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A Comparative Study and Stepwise Approach for Routing In Vanets

[1]Mostofa Kamal Nasir, [1]Syed Adeel Ali Shah, [1]Rafidah Md Noor and [2]Sharmin Parveen

[1]*Innovative Netmobility Research Group, Faculty of Computer Science and Information Technology, University of Malaya, 50603, Kuala Lumpur, Malaysia.*
[2] *Faculty of Computer Science and Information Technology, University of Malaya, 50603, Kuala Lumpur, Malaysia.*

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ABSTRACT

Vehicular Ad hoc Networks (VANETs) have significant potential to host diverse applications associated with traffic safety, traffic efficiency and infotainment. For such realization to happen, applications on VANETs desire dependable routing protocols; protected and trusted communication environment; realistic coverage of network on the road among vehicles as well as cooperation from drivers. In VANETs, routing protocols that exhibit the distinctive characteristics of a networking environment is a subject of interest for many researchers. This paper reviews routing protocols that have been adapted for VANETs. We structure these routing protocols into six broad categories i.e. topology based routing, position based routing, cluster based routing, geocast routing, broadcast routing and adaptive routing. We also describe and conduct a comparative analysis and find the merits and demerits of each subclass. We then analyze the selected protocols in terms of performance metrics based on application scenarios, virtual infrastructure, delivery rate, latency, packet overhead and mobility models. Finally, we also propose a stepwise approach to improve VANET routing protocol.

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INTRODUCTION

Integrated software based intelligence in cars can increase the passengers' safety and travelling experience. VANETs paves way to research due to its mobility patterns which present unique challenges for discovering routes in the network layer. Such challenges are further enhanced due to several VANET applications having exclusive requirements at each layer for performance efficiency. The demand for more dependable, consistent and safer vehicular network standards is ever increasing due to emerging commercial applications such as ITS(Nasir and Whaiduzzaman, 2012; Report, 2009) and infotainment. The main goal of VANETs is to provide the drivers and passengers a safe and comfortable journey by minimizing the risks of accident and by introducing applications that notifies a vehicle about collision warnings, road signal alarms, infotainment and file sharing procedures(Ahmed *et al*., 2013; Oche, Noor, Al-jawfi, Bimba, and Nasir, 2013). VANETs are ad-hoc networks formed by moving vehicles and stationary Road Side Units (RSUs). In comparison with other conventional ad-hoc networks, the computational equipment in VANETs are not resource-constrained as well as distinct in their movement and also much more communication oriented(Nasir, Noor, Kalam, and Masum). The most important characteristic of VANETs is the high mobility of the nodes, which is the fundamental cause of a series of VANET-specific attributes requiring the expansion of applicable solutions. It is therefore significant to consider such aspects when designing a data transfer scheme in VANETs. In these circumstances nodes can move with certain mobility pattern on roads i.e. restricted by streets, traffic and traffic rules. In Urban areas the traffic density is high during rush hours, whereas roads experience recurring network fragmentation in rural areas. Therefore routing algorithms for VANETs should be optimized and be dynamic to allow multiple communication on different application. The performance and quality of service (QoS) of VANETs depend on how the routing protocol performs in the network(Joe-Air Jiang* *et al*.). In general, routing is a process of forwarding data from a source to a destination which require multi-hop forwarding nodes. In specific, routing protocols are responsible to determine the paths to forward the packets to their destinations, and also to find alternative paths in case of failure. Efficient routing protocol is one that is able to deliver packets in a short amount of time and consume minimal bandwidth. For obtaining better performance of various applications such

Corresponding Author: Mostofa Kamal Nasir, Innovative Netmobility Research Group, Faculty of Computer Science and Information Technology, University of Malaya, 50603, Kuala Lumpur, Malaysia

as safety applications, rescue operation and infotainment we need an efficient and dynamic routing for VANETs. The main obstacle is to establish steady and reliable communication network, so, for establishing such network, routing protocol design is one of the major challenges.

In this survey we investigate recently published articles about ad-hoc routing protocols for VANETs. Several routing protocols have been defined by many researchers. With the passage of time there is a need of having new protocols in order to have successful communication. The history of VANET routing begins with the traditional MANET routing protocols. Several topological based routing protocols for MANETs have been analyzed and adapted for VANETs. The main aim of our survey is to summarize all the ad-hoc routing protocols and to analyze them comparatively. We also conclude in our work that which routing protocol is most suited in which environment. Finally, we propose a stepwise approach to improve VANETs routing to find a destination.

