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REVIEW: VANET ARCHITECTURES AND DESIGN

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Abstract: Vehicular ad hoc networks (VANETs) are appropriate networks that can be used in smart transportation systems. VANET is based on short-range wireless communication between vehicles. VANETs are made on-the-fly and do not need any outlay, except the wireless network interface The objective of the study is to Vehicular Ad-Hoc Networks (VANET) are special type of Mobile ad Hoc Networks (MANET) where wireless equipped vehicles form a network instinctively while traveling along the road. In this network, messages can be delivered directly between vehicles without fixed infrastructure. In this review paper, we present various kind of communication system in VANET and also discussed VANET Components

Keywords:VANET,VWCA,V2I,V2V

Introduction

Vehicular Ad-hoc Networks (VANETs) are self-organized networks built up from moving. Vehicular Ad-hoc Networks (VANETs) represent a rapidly emerging particularly challenging class of Mobile Ad Hoc Networks (MANETs). VANETs are self organizing communication networks built up from traveling vehicles and characterized[1] by very high speed and limited degrees of freedom in nodes movement patterns. VANETs require the definition of specific networking techniques whose feasibility and performance are tested by means of simulation.

Vehicular ad hoc networks (VANETs) are important module for the development of Intelligent Transportation System. Due to the features of VANET, data dissemination is an important issue that has to be addressed. The protocol is used to approximation the density of vehicles on a given road. As in any clustering algorithm, the formation of the cluster and the use of the bandwidth are important tasks

There are three algorithms:-

1. Vehicular clustering based on the weighted clustering algorithm (VWCA) that takes into kindness the number of neighbours based on dynamic transmission range, the direction of vehicles, the entropy, and the distrust value parameters. These parameters can increase stability and connectivity and can reduce transparency in network. On the other hand, transmission range of a vehicle is important for forwarding and receiving messages. When a fixed transmission range device is used in VANET, it is likely that vehicles are not located in the range of their neighbours. This is because of the high-rate topology changes and high variability in vehicles density.
2. Hello messages and density of traffic around vehicles are used to adaptively adjust the transmission range among them.
3. Determine a disbelieve value for each vehicle used in the VWCA.

2.0 Vanet Architecture

A simple VANET architecture consists of moving vehicles communicating with other vehicle in the range as well as the vehicle communicating with some nearby Road Side Units (RSU). A VANET[7] is differ from MANET in the aspect that the vehicles do not move randomly as in MANETs, rather in VANET the moving vehicles follow some rules and pathway such as roads or highway.

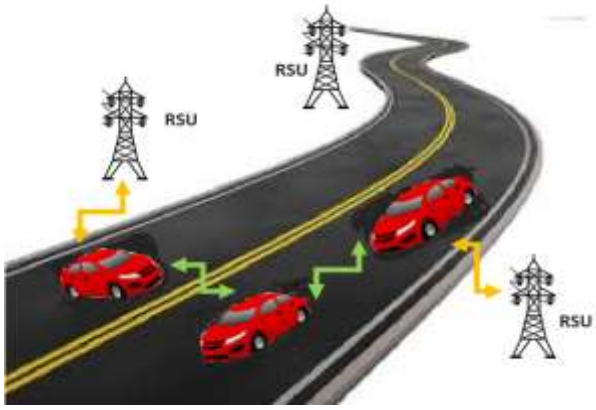

Figure 2.1 . Simple VANET Architecture

The architecture can be break down into three modules namely Mobile unit domain, Infrastructure domain and Management domain.

2.1 Mobile Unit Domain

The Mobile unit domain consist of the mobile unit like the vehicle fitted with intelligent system, mobile users etc.,. In this domain the communication happens mainly by two ways first by using V2C communication model i.e. communication between vehicle to vehicle, second by using V2I communication model i.e communication between vehicles to infrastructure.

2.2 Infrastructure Domain

The Infrastructure domain mainly contains the Road side units (RSU) and other transceivers which are implemented to support the vehicle communication. Here the communication happens by using V2I communication model.

