A Study of Reliable Routing Protocols for Vehicular Adhoc Networks

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ABSTRACT
In smart transport techniques, the coordination between vehicles and the street area devices are of utmost importance. Vehicular Adhoc Networks (VANETS) truly are an encouraging technological innovation to permit the transmissions between vehicles using one side as well as in between vehicles and street area devices on the other side. But, it is really a difficult job to design an efficient routing algorithm for VANETS due to the large mobility as well as the regular changes of the network or dynamic topology resulting in transmission connections which can be extremely at the risk of disconnection in VANETS. The overall objective of this paper is to explore the various routing issues related to VANETs.

Keywords
AODV-R, Link reliability, Routing reliability, VANNETs, Congestion

1. INTRODUCTION
The development of the increased number of cars is designed with Wi-Fi transceivers to be able to connection with different vehicles to develop a particular type of Wi-Fi networks, named as VANETS [14]. VANET is a unique class of Mobile Ad hoc Network (MANET) to support communication between the close by vehicles as well as among the vehicles [1]. VANETS use V2V (Vehicle-to-Vehicle) transmissions to enhance visitors security and performance over the radiant change of data between the vehicles along with street area devices. V2V transmissions are usually dependent on the IEEE 802.11p [2]. VANETS, which are the main target for designers to working to turn vehicles into smart models that commune for security and ease purposes [3]. VANETS have made it easier for arrangement of various protection, convenience and activity applications. Collision alert, road area sensors and visitors changes supplies the driver important data to choose the most effective route in the process to avoid the visitors' congestion as well as incidents [4]. Using Wi-Fi devices, the remote in-time data (for example incidents, visitor congestion and etc) should be acquired by efficiently and regularly multi-hop information distribution [5]. VANET applications can be categorized into two parts [20]:-

1) Application which are effected by delay, e.g., video streaming, downloading multimedia programs from the nearest internet and connecting to the virtual personal network for video or voice conferencing [20].
2) Application which are tolerable to delay, e.g., sending an advertisement or passing simple text message [20].

Routing protocols establish paths to allow communication between devices on a network. There are two main approaches for routing in terms of the number of discovered path, as single-path and multipath routing [21]. VANET has special properties such as large mobility together with the limitation of path topology, originally small market transmission rate, unbounded system dimensions, commercial structure service that will separate it from MANET. Through these properties, this is clear that standard MANET routing protocols has provide problems coming from discovering steady routing routes in VANET surroundings [1]. Wi-Fi ad hoc networks do not rely on predetermined commercial structure for transmission along with the distribution of data. The structure of VANET is made up of different types: Pure cellular/WLAN, Pure Ad hoc and hybrid [29]. VANET will use predetermined cellular gateways and WLAN/WiMax obtains entry at visitors point for connecting to the net, collect visitors detail and for redirecting motivation. This network design is pure cellular or WLAN. VANET can compile both and put together cellular network and WLAN to make the network. In these circumstances all cars and street side units' type form real cellular ad hoc networks. Multiple structures include both commercial structure networks and adhoc networks jointly. Nodes in VANET can self-organized as well as self-manage the data in an allocated style without the directed authority. Considering that the nodes are tending to be movable therefore details of transmitting will be much less efficient [29]. The wheel network create the architecture of VANET as shown in the fig 1 in which every node is vehicle which will communicate with alternative node as well as they can utilized internet service by utilizing street area units. A number of distinctive characteristics of VANET such as large mobility, street topology, no limitations of network dimensions which allow it distinctive from other ad-hoc network like MANET[10].These kind of special qualities of VANETs increase significant routing challenging problems which should be reconciled before deploying these networks effectively. The particularly most difficult problem is possibly the large mobility as well as regular changes of the network topology [16]. The suggested routing protocols and systems which can be utilized in VANETs should adjust to the rapidly changing topology. In addition, they should be effective and offer quality of-service help in order to enable various transmission priorities based on the information visitor type.