The rest of the paper is organized as follows: A classification of VANET routing is discussed in Section 2. In Section 3, we conduct a comparative study and analyze the features of each subclass of VANET routing. A classification of VANET routing is presented in a tabular way in Section 4. Section 5 presents VANET routing challenges and proposes stepwise approach for VANETs; the strategy of improving the routing protocol which is followed by conclusions and future works in Section 6.

2. Classification of VANET Routing Protocol:

As VANETs have a highly dynamic topology, frequent route disconnections occur as vehicles move. Vast numbers of protocols have been developed to cater for VANET specific routing requirements. Different researchers have classified these protocols in different categories. We divide these routing protocols into six broad categories. We also describe the comparative analysis and find the merits and demerits of each subclass. The classifications of routing protocol are topology based routing(Uma Nagaraj, Dr. M. U. Kharat, and Dhamal), position based routing, cluster based routing(Tao, Weiwei, Tiecheng, and Lianfeng), geocast routing(Maihofer; Nasir, Rahman, Sohel, and Islam), broadcast routing and adaptive routing. Fig.1. Shows the detailed classification of VANET routing protocols.

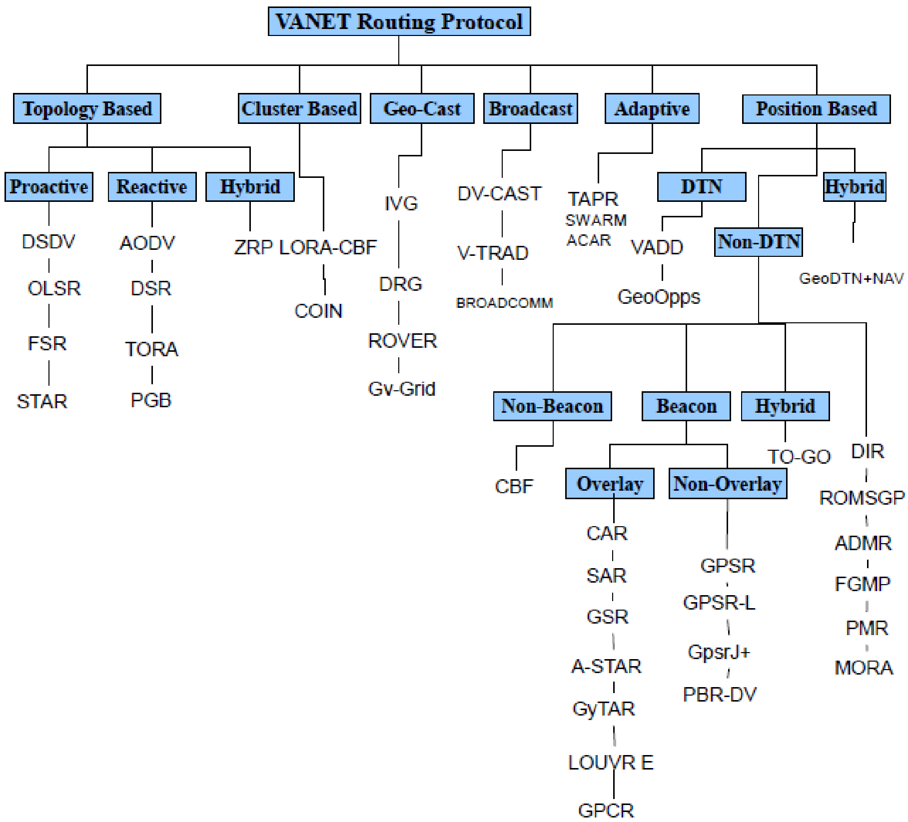

Fig.1. Classification of VANET routing protocol.

3. Comparative Study:

3.1 Topology Based Routing Protocol:

Topology-based routing protocols attempt to balance between being aware of all possible paths and by keeping the overhead at a minimum level. These routing protocols employ routing data that occurs in the network to accomplish packet forwarding. Topology based routing protocols are divided into Proactive, Reactive and Hybrid Protocols.

