A Comparative taxonomy on Routing Protocols of VANET

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Abstract- In vehicular Ad-hoc network safety is one of the major issue for the researcher and it depends on the delivery of the information among the vehicles. Due to the recent advances in the hardware and technology the researcher has concern to improve vehicle and road safety, traffic efficiency, and convenience as well as comfort to both drivers and passengers. The gives a comparative taxonomy of the feature of the different VANETs routing protocols.

Keywords – Keywords- Protocols, VANET, Mobility, Routing , Data Dissemination.

I. INTRODUCTION

Recent advances in wireless technologies have made inter-vehicular communications (IVC) possible in mobile ad hoc networks (MANETs) and this has given birth to a new type of MANET known as the vehicular ad hoc networks (VANETs). A Vehicular Ad-Hoc Network, or VANET as shown in figure-1, is a form of mobile ad-hoc network, which provides communications among nearby vehicles and between vehicles and nearby fixed equipment, usually described as roadside equipment. Enabled by short-range to medium range communication systems (vehicle-to-vehicle or vehicle-to-roadside), the vision of vehicular networks includes real-time and safety applications, sharing the wireless channel with mobile applications from a large, decentralized array of service providers. Vehicular safety applications include collision and other safety warnings. Vehicular Networks have attracted a lot of attention in the last few years. Creating high performance, highly scalable, robust and secure vehicular networking technologies presents an extraordinary challenge to the wireless research community.

The V2V communication infrastructure assumes the presence of high bandwidth with low latency. The radios typically operate on unlicensed band making the spectrum free [2]. Vehicles exchange information with other vehicles within their short radio range, and ad hoc wireless networks are used to propagate information [3].

In comparison to other communication networks, VCNs come with unique attractive features: unlimited transmission power, predictable mobility and plethora of potential applications. However, to bring its potency to fruition, VCNs have to cope with formidable challenges that include: rapidly changing topology subject to frequent fragmentations and congestions, lack of connectivity redundancy, and the stringent application requirement on real-time and robust message delivery.

Road safety has been an important concern in the world over the past few years since millions of people die every year because of car accidents and many more are injured. Networked Electronic Control Units (ECUs) are increasingly being deployed in automobiles to realize diverse functions such as engine management, air-bag deployment, and even in intelligent brake systems[1]. Vehicular Communication Networks (VCNs) are a cornerstone of the envisioned Intelligent Transportation Systems (ITS). By enabling vehicles to communicate with each other via Inter-Vehicle Communication (IVC) as well as with roadside base stations via Roadside-to-Vehicle Communication (RVC), vehicular networks could contribute to safer and more efficient roads.

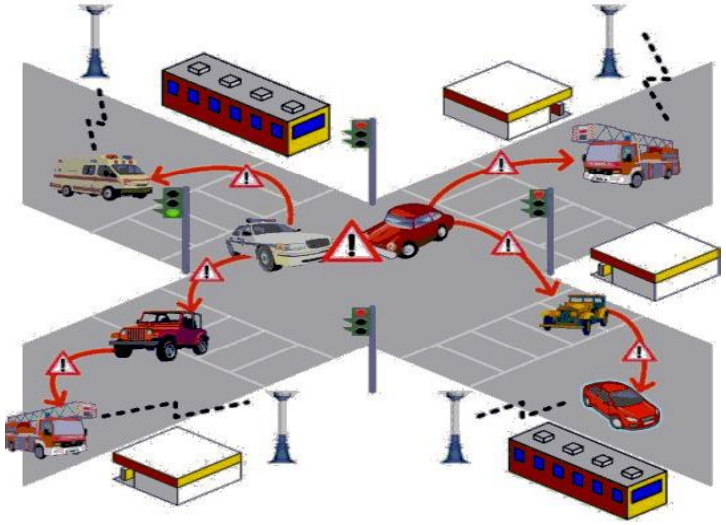

Figure 1: VANET [40]

In driving location changes constantly. So there is a constant demand for information on the current location and specifically for data on the surrounding traffic, routes etc [13].