2.3 Management Domain

The Management domain consists of the management systems like the servers and surveillance applications. Whenever a message comes to the server about any accident or traffic slow down problem, the server send alert message back to other in coming vehicle in the range. This information is very useful for the vehicle to tackle the situation

3.0 Routing Protocol

3.1 Topology-based protocol: In topology-based protocol, a link must be established from source node to destination node before data transmission. Ad-hoc On-demand Distance Vector routing (AODV) is a typical representative of this type. It will send a large quantity of redundant data packets and increase routing overhead by blind Flood.

3.2 Position-based protocol: In position-based protocol needs no fixed link before data transmission, every hop between source and destination can be selected instantaneously and independently. Greedy Perimeter Stateless Routing (GPSR) takes no measure to update the neighbor table and the destination position but it has two shortcomings. Firstly, the neighbor table may be not match the actual position without considering the node mobility. Secondly, the position of destination have never updated after encapsulating in the data packets.

3.3 Map-based protocol: In map-based protocol is applied seldom at the present. It uses the GPS system and digital map to select the best route.

4.0 Related Work

Christian Bonnet et al Continuous progresses in wireless communications have opened new research fields in computer networking aimed at extending data networks connectivity to environments where wired solutions are impracticable. Presented VanetMobiSim, an extension to the Canu MobiSim user mobility framework capable of producing realistic vehicular mobility traces for several network simulators and macroscopic, microscopic levels of VANET.

Grzegor et al The new clustering algorithm for Vehicular Ad-Hoc Networks has been proposed. The main goal was to increase the stability of a cluster Structure as the target environment has very high degree of mobility. The problem of clustering is an important topic among researches working with ad-hoc networks. VANET is a cluster maintenance in case of nodes mobility A vehicular network is an environment with high degree of mobility.

Ameneh et al Vehicular ad hoc networks (VANETs) are appropriate networks that can be used in intelligent transportation systems. VANET is based on short-range wireless communication among vehicles. VANETs are built on-the-fly and do not need any investment, except the wireless network interface. that takes number of neighbors based on transmission range the direction of vehicles the entropy ,value parameters. These parameters can increase stability and connectivity and can reduce overhead in networks.

B.Ayyappan et al (2016) describe VANET has been emerged as a prominent field for research and it receives considerable attention. VANET uses different specifications of the WLAN 802.11 family. It takes the basics of ad hoc network and the VANET creates a network with a collection of independent entities with the ability to communicate among themselves. The Adaption to the various 802.11 family causes a remarkable increase in the number of wireless network. The VANET has various benefits along with many challenges including security, privacy, Quality of communication, effective bandwidth utilization etc. Author reviewed a broadcast based messaging system it need more efficient methods for broadcasting message. Providing reliable broadcasts in a VANET environment is still an open issue of research. While routing the messages in a VANET the time plays an important factor because if the alert message reaches the receiver behind the scheduled time then there is no use of having such system. So the routing mechanisms are choosing in such a way to minimize the time delay in the message communication.

Surmukh Singh et al (2014) describe various existing routing protocols with their merits and demerits. VANET, two kinds of communication can be done to provide a list of applications like emergency vehicle warning, safety etc. These are between various vehicles known as vehicle to vehicle and between vehicles and roadside units known as vehicle to roadside communication. Performance of such kind of communication between vehicles depends on various routing protocols.

Saif Al-Sultan et al (2013) describe related to this field to help researchers and developers to understand and distinguish the main features surrounding VANET in one solid documents, without the need to go through other relevant papers and articles starting from VANET architecture and ending up with the most appropriate simulation tools to simulate VANET protocols and applications. Author reviewed a comprehensive survey dealing with all the issues facing VANET, in particular, VANET architectures components, VANET communication domains, wireless access technologies, VANET characteristics, challenges and requirements, VANET Applications and simulation tools. This investigation enables researchers to focus on the issues surrounding VANET and its applications, showing great deal of understanding of how to tackle all issues related to VANET i.e. what architecture component to focus on?

Maria Claudia Surugiu et al (2013) describe Vehicle-to-vehicle communication is a relatively new concept in the field of road traffic safety, an increasing number of worldwide studies and research being performed on the subject. Traffic safety has become a priority and, with the development of communication technologies and wireless networks, VANET networks have emerged. VANET, or Vehicular Ad-hoc Network, ensures a communication protocol between close vehicles or between a vehicle and infrastructure (indicator, traffic light, road junction). The main purpose of these networks remains occupant safety and comfort in traffic. Author reviewed VANET networks today enjoy high visibility among researchers due to their traffic optimization benefits in urban environments, fuel savings and pollution effect reduction in most cities.

