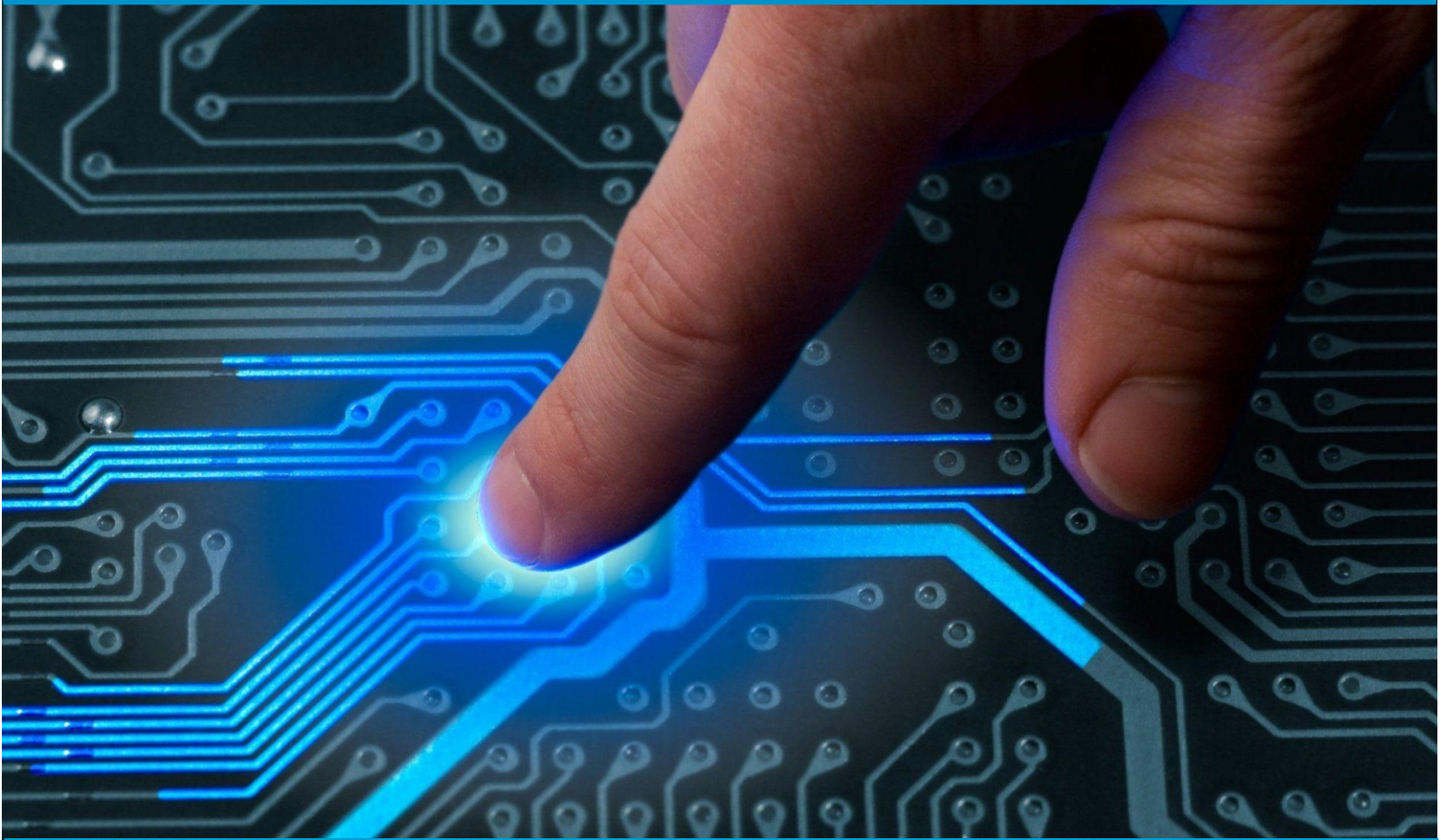




IJIRCCCE

e-ISSN: 2320-9801 | p-ISSN: 2320-9798



INTERNATIONAL JOURNAL OF INNOVATIVE RESEARCH

IN COMPUTER & COMMUNICATION ENGINEERING

Volume 8, Issue 9, September 2020

ISSN INTERNATIONAL
STANDARD
SERIAL
NUMBER
INDIA

Impact Factor: 7.488



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Vehicular Ad Hoc Network (VANET): Overview, Issues, Challenges and Solution

