# A SURVEY ON INTERNET OF THINGS IN VANET

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**ABSTRACT**

All objects should be smart enough, while using Internet of things in VANET. Each object in the IOT is added to additional processors for making communication better. When this feature is added to each object in IOT, it becomes an intelligent node. Such kind of improved intelligence called Internet of Things (IoT) provides a comfortable and safe environment by making interconnection and interoperability possible. In IoT, Vehicle acts as a smart-object communication. In this era, Internet of Vehicles (IoV) plays an important role facilitating comfortable and safe travel. In Internet of Things (IoT), Real-life physical objects with additional features such as computation, communication, etc. can communicate easily and efficiently for the goodness of the society. Vehicular Ad hoc Network is mainly used to exchange information such as safety, routing, entertainment, infotainment, etc. In IoV, instead of objects, Vehicles are used. This paper makes a comparative study of the architecture of IoT and IoV.

***Keyword :*** DSRC, IoV, Internet of Things, VANET.

## I. INTRODUCTION

There is a growing need for vehicular ad-hoc networks (VANET), in which vehicles can communicate with one another, with or without the help of infrastructure on a temporary source. The purpose of creating such a network is to reduce the traffic delay and to make traveling safe for its users. In a typical VANET environment, the act of vehicles directly communicating with others is known as V2V communication, and that of communicating with RSU V2I communication. Each vehicle is equipped with a hardware OBU that has computational as well as communication capabilities[1]. Apart from OBU, these smart vehicles are integrated with micro sensors, embedded systems and GPS. As per the dedicated short range communication (DSRC) standard, a vehicle needs to periodically broadcast traffic and safety-related messages known as beacons. These examples contain four-tuple information, i.e., the speed of the vehicle, its location, direction and traffic events, briefing accident or road scenarios. This example travels in the network carrying data loaded by the sender vehicle to others moving in the same region. For example, a vehicle can carry traffic awareness information about the real-time traffic situations that would help other drivers to take early action in response to an unexpected situation. Due to these attractive features, this technology is considered as a mandate pillar in developing the smart city project.

VANET applications can be classified into four main types: Traffic Management (provides traffic

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information, prevents traffic jams), Safety (life-critical and time-critical applications), enhanced Driver Comfort and Maintenance, and is described below:

- Safety Applications: Proactive measures of traffic signals, stop sign and intersection collision, warning about the emergency vehicle coming, breakdown and wrong way taken by driver and tracking a stolen vehicle, etc. are included in this category.
- Traffic Management Applications: It includes the applications that comprise area access control, electronic toll payment and rental car processing, traffic flow control, etc. for the complete movement of the traffic on the roads.
- Enhanced Driver Comfort Applications: This category of application includes route guidance and navigation, map download/update/GPS correction, parking spot locator, point-of-interest notification, map download/update/GPS correction, etc. for the driver's assistance while moving on the road.
- Maintenance Applications: This category includes safety recall notice, wireless diagnostics, information about software update/flashing, etc.

Vehicular Ad-Hoc Networks (VANETs) permits Dedicated Short Range Communications (DSRC) of vehicles in the 5.9 GHz band, defined in the IEEE standard. They support ITS with both Vehicle-to-Vehicle (V2V) and Vehicle-to-Infrastructure (V2I) communications for applications in both near and far environment. In such a way, VANETs are a technology that enables a combined framework for integrating out-of-date ITS applications, Advanced Driver Assistance Systems (ADAS), Advanced Traveller Information Systems (ATIS), and Advanced Traffic Management Systems (ATMS).

A smart city has no universally accepted definition, but the motive behind developing such cities in every country is to enhance physical, social and economic infrastructure. In simple words, a city becomes smart when it starts adopting the smart use of public resources and requirements, profiting the government, increasing the quality of the services as expected by its citizens and decreasing the operational cost of public administration [2]. The solutions implemented till date are installations of sensors and cameras in the public field to compress the data and use them to utilize for new services such as management of traffic lights, assistance in searching parking slots in crowded areas or help in flow management of public transportation. All such applications not only improve the quality of the lives of citizens but also reduce operational cost leading to financial gains for the economy. Nowadays, specific focus in developing smart city demands smart mobility on the road, which includes enhancing traffic conditions, travel efficiency, vehicle safety and driver/passenger comfort while traveling. Ready availability of the internet gives people the liberty to subscribe to a bundle of services and helps to access real-time information about road conditions and facilities, such as the nearest petrol pumps/Gas station, hospital, restaurant, etc. Such information can be easily accessed by VANET, but requires a permanent network, which is still a big concern.

