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Survey on VANET Based Self Adaptive Prioritized Traffic Signal Control

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ABSTRACT

Increase in the number of vehicle causes traffic congestion at intersections of roads. It suffers the people time and Emergency Vehicle (EV) such as, ambulance, fire brigade etc, are stuck or delay to destination causes heavy losses. To avoid this, Our Traffic control system should be intelligent and adaptive in Management of signal allocation, EV has to be varies with priority order to create desirable circumstances. Here, I propose to use Vehicular Ad Hoc Networks (VANET) to collect, schedule and aggregate speed and location information of individual vehicles to optimize signal control at traffic intersections. By using VANET, The location information and real-time speed of vehicles can be providing to the traffic signal controller. Current Traffic Control System Based on VANET proposed adaptive Job Scheduling to reduce the conflicts across the intersections. But not provided the Solution to minimize the time delays for Emergency Vehicles passes through intersection. In my proposed work, the Priority Scheduling Algorithm (PS) used to provide the efficient prioritize Traffic Control System. The Priority Scheduling Algorithm schedules the higher priority vehicles (that are Emergency Vehicles). The Traffic Controller Unit, which is traffic intersection control fetches the scheduled result and clears a lane of road for EV by leading all in-ranged vehicles, and control the Physical as well as Virtual Traffic Light. It continuously performs its task until EV crossed Intersection.
Keywords : VANET, Priority, Time, Emergency Vehicles, Traffic Signal

I. INTRODUCTION

The term VANET is acronym for vehicular ad-hoc networks was originally adopted to reflect the ad-hoc nature of highly dynamic networks. First, consider the opportunities. If the vehicles can directly interact altogether and with infrastructure, a new paradigm for vehicle safety applications can be created. Second, further challenges are created by high vehicle speed and highly dynamic operating environments. Third, new requirements include new expectations for high packet delivery rates and low packet latency. Further, customer acceptance and governmental oversight bring very high expectations of privacy and security. Driving means constantly changing location. A very important category is driver assistance and car safety. Another category is infotainment for passengers. VANET communication is based on two types. [2] Vehicle-to-Vehicle (V2V) communication, (2) Vehicle-to-Infrastructure (V2I) communication. In V2V communication, VANET communication can be done directly between vehicles as "one-hop" communication, such as car-to-car communication. In V2I communication, VANET communication can be done between vehicles and road side infrastructure as "multi-hop" communication. In this paper, we examine the possibility of deploying a Self Adaptive Prioritized Traffic Signal Controller in VANET, which receives information from vehicles, such as the vehicle's location i.e. its real position by GPS and its speed, and then use this information to optimize the traffic signal scheduling at the intersection.

To control traffic signals there are so many technologies were proposed. In the management of traffic the Emergency Vehicles is highly considerable fact to avoid time delays in the services of EV. Recently increasing the number of cars on city roads has There are many problems created , such as traffic density, people get killed in accidents, emissions, fuel consumption, etc. Emergency vehicle such as ambulances, fire trucks, and police vans are special vehicle designated to respond to emergency immediately. Thus, reaching their destination as fast as possible is their primary concern. Due to traffic congestion, response time of emergency vehicles is increases. Emergency vehicles should be able to respond to emergency calls for an incident with minimum delay. Where time delays in the services of EV causes human lives risks as well as financial losses. Therefore, need a Traffic Management System that responsible for managing traffic with emergency vehicle Consideration, on the roads, efficiently. That can be possible by applying the priority preferences to vehicles. So we motive and avoid this problem by prioritizing emergency vehicles at the traffic signal intersection, Where EV having higher priority than other vehicles. Exists work manages and controls the traffic using the VANET technology, and focuses only on job scheduling, where jobs are the Platoon (the Platoons are the group of one or more vehicles that are to be cross through the intersections) [1]. But the priority considerations for Emergency Vehicles are not considered in this System. This makes the more chances of time delays in the services of EV. Hence in exists work only applicable to reduce conflicts at intersections but not to overcome the time delays of EV. This work focuses on the particular problem of traffic management for emergency services, for which a delay of few minutes in the services of EV may cause human lives risks as well as financial losses. In our proposed scenarios the idea to solve the problem with traffic emergency control, by designing Emergency Vehicle Priority Preference at Intelligent Road Traffic Signal Control System in VANET where the emergency vehicles will be consider first based on calculated arrival time at the intersections. Every Emergency Vehicle is always deals with high priority than other vehicles. The Priority Scheduling Algorithm schedules the higher priority vehicles and provides the circumstances in such a way that, the EV will scheduled to high priority vehicles and cross over intersection without any conflict at intersection.