3.1.1 Proactive Routing Protocol:

This type of routing protocol is table driven and similar to the connectionless protocol of conventional TCP/IP networks. Proactive protocols conserve routing information about the available paths but if the network routes are rarely used then, such protocols need periodic updates in the routing table. Thereby a major part of the existing bandwidth is wasted and it is not appropriate for the high mobility network. The most important characteristic of proactive routing protocol is the absence of route discovery before communication between real time applications resulting in low route finding latency. The examples of this type of routing protocol are DSDV(Charles E. Perkins and Bhagwat), OLSR(T. Clausen and P. Jacquet), FSR(Guangyu, Gerla, and Tsu-Wei) and STAR(Garcia-Luna-Aceves and Spohn).

Fisheye state routing (FSR)(Guangyu, et al.)

Fisheye state routing formulates a mechanism for a node to store accurate route information about its immediate neighbors; and for the neighbors far apart, comparatively less route details are stored. FSR falls in the category of link state routing where information about the links is recorded and flooded. However, in FSR this information is only shared with immediate neighbors and is not flooded across the network. FSR performs relatively well when compared to Dynamic Source Routing Protocol (DSR)(David B. Johnson) and Temporally Ordered Routing Algorithm TORA(Park and Corson) but due to lack of information stored about distant neighbors the routing may become inaccurate as the distance from the node to destination increases as shown in Fig. 2. It also shares along with other topology based routing protocols the property of not scaling well to increasing network size. FSR is a topology based proactive routing protocol which is best suited for urban areas and does not require any virtual infrastructure. Delivery rate and control packet overhead is high in FSR. The links are established by considering path states and its applicability for a certain propagation model is unknown.

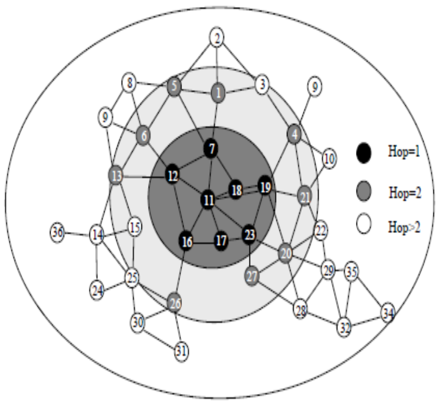

Fig. 2: Fisheye State Routing Protocol.

3.1.2 Reactive Routing Protocol:

Reactive routing protocols do not maintain any prior routing table. In this type of protocols a node discovers route to destination whenever a packet needs to be sent. These protocols keep a routing table or build a routing table when a node request for a packet or a node needs to send a packet so that a route could be found effectively. Reactive protocols consume less bandwidth than proactive protocols; nevertheless the delay in determining a route can be substantially larger. A major disadvantage is that excessive flooding of the network which causes disruption of nodes communication and the packets transmitted to the destination are lost if the route to the destination changes. The examples of such type of routing protocols are Ad-hoc on Demand Distance Vector Routing (AODV)(C. E. Perkins and Royer), DSR(David B. Johnson) , TORA(Park and Corson, 1997) , and PGB(Valery Naumov, Baumann, and Gross, 2006) .

Ad-hoc on Demand Vector (AODV)(C. E. Perkins and Royer, 1999):

AODV finds a route from source to destination through a technique called backward learning. If destination is not a source node's neighbor then a broadcast RREQ message is generated. A node receiving RREQ will reply with a RREP containing the path to the destination or otherwise rebroadcast RREQ. Traversal of RREP ensures that every node maintains a forward path from source to destination. Sequence numbers are used as a mechanism for preventing loops and segregating between different RREQ messages. Due to its high packet overhead AODV suffers from low packet delivery rate in roads with a high density of vehicles. Being a protocol designed originally for MANETs, researchers have introduced several extensions to AODV to make it more scalable and robust for VANETs. Fig. 3(a). shows a PREQ message broadcast to find a destination and Fig. 3(b). shows the path of a destination message RREP. AODV performs well in urban areas without any virtual infrastructure. It has a high delivery rate and packet overhead in a dense network of nodes and it relates to probabilistic propagation model.

