Research Paper

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# A Taxonomy Of Routing Protocols In VANET

Engineering

**KEYWORDS :** VANET, Routing Protocols

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## ABSTRACT

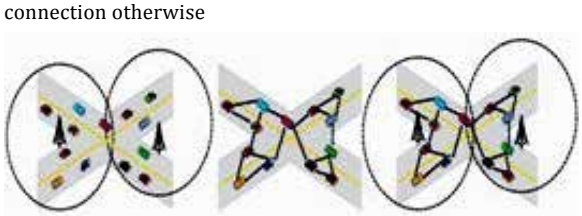
*VANET is an emerging technology to achieve intelligent inter-vehicle communications, seamless internet connectivity resulting in improved road safety, essential alerts and accessing comforts and entertainments. The technology integrates WLAN/cellular and Ad Hoc networks to achieve the continuous connectivity. The survey of routing protocols in VANET is important and necessary for smart ITS(Intelligent Transport System).The existing routing protocols for VANET are not efficient to meet every traffic scenarios. Thus design of an efficient routing protocol has taken significant attention. So, it is very necessary to identify the pros and cons of routing protocols which can be used for further improvement or development of any new routing protocol.This paper discusses the advantages / disadvantages and the applications of various routing protocols for vehicular ad hoc networks.*

**1.Introduction:**

With the sharp increase of vehicles on roads in the recent years, driving has not stopped from being more challenging and dangerous. Roads are saturated, safety distance and reasonable speeds are hardly respected, and drivers often lack enough attention. Without a clear signal of improvement in the near future, leading car manufacturers decided to jointly work with tonal government agencies to develop solutions aimed at helping drivers on the roads by titivating hazardous events or avoiding bad traffic areas. One of the outcomes has been a novel type of wireless access called Wireless Access for Vehicular Environment (WAVE) dedicated to vehicle-to-vehicle and vehicle-to-roadside communications. While the major objective has clearly been to improve the overall safety of vehicular traffic, promising traffic management solutions and on-board entertainment applications are also expected by the different bodies. When equipped with WAVE communication devices, cars and roadside units form a highly dynamic network called a Vehicular Ad Hoc Network (VANET), a special kind of Mobile Ad Hoc Networks (MANETs). While safety applications mostly need local broadcast connectivity, it is expected that some emerging scenarios, developed for intelligent transportation systems would benefit from unicast communication over a multi-hop connectivity. Moreover, it is conceivable that applications that deliver contents and disseminate useful information can flourish with the support of multi-hop connectivity in VANETs.

**2. Network Architectures**

Wireless ad hoc networks generally do not rely on fixed infrastructure for communication and dissemination of information. VANETs follow the same principle and apply it to the highly dynamic environment of surface transportation. As shown in Fig. 1, the architecture of VANETs mainly falls within three categories: pure cellular/WLAN, pure ad hoc, and hybrid. VANETs may use fixed cellular gateways and WLAN / WiMax access points at traffic intersections to connect to the Internet, gather traffic information, or for routing purposes. The network architecture under this scenario is a pure cellular or WLAN structure as shown in Fig. 1(a). VANETs can combine both cellular network and WLAN to form the networks so that a WLAN is used where an access point is available and a 3G connection otherwise



**(a) Cellular/WLAN (b) Ad Hoc (c) Hybrid**
**Figure 1: Architecture of VANET**

Stationary or fixed gateways around the sides of roads could provide connectivity to mobile nodes (vehicles), but are eventually unfeasible considering the infrastructure costs involved. In such a scenario, all vehicles and road-side wireless devices can form a pure mobile ad hoc network (Fig. 1(b)) to perform vehicle to vehicle communications and achieve certain goals, such as blind crossing. Hybrid architecture (Fig. 1(c)) of combining infrastructure networks and ad hoc networks together has also been a possible solution for VANETs. Namboodiri proposed such a hybrid architecture, which uses some vehicles with both WLAN and cellular capabilities as the gateways and mobile network routers so that vehicles with only WLAN capability can communicate with them through multi-hop links to remain connected to the world. The hybrid architecture can provide better coverage, but also causes new problems, such as the seamless transition of the communication among different wireless systems.

