IOV) which uses external devices like sensors, smart phones for data collection and uses state of art VANET routing protocols. The protocols discussed provide a thrust to explore new ideas.

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