In this paper gives an overview and features of the technologies and protocols in VANETs. The remainder of this article is organized as follows. Section 2, provides the necessary background and applications of VANETs. Section 3, gives a comparative taxonomy of VANETs routing protocols and Section 4, finally concludes the paper.

II. VANET AND ITS APPLICATION

Many lives were lost and much more injuries have been incurred due to car crashes. A driver realizing the brake lights of the car in front of him has only a few seconds to respond, and even if he has responded in time cars behind him could crash since they are unaware of what is going at the front.[5] The original motives behind vehicular communications were safety on the road, This has motivated one of the first applications for vehicular communications, namely cooperative collision warning which uses vehicle to vehicle communication. Besides road safety, new applications are proposed for vehicular networks, among these are Electronic Toll Collection (ETC), car to home communications, travel and tourism information distribution, multimedia and game applications just to name a few. However these applications need reliable communication equipment which is capable of achieving high data rates and stable connectivity between the transmitter and the receiver under high mobility conditions and different surroundings.

Wireless research field is growing faster than any other one. It serves a wide range of applications under different topologies every one of which comes with some new specialized protocols [12]. VANET presents a new and promising field of research, development and standardization. Throughout the world, there are many national and international projects in governments, industry, and academia devoted to the development of VANET protocols for the safety and ease of transportation [12]

VANET communications can be used for number of potential applications with highly diverse requirements as shown in figure-2. There three major classes of applications in VANET which are safety oriented, convenience oriented and commercial oriented[39].Some of the applications are as follows.

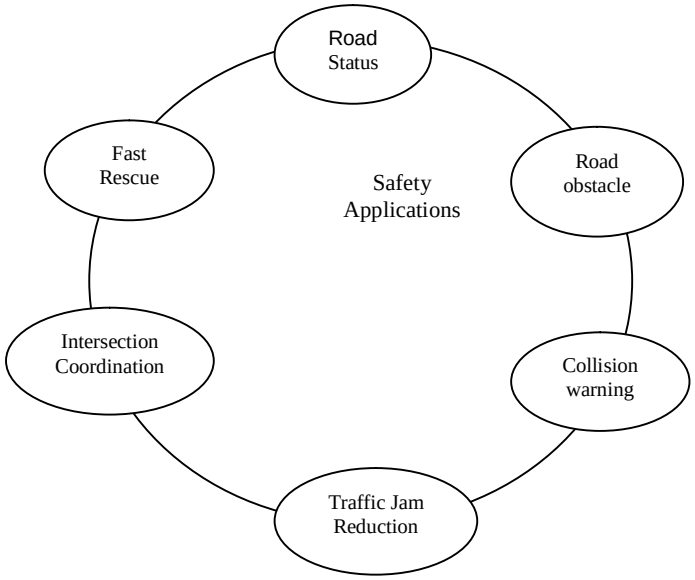

Figure 2: Safety applications

A Post Crash Information

Sometime in the remote area rescue team cannot take quick action in case of an accident, so it will be better that an accident vehicle 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. For the convenience of the vehicle, 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.

B. Highway Safety

In [39] applications include immediate collision warning, forward obstacle detection and avoidance, emergency message dissemination, left/right turn assistant, lane changing warning, stop sign movement assistant and road-condition warning, intersection decision support, cooperative driving , VANET will support the driving.

III. COMPARATIVE STUDY OF SOME ROUTING PROTOCOLS IN VANET

During the last few years, a lot of protocols for VANETs have been reported in the literature. TrafficInfo [7] is an example of fixed broadcast interval protocol in which every vehicle is equipped with a global positioning system (GPS) and digital road map and periodically broadcasts the traffic information stored in its database. During broadcasting process each vehicle stores its own travel time and time taken by other vehicles during travelling into the database. Although single-hop broadcasting scheme is inefficient in broadcasting all the records from database but, TrafficInfo uses the bandwidth efficiently and broadcasts only the most relevant top information from the database.

