Congestion free analysis for emergency vehicles response in tri-city (Panchkula-Chandigarh-Mohali) using LTE-A

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ABSTRACT

For any country's growth is depend on their people's growth, whenever we talk about the growth of any country then it shows the achievements done by their peoples. Day by day population are increasing and peoples are enjoying their luxurious life with big bungalows, and big luxurious cars but not a single vehicle it could be per person average of two-three vehicles results to noise, air pollutions and important factor is the increment of traffic of the city. In this paper we are not praising for the growth of the country, no doubt for the growth but we want to focus on the traffic system control. Day to day traffic is increasing in which the big problem is faced for the safe passage for the ambulance vehicle's escape or some other person who is in need of urgent work anywhere apart from medical facilities. We heard many patients leads to death in the ambulance and doctor says ''it's too late, if you could reach at least 10minutes before then the patient could have been saved his/her life''.
So here we focused in paper to facilitate the emergency services (only concerned to patient's ambulance) signal free. This will be possible by using the telecom technologies along with city traffic control stations to implement the things made easier for the signal free passage to escape of ambulance from the traffic lights or streets means the ambulance would not stop in the traffic jams. This can be made possible using VANET-LTE advanced technology.

1. INTRODUCTION

In today's era, every second is very important. We feel very bad whenever we face a traffic jam situation, which is called Traffic congestion. But in metropolitan cities, it is a major problem. So, Delhi state government in India is trying to provide signal free road network that is why signal free corridor is being constructed i.e. Delhi to Chandigarh. This congestion on road network is increasing day by day due to new vehicles entry in the same density of the road network, which slower the speed of vehicles. This congestion shows the insufficient capacity of that road network. Such type of situation of the road network indicates to saturation. It is just like increment of population every second. Traffic congestion [1] represents a negative impact or effect on the economy, health due to pollution, environments, and as well as on quality of life.

So it is very important to resolve the issue of traffic jams. There are various methods of resolving the traffic jam or congestion issue like video data analysis, IR sensors, loop detection technique and wireless sensor network etc. These methods are very fruitful for smart traffic management system.

Presently the traffic control system (TCS) is made of microcontroller and microprocessor based as shown in the upper part of figure 2 (a). This system has the limitation which doesn't works on real time basis. In this case, Red, Yellow and Green light sometimes plays unwanted delays due to fixed time interval provided.

To make traffic light control system smart a new technique called intelligent traffic light using sensor networks with embedded system. With this technique, traffic congestion reduces with the optimization of total traffic and helps in increasing the traffic capacity and traffic flow.

In figure 2(b), vehicular ad-hoc network (VANET) [2] plays an important role for making the system smart traffic management. In this case V2V communication is possible as well as sends multipath information [3] in terms of message to roadside unit. This helps to reduce the traffic jams, congestion and accidents and provide help in respect of safety to vehicles as well as drivers. It also helps in reducing the wastages of fuel and time.

Figure 1. Example of IoT enabled system

Figure 2. (a) Existing techniques TC System for ERA
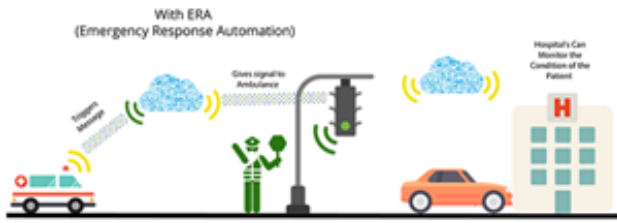

Figure 2. (b) VANET-LTE based Emergency Response Automation

VANET consist of mobile nodes, On Board Units (OBU) and Road Side Unit (RSU) attached to the infrastructure [4] is installed along the road side. It uses wireless communication between the vehicles for one to one communication. Due to this becomes the part of intelligent transportation system.