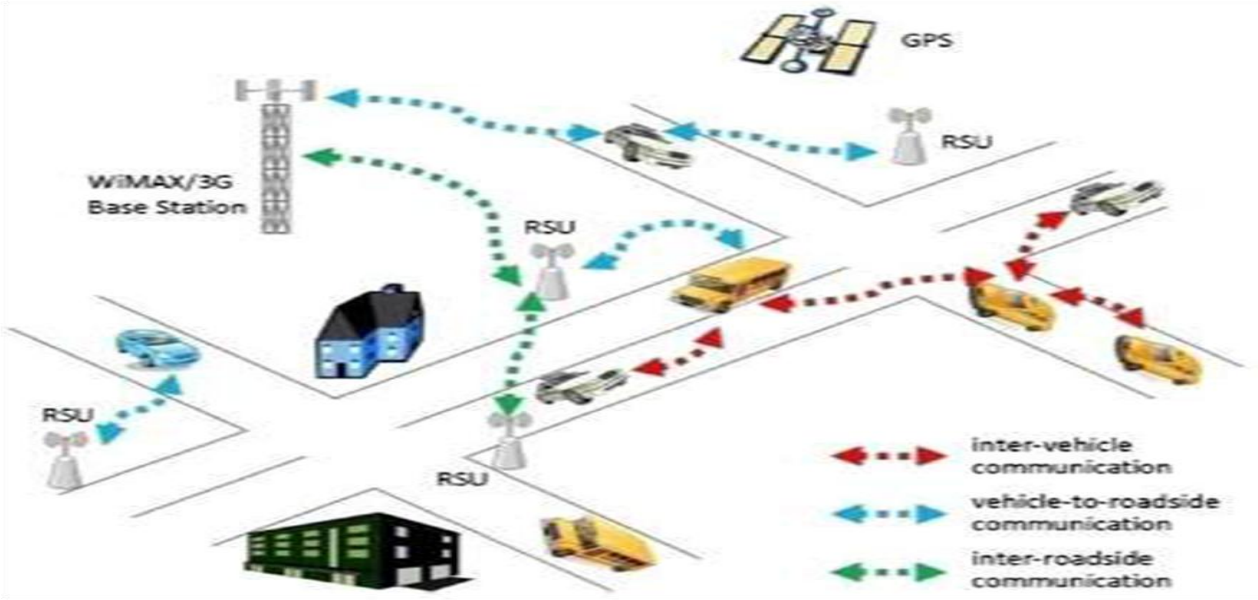

Fig 1.VANET Architecture [14]

2. ROUTING PROTOCOL

Various routing protocols have already been developed for VANETs environment which is often separated in many types based on the various aspects such as for example protocols properties, methods used, routing details, quality of services, network architecture, routing algorithms etc [18]. Routing protocols can be classified on the basis of:

1. Techniques such as: Topology based, Position based, Geocast protocols, Broadcast protocols, and Cluster-based routing protocols [18].
2. Network Structures based Routing Protocols: Hierarchical, Flat and Position-based routing protocols [18].

2.1 Topology based protocols

This type of routing protocols use transmission links information which is present in the network to perform packet forwarding [29]. These protocols set up the path as well as maintain it in a table before the sender starts transferring information. Topology based protocols are divided into proactive and reactive protocols [6].

2.1.1 Proactive routing protocols

The proactive protocol is also named as table driven routing protocol. These protocols perform functions by regularly interchanging the data of topology between most of the nodes of the network. The proactive protocols do not posses original path finding and hold up although; it uses wide range of bandwidth for regularly changes of topology. A proactive routing protocol [10] includes:

2.1.1.1 Optimized link state routing protocol (OLSR)

OLSR is proactive in nature and involves regular exchange of messages to maintain topology data of the network at each and every node. OLSR is definitely an optimization over a healthy link state protocol because it shrinks the length of data sent in the messages and reduces the quantity of retransmissions to flooding these communications in entire network. Due to this, the protocol involves multipoint relaying approach to efficiently and economically flood its control messages [18]. It provides optimal routes when number of hops, which are promptly accessible when needed. This protocol is beneficial and suitable for big and dense adhoc networks.