II. LITERATURE REVIEW

Vehicle-to-vehicle communication is a very actual and challenging topic. Vehicles equipped with devices capable of short-range wireless connectivity can form a particular mobile ad-hoc network, VANET—Vehicular Ad-hoc Network. The existence of such networks opens the way for a wide range of applications. Two of most important classes of such applications are those related to traffic safety and route planning. Route planning aims to provide drivers with real-time traffic information, which, in the absence of a VANET, would require an expensive infrastructure. By contrast, the VANET approach is scalable and has low maintenance costs. Moreover, short-range wireless communication technologies have no associated cost, other than the communication devices. Safety applications involve disseminating urgent information, which is not present in the driver's field of view, or it is difficult to notice for reasons such as fog or other vehicles obstructing the line of sight. For instance, a lot of accidents occur in foggy conditions because drivers notice too late that some kind of incident has occurred in front of them. Safety at intersections could also be enhanced, since the risk of collisions could be detected in advance and the driver could be warned seconds before what would otherwise be an imminent accident. The evaluation of VANET protocols and applications could be made through real outdoor experiments, which are time-costly and claim for a large number of resources in order to obtain significant results. Instead, simulation is a much cheaper and easier to use method. Obviously, this leads network and application developers to use simulation in order to evaluate different simple or complicated and innovative solutions before implementing them.

1. Vehicular Ad hoc Network (VANET)

The Vehicular ad hoc networks (VANETs) are basically using the working principles of mobile ad hoc networks (MANETs), where MANET is the spontaneous creation of a wireless network for data exchange to the domain of mobiles [7]. In 2001 VANETs were first mentioned and introduced under "car-to-car ad hoc mobile communication and networking" applications, where networks for vehicles can be formed and information can be relayed among cars. There is vehicle-to-vehicle and vehicle-to-roadside communications architectures will co-exist in VANETs to provide road safety, navigation, and other roadside services.

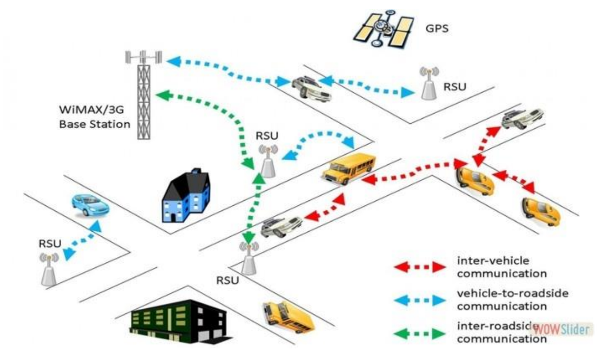

Figure 2.1: Overview of VANET

VANETs are sometimes referred as Intelligent Transportation Networks because it is the key part for the intelligent transportation systems framework. In the early 2000s, VANETs were seen as only one-to-one application of principles of MANET. The more generic term inter-vehicle communication (IVC) was changes to the mostly synonymous term VANET up to 2015 [8] , but the focus remains on the aspect of spontaneous networking and less focus on the use of road side infrastructures like Road Side Units (RSUs).

2. Communication in VANET

In a typical VANET, Communication takes place in between on-board unit (OBU), installed at vehicle and the road-side units (RSU) installed along the roads. In backend, the trusted authority (TA) or some other application servers are installed for additional support. The Dedicated Short Range Communications (DSRC) is used for interaction of OBUs with RSUs over the wireless channel [12]. But the backend application servers or TA communicate with RSUs using a secure fixed network (e.g. the Internet). VANET communication is based on two types. [2] Vehicle-to-Vehicle (V2V) communication, (2) Vehicle-to-Infrastructure (V2I) communication. In V2V communication, VANET communication can be done directly between vehicles as "one-hop" communication, such as car-to-car communication. In V2I communication, VANET communication can be done between vehicles and road side infrastructure as "multi-hop" communication. The onboard sensors in vehicles are deals with this mechanism and standard wireless communication protocols specifically for vehicular applications for communication, vehicles can use wireless communications for vehicle-to-vehicle (V2V) or vehicle-to-infrastructure (V2I) communications, as described in the dedicated short-range communications/wireless access in vehicular environments standards operating in the spectral range of 5.85– 5.95 GHz [5]. For example, all vehicles are already equipped with a speed sensor or meter. In addition, new vehicles are fortunately being equipped with Global Positioning System (GPS) units that can provide the information of location [6]. As such, a VANET can also be interpreted as a sensor network because the traffic control center or some other central servers can collect lots of useful information about road conditions from vehicles. It is natural to investigate how to utilize the collected real time road conditions to provide useful applications.