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ABSTRACT: In the current scenario, people use public transport and private vehicles frequently. The safety on the road is the primary requirement for travellers. To provide security and safety on road during travelling, there is various technology suggested by the researchers in literature. Moreover, many of the technology is adopted by the vehicles manufacturers and by various governments. However, it seems not to be sufficient to provide safety in a large manner. VANET emerge as a significant solution to handle all such issues of safety. This paper analyses and provide the information about VANET characteristics, major application, issues, challenges and their solution with the motive to energised the researchers to work over them and carry the existing work one step forward.

KEYWORDS: VANET, Clustering, DSRC, MANET

I. INTRODUCTION

Ad hoc network is an infrastructure-less network. The ad hoc network is required to form where the infrastructure is either not available or necessary to form network temporary to establish communication among devices. Mobile ad hoc network is one category of ad hoc network where nodes are mobile. Network exist among moving laptop is one of a primary example of a mobile ad hoc network. Vehicular ad hoc network (VANET) is a special category of mobile ad hoc network [1-3]. In VANET, the nodes are highly mobile. The VANET technology comes in the scenario for collision avoidance and providing safety in road. The communication exists among vehicles in VANET with the help of Dedicated Short Range Communication technology (DSRC). DSRC is a short-range communication technology specially designed for establishing communication among high-speed vehicles.

Safety and non-safety two main category of information sharing among vehicles. Safety information mainly for accident avoidance and non-safety information is for providing comfort to a passenger during travelling. There are generally three types of communication architecture exist in VANET. The description of such architecture is given below.

1. Vehicle-to-Vehicle (V2V): In this communication architecture the communication exist among vehicles.
2. Vehicle-to-Infrastructure (V2I): In this architecture, the communication exist between vehicle and some infrastructure unit like Roadside unit (RSU).
3. Hybrid architecture: In this architecture, both types of communication V2V and V2I exist in the network.

The above-given description of communication architecture is shown in Fig. 1.

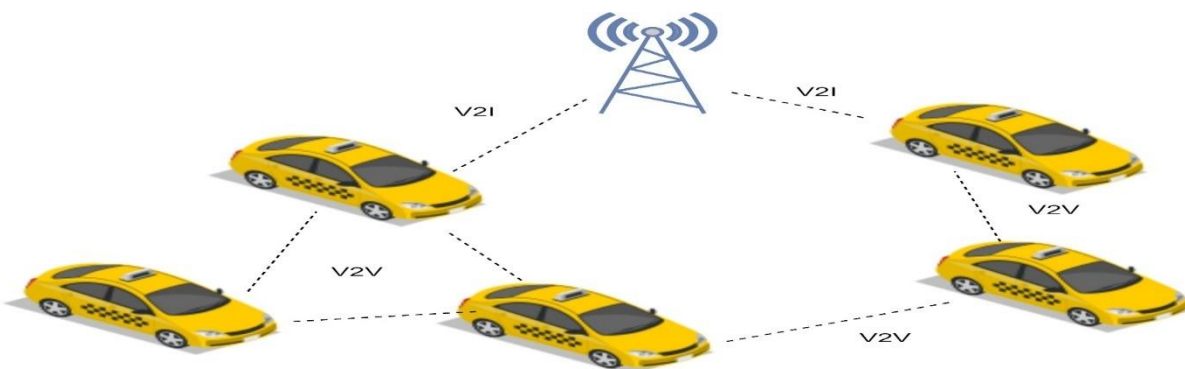


Fig. 1. Communication architecture in VANET

II. CHARACTERISTICS

The main characteristics of VANET are described below one by one:

- Dynamic network topology: In VANET nodes generally changes their position frequently due to their high speeds. As a result of this, the network topology changes frequently.
- Fast Mobility: The nodes moving at VANET with high speed. Efficient communication and accurate position identification is a difficult task.
- Fast Information exchange: The main aim of forming VANET to avoid an accident on the road. So it required to exchange information frequently to provide safety.
- Wireless communication mode: The nodes are moving in nature. So the VANET is designed for wireless communication mode.
- Time-Bound: The information should be reached to a concerned vehicle at a bound time limit. So that the vehicle can take appropriate action within time.
- Constrained Path: The nodes are generally moving at a constrained path, i.e. on the road.
- No energy-constrained: Energy is not an issue in VANET. Vehicles have a powerful battery, and that has the capacity to provide power to in build VANET devices.
- Network density variation: Density in VANET varies depending on the traffic.

III. APPLICATIONS

The important applications of VANET are described below.

- Traffic Management: Traffic Jam is a big problem faces by travellers over the world. The traffic information sharing among vehicles helps the driver to choose the path accordingly.
- Avoided Collision: The high number of casualties recorded daily over the world due to lack of communication among vehicles. Efficient communication among vehicle can avoid 60 % of the accident [4].
- Assistance to Driver: The different alarm warns the driver to take appropriate action for safe driving. Lane change, speed warning is some important alarm which may help to avoid an accident.
- Peer-to-Peer Sharing: During travelling, the user can take the benefit of sharing music, video through peer to peer application.
- Commercial Services: Toll taxes payment, fuel station, restaurant information are some of the commercial services that user can get through the VANET.

IV. ISSUES AND CHALLENGES

- Efficient management of network: Due to the high topological changes in the network, it is difficult to manage the network.
- Environmental Issues: Electromagnetic waves are used to form communication among vehicles in VANET. These electromagnetic waves are affected by the conditions of the environment.
- MAC Design Issue: The medium is shared in VANET for communication. So efficient designing of MAC protocol is a big challenge.
- Routing Issue: Efficient information sharing among vehicles from source to destination is a big issue. Due to the dynamic changes in topology, it is a big challenge to design an efficient routing protocol.
- Security: The communication should be secured in VANET. Any unsecured information shared among vehicles may create complicated issues and raise the conditions of accidents [8-10].
- Signal fading: The obstacle among vehicles prevents the signal to reach the destination. This obstacle, like building, create disturbance in efficient communication.

- **Bandwidth Constrained:** The bandwidth allocation for VANET is limited. So efficient utilization of bandwidth is required.
- **Stability and Scalability:** Due to high topological changes in the network, VANET faces the problem network stability and scalability. These are the two main issues that affect the reliable delivery of data to the destination.

V. SOLUTIONS

The lack of router devices in VANET create an issue of scalability and reliable delivery of data. The clustering technique is introduced in VANET to solve such issues efficiently and provide stability in a network. The cluster-based solution and the importance of clustering in VANET is comprehensively discussed in the literature [5-7].

Clustering is a technique that forms the logical groups of vehicles. The groups form mainly based on the speed of a vehicle and the position of a vehicle. In a cluster, the vehicles have in one of the following roles.

1. **Cluster Head:** The head of a group that coordinates the information among vehicles of a group and with the CHs of another group.
2. **Cluster Member (CM):** The normal vehicle of a group that does not have an inter-cluster link.
3. **Cluster-gateway (CG):** The vehicle provides inter-cluster link between vehicles of two or more cluster.

VI. CONCLUSION

VANET is an important category of MANET. The successful implementation of VANET can avoid collision avoidance at a large extent and may solve many important issues that traveller faces during travelling. The characteristics of VANET is compressively discussed. To consider these characteristics, the researchers working for efficient solutions against various issues. The wide applications of VANET are discussed that tells the importance of VANET. The important issues and challenges help to researchers to work on them and find a more efficient solution. Clustering is discussed in the literature as a solution to many issues, mainly for handling stability and scalability issues.

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