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A Survey on Vehicular Adhoc Networks-Domain, Characteristics, Tools And Current Issues

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ABSTRACT

Vehicular Ad hoc Network (VANET) is an emerging application of Mobile Ad hoc Network (MANET), which recently attracted most of the researchers in the field of Wireless communication. It enables communication through the vehicles on the roadside in which vehicles acts as a node. Though VANET are classified application of MANET, VANET has its own challenges like high mobility of nodes which makes the MANET protocol unsuitable for VANET. It acts a promising technique for the implementation of Intelligent Transport System (ITS).This paper aims to produce comprehensive survey on Vehicular Ad hoc Network(VANET) starting from its architecture to its routing protocols and stimulation tools.

KEYWORDS ITS, OBU, RSU, AU.

1.INTRODUCTION:

In this fast developing world many people owns their own vehicles due to this the road accidents and fatality rate gets increased day by day this has been considered as an serious issues nowadays, VANET are the extended application of MANET, a wireless communication with Dedicated Short Range Communication (DSRC).It follows the standardization of IEEE 802.11p a low overhead operation [7] [8]. WAVE (Wireless Access Vehicular Network) is standardized by IEEE as 1609 stack-family of standards [1]. In VANET Vehicle to Vehicle (V2V) communication or Vehicle to Road Side Unit (RSU) or Vehicle to Infrastructure (V2I) communication take place. The main application of VANET is to prevent traffic and to give alert messages regarding the speed, curve speed warning, accident prone zones and so on. The aim of it is to save people's life by providing alert messages to the drivers. This emerging field recently attracted researchers and provide abundant challenges like security, privacy, rapid node movement which makes the routing protocol of MANET unsuitable.

Achievements of VANET are analyzed by Li and Wang in 2007 and Hartenstein and Laberteaux in 2008 addressed the security and privacy issues of VANET and routing protocol is categorized by Linetal in 2010[1][6].This paper covers different issues such as network architecture, communication domains, challenges, applications, simulation tools and literature survey on various routing protocols.

2. MATERIALS AND METHODS:

2.1 SYSTEM COMPONENTS

There are three major system components in VANET they are OBU (On Board Unit), AU (Application Unit) and RSU (Road Side Unit) [1].

2.1.1 OBU

On Board Unit is a mounted device in a vehicle in which RSU or other OBU mounted in another vehicle communicates. The RCP (Resource Command Processor) is to perform read/write, store or retrieve information between OBU and the network device which is connected to RSU or other. It includes another device for non-safety application of standard based on 802.11p radio technology. The connection between OBU and RSU based on IEEE 802.11a/b/g/n. The function of OBU is AD hoc network, geographical routing, network congestion control, data security and IP mobility.

2.1.2 AU

Application unit is mounted in a vehicle, which acts as a PDA(Personal Digital Assistance) or safety device.AU connects OBU through wired or wireless medium.

2.1.3 RSU

It refers to railway station, buildings, lane which are located on the roadside. It follows the standardization of IEEE 802.11p and other network devices to provide a DSRC. According to C.C.Communication Constorium, the main functions [3] are the range of communication extended by byte distribution of information to OBU, RSU or AU,Running safety applications like stop signal warning, pedestrian crossing warning and To provide internet connection with OBU to transfer information. The domains are classified as follows:-

Vehicle Domain:

It is a combination of OBU and many AU, which communicated with the help of WUSB or VWB. Both OBU and AU should be present within a single device, AU communicates through OBU link to execute more number of applications.

Ad-hoc domain:

In Ad-hoc domain, the RSU and OBU should present in a single device. According to C.C.Communication constorium two types of communication[1][3] takes place. One of them is single hop communication, where communication takes place in common direction in case of direct wireless medium and the another is multi hop communication where there is no dedicated connection between the routing protocols,The data forward from one vehicle to another until it reaches its destination.

Infrastructural domain (or) Architecture of VANET:

RSU are not capable of directly connected to the internet (or) infrastructural network .so OBU register helps in establishment of connection. There are three types of communication in VANET. They are Vehicle to Vehicle (V2V) (or) Inter vehicle communication, Vehicle to Infrastructure (or)Vehicle to Roadside communication and Inter Roadside communication (or) Hybrid vehicle to Roadside communication.

3.COMBINED WIRELESS ACCESS TECHNOLOGY:

It has continuous air interface for both long and short medium range(ALM M5).It consists of set of wireless technology includes GSM-2G/GPRS-2.5G/UMTS(3G).Infrared and wireless communication system in the 60GHZ band adopted to the

standardization of IEEE802.11p.There is a P2P(People to People) network formed by people with smartphones and communicate with each other.

4. VANET CHARACTERISTICS [1][12]:

4.1. Predictable mobility:
The random mobility of node is predictable because vehicles move according to the road topology, traffic and soon.

4.2. No energy and storage constraint:
Battery have long-life because vehicles are capable to providing continuous power supply.