The combination of both short-range wireless technology and ad-hoc networking facilitates C2C and C2I communications, known as Car-to-X (C2X) communications [13]. Usually viewed as a critical element of the Intelligent Transport Systems (ITS) architecture, VANETs provide solutions for improving road safety and to enable a set of onboard potential services for drivers and passengers as well as different communication facilities between moving vehicles. The importance and potential impact of VANETs have been confirmed by the considerable attention given from the research community and the automotive industry as well as from Governmental authorities and standardization organizations.

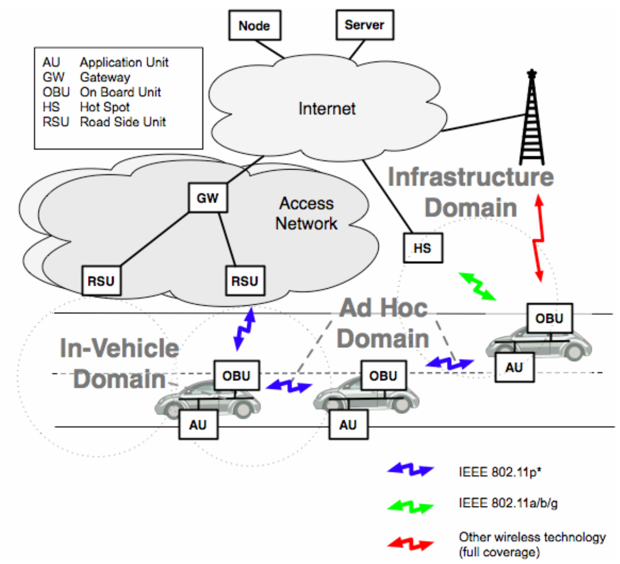

Figure 2.2: Car-to-X (C2X) communications

The **In-Vehicle Domain** refers to the vehicle internal network. Each vehicle is equipped with an On-Board Unit (OBU) that implements the communication protocol stack and offers an interface to driver and passenger devices, called Application Units (AUs).

The **Ad-hoc Domain** is composed of vehicles equipped with OBUs and fixed network nodes installed along roads, Road-Side Units (RSUs). OBUs and RSUs form a VANET, which allows communications in a fully distributed and self-organized manner, without the need of centralized coordination. OBUs directly communicate if wireless connectivity exists among them, or perform multi-hop communications through the use of a dedicated routing protocol.

Finally, in the **Infrastructure Domain**, the RSU can simply extend the VANET coverage by acting as forwarding entity, or be attached to an infrastructure network, which in turn can be connected to the internet. The RSU will allow the OBUs to access such infrastructure, and hence, the vehicle AUs can communicate with any host on the internet.

The C2C-CC basic system is composed by individual components:

An **Application Unit (AU)** is a dedicated entity that runs applications and uses the OBUs communication capabilities. An AU can be embedded in the vehicle and be permanently connected to an OBU, or can be dynamically plugged into the in-vehicle network by drivers or passengers. It can also be a portable device such as laptop or PDA. Multiple AUs are allowed to a single OBU.

An **On-Board Unit (OBU)** implements the communication protocol stack and provides C2X communications services to AU's. OBUs are equipped with at least one network device for short-range wireless communications based on IEEE 802.11p, and may also be equipped with more network devices from different technologies. Its main functions and procedures include wireless radio access, geographical ad-hoc routing, network congestion control, IP mobility support, and others.

The **Road-Side Units (RSUs)** are fixed nodes placed along the roads or highways, or at dedicated locations such as traffic signs, parking places or gas stations. The RSU has the same communication capabilities of OBUs. Is equipped with at least one device for short-range wireless communications based on IEEE 802.11p, and may also be equipped with other network technologies in order to allow communications with an infrastructure network. RSUs may extend the communication range of the Ad-hoc Domain, may provide internet connectivity or may cooperate with other RSUs in forwarding information.