2. RELATED WORK

Related work can be understood with the author's views as follows:

A. K. Mittal and D. Bhandari [5], provide a proposal for turning the green light from red light for the safe passage of emergency vehicles in case of any traffic. In this paper, a green wave setup system was setup focus only to the emergency services needed vehicles. Here the advantage of GPS plays a great role for this work. With the setup, emergency vehicle passes through a green signal will receive as it moves along the road. Disadvantage of the green wave signal is distributed then due to disturbances traffic will be collapsed.

Geetha. E. V. Viswanadha, Kavitha. G [6], the authors proposed smart traffic control system to overcome the traffic congestion problems. The system must be such that the vehicular traffic receives proper coordination related to road congestion. During the rush hour of vehicles, there might be possibility of emergency vehicles and so this vehicle can be stick to the traffic jam. Hence smart traffic control system is proposed based on the PIC 16F877A MCU, IR sensors and radio frequency Identification (RFID) technology.

N.Ahmed Surobhi and Abbas Jamalipor [7], suggested M2M-based service for overage mobility model to user's post emergency complex behavioral changes. The proposed outline provides continuous service coverage for the best accurate predictions of the central server. In other words, no supervision for M2M or machine-to –machine networks and requires fewer resources.

Chiranjib Sur, Sanjeev Sharma, Anupam Shukla [8], proposed a novel approach for vehicular traffic is considered called EcoTrec or eco-friendly routing algorithm. This used for VANET to gather data from conveyed vehicles and carry forward the information to get the aid of routing algorithm. This algorithm is basically focused on providing the best route for vehicles so called fuel efficient vehicles. When algorithm calculates the different paths on fuel proficiency based then it directs the vehicles fuel efficient routes but avoiding flash crowding etc. Here note that eco-friendly routes and shortest route are possibly not the same hence, shortest distance and shortest duration routes could not be same. The main agenda of providing this algorithm is to provide extra routes or choice of routes so that the cost to drivers could be lessens and also they can make the choice routes for trade-off.

Regardless of the possibility that the driver can take eco-friendly routes in some other trips and hence results to decrement oil utilization and emission which are very helpful to the drivers and general public. In the large portion of the event drivers try to utilize the system network.

Ove Anderson, Christan S. Jensen, Kristian Torp, Bin Yang EcoTour [9], proposed VANET based colony optimization techniques called Time-Ants. This technique utilizes the historical traffic flows, a new kind of optimization techniques so that the traffic congestion can be managed. Here simulation has been performed and compared time-ants against a no. of other VANET-based routing techniques. This technique outperformed the next best approach by 19% after four days of running this algorithm.

Ronan Doolan, M. Hipp, F. Kargl and M. Weber [10], in this paper traffic congestion information is received on FM radio so that new vehicles do not join the already met vehicles in traffic. They discussed such gullibility errors where the drivers follow the automotive navigation's directions even when they don't make sense. Additionally it is noted that the drivers don't generally follow the advice of the navigation system. With these strategies drivers can get advantages for taking decision and indicate the choices. As machines are not generally capable of judging the advantages of few ideas and different users will have different preferences like few drivers will not use specific roads.

[11, 12] paper represents the information captured in real time for the observation can be used for traffic optimization, but the techniques and methods can be changed. There is a centralized entity stores the traffic congestion information conveyed by the vehicles moving on the roads. The road traffic is calculated by comparison of normal travel time of each segment with increased initial time measured due to vehicles in the road traffic then it shows the congestion on that road route.

[13], author introduced the traffic jams regularly and broadcasted its report by messages sent by the visited vehicles. These messages evaluate the estimated status and traffic routes. The problem occurs when there are overloaded messages on the communication channel because they exchange the large no. of packets for making the communication proper.

[14, 15, 16], in these papers authors discuss for the urban traffic management. This concept was used mainly to optimize the traffic signals deployed at the intersections from the collected data of real-time traffic. The important role of this optimization technique is to reduce the wait states for no. of vehicles at the crossing intersection. Then the traffic lights are used to synchronize the different intersections which improve the traffic problems in all directions. Sometimes a local synchronization for an intersection influence on all other intersections of the road network. Hence optimizing the desired goals include the minimizing of wait time and length of the queue could not be achieved in other intersections so

congestion could be more.

