REVIEW ON VANET ARCHITECTURE AND APPLICATIONS

RadhaKrishna Karne[1], Dr. T.K.Sreeja[2]
[1]Research Scholar, Electronics and Communication Engineering, Noorul Islam Centre for Higher Education, Kumaracoil, Kanyakumari, Tamilnadu, krk.wgl@gmail.com
[2]Associate Professor, Electronics and Communication Engineering, Noorul Islam Centre for Higher Education, Kumaracoil,Kanyakumari,Tamilnadu, sreejaeng07@gmail.com

Abstract
Rapid advances in wireless technology have been occurring in recent years. Nowadays, most research is conducted in the field of telecommunication. In the area of wireless communication, VANET is the fastest growing area. A mobile ad hoc network (MANET) is defined as a network that operates ad hoc on a mobile device (VANET) and which can be used to improve the road safety and also to improve the experience of passengers. VANET is comprised of vehicles to vehicles (V2V) and vehicles to infrastructure (V2I) communications supporting IEEE 802.11p wireless access technologies. ITS (Intelligent Transport Systems) are expected to improve road safety and motor traffic efficiency through this innovation in wireless communication. In order to make the VANET more robust, many issues must be addressed. An infrastructure based VANET might use mobile vehicles as sensors. By detecting, gathering, and disseminating real-time data about traffic conditions and road hazards, they can be able to detect, gather and share traffic information. This paper focuses on the history of VANETs, their challenges and potentials, as well as the way to preventing the long-awaited ITS.

Keywords: VANET, V2V, V2I, ITS, IEEE 802.11p, OBU, RSU.

1. INTRODUCTION

In the automotive industry as well as in our society, information and communication technology has been a driving force for many major innovations. Mobility has forever altered the way we live, as it allows us to share information anytime, anywhere. Within the next few years, vehicles will have access to these mobile communications systems. Figure 1 represents VANET Communication Model [7]. Intelligent Transport System (ITS) has recently developed into a reality and an indispensable element of smart cities directly as a result of the emergence of Information and Communication Technologies (ICTs) and wireless embedded sensing devices. Infotainment is used to enhance safety, traffic efficiency, and provide information [6]. In spite of being of exceptional quality and exhibiting some similarities to MANETs, a VANET has some specific characteristics [4]. VANET refers to networks of mobile vehicles, which are a subgroup of MANET. Toward realizing vehicular communications on a wider scale, automotive industry members, academics, and government agencies have been putting more effort into joining together in recent years [2]. Numerous VANET research projects and associated standardization projects have been undertaken around the globe due to the potential envisaged in VANETs [8]. The European Automotive Industry has co-funded a project with the European Communications Commission (ECC) called the Vehicle Safety Communications Consortium (VSCC), to develop the DSRC system [9].

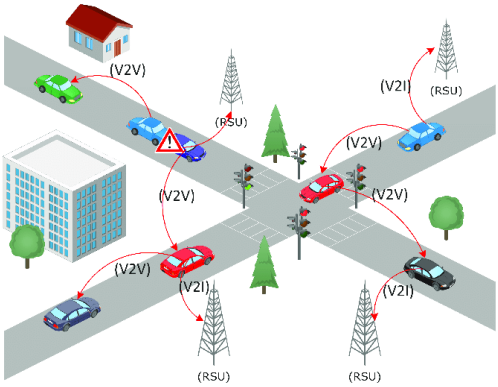

Figure 1. VANET Communication Model

2. VANET ARCHITECTURE

WAVE is a wireless medium for communicating between vehicles and between a vehicle and a Roadside unit (RSU). In addition to providing drivers and passengers with a wide range of information, this method of communication allows safety applications to enhance road safety and provide a comfortable driving experience [7]. User and provider are terms used to describe two different entities. A provider provides the services while a user uses them. According to their roles within the network, RSUs and OBUs can act as either providers or users [3]. A system includes three main components: an On Board Unit (OBU), an Application Unit (AU), and a Roadside Unit (RSU) [4].Architecture of VANET is depicted in Figure.2.

2.1 On Board Unit (OBU): An On-Board Unit (OBU) is a piece of hardware installed in every vehicle. WAVE devices called OBUs are usually mounted on vehicles for exchanging information with RSUs or with other OBUs. A radio frequency aerial and a processor are connected with the transceiver, much like a router [11]. As well as transmitting information, it also relays information to other OBUs. AU receives support from it in the form of service programs [10]. Several wireless communication technologies might be supported as a means to interact with all external components [15].

