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Vehicular Ad Hoc Network

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***Abstract*—**A Vehicular Ad-Hoc Network (VANET) is a mobile Ad-Hoc Network that provides connectivity moving device to fixed equipments. Such type of device is equipped with vehicle provides safety for the passengers. In the recent research areas of traffic management there observed the wide scope of design of new methodology of extension of wireless sensor networks and ad-hoc network principal for development of VANET technology. This paper provides the wide research view of the VANET and MANET concept for the researchers to contribute the better optimization technique for the development of effective and fast atomization technique for the large size of data exchange in this complex networks.

***Keywords*—**Ad-Hoc, MANET, Sensors, Security, VANET

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I. Introduction

VEHICULAR Ad hoc Networks (VANET) is an intelligent transportation system (ITS) that provides rich application to the users [1]. It falls in the special class of Mobile Adhoc Network (MANET); where nodes are mobile vehicle which communicate with other vehicle or the sink i.e. base station, using security and service applications [2]. The difference between the Cellular, MANET and VANET is represented in Fig. 1.

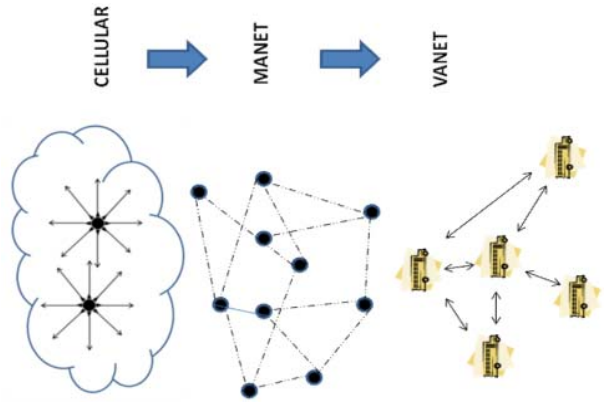


Fig. 1 Comparison of Ad-Hoc network

A cellular network is a radio network distributed over land through cells where each cell includes a fixed location transceiver known as base station. These cells together provide radio coverage over larger geographical areas. User equipment (UE), such as mobile phones, is therefore able to communicate moving through cells during transmission. MANET uses the mobile nodes temporarily to form a network for information sharing and require no need of routers. It is decentralized and self-organized infrastructure-less network of mobile devices connected by wireless. Each device in a MANET is free to move independently in any direction, and will therefore change its links to other devices frequently.

VANET is a self organized and distributed network, using fast moving vehicles. These networks have no fixed infrastructure and instead rely on the vehicle themselves to provide network functionality. VANET nodes are mobile and complex administrative structure. VANET is having Ad-Hoc network connecting to operate without any infra-structure. Each vehicle of VANET device can receive or transmit message through the wireless network in ad-hoc mode. Such mechanism provides collision, traffic conditions, road sign, alarm etc. The device is equipped with multimedia and internal connectivity facilities for the wireless coverage vehicles. VANET provides automatic vehicle parking and toll collection facilities.

In this paper: Section II, discuss on related works. Section III discuss about VANET and Section IV about its architecture. Section V, discussed on MANETs. In section VI implementation of VANET is given. Sections VII and VIII, describe the advantages and disadvantage of VANETs. In Section IX applications of VANETs are given. Finally conclude with the Section X.

II. Related Works

The promising feature of vehicular ad-hoc communications is to support several research projects around world such as increase traveler safety, reduce fuel consumption, and pollution in US, FCC allocated DSRC spectrum [3]. Blum et al. [4] propose security architecture for VANETs based on intelligent collisions for only one type of attacks. In this the cluster-head is used for the exchanging messages. Similarly Gerlach [5] and Hubaux et al. [6] propose security concept for vehicular networks. M. Raya et al. [7] propose VANET security issues and its architecture. A. Benslimane [8] proposed localization in VANET using a Global Positioning System (GPS). Ehsan Ahvar et al. [9] discussed on various sensors embedded on the vehicle for distribute of safety information.

III. VANET

VANET is part of MANET, this means that every node can move freely within the network coverage and stay connected. In the VANET and MANET, the nodes are mobile. However, the VANET mobility is constrained to the roadside infrastructure, whereas MANET movement is more random in nature. Nodes in VANET are highly mobile and synchronize to fast topology changes having sufficient rechargeable battery power. VANET is having facility of safety measure in vehicle, streaming communication between vehicles and telemetric

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device. It operates on Dedicated Short Range Communication (DSRC), with Wi-Fi, cellular, satellite and WiMAX. In 1998, engineers from Delphi Delco Electronics System and IBM proposed a network vehicle concept aimed for providing a wide range of applications.

As per the report by the National Highway Traffic Safety Administration (NHTSA), shows that the car accidents on highways have an ascending rate. In the US only, vehicles' crashes on the highways resulted in the loss of as many as 40,000 lives and overall economic losses of more than $230 billion. (Similarly in India in 2012, 20,081 accidents occurred on roads other than State and National Highways. The number of accidents on National Highways was 9,375 and on State Highways, 6,718. In 2011, the corresponding figures were 19,296, 9,519 and 6,401. In Kerala the highest number of accidents in 2012 was in Ernakulum district, 5,718, followed by Thiruvananthapuram district, 4,618. Wayanad accounted for the lowest with 579 accidents. The number of accidents that occurred in the State in 2012 was 36,174 and in 2011, 35,216).