[17], the paper shows the preventions of accident based traffic for VANETs called CAOVA (Car Accident light Ontology for VANETs). Here the instances of ontology are filled with: (i) the information collected when the accident meets and, (ii) the data available in the general estimate system (GES) accident data base. We access the reliability of our proposal in two different ways: one is realistic crash tests; and other using a network simulator structures.

[18], authors proposed here an effective fuzzy based energy efficient load distribution schemes which takes care of energy consumption which considers congestion parameters. When compared with the existing energy aware routing strategies the proposed method substantial enhancement in the total energy consumption, network lifetime, totals no. of dead nodes, and average throughput.

[19] Pushparaj Pal et. al, author proposed Location information based routing technique that provide better path according to vehicle's location when vehicle meets accident on the path. This protocol broadcast the information packet in vehicle direction towards the city or vehicle near by the city or control room of the city which provide quick response for the accidental vehicle. This protocol reduces flooding of the packet over the network and provide efficient path to get better and quick service required by the accidental vehicle.

3. PROBLEM FORMULATION

Now, thoughts arises to resolve the traffic issues occurred due to existing static or fixed technology which uses microcontroller and embedded system for its operation and provides unnecessary delays even though there is no vehicles on other side. We focused only for emergency response services like ambulance, VIP persons or fire fighting vehicles etc. It can be resolved using location based strategies w.r.t GPS monitoring systems. The strategies will be focused on the monitoring of traffic situations from source to the destination. Here, source is defined as the patient's residence location or nearby local hospitals where they are getting medical services moves towards the major hospitals (where all the treatments facilities are available) like GMCH-32, GMSH-16 and PGI-12 of city Chandigarh. To accomplish traffic solutions we are using infrastructure network along with infrastructure-less networks VANET, GPS traffic control center. This problem can be simulated on the NetLogo Simulator or Cup-Carbon U-One 3.8 Simulator as well as implemented practically for the improvement of the city traffic systems. Due to the increase of vehicles traffic on the road of tri-city connected with cities Panchkula-Chandigarh-Mohali in India.

4. OBJECTIVES AND METHODOLOGY

4.1 Objectives

The objective of this paper is to resolve the traffic system to make the city smart in terms of utilizing latest technologies and can be fulfilled by the following:

Smart city in terms of traffic congestion free for emergency services or one can call it as a signal free city or one can say smart city or many words could be assigned for

such work. In this system, few points can be used for making city smart:

(1)   We assume our city is smart in terms of technology as now a days we are using high speed wireless telephone systems and get the advantages of online data streaming in real time approximately, video conferencing, video calling etc. with the help of 4G called LTE technology, firstly monitor real time based traffic on the way to emergency services means source to destination of the ambulance.

(2)   Focusing to the LTE-A massive much high speed data rate with 5G technology our all objects/device (M-to-M, V-to-I, V-to-V) can be smart to which we want in today's life.

4.2 Methodology: System model

(1)   Ambulance is moving (enabled with high-tech equipments like LTE or LTE-A, equipped with GPS and many more technology) from source to/from destination.

(2)   Update of every moments (like location with the help of GPS, reducing distances towards destinations, and pre-arrangements at the destination i.e. hospitals if made possible to be well prepared about the coming patients—here source will send complete history or detail about the patient so that accordingly hospital admin be well prepared) of ambulance to nearby sub control module called smart vehicle approaching towards the destination as well as vehicles moving at a distance in the direction of ambulance but in front of it. Due to this the information (like a popup message spread in a approx.1Km radius of the patient vehicle) can be carry forward with the help of smart vehicles moving towards destination of emergency vehicles i.e. ambulance to get the services.

(3)   Interconnected City Traffic control stations along with public vehicles

(4)   Surveillance system for security purpose only

(5)   Ambulance vehicle will be provided safe traffic passage even though there is no patient in it, because it might get urgent need at the source.