2.1.1.2 Intra-Zone Routing Protocol (IARP)

Intra-zone Routing protocol is the aspect of the Zone Routing Protocol (ZRP). It is a proactive routing protocol used within a zone. It does apply as a standalone mode. IARP keep redirecting details for nodes which are inside the routing zone of the node. The Intra-zone Routing Protocol (IARP) proactively preserves paths to locations inside a neighborhood area that will be known as a routing zone. Moreover additionally, a node's routing zone is described as an accumulation of nodes that has minimal range in hops through the node involved can be higher when compared to the parameter known as the zone radius. Note that every node maintains a unique routing zone [18].

2.1.2 Reactive routing protocols

These types of protocols are known as on-demand routing protocols as it consistently upgrade the routing table, whenever little information is there to deliver. However these protocols work with flooding method for path finding, that in turn provides additionally routing overhead cost and may have difficulties with the original path finding method, that will make this inappropriate for security purposes in VANET [6].

2.1.2.1 Adhoc on demand distance vector (AODV)

AODV is a reactive routing protocol intended for powerful Wi-Fi network. It is an on demand protocol, start path discovery operation only whenever a resource node wishes to send data packet to the location node. The path finding operation is performed by transmissions Route Request packet (RREQ) to its neighbors [18]. Each node retains broadcast-id which often steps for new RREQ. Every time a RREQ comes at a node, it verify the broadcast id if whether smaller or equal to earlier information this will eliminate the packet.

2.1.2.1 Temporally-ordered routing algorithm (TORA)

In this every node builds a directed new cyclic graph by transmitting query packets. On receiving a query packet, if the node contains the path to the location it will transmit a reply packet, otherwise it declines the packet. A node on receiving a

reply packet will updates its length only when the length of packet is lesser than as compared to other reply packets [15]. It provides a path to all the nodes within the system, although maintenance of all the paths is not easy task in VANETS.

2.2 Position based protocols

These kinds of protocols employ geographical placing data to choose other sending hops consequently no global path among the sender and receiver should be developed as well as also updated [6].

2.2.1 Greedy perimeter stateless routing

Every single node regularly broadcasts beacon information in order to its neighbors that contains id and location. In the event if any node do not gets any beacon information from a neighbor for a certain time interval, after that GPSR device considers the neighbor provides unsuccessful or even away from range, and removes the neighbor from its table. It requires greedy sending options utilize details regarding instant neighbors in the network. For any node if greedy sending doesn't seem possible then it makes use of edge of the area technique to get the upcoming sending hop. In a town circumstances greedy sending is usually limited due to immediate transmissions among the nodes might not occur because of the limitations like structures and trees. Transforming system topology into chart as soon as greedy sending is tough it will eventually weaken the efficiency associated with redirecting [15].

2.2.2 Vertex-Based predictive Greedy Routing

This is a multi-hop car-to-building routing protocol with regard to city atmosphere. It estimates some sort of routine with appropriate junctions from the sender node to the predetermined commercial structure and then, transfer information towards the predetermined commercial structure throughout the routine of junctions. It makes use of location, speed and track of associated vehicles for determining each routine of appropriate junctions as well as greedy sending. With computation on the routine of appropriate junctions, the sender node determines the smallest route among themselves and its closest predetermined commercial structure using the assistance from routing network [6]. If the sender node receives several paths to the predetermined commercial infrastructure along with exact identical number of junctions that it arbitrarily chooses single path between them. This makes use of anticipating online greedy redirecting to send information through sender node to the closest predetermined structure.