These depressing statistics have motivated both academician and industrial researches to find out a solution by means of VANET. However, Vehicular networks have received intensive of research work in the recent years.

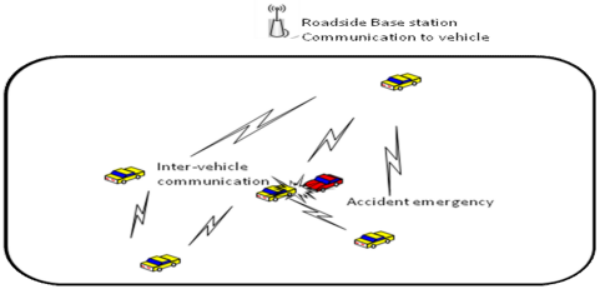


Fig. 2 VANET safety message exchange

Fig. 2 represents a VANET consists of vehicles and roadside base stations that exchange primarily safety messages to give the drivers the time to react to life-endangering events.

The Car2Car Communication Consortium is initiated by six European car manufacturers. Its goal is to create a European industrial standard for car-to-car communications extend across all brands. European Commission is pushing for a new research effort in this area in order to reach the goal of reducing the car accidents of 50% by 2014, aiming to reach a satisfactory level of secure.

IV. Architecture of Vanet

Vehicular Ad Hoc Network (VANET) is the most important component of Intelligent Transportation System (ITS) [10], in which vehicles are equipped with some short-range and medium-range wireless communication. The architecture of VANET includes computer controlled device and radio transceiver for exchanges having communication range of 300 mts. to 1km. The network connectivity is directly link to roadside base station for data exchange.

Some of the typical components, messages and communications of the VANET are listed below:

- *Component Units*

- OBUs (on Board Units)
- RSUs (Road Side Units)

- *Message Types*

- Safety Message
- Non-safety Message

- *Communication Types*

- V21 Communication
- V2V Communication

In the VANET sensors can be classified into two types: autonomous sensors and co-operative sensors. In the autonomous sensor includes Range Threshold (ATR) for radio network communication range observation, Mobility Grade Threshold (MGT) based on nodes maximum speed, Maximum Density Threshold (MDT) for restricted number entries in the physical areas. Such provision is to avoid the Sybil attack and over hearing issues. In the co-operative sensor the proactive exchange portion is corresponds to data received and reactive position corresponds to portion verification. Following in Fig. 3 shows typical components of VANET.

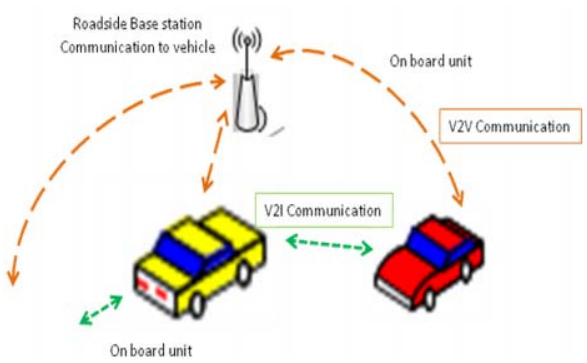


Fig. 3 Typical components of VANET

VANET is a fusion of WSNs and MANET, which can be divided in to three layers. The upper layer consisting of traffic monitor stations, e.g. traffic police located at the cities connected by either fiber optic cables to form the backbone of traffic information network [11]. The middle layer is region layer, consisting of traffic check post located through highways connected via the Internet or local networks, and finally the lower layer is the field layer, consisting of WSN nodes deployed on beside the highway and onboard sensors which are carried by the vehicles.

V. MANET

A Mobile Ad-Hoc Network (MANET) is also called as mobile mesh network, is a self configuration network of mobile devices connected by a wireless links. This was popular in late 1990s. Fig. 4 shows a mobile infrastructure based on ad-hoc communications between mobile nodes known as MANET.

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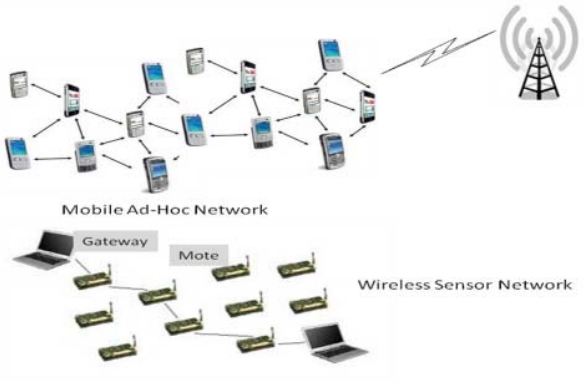


Fig. 4 MANET Network

The MANET is a mesh network having routable networking on top of link layer. The device changes its link frequently to other devices for MANET devices for free movement. From a distributed architecture point-of-view, the mobile nodes are grouped in a peer-to-peer heterogeneous MANET that integrates both Wi-Fi and BT technologies for local ad-hoc communications. Several research works carried out in MANET to evaluate protocols. Different protocols are evaluated based on the packet drop rate, overhead and other measures.

