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# The Study of Routing Strategies in Vehicular Ad-Hoc Network to Enhance Security

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**Abstract**
In VANET, or Intelligent Vehicular Ad-Hoc Networking, defines an intelligent way of using Vehicular Networking. In VANET integrates on multiple ad-hoc networking technologies such as WIFI IEEE 802.11p, WAVE IEEE 1609, WIMAX IEEE 802.16, Bluetooth, IRA, and ZIGBEE for easy, accurate, effective and simple communication between vehicles on dynamic mobility. Effective measures such as media communication between vehicles can be enabled as well as methods to track the automotive vehicles. In VANET helps in defining safety measures in vehicles, streaming communication between vehicles, infotainment and TELEMATICS.

***Keywords:*** *Protocol Design, VANET, Protocols of VANET.*

## Introduction

Vehicular Ad-hoc Networks are expected to implement a variety of wireless technologies such as Dedicated Short Range Communications (DSRC) which is a type of WIFI. Other candidate wireless technologies are Cellular, Satellite, and WIMAX. Vehicular Ad-hoc Networks can be viewed as component of the Intelligent Transportation Systems (ITS).

A Vehicular Ad-Hoc Network or VANET is a technology that uses moving cars as nodes in a network to create a mobile network. VANET turns every participating car into a wireless router or node, allowing cars approximately 100 to 300 meters of each other to connect and, in turn, create a network with a wide range. As cars fall out of the signal range and drop out of the network, other cars can join in, connecting vehicles to one another so that a mobile Internet is created. It is estimated that the first systems that will integrate this technology are police and fire vehicles to communicate with each other for safety purposes.

As envisioned in ITS, vehicles communicate with each other via Inter-Vehicle Communication (IVC) as well as with roadside base stations via Roadside-to-Vehicle Communication (RVC), the optimal goal is that Vehicular networks will contribute to safer and more efficient roads in the future by providing timely information to drivers and concerned authorities.

## Protocol Design

The Vehicular Reactive Routing (VRR) protocol is integrated with the WAVE stack and is embedded at the Logic Link Control layer. VRR is a multi-channel protocol which exercises efficient route discovery, route maintenance and data deliver processes with the use of the Control Channel (CCH) and a Service Channel (SCH). Standard WSA messages are transmitted over CCH and IPv6 packets are transmitted over SCH. To obtain a current neighbour location the WSA frame is modified to carry position information (incurs an additional 4 Bytes). Route request and route reply demands are transmitted inside WSA frames (additional 40 Bytes) over the Control Channel and data acknowledgment and all application data (IPv6 packets) are sent over the Service Channel. Due to these modifications, a route is firstly established over the CCH and afterwards data are transmitted over the SCH.
The VRR protocol uses 3 signaling message types. Messages, route request (RREQ) and route reply (RREP) are broadcast on the CCH and acknowledgment (ACK) packets are transmitted on the SCH. Data packets are IPv6 packets and are transmitted after route discovery or route maintenance on one of SCHs. RREQ and RREP are situated inside the WRA field of WSA frame

and on each hop the WSA frame is discarded and a new WSA frame created. Both messages are transmitted in the lowest Traffic Class (background).

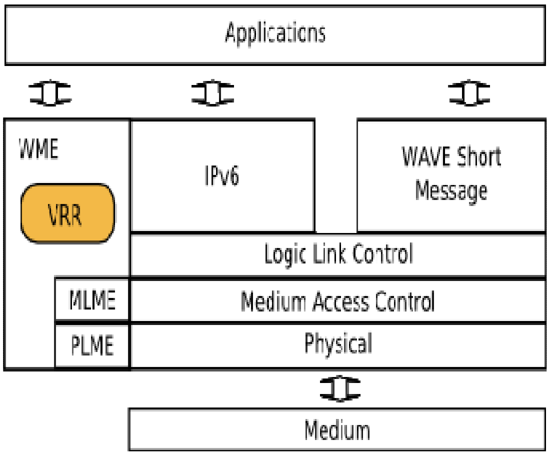


**Figure 1: The Different Link Controls**

## VRR Protocol

Vehicular Reactive Routing protocol (VRR)[1] is a reactive routing protocol with geographical features which is specifically designed for Wireless Access for the Vehicular Environment (WAVE) standard in Vehicular ad-hoc Networks (VANETs). The protocol takes advantages of the multichannel scheme defined in WAVE and uses the Control Channel (CCH) for signaling, and relies on one of the multiple Service Channels (SCHs) for payload data dissemination.

## VRR Broadcasting

This algorithm is based on combination of three approaches

- Neighbor elimination family: receiving nodes themselves decide to rebroadcast data or not on base of network coverage. If all nodes in transmit range of receiver node are covered by the information, then the receiver node does not rebroadcast. If some node is not covered by the information in transmit range of the node then the node prepares data to rebroadcast.
- Source-dependent dominating sets: The principle is that a sender determines for a small subset of neighbors which is called multipoint relay (MPR). Only nodes inside the subset can rebroadcast information from the source.
- Probability: where probability depending on the distance between a transmitter and a receiver. A Higher probability is chosen for node further from a source and vice versa with a lower probability for closer nodes.

Principle of VRR Broadcasting simply like that: A transmitter sends a broadcast data.

- If receiving node is chosen as MPR node by transmitter, it sets up shortest backoff time (waiting time before rebroadcasting).
- If receiving node is not chosen as MPR node by transmitter, it sets up backoff time depend on its mobility behaviour (distance from a transmitter, speed and vector of motion).
- If receiving node calculates that its neighbor’s nodes are already covered by broadcast information, then the node doesn't rebroadcast.