**3. Routing Protocols:**

A routing protocol governs the way that two communication entities exchange information; it includes the procedure in establishing a route, decision in forwarding, and action in maintaining the route or recovering from routing failure. This section describes recent unicast routing protocols proposed in the literature where a single data packet is transported to the destination node without any duplication due to the overhead concern. Some of these routing protocols have been introduced in MANETs but have been used for comparison purposes or adapted to suit VANETs' unique characteristics.

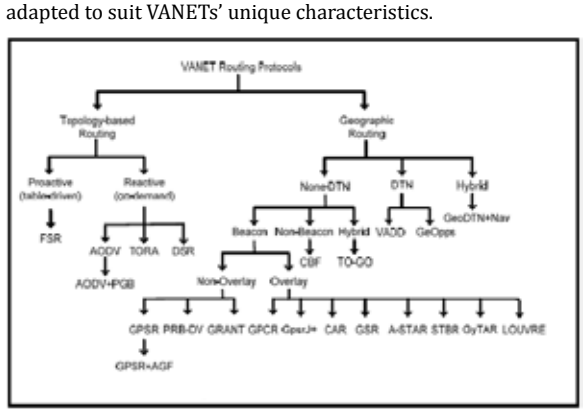



**figure 2: A Taxonomy of Various Routing Protocols**

**i) Topology-based Routing Protocols:**

These routing protocols use link's information that exists in the network to perform packet forwarding. They can further be divided into proactive (table-driven) and reactive (on-demand) routing.

a) Proactive (table-driven):
b) Reactive (On Demand):

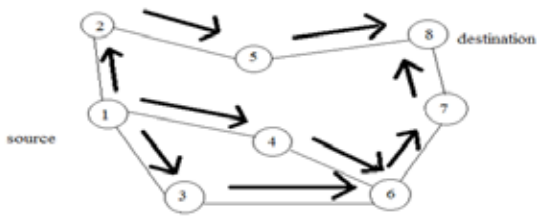



**Fig 3: Propagation of RREQ**

**AODV** – In Ad Hoc On Demand Distance Vector (AODV) routing, upon receipt of a broadcast query (RREQ), nodes record the address of the node sending the query in their routing table. This procedure of recording its previous hop is called backward learning. Upon arriving at the destination, a reply packet (RREP) is then sent through the complete path obtained from backward learning to the source. At each stop of the path, the node would record its previous hop, thus establishing the forward path from the source.

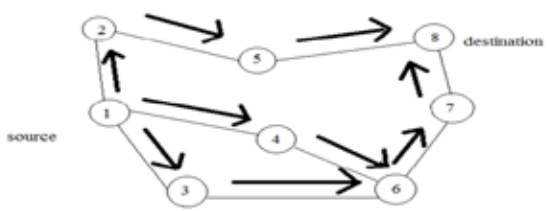



**Figure 4: Path of RREP to source**

**AODV+PGB** – Preferred Group Broadcasting (PGB) is a broadcasting mechanism that aims to reduce broadcast overhead associated with AODV's route discovery and to provide route stability especially important in VANETs where fast moving vehicles are used as wireless hosts. Based on the received signal of the broadcast, receivers can determine whether they are in the preferred group and which one in the group to broadcast. Since only one node is allowed to broadcast and since the preferred group is not necessarily the one that makes the most progress towards the destination, route discovery might take longer than before.

**DSR** – Dynamic Source Routing (DSR) uses source routing, that is, the source indicates in a data packet's the sequence of intermediate nodes on the routing path. In DSR, the query packet copies in its header the IDs of the intermediate nodes that it has traversed. The destination then retrieves the entire path from the query packet, and uses it to respond to the source.

