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Reconnaissance of Routing Protocol in VANET

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Abstract- Vehicular Ad Hoc Networks (VANET) is a subclass of Mobile ad hoc networks which provides a distinguished approach for Intelligent Transport System (ITS). Vehicular networking has various prospects and opportunity to facilitate various functions connected with traffic safety, Effectiveness system infotainment and on their improvement. This paper includes network architecture, VANET Protocols, Challenges for VANET. In this paper we are discusses the following types of protocols for VANET i.e. Geo Cast, Cluster Based Protocols Topology Based, Positioned Based, Broad Cast.

Index Terms- *Classification of WANETs, VANET, Challenges, VANET Protocols*

1. INTRODUCTION

Recent year's quick development in automobile and its technologies, the wireless communication had made new type of Ad-hoc networks which known as the Vehicular Ad-hoc Network (VANET) for transportation.

Wireless Ad-Hoc Network (WANET) has many categories such as wireless mesh network, (WSN) wireless sensor network and Mobile Ad-Hoc Network (MANETs) as shown in Fig 1. VANETs is a subset of MANETs with a unique characteristic of dynamic nature or node mobility, infrastructure less nature, frequent exchange information, self-organizing, real time processing, low volatility and distance. It is to be considered the first commercial vehicles of MANETs [1]. In the VANETs there are two type of communication mechanism one is vehicle to vehicle (V2V) communication in which vehicle communicate with other vehicles in the network second is vehicle to infrastructure (V2I) communication in which vehicle will communicate with access points i.e. Road Side Units to get required information as shown in Fig 2. It provides safety and comfort to road users. VANET assists vehicle drivers to communicate and to coordinate among themselves in order to avoid any critical situation through vehicle to vehicle (V2V) communication. For an example road side accident; traffic jam; speed control free passage of emergency vehicles and unseen obstacles etc. are many examples. Besides the safety applications, VANET is also provide comfort applications to road users through vehicle to infrastructure communication (V2I). For example, information of petrol pumps, information of nearby hospital, hotel, weather forecasting information, internet access and multimedia applications [2].

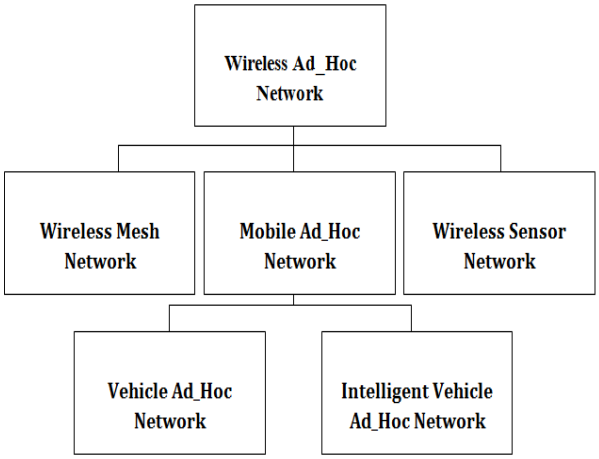


Fig. 1 Classification of WANET

2. HOW VANET WORKS

Vehicular Networks System consists of large number of nodes, number of vehicles approximately which exceeding 750 million in the today's world , these vehicle will require an authority to govern it and then each vehicle can communicate with other vehicles using short radio signals DSRC (5.9 GHz), for range can reach 1 KM, so in this case communication is an Ad Hoc communication means each connected node can move freely and there is no wires required, therefore the routers which used is called Road Side Unit (RSU), the RSU works as a router between the vehicles on the road and connected

to other network devices. Each vehicle has OBU i.e. on board unit; this unit connects the vehicle with RSU via DSRC radios, and another device is TPD i.e. Tamper Proof Device, this device has all the information about the vehicle like keys, drivers identity, trip details, speed etc. and also it can be hold the vehicle secrets [3].