2.2.3 Greedy traffic aware routing (GYTAR)

It is a better Greedy Traffic Aware Routing Protocol for Vehicular Ad Hoc Networks in urban atmosphere. It includes two segments first is junctions' selection which forwards information between two junctions. A packet will pass through junctions to reach its destination. In junction selection process a value is given to each junction by comparing the traffic density between the current junction and the next candidate junction along with curve metric range towards the location. This particular junction who has maximum value is likely to be selected with regard to packet sending. In second unit every vehicle keeps a table that includes location, speed as well as path of every neighbor vehicle as well as the table is modified regularly. Hence every time a packet will be obtained, the sending cars calculates the latest estimated location of every neighbor utilizing the table and after that chooses the next hop neighbor that is nearer towards the desired junction that might trigger packets inside a nearby highest [6]. To conquer this challenge GYTAR utilizes save as well as send methods.

2.3 Geocast based protocols

This kind of protocols is widely used for delivering information to every vehicle within a described regional area [12].

2.3.1 Robust vehicular routing

It is an efficient regional multicast protocol in which control packets are broadcasted in the system and the data packets are unicast. This protocol is usually used for delivering information all other vehicles inside the particular Zone of Relevance (ZOR). The ZOR can be described as new rectangle shape laid out in its area coordinates. Information is based on this triplet [A, M, Z] this signifies particular program, information along with verify of a zone respectively. Every time the vehicles gets information, then takes the information when if it is inside the ZOR. This represents a Zone of Forwarding (ZOF) that contains such as the origin and ZOR. Almost the cars within the ZOF are employed in the redirecting method [10]. That works with a reactive path finding method inside a ZOR. That protocol produces wide range of unnecessary information in the system that results in traffic jam and maximum delay in data sending.

2.3.2 *Dynamic time stable geocast routing (DTSG)*

The primary goal of this protocol is to work even with short density networks. It directly adjusts the protocol depending on the network density and the vehicles speeds intended for better performance. This describes different stages: pre-stable and stable period. Pre-stable stage allows this content being disseminated inside the area and stable-period directly node makes use of save as well as send process for described periods inside the area. Additionally this attempts for stability among packet transmitting rate and system cost [15].

2.4 Cluster based protocols

In cluster-based routing protocols cars close to one another make a new cluster. Every cluster has got single cluster-head that in turn can be accountable for intra and inter-cluster operation functions. Intra-cluster nodes talk one another utilizing immediate transmission process, in case of inter-cluster transmission can be accomplished through cluster headers. In cluster based routing protocols the development of clusters along with the choice of the cluster-head is a crucial problem. Within VANET on account of large mobility powerful cluster development is a massive process.

2.4.1 Cluster based routing

In this regional place is split into square grids. Every node determines best neighbor cluster header to be able to send information to another hop by making use of regional data. The redirecting charges are lesser amount that it does not need to find path as well as keep in redirecting table. The cluster header forwards LEAD data to their neighbors with coordinate of its grid and the position of cluster header. In the street area the grid can behave as a cluster header. Any time when the header is departing the grid that transmit LEAVE data including their grid location. The beginner node saves till a latest cluster header will be chosen [6]. The latest cluster header employs these details with regard to information redirecting. This protocol won't look at speed and path that can be significant variables in VANET.

2.4.2 Cluster-based directional routing protocol

It separates the vehicles into clusters along with those vehicles that are planning to follow a same path to form a cluster. The sender transmits data to the cluster header and further it transmits the data to header that are incorporated with identical cluster together with the location. Finally the particular location header transmits data towards the location. This cluster header choice and preservation can be exact as CBR however they look at speed and path of a car [6].

2.4.3 Hierarchical cluster routing protocol (HCB)

It represents a hierarchical cluster routing protocol intended for large mobility adhoc networks. HCB is two-layer connection architecture. Layer-1 mainly nodes posses individual radio station user and in addition they connect together through multi-hop route. The number of nodes provides an additional interface along large radio transmission variety known as excellent nodes that can be found in either on layer-1or layer 2. Excellent nodes have the ability to talk with each other through the base Station in layer-2. Through the cluster development, every node will connect to the closest cluster header as well as excellent nodes can get cluster headers in layer-1. In HCB, intra-cluster routing is accomplished individually in every cluster. Cluster heads changing account details regularly to allow inter-clusters redirecting [10].