An advantage of VRR Broadcasting approach is that all receiving nodes have some opportunity to rebroadcast information (not only MPR nodes), but only a few nodes have the best opportunity (i.e. the shortest back off time) for rebroadcasting. Another advantage is that in the case of the multipoint relay node not always receiving the broadcast due to collisions (in a dense busy network) then other nodes who overhear can transmit the information instead.

## Route Discovery Technique

The RREQ frames are broadcast by the VRR Broadcasting algorithm. If a node doesn't have a route to destination then the node rebroadcasts depend on the algorithm. If a node has a route to destination, it creates broadcast frame RREP and set up back off time depend on mobility behavior (distance from a transmitter, speed and vector of motion). If a RREP is transmitted by a transmitter, all neighbor’s nodes received also the RREP and they discards own RREQ or RREP effort except node which is on a way to a source node.

## Interesting types of data exchanged

Traffic/road conditions

Accidents/events

Commodity/entertainment

## Proactive Protocol

The proactive protocols, such as Optimized Link State Routing (OLSR) [5] and Destination-Sequenced Distance-Vector Routing (DSDV) [6] compute and maintain routing information about all available paths in the networks even if no data traffic is exchanged.
In DSDV, every node maintains a vector of distances to every known destination. Therefore, frequent broadcast messages are issued by all nodes to learn periodically about their neighbors or to advertise topology changes (e.g. link breakages). Similarly, OLSR floods the network by the topology control messages in order to disseminate the link states information.
Throughout the entire network showing which nodes are connected to which other nodes? This additional traffic used in proactive approaches for the maintenance of unused paths has several drawbacks.
First, it consumes the networks resources and wastes a part of the bandwidth for control messages that increase with rapid changes. Moreover, the use of flooding increases the network congestion and leads to the loss of messages because of collision. So proactive solutions do not scale well in very large networks with a high number of nodes joining and leaving the network over a short time, which is the case for VANETs.

## Reactive Protocol

On the contrary, reactive protocols such as AODV and DSR determine a route to a given destination only on-demand. They reduce the overhead by restricting the route maintenance only between nodes that need to communicate. In other words, route discovery is only initiated when a sending node has to set up a valid path towards a given destination. Also most of reactive protocols use the flooding technique to establish the communication between the source and destination and consume a lot of the available bandwidth.
Because of the high mobility of vehicles, the topology-based algorithms fail to handle frequent broken routes usually constructed as a succession of vehicles between the source and the destination.
Moreover, the route instability and frequent topology changes increase the overhead for path repairs and thus, degrade the routing performances.

## Position-based routing

Position-based protocols perform the routing decisions based on the geographic information of the nodes. This class offers an alternative approach known to be more robust to face the mobility issues. Indeed, no global knowledge of the network topology is required; a purely local decision is made by each node to make a better progress towards the destination. Therefore, they require all nodes to be aware of their physical positions as well as their neighbors' positions. They also assume that the sending node knows the position of the destination. Typically, a location management service is responsible for querying this information.

## Greedy Perimeter Stateless Routing

As a representative example of the position-based algorithms, Greedy Perimeter Stateless Routing (GPSR) seems to be the most popular candidate for dynamic networks. Typically, there are several requirements on the availability of position information: GPSR requires that each node is able to obtain its current location e.g., through a GPS receiver as it is becoming standard equipment in vehicles. Furthermore, it assumes that each node learns about the existence of its direct neighbors and their current positions through the exchange of periodic HELLO messages. To make the routing decisions, a source node needs to know the position of the destination. The source node forwards the packets to its neighbor which is geographically closest to the destination. This procedure, known as Greedy Forwarding, is recursively applied by intermediate nodes until the final destination is reached. However, packets can reach node that has no neighbor which is closer to the destination than itself.

## Geographic source routing

The first protocol to use the knowledge of the underlying map of the streets was Geographic Source Routing (GSR) which is mainly proposed for urban environments. Assuming the availability of such information through a navigation system, a given source computes the shortest path to an intended destination using Dijkstra's algorithm based on the distance metric. The computed path consists of a sequence of junctions IDs known as Anchor Points (AP), along which packets should be forwarded to reach the destination. These anchors, obtained from the streets map, reflect the underlying road topology and usually represent the road intersections where decisions are made. The list of junctions is then inserted into the header of each data packet sent by the source. The packets are forwarded over the selected path successively from one AP to the next AP using the greedy forwarding scheme. the insertion of the entire path in the packet's header cannot be preferred in case of a long route between the source and the destination since it causes an additional packet overhead.

## Conclusion and Future Work

Routing is an important component in vehicle-to-vehicle (V2V) and infrastructure-to-vehicle (I2V) communication. This paper discusses various routing protocols of VANET. Designing an efficient routing protocol for all VANET applications is very difficult. Hence a survey of different VANET protocols, comparing the various features is absolutely essential to come up with new proposals for VANET. The performance of VANET routing protocols depend on various parameters like mobility model, driving environment and many more. Thus this paper has come up with an exhaustive survey and comparison of different classes of VANET routing protocols. From the survey it is clear that position based, geo-cast and cluster based protocols are more reliable for most of the applications in VANET.

This section suggests some directions of future research for VANET in general. As seen in some of the studies presented, the transmission range of a vehicle may be too strong or too weak during certain times of the day and in certain city environments.

When the transmission is too strong, it creates interference and lowers the system throughput. When transmission is too low, the vehicle cannot reach other vehicles. Smart algorithms that adjust the transmission range according to external factors can help finding the balanced transmission range. Further research is needed to provide these smart algorithms based on the characteristics of vehicular networks.

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