## RELATED WORK ON VEHICULAR AD-HOC NETWORKS IN SMART CITY

Traditional cities (TC) were very simple in structure and developed for a thin population, though the continuously increasing movement of rural population

into urban areas generated the idea of developing smart-cities (SC). The current scenario of the city is very complicated as it has multi-cultured population, different modes of transport and various communication technologies and utilities. Thus, to improve the shape of the current situation of a metro city the idea of a smart city has been gaining lots of attention from researchers and government, though debates are still on about its attribute set and standard needs. It is expected that these requirements cannot be satisfied without using Information and Communication Technology (ICT), which is already helping most of the cities with the proper utilization of resources. The extensive use of ICT in the smart city plays a vital role in collecting and delivering information and knowledge, by improving the quality of the lives of citizens providing facilities such as services. A more in-depth involvement of citizens in the city governance and proactive steps are due to democracy and public participation [3]. ICT acts as a digital nervous system that obtains data from heterogeneous sources such as parking spaces, traffic signals, security cameras, school thermostat, etc. The role played by ICT helps in decision-making and planning and controlling activities within the automatic routine process. A perfect blending of the right data and right policies can help peak hour traffic run smoothly in cities [4]. In [5], the importance of ICT in healthcare sector has been discussed, i.e. using ICT; diagnosis of diseases and prevention can be made remotely by healthcare department. Apart from that, observation of patients from hospitals can be done on demand. This movement from TC to SC can make learning system move forward, and it can help in improving and capitalizing education. Also, it can create more opportunities for students and teachers using ICT tools. By using these tools, learning can become interactive and more research can be done [6]. The cities that are proposed to develop as SC have vary in size, and for this reason we cannot have a standard approach to apply technologies. Another significant contribution was mentioned in [7] where the authors monitor traffic with a novel approach of collision detection and smart traffic management applications with a compact and strong infrastructure approach. In [7], it is suggested that initially, we should do a pilot study on smaller cities, which not only is cost-effective but also helps in calculating the outcomes fairly. The environment sustainability of a city is always an essential factor as it may help to figure out the available green spaces which reflect the quality of life of the citizens. Therefore, the implementation of SC idea in such cities will help to lower the marginal cost, if further improvements are provided [8].

*Figure 1 Complex scenario of traffic*

**FEATURES OF VEHICULAR NETWORKS**

Vehicular networks are composed of vehicle-to-infrastructure communications (V2I) and vehicle-to-vehicle communications (V2V). Vehicles and RSUs form a vehicular network. Figure 2 shows the example of a vehicular network. As shown, there are communications among vehicles, and between

vehicles and the infrastructure. With the help of infrastructure, vehicles are able to access Internet. V2V communications have the following advantages: they allow

- Short and medium range communications,
- Reduction of deployment costs,
- Short messages delivery
- Minimization of latency in the communication link.

The system model has the following entities. It is shown in Fig 2.

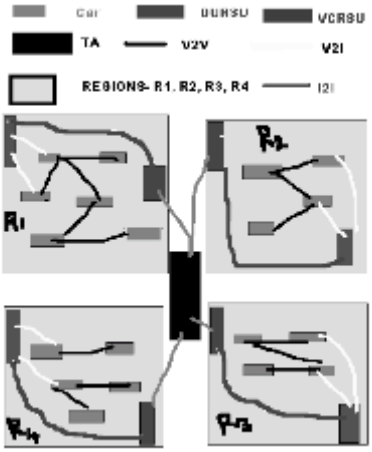


*Fig 2. IoV Architecture*

1. Trusted Authority (TA): It distributes anonymous certificates for all the on-board units which are attached to Vehicles and the secret key for all VCRSUs in VANET.

2. Road Side Unit (RSU): It is fixed and distributed all over the network. It is communicated with Trusted Authority and the vehicles. It can store Certificate Revocation List (CRL).

3. On Board Units (OBU): It is embedded in vehicles. It can communicate either with other OBUs through V2V communications or with RSUs through V2I communications.

Trusted Authority prepares a set of anonymous certificates for all On Board Units in the network and also distributes private and public keys of the On Board Units to the corresponding region VCRSU in the network.

1. The whole network areas are categorized into regions, i.e. Mix zones. Each region has two types of Road Side Units.

- Vehicle communication RSU (VCRSU): It is involved in communication with vehicles in its region.

- Data Updating RSU (DURSU): It monitors the incoming and outgoing vehicles in the region and updates the CRL data and sends the updated CRL to VCRSU which is in its region.

**REQUIREMENT OF VANET INFRASTRUCTURE IN SMART CITY :** Smart cities are meant to enhance the performance of urban services through tight coupling of several sectors using Internet and Communication Technologies. The purpose of developing a smart city is to satisfy the requirements that can change in real-time, depending on the events appearing in the city. This section presents the requirement of VANET application in the smart city.

