A Survey on Routing Mechanism and Techniques in Vehicle to Vehicle Communication (VANET)

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ABSTRACT

Now a day, one of the most attractive research topics in the area of Intelligent Traffic Control is Inter-vehicle communication. In V2V communication or we can also called VANET i.e. vehicular ad-hoc network; a vehicle can communicate to its neighboring vehicles even in the absence of a central Base Station. The concept of this direct communication is to send vehicle safety messages one-to-one or one-to-many vehicles via wireless connection. Such messages are usually short in length and have very short lifetime in which they must reach at the destination. The Inter-vehicle communication system is an ad-hoc network with high mobility and changing number of nodes, where mobile nodes dynamically create temporary networks and transferring messages from one node to others by using multiple hops due to limitation of short range. The routing in vehicular Ad hoc Networks (VANET) has attracted many attentions during the last few years. So in this paper we are focusing on the routing concept for the VANET i.e. principles for routing, decomposition of the routing function and requirement. The data delivery through Vehicular Ad-hoc Networks is challenging since it must efficiently handle rapid topology changes and a fragmented network.

KEY TERM'S

Routing, VANET, MANET, Communication, Topology, GPS, DYMO

1. Introduction

Vehicular ad hoc networks (VANET) represent a rapidly emerging research field, being a particularly challenging class of Mobile Ad Hoc Networks, used for communication and cooperative driving between cars on the road. VANET have particular features like: distributed processing and organized networking, a great number of nodes, the distribution and the speed of these nodes, a constrained but highly variable network topology, communication conditions and mobility patterns, signal transmissions blocked by buildings, frequent partition due to the high mobility, and finally there are no significant power constraints. So the routing is the more important aspect in the field of VANET [16]. A simple definition of routing is learning how to

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get from here to there. The classical definition of a route tempered by the very practical observation that routes are both source and destination dependent; i.e., that knowing how to get there isn't enough, you have to know where we are starting from as well. In some cases, the term routing is used in a very strict sense to refer only to the process of obtaining and distributing information, but not to the process of using that information to actually get from one place to another for which a different term, forwarding, is reserved. Since it is difficult to grasp the usefulness of information that is acquired but never used, we employ the term routing to refer in general to all the things that are done to discover and advertise paths from here to there and to actually move packets from here to there when necessary. The distinction between routing and forwarding is preserved in the formal discussion of the functions performed by OSI end systems and intermediate systems, in which context the distinction is meaningful.

2. Routing Principle for VANET

The principal criterion of successful routing in VANET is correctness but it is not the only criterion. We also prefer to take the most direct route i.e. one that takes the least time , the most reliable route i.e. one that is not likely to be closed by a heavy snowfall, the most scenic route i.e. one that follows pleasant country roads rather than busy highways), the least expensive route. In its most general form, optimal routing involves forwarding a packet from source to destination using the best path. What constitutes the best path can, of course, become quite a complicated question, as this example shows; networks, like the highway system, have variable costs, transit restrictions, delay characteristics, and residual error rates, and all of these can be more or less important in the determination of what means for a particular source and destination or for a particular packet. The VANET is the open system architecture [16]. The principal objective of an open systems routing architecture is not to achieve optimal routing-such a thing does not exist in the abstract. Such architecture must nevertheless be based on principles that account for what is happening in the real open systems world of today and tomorrow in which computers are being connected to networks at a rate that more than doubles the number of systems connected to the worldwide internet each year. The routing operations of finding how to get packets from source to destination and then actually getting from destination to source can be done in two basic ways. In source routing, all the information about how to get from source to destination is first collected at the source, which puts it into the packets that it send toward the destination. The job of the intervening network i.e. with its collection of links and intermediate systems is simply to read the routing information from the packets and act on it faithfully. In hop-by-hop routing, the source is not expected to have all the information about how to get from source to destination, it is sufficient for the source to know only how to get to the next hop i.e. perhaps an intermediate system to which it has a working link, and for that system to know how to get to the next hop, and so on until the destination is reached [11]. The job of the intervening network in this case is more complicated; it has only the address of the destination rather than a complete specification of the route by the source with which to figure out the best next hop for each packet.

3. Requirement for Routing in VANET

These observations suggest that an open systems routing architecture should posses following points:

- Scale well

- Support many different sub network types and multiple qualities of service.
- Adapt to topology changes quickly and efficiently i.e., with minimum overhead and complexity.
- Provide controls that facilitate the "safe" connection of multiple organizations.

It is not likely that the manual administration of static routing tables will satisfy these objectives for a network connecting more than a few hundred systems because the earliest medium for the maintenance of inter network routes, in which a complete set of fixed routes from each system to every other system was periodically-often no more frequently than once a week -loaded into a file on each system [14]. A routing scheme for a large-scale open systems network must be dynamic, adaptive, decentralized, to be capable of supporting multiple paths offering different types of service, and provide the means to establish trust, firewalls, and security across multiple administrations.