Zaydoun Y Rawashdeh et al (2012) describe a new clustering technique suitable for the VANET environment on highways with the aim of enhancing the stability of the network topology. This technique takes the speed difference as a parameter to create relatively stable cluster structure. A simulation was conducted to evaluate our method and compare it with the most commonly used clustering methods. Author reviewed new VANET cluster formation algorithm that tends to group vehicles showing similar mobility patterns in one cluster. This algorithm takes into account the speed difference among vehicles as well as the position and the direction during the cluster formation process. After conducting a simulation experiment, author observe that our technique groups fast moving vehicles on the fast speed lanes in one cluster, while slow moving vehicles in another cluster. The simulation results show that our proposed algorithm increases the cluster lifetime and reduces vehicle transitions between clusters. The results show that our technique significantly increases the stability of the global network topology by reducing the rate at which clusters are created.

V.Vanet Communication Domains

The communication between vehicles and the RSU and the infrastructure form three types of domains:-

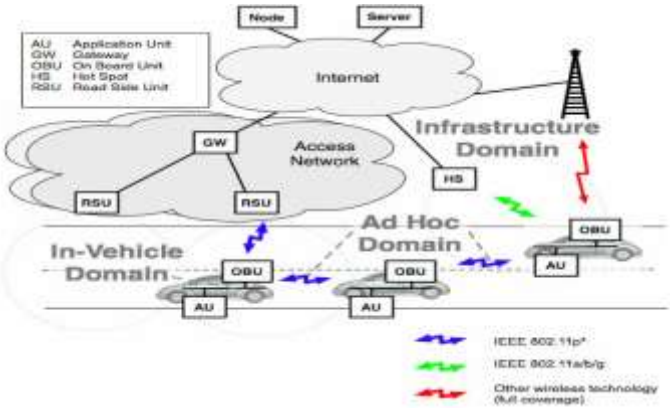

Figure 5.1 . Communication domains in VANET

5.1 In this figure Intra-Vehicle communication[5] which refers to the In-vehicle domain in our classification; Vehicle to Vehicle communication (V2V) and Vehicle to Roadside Infrastructure communication (V2I) which we classify them as the Ad hoc domain and the last type of communications is the Vehicle to Broadband Cloud communication where the vehicle communicate with a monitoring data centre, this type incorporate the Infrastructural domain in our classification.

The communication between vehicles and the RSU and the infrastructure form three types of domains:-

5.2 Ad hoc Domain: The ad hoc domain on VANET is composed of vehicles prepared with OBUs and a station along the road side, the RSU. Two types of communications are available in the ad hoc domain:

- As a component and concrete application of an ITS inter vehicle communication gain attention from researchers, academics and industry leaders, especially in US, EU and Japan. Owing to its ability to improve road traffic safety, driving efficiency and to extend on board device horizons vehicles communicate with other vehicles through OUBs forming a MANET, which allows communication between vehicles in a fully distributed manner with decentralised coordination. Vehicle communicate with another vehicle directly if there is a direct wireless connection available between them, forming a single hop vehicle to vehicle communication (V2V); when there is no direct connection between them a committed routing protocol is used to forward data from one vehicle to another until it reaches the destination point, forming multi-hop vehicle to vehicle communication.
- Vehicle communicate with an RSU in order to increase the range of communication by sending, receiving and forwarding data from one node to another or to benefit from the ability of the RSU to process special application forming vehicle to infrastructure communication (V2I).

5.3 Infrastructural Domain: The RSU can connect to the infrastructural networks or to the Internet, allowing the OBU to way in the infrastructure network; in this case it is possible that the AUs are registered with the OBU to connect to any internet based host.

6.0 Vanet Components

6.1 Application Unit (AU): The AU is the device prepared within the vehicle that uses the applications provided by the provider using the communication capabilities of the OBU. The AU can be a dedicated device for safety application or a normal device such as a Personal Digital Assistant[6] (PDA) to run the Internet, the AU can be connected to the OBU through a wired or wireless connection and may be located in with the OBU in a single physical unit; the distinction between the AU and the OBU is logical. The AU communicates with the network solely via the OBU which takes responsibility for all mobility and networking functions.