2.2 Application Unit (AU) : An AU is a device mounted inside the vehicle that is used with the application provided by the provider in order to communicate with the OBU. In addition to safety applications, the AU could also be run via a normal device; for example, a personal digital assistant (PDA) running online services [7]. OBU is connected to Application Units via a wired or wireless medium. Internet connectivity is provided by it to OBU so that data can be sent and received [3].

2.3 Road Side Unit (RSU) : Wave devices called RSUs are typically installed along the roadside or in specific positions, such as near intersections and parking lots [14]. In addition to providing the user with security information, the device connects to the internet and therefore can be used to prevent accidents. Information may only be accessed by an authenticated user. We use pseudonyms, mix zones, ad hoc anonymity, and silent periods as techniques [15]. For example, they are near intersections, and parking lots, where there is a high vehicle density.

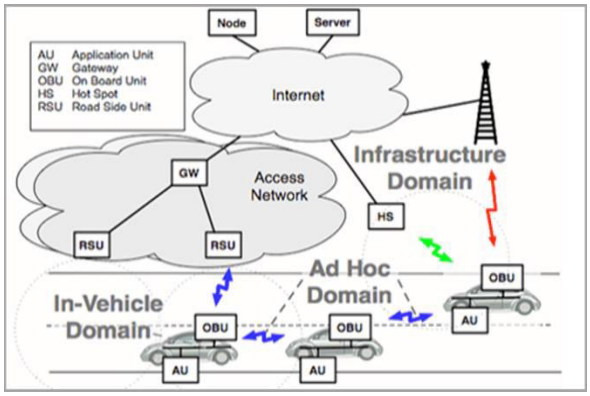

Figure 2. VANET Architecture

3. VANET CHARACTERISTICS

VANETs differ from other networks in their behavior and characteristics.

3.1 High mobility : VANET is operating in a very dynamic environment. Traffic flows more densely during rush hours as vehicles travel at different speeds [3]. The main components of a VANET are fixed RSUs and mobile vehicles. Due to the variable speed of the vehicle, communication challenges arise at very low and very high speeds. In fact, high traffic jams slow down or stop traffic, and so vehicles have time to exchange messages.

3.2 Predictable mobility: Roadways are the only routes where vehicle movements can be predicted. Using GPS, it is easy to find information about roads. A vehicle's position can easily be determined by looking at its speed and road trajectory.

3.3 Network connectivity and topology : Topology is constantly changing as vehicles change their positions. Node connections and disconnections are seen as common changes in topology.

3.4 Power resource availability: The power constraint is no longer an issue in vanet, since vehicles have strong batteries that provide the constant power to the OBU. A network that allows the transmission of information from one vehicle to another by not requiring energy or computation resources is constructed. In addition to their own batteries, they have extremely powerful computers to process complex calculations.

3.5 Inconsistent network solidity: Traffic density varies in vanet depending on the network density. As compared to urban areas or highways, rural areas have a lower accident rate.

3.6 High computational facility: Recently, service providers have provided vehicles with high computational capabilities, such as memory, effective sensors, storage space, internet access, advanced antenna technology, and GPRS.

4. CHALLENGES & REQUIREMENTS IN VANET

Ad hoc networks are an attempt to address the issues involved when trying to make driver behavior better through ad hoc networks, in order to reduce the number of traffic fatalities. VANET concept requires consideration of many factors that have a critical impact on achieving the goal, such as safety applications and non-safety applications [7].

4.1 Signal loss : When two moving vehicles are communicating via a wireless connection, it can be a challenging task, especially when there is an obstacle present. It might be a large building or a vehicle in the city. Consequently, the VANET communication efficiency will be affected by signal fading.

4.2 Bandwidth confines : The vanet environment does not have a central monitoring or access point to collect all information and transmits, the node makes use of the available bandwidth to increase its performance.

4.3 Connectivity : Rapid changes in network topology lead to frequent fragmentation of the network, and increases response, as well as reduces efficiency.

4.4 Security and privacy: One of the main challenges in VANET is finding the right balance between security and privacy. In other words, only an authenticated person can send the information, and the recipient must trust the message.