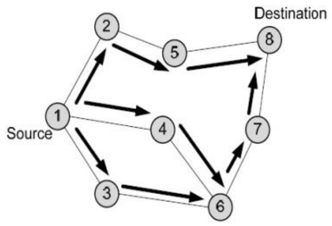

Fig. 3(a). Propagation of PREQ

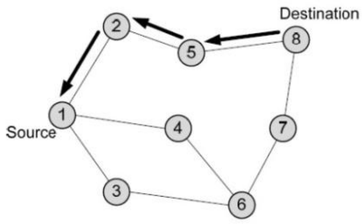

Fig. 3(b). Path of the PREQ to the source

3.1.3. Hybrid Routing Protocol:

Hybrid routing protocol is a combination of both proactive and reactive routing protocols. Such protocols are introduced with an objective to minimize the packet control overhead and route finding latency in proactive and reactive routing schemes respectively. Zone Routing Protocol (ZRP)(Haas, Pearlman, and Samar, 2002) is an example of hybrid routing protocol.

Zone Routing Protocol (ZRP)(Haas, et al., 2002):

ZRP tries to overcome the disadvantages related to route discovery latency and high packet overhead in reactive and proactive routing protocols respectively. This is achieved by implementing a proactive routing scheme within the transmission range (zone) of a node and reactive routing scheme for nodes that befall outside the zone of a node. Message passing within the zone is accomplished through Intra-zone Routing Protocol (IARP) which maintains route and metric information about neighbors of every node. If the node to be reached is outside the zone then the source sends a request message to the outer node of the zone. This message is broadcasted until a route to the destination is found. This part of routing is based on reactive routing scheme i.e. Inter-zon Routing (IERP). Like reactive and proactive protocols, hybrid routing protocol can also perform in urban areas. It reduces the control overhead ensuring a higher delivery rate. It considers link states and shares the same probabilistic propagation model as of AODV.

3.2 Position Based Routing Protocol:

In position based routing algorithm every node of the participating network knows its own and neighbor node's geographic position. There is no need to maintain any routing table or exchange any link state information with its neighborhood node in such routing schemes(Nasir, Sohel, Rahman, and Islam, 2013). The nodes find this location information through the Geographical Positioning System (GPS). Position based routing protocols are more appropriate for VANETs since the vehicular nodes are known to move along established paths. The routing overhead is minimized in these types of protocols because no routing tables are used or created. The position based routing protocols are of three types; Delay Tolerant Network (DTN), non-Delay Tolerant Network (non-DTN) and Hybrid.

3.2.1 Delay Tolerant Network (DTN):

Delay Tolerant Network algorithms take some necessary steps to overcome intermittent connectivity in urban areas. Carry and forward strategy are used to cater for frequent disconnections of nodes in the network. In carry and forward strategy when a node cannot contact with other nodes it stores the packets and forwards them upon connection to a neighboring node. Example of DTN routing algorithm are VADD(Zhao and Cao, 2006) and GeoOpps(Leontiadis and Mascolo).

Vehicle-Assisted Data Delivery in Vehicular Ad hoc Networks (VADD)(Zhao and Cao, 2006):

The main concept of VADD is based on the query and forward. One of the vital issues is the choice of a forwarding path with limited packet delivery time and it follows some basic principles, which is to transmit maximum routing information through wireless channels and it must select the road with higher speed when the packet has to be carried through certain roads. As vehicular ad-hoc networks have a very high probability of topology change so guaranteed packet delivery along the pre-computed optimal path is not assured, that is why the dynamic path selection should continuously be executed throughout the packet forwarding process. VADD routing algorithm has three modes of operation: Intersection, Straightway and the Destination, where every vehicle takes a choice at a junction and goes for next forwarding path depending on the operations. VADD is applicable in urban VANET scenarios and its operation requires no infrastructure. The data delivery rate as well as control packet overhead is high. The link establishment occurs through beacon messages.