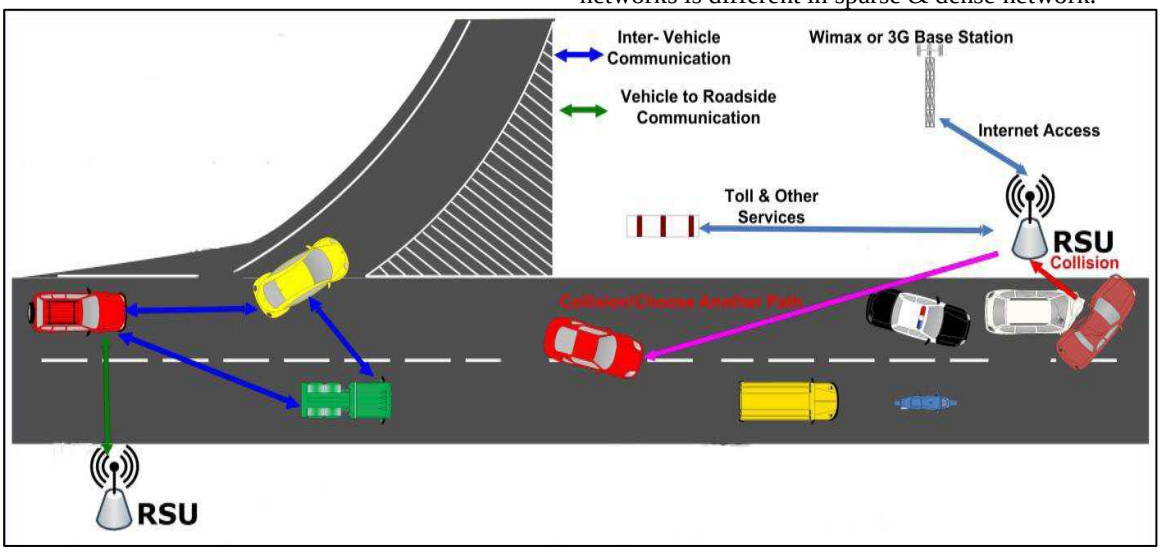


Fig.2 VANET Structure

3. CHARACTERISTICS

There are some unique characteristics of VANET which make it different from MANET as well as challenging for designing VANET applications:

3.1. *Frequent disconnected network*

From the highly dynamic topology results we observe that frequent disconnection occur between two vehicles when they are exchanging information i.e. occur in most sparse network.

3.2. *Mobility modeling*

The mobility pattern of vehicles depend on traffic environment such as roads structure, speed of vehicles, driver's driving behavior and so on.

3.3. *Battery power and storage capacity*

In modern vehicles battery power and storage is unlimited. It has enough computing power which is unavailable in MANET. With the help of this effective communication occurred & it will make routing decisions helpful.

3.4. *Communication environment*

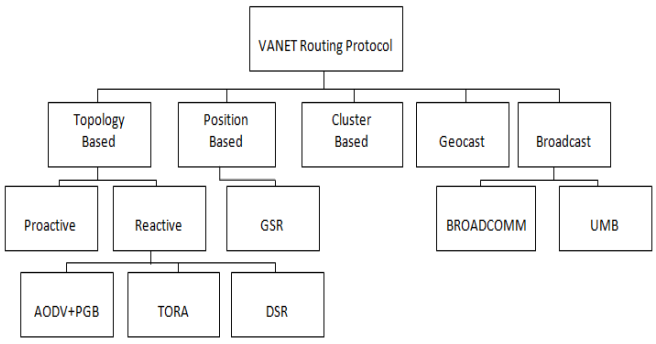
The communication environment between vehicles is different in sparse network & dense network. In the dense network tree, building & other objects behave as obstacles and in sparse network like high-way this things are absent. So routing approach of these two networks is different in sparse & dense network.

3.5. *Interaction with onboard sensors*

The current position and the movement of nodes can easily besensed by onboard sensors like GPS device. It is benifical for effective communication & routing decisions.[4].

4. OVERVIEW OF ROUTING PROTOCOLS

A routing protocol governs the way that two communication entities exchange information; it includes the procedure in establishing a route, decision and action in forwarding and maintaining the route or covering from routing failure. [5] In VANET, the routing protocols are classified into five Categories: Cluster based, Topology based, Position based, Broadcast, Geo cast as shown in Fig.3.



. Fig. 3 Classification of Routing Protocol

4.1. *Topology based routing protocol*

These routing protocols use links' information that exists in the network to perform packet forwarding. There are two types of Topology based Routing protocols one proactive (table driven) and other reactive (on-demand) routing.

4.1.1 Proactive routing protocol

It carries the various features: the routing information such as the next forwarding hop is maintained in the background regardless of communication requests. Packets are constantly broadcast and flooded among nodes to maintain the paths or the link states between any pair of nodes even though some of paths are never used. A table is then constructed within a node such that each entry in the table indicates the next hop node toward a certain destination. The advantage of the proactive routing protocols is that there is no route discovery since route to the destination is maintained in the background and is always available upon lookup. It also provides low latency for real-time application [5].