3. VANET Applications

In real time message information dissemination of different type, VANETs support the different types of applications – from simple one hop information dissemination to multi-hop dissemination of messages over large distances. Where, simple one hop information dissemination is Cooperative awareness messages [9]. Some of working phenomenon of MANET's are as VANET, but details are different. In MANET, mobiles are moving at random axis, but vehicles are tends to move in an organized way, and most of the vehicles are restricted to move in the specific range, for example, The vehicle range of motion is limited. Following are some range of applications for VANET [10]:

A. ***Electronic brake lights:*** Brake event information is spread to others, it is useful for other drivers to react to vehicles braking in case of obscured views, which caused by fog on road due to environmental changes.

B. ***Platooning:*** Platoons are group of vehicles, which are moving on road very closely altogether by following to the leading vehicle through wirelessly receiving speed acceleration and steering rotavation information, the moving vehicles forms the road trains by following leader rules.

C. ***Traffic information systems:*** The vehicles on the road are with electronic information, such as speed, GPS location, etc. This can be providing by communication in VANET to deal with traffic, like as intelligent traffic control system.

D. ***Road Transportation Emergency Services:*** In daily transportation services, emergencies are even important to handle. Reduce in time delays and speed up of emergency rescue operations are possible by VANET communications, where VANET networks, and road safety warning and status information dissemination are used.

E. ***On-The-Road Services:*** It is also envisioned that future transportation highway would be one that is "information-driven" and "wirelessly-enabled". While a driver drives on the road, he can discover services (shops, gas stations, etc) on that street by using VANET and even if ongoing sale can be notified at that moment.

4. About Traffic Management

The Traffic Management System manages the available traffic passing on the roads well and efficiently. It is very important and necessary to improve this system, because of rapidly change in the volume of traffic with respect to time.

5. VANET Enabled in traffic signs

Understanding traffic sign information correctly is crucial. It helps the driver to anticipate future situations, make decisions and respond in an appropriate way. There are many different kinds of road signs and they are mostly placed above or beside highways and streets. However, these traditional static traffic signs have known limitations. The period of time the drivers have to analyze the information is limited, and even if the road signaling is predominantly standardized, most of the signs use text to convoy meaning restricting the understanding to readers of the language. They are likely to be overlooked during complex driving tasks, and sometimes, the adverse weather conditions or vehicles blocking the line-of-sight between the driver and the sign, make its recognition very difficult. In contrast to traditional traffic signs, traffic signs displayed within the vehicle will solve a big amount of these limitations, as well as they will provide additional help to the driver on his driving tasks. In fact, in-vehicle traffic signs are one of the main ITS technologies. Expensive systems, such as interactive Variavel Message Signs (VMSs) [15] can present traffic-related information and guidance to drivers through electronic signs located beside or above the highway. The main advantage of these systems is that they can present real-time information that cannot be displayed on traditional static traffic signs, such as information related to hazards, traffic conditions, parking, public transport or environment. A special category of VMS, the called Vehicle-Activated Signs (VASs) [15] has been designed to deliver targeted warning information to individual drivers when they exceed a particular vehicle performance threshold (usually speed or following distance). Road sensors, such as buried induction loops or microwave detector heads have been used to monitor individual vehicle behaviors. Unlike the traditional road sign, in which the communication takes place between the sign and the driver, the behavior of the driver can influence the information displayed on the VMS.

6. Exist work

A paper Adaptive Traffic Signal Control With Vehicular Ad hoc Networks represented by Kartik Pandit, Dipak Ghosal, In this paper, the vehicular ad hoc networks (VANETs) is used to collect real-time speed and position information of all individual vehicles . This information is used to optimize the signal control at traffic intersections. They grouped vehicles into approximately equal-sized platoons, where platoons consider as job on processor. This can then be scheduled using OJF (Oldest Job First) algorithm. In this literature they used the two-phase approach as, where first phase is grouping of the vehicular traffic into platoons (Platoons are group of vehicle either of same density or different) and secondarily apply the OJF algorithm, i.e., the oldest arrival first (OAF) algorithm. They described the simulation results under light and medium traffic load where the OAF algorithm reduces the delays experienced by vehicles as they pass through the intersection, as compared with vehicle-actuated methods, Webster's method, and pre-timed signal control methods [1]. But the Oldest Arrival First (OAF) algorithm's result analysis are same as vehicle-actuated traffic method for heavy vehicular traffic load, but when compared with Webster's method and the pre-timed signal control method it still produces lower delays under heavy vehicular traffic load [1]. The Intelligent traffic control mechanism studied in literature [3], in this mechanism of implementing intelligent traffic signal control depends on roadside sensors, like loop detectors, which can only detect the presence or absence of vehicles, and traffic monitoring cameras[4]. These loop detectors are connected to the traffic signal controller, and this connection is used to establish communication between loop detectors and traffic signal controller, the information gathered from the loop detectors to the traffic signal controller through the connection, This gathered information used by traffic signal controller to schedule traffic through the intersection by cycling through preset phases and assigning specific amount of green signal time or skipping the all phases.