3.2.2 Non Delay Tolerant Network (non-DTN):

The non-DTN types of geographic routing protocols do not consider discontinuous connectivity and are only practical in highly congested VANETs. If there is no neighbor of a node in position based routing then forwarding strategy fails to deliver a packet and the situation is called local maximum. In this situation the routing protocol of non-DTN routing protocol performs a recovery strategy to deal with such a failure. The non DTN routing protocol is further divided into a beacon, non-beacon and Hybrid. There are also two categories of beacon routing protocol i.e. non-Overlay and Overlay. Example of Non-DTN overlay is CAR(V. Naumov and Gross), SAR(Jing, Lu, and Rothermel), GSR(C. Lochert *et al.*), A-STAR(Seet;, Liu;, Lee;, Foh;, and Lee;), GyTAR(C. Lochert, *et al.*), LOUVRE(Lee, Le, Harri, and Gerla) and GPCR(Christian Lochert *et al.*, 2005). GPSR(Karp and Kung, 2000), GPSR-L(Rao, Pai, Boussedjra, and Mouzna), GpsrJ+(Lee, Haerri, Uichin, and Gerla, 2007) and TO-GO(Lee, Lee, and Gerla) are examples of non-DTN hybrid routing protocol.

Geographic Source Routing (GSR)(C. Lochert, et al.):

GSR is position based routing algorithm that is uses location based information of neighboring nodes. In GSR the querying node floods the network with a 'position request' for a particular node. Upon receipt the node replies with a 'position reply' to the querying node. GSR uses extensive flooding and it has several extensions that address to minimize flooding. Such extensions require more processing at the cost of better performance. VANETs have superior processing and storage for such algorithms. GSR is a broad position based non-DTN routing protocol and its application scenario is urban area. Similar to all position based routing protocols it doesn't need any virtual infrastructure. The data delivery rate of GSR is low whereas the control packet overhead is moderate. The link type of GSR is beacon and path states with propagation model is road blocking.

3.2.3 Hybrid:

Hybrid type of geographic routing protocols combines the non-DTN and DTN routing protocols to exploit partial network connectivity. GeoDTN+NAV(Cheng *et al.*, 2010) is a hybrid position base routing protocol.

GeoDTN+NAV(Cheng, et al., 2010):

GeoDTN+NAV is a hybridization of non-DTN and DTN routing approaches that combines the greedy mode, the perimeter mode, and the DTN mode. The concept of the GeoDTN+NAV is that nodes belong suspecting with the network is disconnected based on the number of hops packet has travelled in the perimeter. It also measures the distance travelled by the packet so far, delivery rate and neighbor's direction with respect to the destination. GeoDTN+NAV is applicable in urban areas as a pure adhoc protocol. The data delivery rate and control packet overhead are both moderate. It uses beacon messages for path establishment and can use the road blocking propagation model.

3.3 Cluster Based Routing Protocol:

In cluster based routing each network is partitioned into interconnected sub networks. Each sub network is called a cluster. Each cluster has a cluster head (CH) as coordinator within the substructure. Each CH acts as a temporary router within its zone or cluster and communicates with other CHs. Hence each cluster has one cluster head and the cluster is identified by the head cluster ID. Every node in the cluster is uniquely identified by a string called Node ID. A host in the cluster maintains a bi-directional link with the head of the cluster. LORA-CBF(Santos, Edwards, Edwards, and Seed, 2005) and COIN(Blum, Eskandarian, and Hoffman) are the example of cluster based routing protocol.

Location Routing Algorithm with Cluster-Based Flooding (LORA-CBF)(Santos, et al., 2005):

LORA_CBF is a cluster based geographic reactive protocol which tries to find a route to destination through position based information whenever a route is needed. It also introduces gateways between clusters to reduce the amount of broadcast data; only control messages are sent through broadcast. The protocol is similar to some of the cluster based protocols in MANETs. It creates cluster heads and gateways by implementing simple 'HELLO' beacons, REQ/REP messages and the timers. Routing tables are used within a cluster head and every other node knows its relative position within a cluster through GPS. However, using this protocol in the intermittent VANET scenario can be inefficient with very few nodes and clusters. Moreover, performance metric of this protocol related to cluster formation time is high in VANETs. LORA-CBF can run in intermittent connectivity scenarios by introducing cluster based communication. It has two-ray grounded propagation model and has moderate overhead and low packet delivery ratio.