VI. Implementation

VANET technology use mobile vehicle as nodes in a network to create a mobile network. VANET nodes are characterized by high node mobility and for fast changing topology. The network implementation is based on nodes of approximate of 100 to 300 meters range [12]. When one vehicle leaves the range then other device joins for maintaining connectivity. For each cycle and fire vehicle communicate each other to maintain safety.

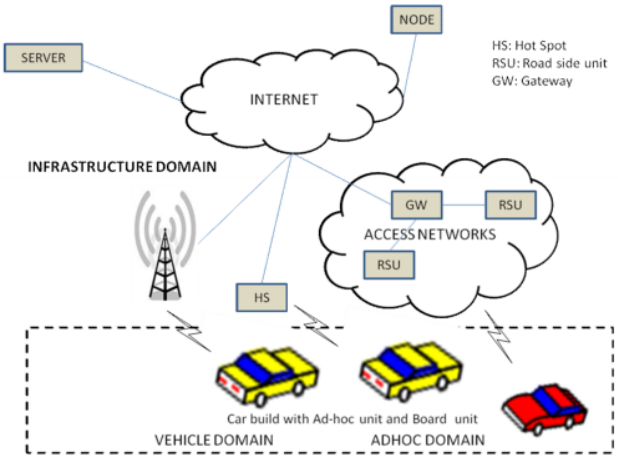


Fig. 5 VANET architecture

Fig. 5 shows the system architecture of VANET is divided in C2C-CC, three distinct domains. The VANETs system architecture is divided into five layers: Physical Layer, MAC Layer, Network Layer, Transport Layer, and Application Layer.

VII. Advantages

1. VANET technology provides high speed internet access in the car.
2. It provides safety facilities as productive tools.
3. VANET determine the time management in utilizing the traffic jam into productive work time.
4. The traffic management can be monitored by the GPS system
5. It also provides VoIP services such as Google talk or Skype between users lowering telecommunication cost.

VIII. Disadvantages

1. In VANET the excessive usage of internet may be distracting and time wasting concerns.
2. The applications such as the web, watching video during driving may lead to accidents.
3. There are chances of more accidents during the access of watching.
4. The prime concern many VANET researchers is the security of the network.

IX. Applications

The VANET applications are for safety convenience and commercial oriental.

1. Safety Application: Monitor the surrounding road, approaching vehicles, road surface, curve etc by exchange warning message to its neighborhood. Some of similar types of applications are Emerging Electronic Break-Light (EEBL), Post Crash Notification (PCN), Road Hazard Control Notification (RHCN) and Co-operative Collision Warning (CCW).
2. Commercial application: Provide the drivers with the entertainment and services as web access, streaming audio and video. Some of services are Remote Vehicle Personalisation Diagnostics (RVP/D), Service Announcement (SA), Content Map Database Download (CMDD) and Real Time Video.
3. Comfort application: Mainly of traffic management type to enhance traffic efficiency by looking the degree of convenience for drivers. Congested Road Notification (CRN), Parking Availability Notification (PAN) and Toll for vehicle toll collection, Traffic information system, gas station and weather information are example of comfort application [13].

In following Fig. 6 represents the design of a modern vehicle's network architecture systems and systems contained in a modern vehicle's network architecture. The future vehicular communication scenario is the vehicles that can consist of several electronics communication gadgets that communicate to the roadside Internet gateway via the ad hoc network.

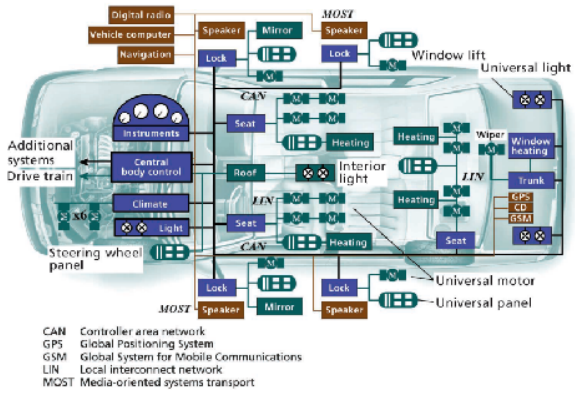


Fig. 6 Design of a modern vehicle's network architecture [14]

X. Conclusion

In this paper presented a state-of-the-art survey in Vehicular Ad hoc and Sensor Network (VASNET), a fusion of Wireless Sensor Networks (WSN) and Mobile Ad Hoc Networks (MANETs), as a promising approach for future intelligent transportation system (ITS). Here explained feasible topology and communication architecture applicable to VASNET. VANET is looking towards future growth. Several research works based on empirical performed to validate the architecture design of Vehicular network that can support users as per application.

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