2.5 Broadcast based protocols

Broadcast is a commonly used routing approach in VANETs, for example spreading visitors, climate, path condition between cars, and providing advertisements as well as declaration. Broadcast can also be used in unicast routing protocols (redirecting finding phase) to discover a highly effective path to the particular location. When the information required to be circulated towards the cars after the transmitting variety, multi-hop is used. The easiest method is to apply a broadcast service is surging in this every node rebroadcasts information to any of its neighbours other than those who received this information through. Surging assures the information will ultimately arrive at almost all nodes in the system. Surging works fairly work for a restricted number of nodes and it is simple to be executed. However once the amount of nodes in the system rises, the operation falls promptly [15]. The actual bandwidth required for one transmits information broadcast may rise exponentially. Surging may have considerable overhead as well as particular sending will be used to prevent system congestion.

2.5.1 Distributed vehicular broadcast protocol (DVCAST)

It makes use of nearby topology details by utilizing the regular hello announcements for transmitting the data. Every car relies on a flag parameter for evaluating either the packet is obsolete or not. This type of protocol splits the cars in several ways based upon the nearby connections and remains connected, sparsely connected, completely turned off neighborhood. In well-connected area utilizes determination plan (weighted p persistence, slotted 1and p persistence) [10]. In sparsely linked area immediately getting the transmit information, cars can instantly retransmit through the cars rotating in the similar location. In completely turned off area cars are utilized to keep transmit information so that other car goes into communication range, or else if the period ends it will dispose of the packet. This protocol leads to large control overhead and end to end delay in information sending.

2.6 Infrastructure based protocols

These protocols are generally infrastructure dependent for the reason that they pass on predetermined infrastructure for their routing [6].

2.6.1 Roadside-aided routing (RAR)

It is actually a platform for efficient routing throughout cars multiple networks instead of a definite redirecting protocol. Their paths are separated into areas using street area devices, as well as the path includes cars and street side area devices. This kind of protocols is not effective for large approach situations because they need fixed node or RSU [15].

2.6.2 Static Node Assisted Adaptive Routing (SADV)

It is a fixed node served flexible information distribution protocol for vehicular networks. This works on fixed nodes at junctions in order to delivers a packet. It uses to keep as well as send procedure in the fixed nodes until a car goes into transmitting range or best route is available [6].

3. RELATED WORK

Wu, cheng-shiun et al. [1] planned a multipath routing protocol for VANET called fast restoration on-demand multipath routing. FRMOR is targeted on quickly making on another route in case the first path is shattered. To acquire to lower the quantity of manage information in addition to better the route strength. Rondinone, Michele, and Javier Gozalvez et al. [2] have shown a new work on contention-based sending protocol which directly select redirecting route establish with their multi-hop connectivity. The achieved results show the accomplished higher packet transmission ratios, although it decreases the overhead and successfully controlling the transmissions route. Mershad, Khaleel, and Hassan Artail et al. [3] use the infrastructure of roadside devices to effectively and reliably route packets in VANETs. They approved their evaluation by evaluating its results with the results of the simulations they executed using the ns2 software. Venkata M. D. et al. [4] suggested the clustering method for visitors checking in addition to the location and where the Cluster Head (CH) election is conducted depend on distance and direction details. The simulation results display enhanced stableness, precise density evaluation in the cluster, enhanced End-to-End delay and better delivery ratio. Song, Chao et al. [5] suggested a novel routing plan, called Buffer and Switch (BAS) Distinctive from standard protocols in VANETs, the producing of replicates within BAS is bidirectional over the redirecting route. The simulator outcomes reveal that BAS can outperform the previous protocols, particularly when the network options are restricted. Hou, Jie et al. [7] proposed a scheme to improve the safety performances of position-based routing protocols. Just including some another protection methods, this certainly make use of digital signature to ensure the verification, file reliability and non-repudiation. This kind of procedures has become efficient and it has improved protection and network performance. Wu, Celimuge et al. [8] offered a VANET routing protocol which find out the appropriate path by making a use of fuzzy constraint Q-Learning algorithm. The protocol utilizes the fuzzy logic to examine whether a wireless link is superior or not by considering multiple metrics of signal strength, available data transfer usage and relative car motion. Ghafoor, Huma et al. [9] proposed a novel position-based routing protocol Anchor-based Connectivity Aware Routing for Vehicular Ad-hoc Networks, which takes both buses and cars as vehicular nodes running in both clockwise as well as anti-clockwise directions. ACAR is a hybrid protocol, uses both the greedy