4. Assumption for Routing in VANET

- No power concerns with regarding to routing in VANET.
- In VANET the mobility is more structured as compared to MANET.
- Nodes have very high speed.
- Road network information is available.
- Geographic position is available.

5. Routing Architecture for VANET

The architecture of routing in VANET is basically the same as the architecture of routing in other connectionless networks. As usual, the conceptual framework and terminology of VANET are more highly elaborated than those of its roughly equivalent peers [6]. The VANET routing architecture applies to hop-by-hop connectionless open systems routing in general. The routing architecture for VANET is given in figure-1. The VANET routing scheme consists of:

- A set of routing protocols that allow end systems and intermediate systems to collect and distribute the information necessary to determine routes.
- A routing information base containing this information, from which routes between end systems can be computed i.e. directory information base, the routing information base is an abstraction and it doesn't exist as a single entity. The routing information base can be thought of as the collective (distributed) information of an entire subsystem concerning the routing-relevant connectivity among the components of that subsystem.
- A routing algorithm that uses the information contained in the routing information base to derive routes between end systems.

End systems (ES) and intermediate systems (IS) use routing protocols to distribute some or all of the information stored in their locally maintained routing information base. ES and IS send and receive these routing updates, and use the information that they contain and information that may be available from the local environment, such as information entered manually by an operator to modify their routing information base. The routing information base consists of a table of entries that identify a destination e.g. a network service access point address, the sub network over which packets should be forwarded to reach that destination also known as the next hop, or "next hop sub network point of attachment address, and some form of routing metric which expresses one or more of the characteristics of the route i.e. its delay properties or its expected error rate in terms that can be used to evaluate the suitability of this route, compared to another route with different properties, for conveying a particular packet of class of packets. The following illustrates the decomposition of the VANET routing function.

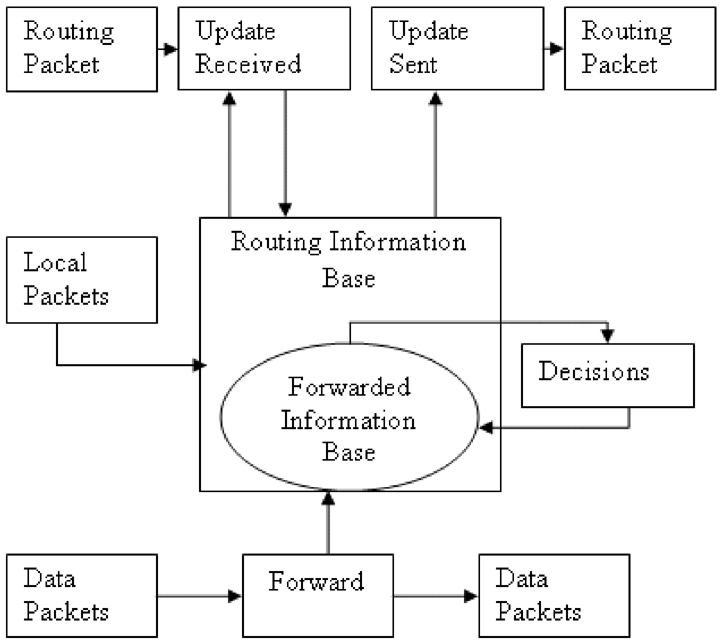

Figure-1 Architecture of VANET

6. Routing Techniques for VANET

In VANET we are using the following type of routing scheme:

6.1. Geographic Source Routing

Geographic Source routing is a position based routing with topology information. Geographical routing states that each node knows its own location by using the global positioning system (GPS) or some other indirect, localization technique [15]. When a source wants to send a packet to a destination, it uses the destination's location to find a neighbor that is closest in geographical distance to the destination, and closer than itself, and forwards the packet to that neighbor. The neighbor repeats the same procedure and until the packet makes it to the destination. The location of potential destination nodes is assumed to be available via a location service. This approach is particularly suitable for sensor and automotive networks. In the first case we have a network strongly embedded in the surrounding environment that leads to consider geographical traffic flows, instead of mere logical ones. In the automotive context the aim of traveling to a specific destination and the GPS navigator mounted in the vehicle best represent a possible application of geographical routing. The application fields mentioned above are characterized by frequent topology changes that may cause route oscillation and, consequently, path instability. A novel approach is the Trajectory Based Forwarding (TBF) which exploits this basic observation proposing a routing scheme that, similarly to source routing, requires the source node to encode a geographical trajectory, into the packet header. Since the sequence of forwarding nodes is not specified, packets are routed hop-by-hop according to nodes positions with respect to the trajectory. Geographical routes are quite stable due to the physical characteristics of the service area.