4.1.2. Reactive protocol

On demand or reactive routing protocols were designed to overcome the overhead problem, that was created by proactive routing protocols, by maintaining only those routes that are currently active . These protocols implement route determination on a demand or need basis and maintain only the routes that are currently in use; so thereby reducing the burden on the network when only a subset of available routes is in use at any time.

4.1.2.1. 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. It is based on the received signal of the broadcast, receivers can determine whether they are in the preferred group or not and which one in that group to be broadcast. Since only one node is to be allow to broadcast and so that preferred group is not necessarily the one that makes the most progress towards the destination, route discovery might take longer than before [5].

4.1.2.2. Temporally Ordered Routing Algorithm

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. The directed acyclic graph directs the flow of packets and ensures reachability to all nodes. When a node has a packet which is to be send and it broadcasts the packet. Its neighbor only broadcasts the packet if it is sending the node's downward link which based on the directed acyclic graph. A node would construct the directed graph by broadcasting a query packet. Upon receiving a query packet, if a node has a downward link to the destination, it will broadcast a reply packet; otherwise, it simply drops the packet. A node when receiving a reply packet it will update its height only and if the height from the reply packet gives the minimum of all the heights from reply packets it has received so far. It then rebroadcasts the reply packet. The advantages of TORA are that the execution of the algorithm gives a route to all the nodes in the network.

4.1.2.3 DSR

Dynamic Source Routing (DSR). In DSR, the query packet copies in its header the IDs of the intermediate nodes that it traversed and then destination retrieves the entire path from the query packet and uses it to respond to the source. Then source can establish a path to the destination. If we allow the destination to send multiple route replies, the source node may receive and store multiple routes from the destination. An alternative route can be used when some link in the current route breaks. If a network has low mobility, this is advantageous over AODV since the alternative route can be tried before DSR initiates another flood for route discovery. There are two major differences between AODV and DSR. The AODV data packets carry the destination address, whereas in Dynamic Source Routing; data packets carry the full routing information. It means that DSR has more routing overheads than AODV [5].

4.2. *Position-based routing protocol*

Position or geographic routing protocol is based on the positional information in routing process; where the source sends a packet to the destination using its geographic position rather than using the network address. Position Based protocol required each node is able to decide its location and the location of its neighbors through the Geographic Position System assistance. The node identifies; its neighbor as a node that located inside the node's radio range. When the source send a packet and it stores the position of the destination in the packet header which will help in forwarding the packet to the destination without any route discovery and its maintenance even awareness of the network topology [6].

4.2.1. Geographic source routing

Earlier GSR has been used for MANET, now a day's it is improved to use in VANET scenario by incorporating in to it greedy forwarding of messages toward the destination. If at any hop there are no nodes in the direction of destination then GPSR utilizes a recovery strategy known as perimeter mode. It has two components one is distributed planarization algorithm that makes local conversion of connectivity graph into planar graph by removing redundant edges. Another component is online Routing algorithm that operates on planer graphs. Due to this in VANET perimeter mode of GPSR is used. In the GPSR mode if any obstruction or void occurs then algorithm enter perimeter mode and planner graph routing algorithm start operations that involves sending the message to intermediate neighbor instead of sending to farthest node, but due to this method there is long delays due to greater numbers of hop counts.

4.3. Cluster based routing protocol

In the CBRP routing is done using source routing. But this protocol uses also route shortening. When a node receives the reply of the destination to the source, it tries to find the farthest node in the route that is its neighbor. With this principle the route between source and destination can be reduced. Fig 4 [7] shows Cluster based routing protocol. If source node has to send data to the destination node, Source node sends route requests to all the neighboring cluster-heads, and only to the Cluster-heads. When a cluster-head receives the route request, it checks if the destination node is in his cluster. If this is the case, the cluster-head sends the request directly to the destination, but when Destination isn't in the cluster, it sends the route request to all the adjacent cluster-heads. All cluster-head saves his address in the packet, so when a cluster-head receives a route request where his address is saved in the packet, it discards this packet. When the route request packet arrives at the destination, it replies back with the route that had been recorded in the request packet. When the source doesn't receive a reply from the destination within a time period, it tries to send a route request again.