**TORA –** Temporally Ordered Routing Algorithm (TORA) routing belongs to a family of link reversal routing algorithms where a directed acyclic graph (DAG) toward the destination is built based on the height of the tree rooted at the source. The directed acyclic graph directs the flow of packets and ensures reachability to all nodes. When a node has a packet to send, it broadcasts the packet. Its neighbor only broadcasts the packet if it is the sending node's downward link based on the DAG.

**ii)Geographic (Position-based) Routing:**
In geographic (position-based) routing, the forwarding decision by a node is primarily made based on the position of a packet's destination and the position of the node's one-hop neighbors. The position of the destination is stored in the header of the packet by the source. The position of the node's one-hop neighbors is obtained by the beacons sent periodically with random jitter (to prevent collision). Nodes that are within a node's radio range will become neighbors of the node. Geographic routing assumes each node knows its location, and the sending node knows the receiving node's location by the increasing popularity of Global Position System (GPS) unit from an onboard Navigation System and the recent research on location services respectively. Since geographic routing protocols do not exchange link state information and do not maintain established routes like proactive and reactive topology-based routings do, they are more robust and promising to the highly dynamic environments like VANETs.

**iii) Non-DTN – Overlay:**
The fundamental principle in the greedy approach is that a node forwards its packet to its neighbor that is closest to the destination. The forwarding strategy can fail if no neighbor is closer to the destination than the node itself. In this case, we say that the packet has reached the local maximum at the node since it has made the maximum local progress at the current node. The routing protocols in this category have their own recovery strategy to deal with such a failure.

**GPSR** – In Greedy Perimeter Stateless Routing (GPSR) a node forwards a packet to an immediate neighbor which is geographically closer to the destination node. This mode of forwarding is termed greedy mode. When a packet reaches a local maximum, a recovery mode is used to forward a packet to a node that is closer to the destination than the node where the packet encountered the local maximum. The packet resumes forwarding in greedy mode when it reaches a node whose distance to the destination is closer than the node at the local maximum to the destination.

**GPSR+AGF –** It has been observed that there are two problems with GPSR in VANETs. First, due to the mobile nature of VANETs, a node's neighbor table often contains outdated information of neighbor's position. The problem can be solved by increasing beacon's frequency, yet such a solution only increases congestion and brings in potential collisions. The second problem is that the destination's location within the packet is never updated despite the destination is moving. To address these two problems, Advanced Greedy Forwarding (AGF) has been proposed that incorporates the speed and direction of a node in the beacon packet and the total travel time, including the time to process the packet, up to the current forwarding node within the data packet.

**PRB-DV –** Position-Based Routing with Distance Vector Recovery (PBR-DV) uses AODV-style recovery as packets fall into a local maximum. The node at the local maximum would broadcast a request packet in which is the node's position and destination's location. Upon receiving a request packet, a node would first check if it is closer to the destination than the node at the local maximum. If it is not, it records the node from which it receives the request packet (similar to backward learning) and rebroadcasts the request; otherwise, it sends a reply to the node from which it receives the request..

**GRANT –** It uses the concept of extended greedy routing where every node knows its *x* hop neighborhood. This gives every node a far sighted vision of the best route to take to avoid local maximum. The metric in selecting the next forwarding neighbor E is based on the multiplication of the distance between the node *N*, x hop away from E and the destination, the shortest path from N to E, and the charge . Since the evaluation is done on static traces and the *x*-hop neighbors are assumed to be available, the beacon overhead and possible inaccuracy are not measured and well understood.

**iv) Overlay:**
An overlay routing has the characteristic that the routing protocol operates on a set of representative nodes overlaid on top of the existing network. In the urban environment, it is not hard to observe that decisions are made at junctions as these are the places where packets make turns onto a different road segment. Therefore, the overlaid routing protocols presented below have something to do with nodes at junction.

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**4.Conclusion:**

In this paper, we have investigated the advantages and disadvantages of different routing protocols for inter-vehicle communication in VANET. By studying different routing protocol in VANET we have seen that further performance evaluation is required to verify performance of a routing protocol with other routing protocols based on various traffic scenarios. Comparison can be done among the routing protocols in the Overlay and so on.

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