# Survey on Vehicular Ad-hoc network

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***Abstract*- Vehicular ad hoc networks (VANETs) have been quite a hot research area in the last few years. Due to their unique characteristics such as high dynamic topology and predictable mobility, VANETs attract so much attention of both academia and industry. In this paper, we provide an overview of the main aspects of VANETs from a research perspective. This paper starts with the basic architecture of networks, then discusses three popular research issues and general research methods, and ends up with the analysis on challenges and future trends of VANETs.**

***Index Terms*- RSU, BSU, TMC, OBU**

## I. INTRODUCTION

Recently, with the development of vehicle industry and wireless communication technology, vehicular ad hoc networks are becoming one of the most promising research fields. VANETs which use vehicles as mobile nodes are a subclass of mobile ad hoc networks (MANETs) to provide communications among nearby vehicles and between vehicles and nearby roadside equipment but apparently differ from other networks by their own characteristics. Specifically, the nodes (vehicles) in VANETs are limited to road topology while moving, so if the road information is available, we are able to predict the future position of a vehicle; what is more, vehicles can afford significant computing, communication, and sensing capabilities as well as providing continuous transmission power themselves to support these functions. However, VANETs also come with several challenging characteristics, such as potentially large scale and high mobility. Nodes in the vehicular environment are much more dynamic because most cars usually are at a very high speed and change their position constantly. The high mobility also leads to a dynamic network topology, while the links between nodes connect and disconnect very often. Besides, VANETs have a potentially large scale which can include many Participants and extend over the entire road network. It is precisely because of both of these unique attractive features and challenging characteristics that VANETs could draw the attention from both industry and academia. Therefore, several articles have tried to summarize the issues about vehicular networks. For example, in the research challenges of routing in VANETs and then summarize and compare the performance of routing protocols; Hartenstein and Laberteaux present an overview on the communication and networking aspects of VANETs and summarize the current state of the art at that time. Raya and Hubaux address the security of VANETs comprehensively and provide a set of security protocols as well as the authors propose taxonomy of a large range of mobility models available for vehicular ad hoc networks. These articles all reviewed specific research areas in VANETs. In addition, others papers like provide comprehensive overview of applications, architectures, protocols, and challenges in VANETs and especially introduce VANETs projects and standardization efforts in different regions (i.e., USA, Japan, and Europe); Al-Sultan et al. provide detailed information for readers to understand the main aspects and challenges related to VANETs, including network architecture, wireless access technologies, characteristics, applications, and simulation tools.

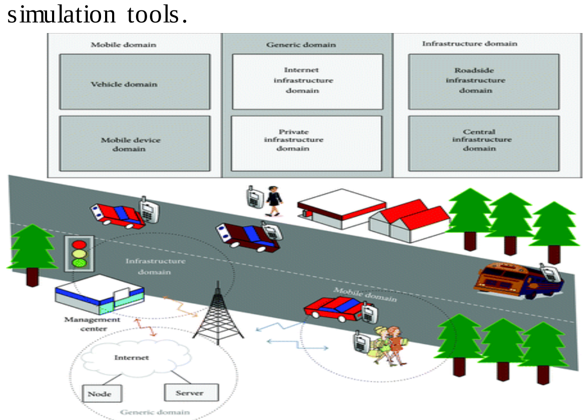


Figure.1

Within the infrastructure domain, there are two domains: the roadside infrastructure domain and the central infrastructure domain. The roadside infrastructure domain contains roadside unit entities like traffic lights. The central infrastructure domain contains infrastructure management centers such as traffic management centers (TMCs) and vehicle management centers.

However, the development of VANETs architecture varies from region to region. In the CAR-2-X communication system which is pursued by the CAR-2-CAR communication consortium, the reference architecture is a little different. CAR-2-CAR communication consortium (C2C-CC) is the major driving force for vehicular communication in Europe and published its "manifesto" in 2007. This system architecture comprises three domains: in-vehicle, ad hoc, and infrastructure domain

Compared with these current articles, this paper adds the introduction of layered architecture for VANETs so that the summary of network architecture is more complete. Also, we organize the overview of the vehicular ad hoc networks in a novel way. That is, we introduce the VANETs from the research perspective in the paper, including some current hot research issues and general methods, which do well to the progress of VANETs. Moreover, we provide a more comprehensive analysis on VANETs research challenges and future trends, beneficial for further systematic research on VANETs. In summary, this paper covers basic architecture, some research issues, general research methods of VANETs, and some key challenges and trends as well as providing an overall reference on VANETs.