6.2 On Board Unit (OBU): An OBU is a wave device usually mounted on-board a vehicle used for exchanging in sequence with RSUs or with other OBUs. It consists of a Resource Command Processor (RCP), and resources contain a read/write memory used to store and retrieve information, a user interface, a specialised interface to connect to other OBUs and a network device for small range wireless communication based on IEEE 802.11p

radio technology. It may additionally include another network device for non-safety application based on other radio technologies such as IEEE 802.11a/b/g/n. The OBU connects to the RSU or to other OBUs through a wireless link based on the IEEE 802.11p radio frequency channel, and is reliable for the communications with other OBUs or with RSUs; it also provides a communication services to the AU and forwards data on behalf of other OBUs on the network. The most important functions of the OBU are wireless radio access, ad hoc and geographical routing, network congestion control, reliable message transfer, data security and IP mobility.

6.3 RoadSide Unit (RSU): The RSU is a wave device regularly fixed along the road side or in dedicated locations, such as at junctions or near parking spaces. The RSU is prepared with one network device for a dedicated short range communication based on IEEE 802.11p radio technology, and can also be prepared with other network devices so as to be used for the purpose of communication within the infrastructural network. The main functions and procedures associated with the RSU are:-

6.3.1 Extending the communication range of the ad hoc network by re-distributing the information to other OBUs and by sending the information to other RSUs in organize to forward it to other OBUs.

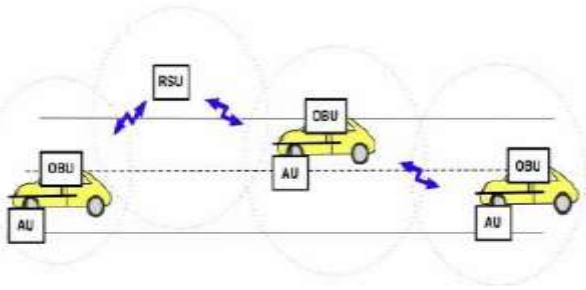

Figure 6.1 . RSU extend the range of the ad hoc network by forward the data of OBUs

6.3.2 Running safety function such as a low bridge warning, accident warning or work zone, using infrastructure to vehicle communication (I2V) and acting as an information source.

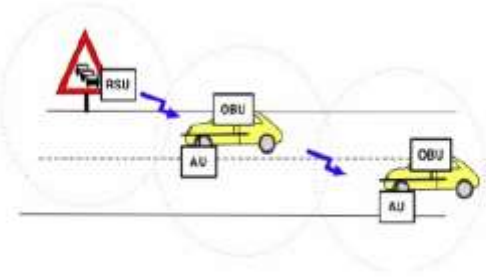

Figure 6.2 . RSU work as information source (running safety applications)

6.3.3 Providing Internet connectivity to OBUs.

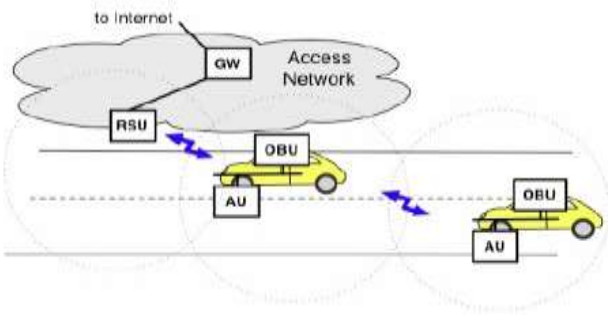

Figure 6.3 . RSU provides internet connectivity to the OBUs

7.0 Conclusion and Future Scope

In this paper , Vehicular communication has to be established in a secure way. Authentication is one among the security features of VANETs. It helps in achieving secure communication among vehicles and RSUs. Hence, various authentication schemes are proposed. Each scheme has its own security features, merits and demerits. Being a broadcast based messaging system it need more efficient methods for broadcasting message. Providing reliable broadcasts in a VANET environment is still an open issue of research. While routing the messages in a VANET the time plays an important factor because if the alert message reaches the receiver behind the scheduled time then there is no use of having such system

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