4.3. Varying network density:
It depends on network density network density high in heavy traffic jams and low density in sub urban areas.

4.4. Comfort and entertainment application:
Providing safe driving, improve passenger comfort and enhancing traffic jams.

4.5. Frequent changes in network density*:*
Due to high speed tyfing vehicle in highways where the lifetime of radio communication range should be high because of change in direction and speed. The communication range is high for the vehicle moving in same direction than on opposite directions, the changes are due to small link diameter and many channels are disconnected before they are utilized.

4.6.Large scale network and high computational ability:
Network scale is high in urban areas and the vehicles are equipped with sufficient number of sensors which helps in obtaining reliable wireless communication and acquiring accurate information regarding its speed, direction and position.

5.CHALLENGES IN VANET [12]:

5.1.Signal fading:
There is an obstacle like building (or) vehicle which stops the signal and leads to its fading.

5.2.Limitation in bandwidth utilization:
There is no central coordinator that controls communication, channel congestion where bandwidth is limited to 10-20MHZ in high dense area .Time delay is reduced by fair bandwidth utilization. If a vehicle wants to send message and there is no medium for transmitting then it has to wait, which leads to high latency.

5.3.Frequent link disconnection:
The link disconnects often due to high mobility, frequent fragmentation which results in increase in transmission power with throughput degradation.

5.4.Small effective diameter:
Maintaining complete global topology is impossible due to weak connectivity between nodes and weak nodes connectivity and results in issue when applying existing algorithm.

5.5.Security and privacy :
The receiver needs the trustworthy information it violates the above concern.

5.6.Routing protocols:
Due to the above challenges designing an effective protocol which transfers maximum packets in minimum time is not possible. Scalability reduces conflict, Simultaneous operation of unicast routing request helps in packet delivery within shortest time during emergency critical path.

6.VANET APPLICATIONS:
The emerging VANET has two types of applications[6] namely environmental application which provides details like nearest petrol bunk, hotels and its price and other is safety application which gather information from one vehicle or infrastructure and deliver it to another vehicle and aims at providing information about intersection collision avoidance, public safety, sign extension, vehicle diagnostics and maintenance.

7.VANET MOBILITY MODEL:
It helps in node movements and node to be connected in adhoc network but VANET has its own challenges and 2 patterns in it is traffic and motion model[1]. In traffic model due to random topology itis difficult to present real-world traffic scenario and survey model based on the data collected and event driven model generated by the action performed according to event occurs. The other models are ELDA and software oriented model(NISIM,TRANSIM).synthetic model depends on the roadwork's and its classified into 5 major categories namely stochastic model, Traffic stream model, car-following model and queue model and motion model depends on topology between vehicles in a network.

8. STIMULATOR EVALUATION:

8.1. Network stimulator(NS2 & NS3):
NS2 developed by using OTCL script by declared specific network topology ,limitations are type of antenna supported which is bidirectional or omnidirectional, nodes should be programmed in order to send or receive data.NS3 is written in cpp,supported by windows,LINUX,UNIX and OSX where coding limited to 100 lines[6].

8.2. GLOMOSIM(Global Mobile Information)
It is capable to run SMP (Shared Memory Symmetric Processor Memory) accessed by all programs simultaneously to reduce CPU workload and supports node and layer aggregation and multiple Wireless Communication [4].

8.3. MOVE
It is a java programming language built In SUMO, it has various consideration of traffic levels. TRANS(Traffic and Network Stimulators) [9] which is integrated with SUMO and NS2 and designed specially for VANET, it supports 3000 nodes and limitation is file found from NS2 cannot returned to SUMO.

8.4. VANET MOBOSIM
It overcome the limitations of canumobosim.it uses topology from TIGER,GOF. The main drawback is it cannot return feedback [10].

8.5. NCTUns
It is a cpp programing language combines traffic and network stimulators to support ITS. It induces directional, bidirectional or omnidirectional antenna.it supports maximum of 4096 nodes.

SUMO (Simulation of Urban Mobility):
SUMO is an open source, highly portable, microscopic and continuous road traffic simulation package designed to handle large road networks. It allows for intermodal simulation including pedestrians and comes with a large set of tools for scenario creation. SUMO can be enhanced with custom models and provides various APIs to remotely control the simulation.

1. The simulation platform SUMO offers many features:
2. Microscopic simulation - vehicles, pedestrians and public transport are modeled explicitly
3. Online interaction – control the simulation with TraCI
4. Simulation of multimodal traffic, e.g., vehicles, public transport and pedestrians
5. Time schedules of traffic lights can be imported or generated automatically by SUMO
6. No artificial limitations in network size and number of simulated vehicles
7. Supported import formats: OpenStreetMap, VISUM, VISSIM, NavTeq
8. SUMO is implemented in C++ and uses only portable libraries

9. CONCLUSION:
This paper presents a wide knowledge on VANET regarding its architecture, characteristicsand stimulation tools. It also points

out the current issues in VANET. It would be very useful for the upcoming researchers in VANET.

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