- Traffic Management: The expected number of people living in India is 1.34 billion, and 32.8 percent of this total population lives in urban areas. Today, cities are responsible for more than 75% of waste production, 80% of emissions and 75% of energy utilization. The road transport produces more than 50% of its total CO2 emissions. This statistics profoundly point out the demand of implementing a technology that can

make city transportation system more sustainable [7]. The first and foremost challenge to while developing a smart city is to resolve its traffic related problems. In metro cities, the road is the only transport medium which creates adverse effects on overall traffic situation and the environment safety level. In such a complex environment, VANET can play a crucial role in improving traffic sustainability by controlling the system more efficiently reducing energy consumption. It can be applied to the smart city infrastructure to help citizens, companies, and city government in the decision-making process, by providing real-time information about road conditions. VANET can resolve traffic situation in many different ways. For example, the GPS enabled vehicle can gather data from the network and predict the expected delays in a defined route and also suggest alternative less time-saving routes to its users. As mentioned already, both types of V2v and V2I network add their benefits into the network. V2V solution mainly focuses on safety, thanks to applications such as emergency slowing system, whereas V2I applications improve traffic flows by setting the most appropriate speed based on the future status communicated by smart traffic lights (i.e., red, yellow, green) [9].

- Parking Management : Parking problem becomes one of the major issues in the city transportation management, since the spatial resource availability in the cities are limited, and parking cost is increasing rapidly. In cities, people spend unnecessary time on searching for free parking spaces which not only consumes energy but also causes chronic stress in life. According to the recent research significantly dealing with the parking problem the traffic flow peak produced by searching for parking facilities can elevate 25-40%, and, on an average, create delays of approximately 7.8 minutes [10]. It has been observed that 30% of the vehicles in the cities are struggling for the parking spot, with a consequent proportional increase of CO2 emissions.

- Collision Avoidance : The VANET safety application set gathers information from other vehicles or sensors or both, for the safety management decisions. These decisions could involve a wide range of safety messages such as emergency braking, collision avoidance, intersection avoidance, alternate routes, etc. In highly populated areas, improving intersection collision systems help in reducing the rate of roads accidents that frequently occur on the T-intersections or blind intersections. This type of communication involves V2I infrastructure of VANET, which is primarily designed for cities [11]. The sensors collect information from the vehicles moving towards the intersection and from the RSU's installed in that location; if the sensors detect any possibility of a collision or any hazardous situation, an alert message is sent to all the vehicles driving towards that intersection.

- Smart Policing : The applications designed for road safety can be significantly proven useful in smart cities to perform the smart-policing. For example, the surveillance sensors installed at traffic signal can send a warning message to the drivers about a dangerous situation. On the contrary, if any vehicle breaks the rule the captured images can help the traffic police to trace

the vehicle's plate. In another situation, a warning message can be used to inform the oncoming vehicle for the stop sign by recalculating its distance from the signal concerning its speed [12]. After receiving the message, the driver can control the speed and avoid violating the sign which in turn helps him avoid an accident. Hence, VANET not only assists the police with its applications but also makes them secure and livable by watching the roads round the clock.

Management Requirement: In our traditional cities the government is entirely responsible for every action. Limited transparency, fragmented accountability, different city division and leakage of resources are some fundamental characteristics of regular government. But in case of SC, we need e-governance which can monitor the whole city remotely. To cover the entire city's traffic and vehicular problems, we have technological solutions provided by VANET like SOS services that help in emergency cases to send a signal to the nearest infrastructure point directly. Alternatively, it depends upon the vehicles in range repeating the signal and delivering it to the most adjacent infrastructure.

To resolve the stated problems, VANET can apply to the smart city project by using the sensors, wireless communication technologies, and efficient applications can be developed to assist the drivers with the information of free parking spots, which reduces the driver's frustration and negative impact on the city's traffic. In some countries, this application is already adopted and has proven very convenient. More recent papers investigated the opportunities enabled by VANET technologies for car parking systems [13]. The car parking system was the object area in the previous frame. Tracking by contour tracking method can be performed using two different approaches, (i) using the state space models to model the outline shape and its motion. (ii) minimizing the outline energy using direct minimization techniques like rise succession.

It is made up of three layers: sensors to detect the occupancy of individual parking spots, communication technologies to collect the information from sensors and an application layer to give (near) real-time information to the drivers. The application layer is crucial to assure a good user experience. After implementation, drivers can avail themselves of the benefits by using their smartphones or internet to make the slot reservation in a particular area parking space. Then, different technologies can be used to recognize each car at entry points (e.g., RFID, Bluetooth) and trigger automatic reservation checking and parking payment [14].

**CONCLUSION :**

Establishing connectivity of vehicles in a smart city is required to provide support to the drivers in alarming situations. Precisely, VANETs are globally accepted as a foundation for safety, minimizing traffic related issues and exciting infotainment applications available for drivers, passengers and walkers in the smart city. The expected contribution of VANETs is to provide information to the drivers about the upcoming potential threats present in their surroundings, also give an alternate route information. The Wireless communication nature of VANET's applications makes its users vulnerable to the city, as we have discussed. Another issue that needs to be considered is that a user should be well aware of the handling methods of such technologies. Mostly, this paper provides an understanding of how the VANET can be useful and applicable to the smart cities at the same moment. To

resolve vulnerabilities, we need government contribution to regulate and apply the standards designed by standardization bodies and research institutions along with car manufacturers, to build secure and safe smart cities.

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