6.2. Data Dissemination Routing Technique

In the data dissemination technique, we transport the information to intended receivers with design objective such as high delivery ratio and low delay. For the data dissemination in v2v communication a mobility-centric data dissemination algorithm has been proposed for a partitioned and highly vehicle network. This algorithm combined the idea of opportunistic forwarding, trajectory-based forwarding and geographic forwarding. Message is stored and forward opportunistically along a pre-defined geographic path.

6.3. Greedy Perimeter Stateless Routing

Greedy perimeter stateless routing protocol specifies the geographic forwarding strategy and assumes the existence of a location. GPSR data forwarding algorithm consist the two component i.e. greedy forwarding and perimeter routing. GPSR [12] uses the default forwarding mechanism to forward the packets. But when the greedy forwarding is not possible then perimeter routing is used. The greedy forwarding is not possible when the packet reaches a node which does not have any neighbor closer to the destination than itself i.e. packet reaches a dead end or void.

6.4. On-Demand Routing Protocol

On-demand routing protocols for ad hoc networks, in which a node attempts to discover a route to some destination only when it has a packet to send to that destination. On demand routing protocols have been demonstrated to perform better with significantly lower overheads than periodic or proactive routing protocols in many situations. Since they are able to react quickly to the many changes that may occur in node connectivity, yet are able to reduce (or eliminate) routing overhead in periods or areas of the network in which changes are less frequent. When a node in the ad hoc network attempts to send a data packet to a destination for which it does not already. know the route, it uses a route discovery process to dynamically determine such a route. Route discovery works by flooding the network with route request (RREQ) packets. Each node receiving an RREQ rebroadcasts it, unless it is the destination or it has a route to the destination in its route cache. Such a node replies to the RREQ with a route reply (RREP) packet that is routed back to the original source. RREQ and RREP packets are also source routed. The RREQ builds up the path traversed across the network. The RREP routes itself back to the source by traversing this path backward.1 The route carried back by the RREP packet is cached at the source for future use. If any link on a source route is broken, the source node is notified using a route error (RERR) packet. The source removes any route using this link from its cache. A new route discovery process must be initiated by the source if this route is still needed. AODV algorithm is the example of such type of technique [2].

6.5. Greedy Forwarding Technique

In this technique, source sends the packet close to Destination (D). The source (S) forwarded packet under various algorithm shown in figure-1 below. Each node starting from source forwarded the message to the neighboring node. The most suitable neighbor (location E in figure-2) may be one that has minimum distance (known as Greedy) from the destination and lies within the range (circle) of forwarding data from 'S'. Apart from this method, the scheme is also consider MFR, NFP, compass routing as explained below.

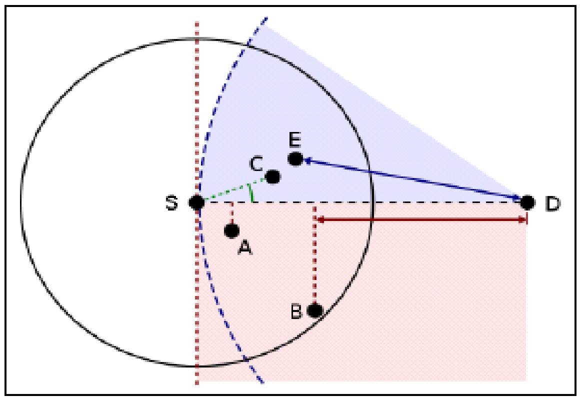

Figure-2: Greedy forwarding variants: The source node (S) has different choices to find a relay node for further forwarding a message to the destination (D). A = Nearest with Forwarding Progress (NFP), B = Most Forwarding progress within Radius (MFR), C = Compass Routing, E = Greedy

6.6. Face Routing Technique

Greedy forwarding at time leads to a dead end. In such cases, it cannot find any nearby neighbor to forward the packet. Face routing technique (figure-3) recover it from that situation and find a path to another node, where greedy forwarding can be resumed.

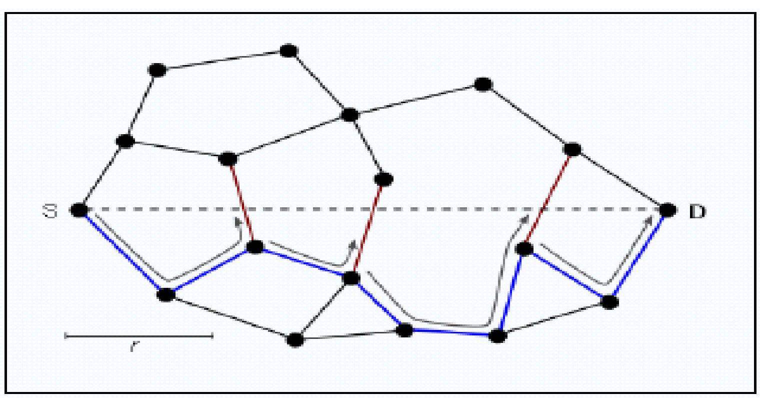

Figure-3: Face routing: A message is routed along the interior of the faces of the communication graph, with face changes at the edges crossing the S-D-line (red). The final routing path is shown in blue.