In this paper, proposed an efficient communication that applies the operation of road traffic system components for single and multiple road intersections. The Sensor node installed at roadside, to collect data and send it to central processor in a real time with the help of wireless access, then generate permitted traffic length through the traffic signal. The contacted vehicles are to be calculating by contacting sensors (reader). The designated value of 6(six) is assigned to each contacted vehicle, and multiply it with the number of contacted sensors (x), and then optimize Green light Illumination by multiplying connected vehicles and sensors(x) i.e. (6*x)= Green light Illumination per circle in Seconds. The green light permitted time interval per seconds is by generated results; however this will be reset per calculation cycle. However to monitors the emergency vehicles, Here some extra calculations are applied: the emergency vehicle's location and provided estimated arrivals time are monitored, using the contacted sensor distance from the cross road. And execute the cycle, given priority to the present emergency track first, based on the calculated arrival time in case of other tracks RED illumination is "ON". It execute emergency track GREEN Illumination will be "ON" and then system will be reset to normal after the departure of the emergency vehicle [13].

In the paper, Emergency Vehicle Priority Preference at Multiple Wireless Network Sensors (MWNS) Intelligent Road Traffic Signal Control System by Okunade Oluwasogo Adekunle1, Osunade Oluwaseyitan proposed the scheme of intelligent traffic signal control system for equitable allocation of time frame by applying multiple wireless network sensors (MWNS)with Radio frequency Identification Reader(RFIDR).

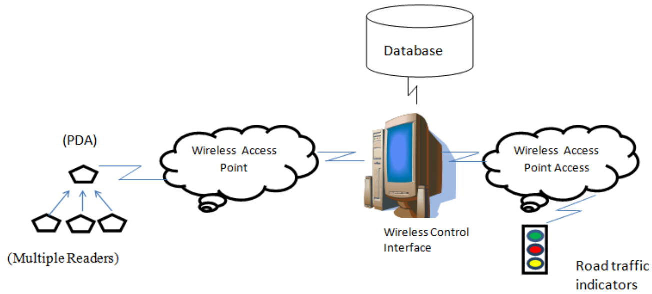

Figure 2.3: A frame work for Intelligent Road Traffic Signal Control System Using Multiple Wireless Network Sensors (MWNS)

Mazeiar Salehie, Soufiene Djahel, Irina Tal and Pooyan Jamshidi stated a theory in the paper “Adaptive Traffic Management for Secure and Efficient Services in Smart Cities” [4]. In this paper adaptive Traffic Management System is chooses to deal with Traffic issues. TMS is of set of Traffic Management Controllers; each of them controls and manages applied traffic in given appropriate area. Where, each TMC having its own job, it requests the corresponding trusted authority to authenticate the vehicle. If the emergency vehicle requested by TMC it is identify and authenticated by authority, Identity in case of emergency and non-emergency. If its emergency level of vehicle is confirmed, the road network authority approves the driving policies. Finally, the TMC provide the best route to the emergency vehicle to speed up its access to the requested emergency area. Simultaneously this route is updated during the journey of emergency vehicle.

III. PROPOSED METHODOLOGY

Start the emergency vehicle from the source. The presence of Emergency Vehicle is detection process is as follows: The Application Unit equipped with OBU passes the Emergency Vehicle ID, its direction related to traffic signal, its average speed, and its destination location to the RSU. The Traffic Signal Controller (TCS) estimate the traffic present or upcoming at intersection. The estimated traffic values and electronic information provided by AU is used by TSC to optimize traffic, as the priority scheduler schedules the estimated traffic by considering higher priority to EV. TCS then applies this priority based scheduled scheme to estimated traffic until EV cross intersection. Where, TSC is already equipped at RSU with historical data and road patterns.

IV. CONCLUSION

In this paper, a self- adaptive, systematic and intelligent approach is represented to manage the issues with traffic management, Especially for Emergency vehicles. The emergency vehicle reaches at intersection, will not face the issues such as wait, conflict, halt sign etc while the prioritized traffic controller is applied as extra ordinary feature to intelligent transportation system. It is possible to reduce the losses caused by delays in emergency services.

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