3.4 Geocast Routing Protocol:

Geocast refers to the delivery of information to a group of destinations in a network identified by their geographical location. It is a specialized form of multicast addressing used by some routing protocol for adhoc network (Rongyan, Chen, and Dongdong, 2010). All protocols have in common that they enable transmission of a packet to all nodes within a geographic region. In contrast to multicast, which enables a packet to be sent to an arbitrary group of nodes, a geocast group is only defined by a geographic region. Example of Geocast routing protocols are IVG(Bachir and Benslimane), DRG(Kihl, Sichitiu;, and Joshi;) and ROVER(Kihl, *et al*.).

Robust Vehicular Routing (ROVER)(Kihl, et al.):

ROVER introduces a concept similar to that of a zone in FSR called Zone of Relevance (ZOR) and a message format that initiates route discovery. However, ZOR is considered to be an application specific zone besides just being in a node's transmission range. ROVER only uses broadcast during passing control messages and unicast otherwise for data packets. ZOR is created at the time of route discovery by sending a Zone Route Request (ZRREQ) message with three parameters i.e. application (A), message (M) and zone of relevance (Z). Traversal of these messages creates a tree among the nodes within a specific ZOR. There is another zone called Zone of Forwarding (ZOF), which includes all the nodes participating in the routing process including source node. This zone ensures that a vehicle only receives and accepts a ZRREQ if it exists within a specific ZOF. A node in ZOF replies by sending a Zone Route Reply (ZRREP) to the neighboring node that sent ZRREQ. Most of the VANET routing protocols apply to urban areas but geocast routing is pertinent in highway scenario. ROVER is most suited for infrastructure less highways. The delivery rate of ROVER is high along with control packet overhead.

3.5 Broadcast Routing Protocol:

For sharing information about traffic, weather and emergency road conditions among vehicles broadcast routing is more suitable. In broadcast routing a node of the network disseminates a message to the vehicle beyond its transmission range through the use of multi hops. Broadcast sends a packet to all nodes in the network, typically using flooding. This ensures that the delivery of such packets consume more bandwidth because of duplicate message reception; also disseminated messages collide due to congestion. It performs better in the sub-urban and highway where a small number of nodes take part in the network. The various Broadcast routing protocols are BROADCOMM(Ntlatlapa, 2008), Urban Multihop Broadcast protocol (UMB)(Korkmaz and Ekici, 2004), Vector Based Tracing Detection (V-TRADE(Tonguz, Wisitpongphan, Bai, Mudalige, and Sadekar, 2007)), DV-CAST(Min-Te *et al*.), EAEP(Nekovee and Bogason), PBSM(Khan, Stojmenovic, and Zaguia), PGB(V. Naumov and Gross), DECA(Nawut Na and Rojviboonchai, 2010) and POCA(Nakom and Rojviboonchai).

Distributed Vehicular Broadcast Protocol (DV-CAST)(Min-Te, et al.):

DV-CAST is a completely distributed protocol designed for different types of connectivity scenarios in VANETs i.e. high connectivity, intermittent connectivity and no connectivity. Local topology information in DV-CAST is of significance in the routing process. It is used in finding whether a vehicle is the referred receiver, whether a vehicle has a connection to another vehicle or to determine the position of a vehicle in a cluster. Routing is based on certain parameters i.e. Destination Flag (DFlg), Message Direction Connectivity (MDC) and Opposite Direction Connectivity (ODC). These messages correspond to the state of a receiving node and to the type of connectivity. DFlg is used by nodes to check whether the message is duplicate or new. Value of MDC and ODC is checked to see the nature of connectivity in a VANET. For instance, if MDC and ODC correspond to zero then the vehicle is completely disconnected from the network. DVCAST has fewer hello messages and number of broadcast messages within a cluster decreases collisions and duplications. DVCAST suffers from low delivery rate due to its distributed nature and high packet overhead. Its link type is categorized as broadcast and propagation model as road blocking.

3.6 Adaptive Based Routing Protocol:

The adaptive routing protocol has the capability to cope with frequent changes in the ad-hoc network topology. The protocol should operate in any heterogeneous scenario without requiring specific configuration by the users. To make routing more efficient the best possible route is selected by considering QoS parameters. As VANET is highly dynamic this type of routing protocol performs better in city scenarios. SWARM(Kassabalidis, El-Sharkawi, Marks, Arabshahi, and Gray, 2001), ACAR(Qing, Lim, Shuang, Jian, and Agrawal, 2008) and Relevance Based Scheme (RBS)(Cenerario, Delot, and Ilarri, 2008) are the examples of this type routing.