6.7. Fisheye State Routing (FSR)

FSR is similar to LSR, in FSR node maintains a topology table (TT) based upon the latest information received from neighboring and periodically exchange it with local neighbors [9]. For large networks to reduce the size of message the FSR uses the different exchange period for different entries in routing tables. Routing table entries for a given destination are updated preferably with the neighbors having low frequency, as the distance to destination increases. The problem with the FSR routing is that with the increase in network size the routing table also increases. As the mobility increases route to remote destination become less accurate. If the target node lies out of scope of source node then route discovery fails.

6.8. Geo-Cast Routing

Geo-cast routing is basically a location based multicast routing. Its objective is to deliver the packet from source node to all other nodes within a specified geographical region (Zone of Relevance (ZOR)). In Geo-cast routing vehicles outside the ZOR are not alerted to avoid unnecessary hasty reaction. Geo-cast is considered as a multicast service within a specific geographic region. It normally defines a forwarding zone where it directs the flooding of packets in order to reduce message overhead and network congestion caused by simply flooding packets everywhere. In the destination zone, unicast routing can be used to forward the packet. One pitfall of Geo-cast is network partitioning and also unfavorable neighbors which may hinder the proper forwarding of messages. The various Geo-cast routing protocols are IVG, DG-CASTOR and DRG.

6.9. Position Based Routing Protocol

Position based routing consists of class of routing algorithm. They share the property of using geographic positioning information in order to select the next forwarding hops. The packet is send without any map knowledge to the one hop neighbor which is closest to destination. Position based routing is beneficial since no global route from source node to destination node need to be created and maintained. Position based routing is broadly divided in two types: Position based greedy V2V protocols, Delay Tolerant Protocols.

6.10. Dynamic MANET on Demand (DYMO)

DYMO[10] is a new reactive routing protocol, which is currently developed in the scope of the IETF MANET working group. DYMO builds upon experience with previous approaches to reactive routing, especially with the routing protocol AODV. It aims at a somewhat simpler design, helping to reduce the system requirements of participating nodes, and simplifying the protocol implementation. DYMO retains proven mechanisms of previously explored routing protocols like the use of sequence numbers to enforce loop freedom. At the same time, DYMO provides enhanced features such as covering possible MANET–Internet gateway scenarios and implementing path accumulation as depicted in Figure 4. Besides route information about a requested target, a node will also receive information about all intermediate nodes of a newly discovered path. Therein lies a major difference between DYMO and AODV, the latter of which only generates route table entries for the destination node and the next hop, while DYMO stores routes for each intermediate hop. This is illustrated in Figure 1. When using AODV, node A knows only the routes to nodes B and D after its route request is satisfied. In DYMO, the node additionally learned a route to node C.

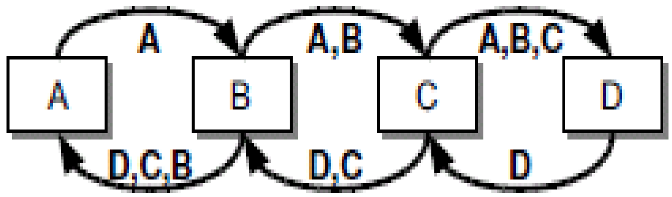

Fig.4. Routing information dissemination in DYMO

7. Conclusion

In this paper we are discuss the routing concept and different routing technique which are used in v2v communication. Routing is the backbone of the network. So the major challenge to protocol design in VANET is to improve reliability of Protocols and to reduce delivery delay time and the number of packet retransmission. The driver behavior should be considered for designing of delay bounded routing protocols since carry and forward is the mainly approach to deliver packets. Geo cast routing for comfort applications should also considered. Comfort messages are usually tolerant of delay, Network bandwidth is generally reserved for emergency messages. The DYMO protocol is also introduce i.e. extension in AODV. In such type of communication, the nearby vehicles are communicating each other directly or indirectly and send the emergency warning messages about their actions, such actions may be sudden and may cause disturbance or confusion that may lead to severe accidents. In order to guarantee the road safety, traffic safety and passenger safety, the Inter-Vehicle Communication is one of the most important factors.

8. Future Work

The future work of this paper is including the simulation result of the above discussed technique. We compare the above technique or algorithm to each other in term of time, overload, packet failure etc., because the time is important factor in v2v communication. If the message reached to the receiver late then there are the no advantage of such type of communication, because the main application of the v2v communication in intelligent Transportation System and time delay leads a big problem in that system.

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