TrafficView is another protocol [32], in this when a vehicle receives a broadcasted packet; it first stores the information in its database. The information is then rebroadcasted in the next broadcast cycle. However, instead of broadcasting all stored record from the database, only a single record is broadcasted after aggregating the multiple records.

Another protocol i.e Geocast protocol which was designed to disseminate safety messages within a useful area where these messages are still relevant [33]. In this, a vehicle which detects an emergency situation first starts broadcasting a warning packet. Packet specifies the area where the warning is still relevant. When another vehicle

receives the warning message, it will act as a relay node and keep broadcasting the warning packet as long as it is still traveling in the concerned area. Each vehicle adjusts its rebroadcast interval dynamically in order to reduce the number of redundant warning packets. The rebroadcast interval is decided by the transmission range, speed, and the relative distance between the emergency site and the vehicle

In Segment-oriented Data Abstraction and Dissemination (SODAD) [34] protocol each road is divided in a number of road segments of a well-known length and the analysis (e.g. the mean of all available data values) is computed on a per-segment basis. Since information on the traffic situation in the local area is also transmitted based on these road segments. This specific form of data abstraction leads to a scalable system, since the amount of data to be distributed is independent of the number of equipped vehicles. An increasing penetration results only in more accurate information and less delay. SOTIS is a decentralized information system based on car to-car communication which is scalable and can successfully distribute traffic.

Urban Multi-hop Broadcast (UMB) protocol [35] is designed to address (i) broadcast storm, (ii) hidden node, and (iii) reliability problems in multi-hop broadcast. The UMB protocol is composed of two phases, namely directional broadcast and intersection broadcast. A new directional broadcast method where sender nodes try to select the furthest node in the broadcast direction to assign the duty of forwarding and acknowledging the packet without any a priori topology information i.e., sender selects the furthest node without knowing the ID or position of its neighbors.

Vehicle-assisted data delivery (VADD) protocols [36] used for road selection at the intersection. The VADD protocols outperform existing solutions in terms of packet delivery ratio, data packet delay and traffic overhead.

A mobility-centric approach for data dissemination in vehicular MADD[3] networks designed to operate efficiently and reliably despite the highly mobile, partitioned nature of these networks. MDDV is designed to exploit vehicle mobility for data dissemination, and combines the idea of opportunistic forwarding, trajectory based forwarding and geographical forwarding.

Reliable Broadcasting of Life Safety Messages (RBLSM) [37] is also a class of delay based multi-hop broadcasting in which as soon as a node receives a packet from source, it determines the waiting time for rebroadcasting the packet. In contrast to the other conventional strategies where the rebroadcast priority is given to the farthest vehicle, in RBLSM the priority is given to the vehicle nearest to the transmitter. Still there are so many other protocols [15, 17,18,20,21,23] having respective strength and weaknesses. Security is also much concern in VANET. The [14] describe that a "Secured Geocast Routing in VANET (Vehicular Ad-Hoc Network) with two stage efficient communication protocol" provide better security and efficient channel utilization in comparison to the well-known available routing algorithm in VANET.

Border node Based Routing (BBR) protocol is another protocol for partially connected VANETs can tolerate network partition due to low node density and high node mobility. This is designed for sending messages from any node to any other node (unicast) or from one node to all other nodes (broadcast).[19] The design goals are to deliver message with high reliability while minimizing delivery delay and to optimize the broadcast behavior for low node density and high mobility networks.

In [6] the Bidirectional Perimeter-based Propagation (BiPP) provides an elegant solution for building Regional Alert System using ad-hoc inter-vehicle networks by exploiting one crucial observation—cars can only enter the alert region if they cross the boundary or the "perimeter" of the alert region.