Adaptive Connectivity Aware Routing (ACAR)(Qing, et al., 2008):

The ACAR protocol combines two necessary elements by correctly selecting an optimal route, consisting of road segments, with the best estimated transmission quality and efficiently forwarding packets hop-by-hop through each road segment in the selected route. To reduce the effects of imprecise statistical density data and development, the adaptive route selection algorithm gathers the real-time density information on-the-fly while forwarding packets. The next hop is selected by using a metric that reduces the packet error rate (PER) of the whole route based on measured PERs at each node. It also handles the frequent network partition by carry-and-forward mechanism. ACAR is more suitable for suburban areas which do not require any infrastructure for the operation. It delivers with moderate control overhead and hence has a moderate delivery rate. The propagation mode for ACAR is unknown.

4. Discussion:

The objective of a routing protocol is to guarantee a reliable and efficient delivery of packets. Each routing protocol for VANET has different features and requirements, suited for different vehicular traffic scenarios. The comparison of various routing protocol types is given below in a tabulated form in terms of application scenario, virtual infrastructure, delivery rate, control packet overhead, Link among node and propagation model. From the Table 1. it is indicated that most of the routing types are applicable in urban areas. Geocast and Broadcast routing algorithms apply to highway scenarios, whereas, only adaptive routing can be applied in suburban areas. The routing algorithms do not require virtual infrastructure except for cluster based algorithms. The packet delivery rate of Non-DTN, Cluster and Broadcast algorithm is low and position based GeoDTN+NAV is moderate. All other routing algorithms have a high packet delivery rate. The control packet overhead is very high for proactive, DTN, geocast and broadcast VANET routing algorithm and reactive type have low control packet overhead but other routing algorithms have moderate control packet overhead. Link among nodes can be path states, beacon, data broadcast and single hop or multi-hop and the propagation model of the routing protocol can be probabilistic or road blocking.

Table 1: Analysis of VANET routing protocol in terms of performance metrics.

Protocol Types		Application Scenario	Infra structure	Delivery Rate	Control Packet Overhead	Link	Propagation
Topology	Proactive	Urban	No	High	High	Path State	Unknown
	Reactive	Urban	No	High		Path State	Probabilistic
	Hybrid	Urban	No	High	Moderate	Path State	Probabilistic
Position	DTN	Urban	No	High	High	Beacon	None
	Non-DTN	Urban	No	Low	Moderate	Path State	Road Blocking
	Hybrid	Urban	No	Moderate	Moderate	Path State	Road Blocking
Cluster		Urban	Yes	Low	Moderate	Broadcast	Two-Ray Ground
Geocast		Highway	No	High	High	Hop	Unknown
Broadcast		Highway	No	Low	High	Broadcast	Road Blocking
Adaptive		Suburban	No	Moderate	Moderate	N/A	Unknown

5. Stepwise Approach for VANETs:

High mobility of the vehicles creates a barrier for developing an efficient routing algorithm. Routes between source and destination node may have multiple hops, this condition is more complicated as compared to the single hop routing. Intermediate vehicles can be used as routers to determine the optimal path along the way. There are also numerous challenges for routing protocols in VANETs such as security threats attack, delay constraints, reliability, prioritization of data packets and congestion control. VANETs behave in a different way as compared to conventional MANETs. In real life scenarios, such as an urban area or rural area, it has great influence by the road structures, traffic lights, big buildings and many more. In VANETs, vehicles move independently by changing their positions restricted to the road structure, and connect with each other in a highly dynamic network topology. The impact of obstacles alongside roads on vehicle communication has been neglected in routing research domain. We proposed stepwise approach in designing a novel routing protocol for VANETs as follows.

Step 1: Set a coordinate or position of the neighboring vehicle to collect the information. The information is required for the source in forwarding the packet efficiently.

Step 2: Identify the obstacles that affect the packet transmission between vehicles. A number of packets forwarded may be increased due to disconnection of vehicle's communication

Step 3: Position of neighboring node is used to calculate the vehicle's density (hop count). The vehicles may be too close especially at traffic light junctions.

Step 4: Choose the next hop node that is closer to the destination. The chosen next hop node is considered as a successor. There are three metrics to consider when choosing the successor, i.e. distance (d_s), traffic load (l_n), and expected successor connectivity (e_c).