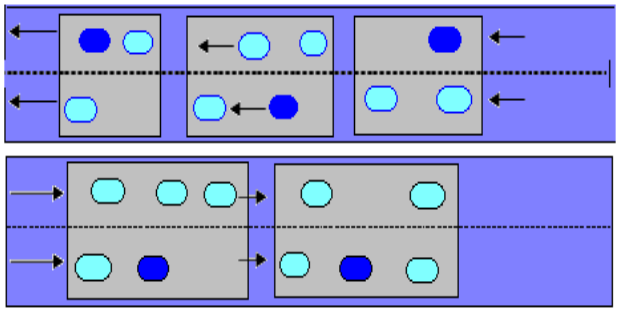


Fig.4 Cluster Based Routing Protocol

4.4. Geo cast routing

Geo cast routing is basically a location based on multicast routing. The 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 as shown in Fig.5 vehicles outside the ZOR are not alerted to avoid unnecessary quick reaction. Geo cast is considered as a multicast service within a specific geographic region. 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. Uncast routing can be used to forward the packet in the destination zone [5].

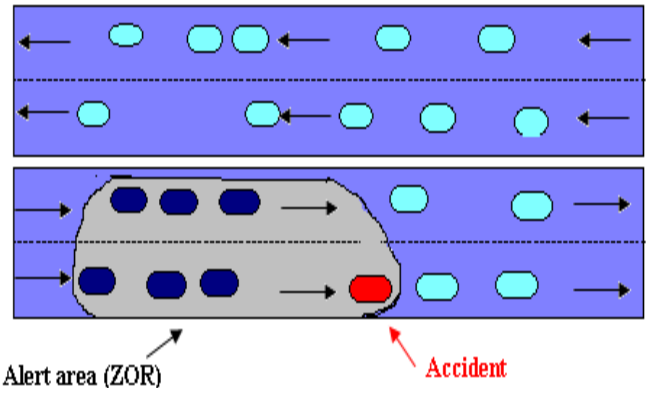


Fig.5 Geocast Routing

4.5. *Broadcast routing*

Broadcast routing is frequently used in VANET for traffic, sharing, weather, emergency and the road conditions among vehicles and delivering advertisements and announcements [10]. The broadcasting is used when message needs to be dispersed to the vehicle beyond the transmission range i.e. multi hops are used. Broadcast sends a packet to all nodes in the network, usually using

flooding techniques, ensuring the delivery of the packet but bandwidth is wasted and nodes receive duplicates. This kind of routing technique performs better for a less number of nodes. Various Broadcast routing protocols are UMB and BROADCOMM.

4.5.1. BROADCOMM routing protocol

Broadcast is based on hierarchal structure for highway network. The highway network is divided into virtual cells which move like vehicles and each nodes in the highway are organized into two level of hierarchy: the first Level hierarchy includes all the nodes in a cell, another level hierarchy is represented by cell reflectors. Few Cell reflected behaves for certain interval of time as cluster head and handles the emergency messages coming from same members of the cell or nearby neighbor [9].

4.5.2. Urban Multi-hop Broadcast Protocol

This protocol performs with much success at higher packet loads and vehicle traffic densities without any prior topology information to sender node tries to select the furthest node in the broadcast direction for forwarding and acknowledging the packet. It is designed to overcome the interference, packet collision and hidden node problems during message distribution in multi-hop broadcast [9].

5. SECURITY ISSUES

Following are the security issues in VANET

5.1. Authentication:-

In Vehicular Communication every message must be authenticated, to make sure for its origin and to control authorization level of the vehicles, to do this vehicles will assign every message with their private key along with its certificate, at the receiver side, the receiver will receive the message and check for the key and certificate once this is done, the receiver verifies the message.

5.2. Availability:-

Vehicular network can be available all the time, for many applications vehicular networks will require realtime, these applications need faster response from sensor networks or even Ad Hoc Network, a delay in seconds for some applications will make the message meaningless and maybe the result will be devastating.

5.3. Non-repudiation:-

Non-repudiation will facilitate the ability to identify the attackers even after the attack happens. It will prevents cheaters from denying their crimes. Any information related to the car like: the trip rout, speed, time, any violation will be stored in the TPD, any official side holding authorization can retrieve this data.