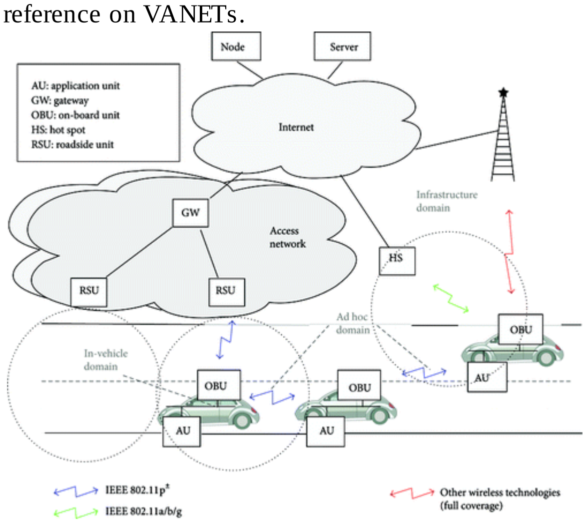


Figure.2

In principal, there is no fixed architecture or topology that a VANET must follow. However, a general VANET consists of moving vehicles communicating with each other as well as with some nearby RSU. A VANET is different than a MANET in the sense that vehicles do not move randomly as nodes do in MANETs, rather moving vehicles follow some fixed paths such as urban roads and highways. While it is easy to consider VANETs as a part of MANETs, it is also important to think of VANETs as an individual research field, especially when it comes to designing of network architecture. In VANET architecture, an on board unit (OBU) in a vehicle consists of wireless transmitter and receiver.

*Routing in VANET*

One of the major challenges in the design of vehicular ad-hoc network is the development of a dynamic routing protocol that can help disseminate the information from one node (vehicle) to another. Routing in VANET is different to the traditional MANET routing because of highly dynamic and ever changing topologies in the former. Few protocols that were earlier designed for MANET environment have been tested on VANET. The challenge however remains as how to reduce delay associated with passing the information from one node to another. Overcoming these hurdles in MANET protocols, can help implement real time applications for VANET environment. Other implications such as reducing control overheads also need to be looked into carefully. Keeping an eye on the dynamic characteristics of VANET (as highlighted previously), the routing protocol should be able to withstand the unpredicted and dynamic nature of vehicular network topology. Perhaps the most difficult task in VANET routing is finding and maintaining the optimal paths of communication in desired environments. Most of the routing protocols in VANET are closely linked with the topology being used in the network architecture and the performance deviates whenever there is a change in network topology.

As highlighted in Figure 1, routing in VANET can be classified into five major categories namely as:

a. Ad-hoc or Topology Driven Protocols
b. Location Based Routing Protocols
c. Cluster Based Protocols
d. Broadcast Protocols

e. Geocast Protocols

Ad-hoc or Topology Driven Routing In general, VANETs are infrastructure-less networks and many routing protocols devised for prior ad-hoc network such as MANET based on different network topologies may be applied to VANETs with certain modifications. Topology driven protocols are sub-classified into three categories such as proactive, reactive and hybrid. A number of such protocols were designed to cater the needs of VANET environment. In a proactive protocol, nodes continuously update their routing table with information regarding new routes within the network.