Fig. 4. Show the flowchart of stepwise approach for VANET routing

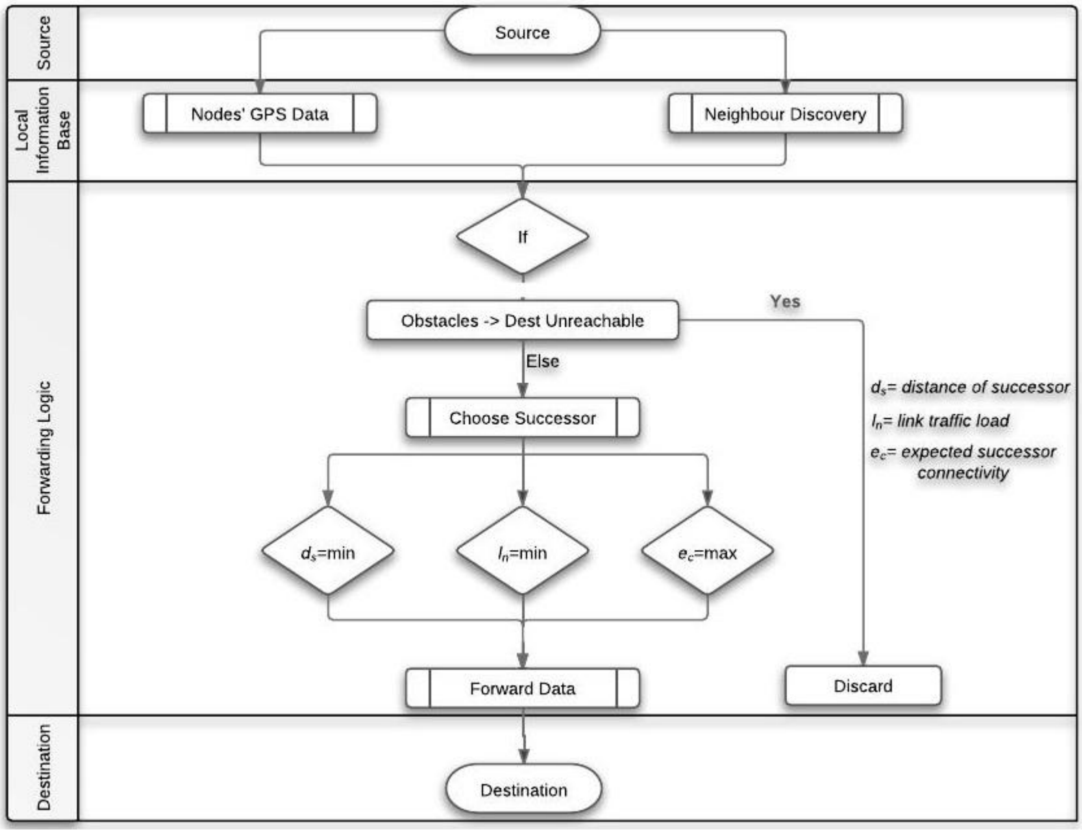

Fig. 4: VANET Routing Stepwise Approach

6. Conclusion:

The routing of data packets in VANETs is challenging subject of extensive research and routing is the most vital scheme that applications rely upon. For successful implementation of any VANET based application it is required to adapt appropriate routing protocol. A unified routing scheme that fits all VANETs scenarios is hard to implement. In this paper we tried to organize and classify all the routing protocols for further investigation that one can easily simulate, verify and improve a routing protocol. Hence, a survey of different VANET protocols, comparing various features is absolutely essential to come up with new proposals for VANETs. The performance of VANET routing protocols depends on various parameters like packet delivery rate, latency, overhead, mobility model, driving environment and much more. Thus the survey has come up with a comprehensive review and comparison of different classes of VANET routing protocols. A lot of research is carried out on VANETs for safety and non-safety applications but there are few applications for post-accident rescue. Our future endeavor is to propose a VANET routing protocol and analyze it for finding a suitable routing mechanism for the very rapid response on rescue operation based on VANET technology, and also new algorithms should be proposed to provide reliable QoS for rescue, safety and comfort applications in VANET.

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