5. SECURITY IN VANET

The main concern in VANETs is communication security. Security in VANET is described in Figure 3, it must ensure that no alterations are made to the information transmitted. Because of the rapid changes in topology, small sized devices, etc., ad-hoc networks often encounter more security issues than other wireless networks.

- The privacy of information is called confidentiality. Getting sensitive information into the wrong hands is the purpose of this. VANET is widely exposed to Social Attacks, Traffic Analysis Attacks, Eavesdropping Attacks, and Illusion Attacks, which threaten data confidentiality.
- The goal of Data Authenticity is to confirm the identity of a person using identification elements such as usernames, passwords. It is the process of ensuring that the system lets only authentic users in after the process of identification. This protocol is also seen as the first line of defense against malicious users.
- To ensure that the traffic situation is correctly informed within a limited time period, the drivers must be held liable. Authenticated Senders must only transmit accurate, integrated information.
- Each expected recipient must have access to the information, and that information must arrive within a certain time limit, as late information is considered useless. Jamming the network by the attackers, leading to network failure.
- Information transmission may be hindered by the environment's impact on magnetic waves. As a result of unbounded network size, collisions and congestion must be controlled.

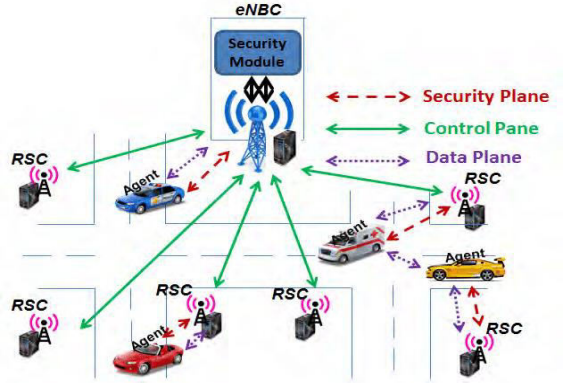

Figure 3. VANET security Module

6. VANET Applications

In the VANET environment, drivers and travelers can access a wide range of information and can develop a large number of applications. Various technologies are used in the on board units of the vehicles, including sensors, advanced antenna technology, and effective wireless access. The system transmits the information from the roadside unit to the other vehicles for safety measures and to make travelers feel comfortable. It will collect data from other vehicles and communicate with it.

6.1 Safety-related VANET applications: Driver assistance, alert information, and warning alerts are the three basic VANET safety applications. Eight potential safety-related applications have been identified by the vehicular safety communications consortium; they are pre-crash detection, curve speed measurement, lane-change, traffic sign violation, emergency electronic brake light, stop sign movement and left turn assistance [13]. In order to reduce road accidents and fatalities, we need to implement major road safety applications on our highways [12]. By providing time-sensitive, lifesaving traffic information to drivers, these applications help them avoid crashes with other vehicles on the road.

6.2 Non-safety-related VANET applications: VANETs can also be used to provide comfort or commercial services. This kind of application improves traffic efficiency, passenger comfort, and advertisement effectiveness and electronic toll collection (ETC). Applications offered by these companies include the ability to identify weather information, traffic, hotels, gas stations as well as different points of interest (PoI) such as parking lots, gas stations, shopping malls, hotels, fast-food restaurants, etc. Using the VANET for the purpose of commercial applications and comfort is thought to be detrimental to traffic safety and traffic efficiency. It also distracts and interferes with safety-related applications.

6.3 Efficiency applications: With this application, a vehicle is identified from its current location within the lanes of the city and its movement is increased. In essence, the vehicle to vehicle communication takes place as well as vehicle to RSU communication. Two categories of applications can be classified as follows: road and crossing management, and traffic jam reduction [4].

6.4 Comfort applications: In this, there are companies that provide the drivers with information that they can use to make their travel more enjoyable and convenient. Climate information, information concerning vacant parking spaces, maps of gas stations, and restaurant areas may be found in this type of application [1].

7. Conclusion

A survey of several research papers on VANET architecture, characteristics, applications, security, and security challenges are presented in this paper. Security is a problem with VANET. The VANET security has become the main requirement of users and so there is a need to do more work relating to it. In vehicular communication, a number of important topics are currently being researched and discussed intensively. Modifications, refinements, safety communication, data security, and V2V communications are among the topics discussed. Mobile ad hoc networks have the potential to evolve into VANETs. V2V and V2I communications will be implemented in future to predict the level of performance of communication established.

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