5.4. *Privacy:-*

Keeping the information of the drivers away from unauthorized observers,this information like real identity, trip path, speed etc. The privacy could be achieved by using temporary (anonymous) keys, these keys will be changed frequently as each key could be used just for one time and expires after usage all the keys will be stored in the TPD, and will be reloaded again in next time that the vehicle makes an official checkup.

5.5. Integrity:-

Integrity of every message should be protected to prevent attackers from altering them, and message contents to be trusted.

5.6. Confidentiality:-

The privacy of each an every driver must be protected; the messages should be encrypted to prevent outsiders from gaining the drivers information [3].

6. APPLICATION OF VANET

VANET communications can be used for number of potential applications with highly diverse requirements. There are three major classes of applications possible in VANET that are safety oriented, convenience oriented and commercial oriented. Safety applications are use to monitor the surrounding road, approaching vehicles, surface and curves of the road. Convenience application will be mainly of traffic management type. Commercial applications will provide the driver with the entertainment and services like web access, streaming audio and video.

6.1. Traffic signal:-

Communication from the traffic light can be created with the technologies of VANET. Safety applications would be Stop Vehicle Advisor (SVA) in which a slow or motionless vehicle will broadcast alert message to its neighborhood. Congested Road Notification (CRN) detects and notifies about road congestions which can be used for route and journey

planning. The toll collection is yet another application for vehicle toll collection at the toll booths without stopping the vehicles. In traffic signal Vehicular networks have been shown to particularly useful for traffic management. Vehicle to infrastructure solution for road tolling is widely deployed.

6.2. Vision enhancement:-

It can be use in vision enhancement, in which drivers are given a clear view of vehicles and obstacles in heavy fog conditions and can learn about the existence of vehicles hidden by obstacles, buildings, and by other vehicles.

6.3. Weather Conditions:-

Either vehicle sensors (grip control, wipers movement, outside thermometer etc); if not available / reliable then information can be updated / requested by an application via DSRC also. In the post-crash notification, a vehicle involved in an accident would broadcast warning messages about its position to trailing vehicles so that it can take decision with time in hand as well as pass information to the highway patrol for support. Parking Availability Notification (PAN) helps to find the availability of space in parking lot in a certain geographical area as per the weather conditions. For the convenience of the vehicle; the highway and urban area maps are available which avoid the traffic jam and accident conditions and also provide shortest path in critical situation which saves the time.

6.4. Automatic Parking:-

Automatic Parking is an application through which a vehicle can park itself without the need for driver intervention. To perform an automatic parking a vehicle needs to find an accurate distance estimators and/or a localization system with sub-meter precision.

6.5. Safety:-

Safety applications include immediate collision warning; avoidance; forward obstacle detection; emergency message dissemination; highway collision avoidance; right/left turn assistant , stop sign movement assistant, lane changing warning and road-condition warning, cooperative driving (e.g. collision warning, lane merging).

6.6. *Searching roadside locations and vehicle's direction:-*

For unknown passenger help to find the shopping center, hotels, gas stations etc. The sensors and database from the nearest roadside base station are capable of calculating information [11].

7. FUTURE SCOPE

To address the drawbacks of topology-based and geography based routing approaches, there is one protocol called as hybrid routing protocol for VANET. Hybrid routing protocol can provide stable and reliable routes between the source node and the destination node with an optimal distance, reduced delay, increased packet delivery ratio and low routing overheads. Hybrid routing protocol combines two fundamental routing methods namely, topology-based routing and the geography-based routing in order to reap their benefits on one hand and avoid their drawbacks at the same time.

Network density is used to determine the type of routing method to use in the VANET environment. This decision is made by the source node after estimating the VANET density based on the number of all nodes extracted from the positions table. In other words, using its positions table, the source node checks the network between the source and the destination after dividing it on a set of sub-networks where each one has a perimeter equal to the transmission range. If the number of nodes in a sub-network is superior to a threshold 'a' called density coefficient, calculated, the topology based routing is applied. Otherwise, the geography-based routing is invoked [12].

CONCLUSION

Routing is an important component in vehicle-to-vehicle (V2V) and infrastructure-to-vehicle (I2V) communication. In this paper discusses various routing protocols of VANET. To designing an efficient routing protocol for all VANET applications is very difficult. The performance of VANET routing protocols depend on various parameters like mobility model, driving environment and many more. From this paper it is clear that Topology based Routing Protocol, position based, geocast .broadcast protocols and cluster based protocols are more reliable for most of the applications in VANET.

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