There are other schemes and protocols which like cluster based information propagation scheme, Optimized dissemination of alarm message in vehicular ad hoc network, A-Star, GyTAR, LBB [15] etc. and have different features.

Anchor-based Street and Traffic Aware Routing,A-STAR is a position-based routing scheme designed specifically for vehicular ad hoc networks in city Environments.

GreedY Traffic-Aware Routing- consists of two modules: (i) dynamic selection of the junctions through which packets must pass to reach their destinations, (ii) an improved greedy strategy used to forward packets between junctions.

LBB Is a location based broadcast routing protocol for highway safety communication. The safety application has to assign a reasonable lifetime to a message. The message is only broadcasted during its lifetime and is dropped afterwards.

Table 3.1 shows a comparative taxonomy of different routing protocols described above. The comparison has been made using three parameters i.e. Hopping, Communication strategy and main feature of Protocol.

Table 1 -COMPARATIVE TAXONOMY OF VANETS ROUTING PROTOCOLS

Protocol	Hopping	Communication strategy	Feature of Protocol
TrafficInfo	Single-Hop	Broadcast/Packet forwarding based on info	Bandwidth efficiency and broadcasts only the most relevant top information
TrafficView	Single-Hop	Broadcast/Packet forwarding based on traffic	Only a single record is broadcasted after aggregating the multiple records.
Geocast	Single-hop	Adaptive Broadcast /Packet forwarding based on area	Broadcast safety messages within a useful area.
SODAD	Single-hop	Adaptive Broadcast /Packet forwarding based on road segment	Provides Information on the traffic situation in the local area based on road segments.
UMB	Multihop	Directional Broadcast/ /Packet forwarding on info based	Designed to address (i) broadcast storm, (ii) hidden node, and (iii) reliability problems in multi-hop broadcast
VADD	Single-hop	Unicast/packet forwarding based on prediction	Used for road selection at the intersection
MDDV	multihop	Broadcast/ opportunistic forwarding	combines the idea of opportunistic forwarding, trajectory based forwarding and geographical forwarding.
A-STAR	Single hop	Unicast /Packet Forwarding Based on Traffic Info	is a position-based routing scheme designed specifically for city Environments.
GyTAR	Single hop	Unicast /Packet Forwarding Based on Street Awareness	dynamic selection of the junctions , an improved greedy strategy used to forward packets between junctions.
LBB	Single hop	Broadcast/packet forwarding based on location	The message is only broadcasted during its lifetime and is dropped afterwards.

IV. CONCLUSION

By reviewing different protocols it has been observed that there are so many protocol in the VANET having their specific application in the transportation But all have their respective advantages and drawbacks. The paper tried to conclude the feature of different protocols. The TrafficInfo mechanisms include that How much to transmit in a broadcast, what to transmit during an interaction and When to broadcast the reports.

In TrafficView the relative positions of vehicles is computed, using stored road maps, by mapping the vehicle's latitude and longitude coordinates to points on the road in which the vehicle is driving. Using the relative positions of vehicles allows TrafficView to work in all kinds of road topologies like a zigzag mountain road. In Geocast a vehicle which detects an emergency situation first starts broadcasting a warning packet. Packet specifies the area where the warning is still relevant. There is no such protocol that can alert vehicle on blind curve in the hilly areas.

In Segment-oriented Data Abstraction and Dissemination protocol each road is divided in a number of road segments and information on the traffic situation in the local area is transmitted based on these road segments. Urban Multi-hop Broadcast protocol is composed of two phases, directional broadcast and intersection broadcast. Vehicle-assisted data delivery (VADD) protocols used for road selection at the intersection.

A mobility-centric approach for data dissemination in vehicular networks designed to operate efficiently and reliably despite the highly mobile, partitioned nature of networks. Border node Based Routing protocol is another protocol designed for sending messages with high reliability while minimizing delivery delay and to optimize the broadcast behavior for low node density and high mobility networks.

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