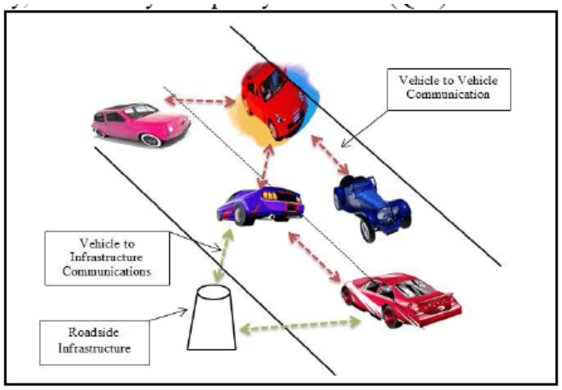


Fig. 1 VANET

Figure.3

This information is passed around to all nodes by sending periodic HELLO packets. This approach, however, creates substantial control overheads. This restricts the use of limited wireless resource such as available bandwidth. On the other hand, in reactive approaches, for example AODV,DSR, BRP nodes will only send the control data when there is a need. This reduces overheads associated with establishing the link, and helps distribute the actual information faster. This approach however still puts undue resource overheads like maintenance of used/unused routes. These unused paths are created and broken, due to stringent network topology of VANET. Overheads created in reactive protocols are associated with discovering the path to send the information. The path finding process is initiated by sending certain type of message called Route Request Message (RREQ). In Figure 4, node (S) wants to send information to node (D). This process will be initiated first by discovering of route to the destination. When node S needs to find a route to node D, it broadcasts an RREQ message to all its neighbors. When intermediate nodes, say node 1 receive a RREQ message, they compare the desired destination with their own identifiers. If there is a match, it means that the request is destined for node 1, otherwise, node 1 will rebroadcast the RREQ to its neighbors and so do all the other nodes. This approach can create a flooding in the network. Once the request reaches the destination (node D in this case), Route Reply Message (RREP) is initiated back to the source using Backward learning method. Besides studying basic reactive and proactive type of protocols, researchers have found tremendous liking to discover hybrid protocols as well. An example of such a protocol is discussed in detail in[33]. In this approach, the authors have focused more on the design architecture of whole network rather than the performance analysis.

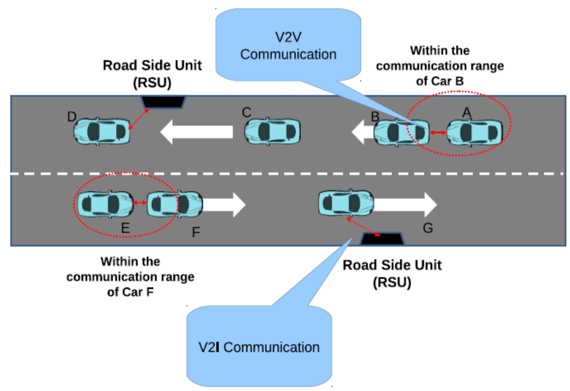


Figure.4

## II. TECHNICAL CHALLENGES

The technical challenges deals with the technical obstacles which should be resolved before the deployment of VANET. Some challenges are given below:

*Network Management:*

Due to high mobility, the network topology and channel condition change rapidly. Due to this, we can't use structures like tree because these structures can't be set up and maintained as rapidly as the topology changed.

*Congestion and collision Control:*

The unbounded network size also creates a challenge. The traffic load is low in rural areas and night in even urban areas. Due to this, the network partitions frequently occurs while in rush hours the traffic load is very high and hence network is congested and collision occurs in the network.

*Environmental Impact:*

VANETs use the electromagnetic waves for communication. These waves are affected by the environment. Hence to deploy the VANET the environmental impact must be considered.

*MAC Design:*

VANET generally use the shared medium to communicate hence the MAC design is the key issue. Many approaches have been given like TDMA, SDMA, and CSMA etc. IEEE 802.11 adopted the CSMA based Mac for VANET.

*Security:*

As VANET provides the road safety applications which are life critical. Therefore security of these messages must be satisfied.

## III. CONCLUSION

In this paper, it has been observed that in implementation of VANETs; have to take care of a number challenging issues. In the research area of VANETs, it becomes more conscious matter related to Security and routing choice. Further this study we can be extended by exploring new challenges and their solutions for smooth infrastructure of VANETs. The avoidance from malicious data is necessary so it can be more reliable and securable information system. The routing or traffic management is needed to meet the communication through network using appropriate design. So we design such a system to overcome all the problems

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