forwarding approach and the carry-store-and-forward approach to guarantee the connectivity of the paths. They compared protocol with A-STAR. Wu, Celimuge et al. [11] proposed a loss-tolerant scheme for unicast routing protocols in VANETs. The proposed scheme uses multiple forwarder nodes to enhance the packet reception ratio at the forwarders and network coding to lessen the amount of required transmissions, producing a significant improvement of end-to-end packet delivery ratio without increasing the message overhead. Wu, Celimuge et al. [12] proposed a new method to route data messages in VANETs. The proposed protocol uses dynamically generated backbone vehicles to forward data messages. As a result, the selected backbone vehicles generate a reliably connected network. Wu, Celimuge et al. [17] proposed PFQ-AODV, which is usually a transportable VANET routing protocol that discovers the optimal path by making use of a fuzzy constraint Q-learning algorithm predicated on ad hoc on-demand distance vector routing. Kazemi, babak et al. [13] introduced a novel approach for routing in VANETS particularly for highways, on the basis of the opposition based ant colony optimization algorithm. The outcome demonstrates that the proposed scheme significantly outperforms similar protocols in the literature. Karande et al. [15] mentioned the study of problem of routing in VANETs and survey recent routing protocols for VANETS. Eiza, Mahmoud Hashem et al. [16] it represents a new vehicular reliability model to provide the reliable routing in VANETs. It extends the known protocol i.e. adhoc on-demand distance vector (AODV) routing protocol to get reliable routing further it extends AODV to AODV-R.

4. GAPS IN LITERATURE

As discussed by Mahmoud Hashem [16], it is observed that AODV-R performs better as compared to AODV but still there are few areas where further improvements are possible.

1. Congestion Control

By conducting the survey related to AODV and AODV-R protocols it is observed that they have not considered the effect of congestion while transmitting the data from one end to another. Therefore AODV and AODV-R requires enhancement when its data transmission fails.

2. Shortest path selection

The use of shortest path routing algorithm enables protocols to find such a path between sender and receiver which has minimum distance. Therefore the path selected by minimum distance algorithm comes up with protocol benefits over available protocols. AODV and AODV-R uses dijsktra and hop by hop algorithm for selecting shortest path. It can be further improved by applying soft computing techniques so that timely delivery of data is done.

3. Clustering

The use of clustering enables efficient data aggregation. It helps in removing data redundancy during the data-fusion. The use of clustering in AODV and AODV-R will improve its performance by removing redundant data from the nodes.

5. CONCLUSION

VANETs are stimulating technology to allow the transmissions between cars on one way and also between cars and street sides devices on another way. But, this is really a hard work to generate an efficient routing algorithm for VANETS because of the large mobility and the regular improvements of the system topology. Transmission connections are extremely at risk of disconnection in VANETS. Moreover the connection reliability should be correctly determined using the location, direction and velocity data of vehicles over the road. Controlling congestion is the important area of concern. Therefore in near future we will propose a new ant colony optimization, data aggregation based AODV-R protocol to enhance quality of service of AODV-R further for VANETS.

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