5. PROPOSED WORK

Procedure to obtain the proposal:

(1)   We assumed the city is fully equipped called IoT (Internet of Things-in this case all the devices or Machine-to-machine is connected with the high speed internet). So in my work we want to use very high speed data networks like LTE-A (Long Term Evaluation Advanced i.e. proposed 5G in 2020). Currently, we are using LTE which is the base of 5G.
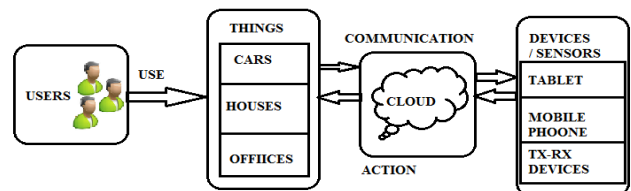

Figure 3. Architecture of IoT

(2)   Now, based on assumptions (LTE-A) can be equipped with technology for making smart traffic as shown: -
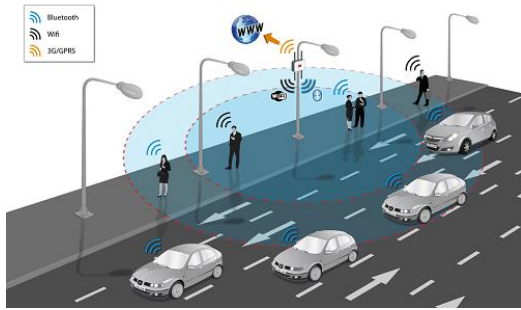
Figure 4. Interconnection of Users, vehicles with smart electric poles via Bluetooth/wifi/3G

Roadside electrical poles can be used as pole antenna to increase the number of subscribers and coverage for large population of the city so electrical poles can play important role in radiating signals safely. With this practical experience, it is possible to provide services over a large number of new subscribers introduced in the network).

(3)   By assembling antenna only due to this infrastructure in set up of mast is 100% reduced. Only antenna will get current supply from the poles itself.

Figure 5. Smart electric poles equipped IoT gateway

(4)   Here electric poles (within 500mtr. range) then there will be on CH-cluster head so that if any one or two poles are not working then comm. will be properly maintained, and between (2km range electrical poles is headed by BTS so that BTS is responsible for making break free connection).
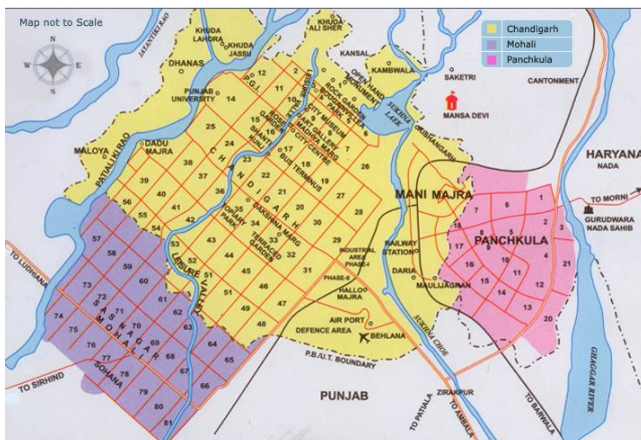

Figure 6. Map of tri-city connected (Panchkula-Chandigarh-Mohali)

BTS (it could be one electric pole say out of ten poles depend on the possibilities exist) will provide any means of connection at long range if any breakdown is there in CH coverage area. Here BTS supervise the complete activities with the old activities. The special antennas will be responsible for the emergency activities and monitors or provide the highway signal strength of VANETs or all vehicles.
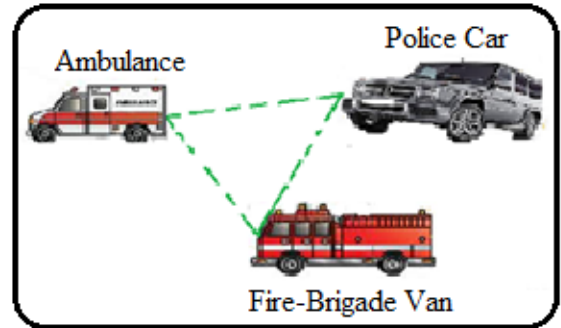

Figure 7. Inter-connection of vehicle network

With this vehicle will receives the update of pre-calculated traffic, any accident occurred in real-time on the road or highway towards journey called destination. So the ambulance driver can get the advantage to decide and to avoid the merger or collision route/damaged routes etc.
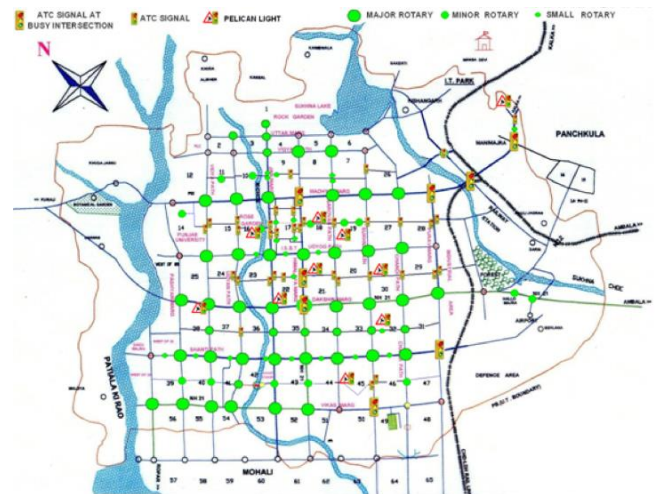

Figure 8. Map of Chandigarh city

5.1   ALGORITHM FOR THIS WORK

(1)   Start ambulance with patient from source to destination.

(2)   Spread the required details for both end source and destination in the direction of destination (like hospital, patient details which are required for the destination hospital, approx. time to reach at destination-after assuming clear passage means without traffic jams)

(3)   Transmitted signal is intercepted by in between smart vehicles of 'S' and 'D' i.e. Source and Destination. These smart vehicles will act as intermediated nodes.

(4)   The nodes or vehicles approaching towards destination will be valid nodes and the nodes moving outwards to the destination nodes will be invalid nodes but these nodes will keep complete information spread till it do

not pass on the neighbor vehicles which is moving just in opposite direction means to say that is in the destination side.
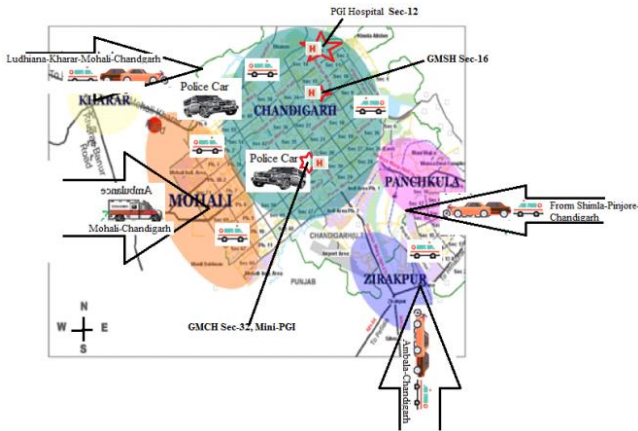

Figure 9. Proposed congestion free paths of vehicles in Tri-city

(5)   In our network (requested and expected zone), no smart vehicle is invalid either it is on idle mode because such nodes avoid traffic jams with new vehicle's meet so that the packet can be pass on to all the smart vehicles to aware new vehicle can change their route voluntarily based and so avoid the traffic jams. Due to this new vehicle will slower their speed so that they can help the emergency vehicles to go without any traffic jams called signal free movement for emergency vehicles in the city. With this city will highly praised and traffic free city.
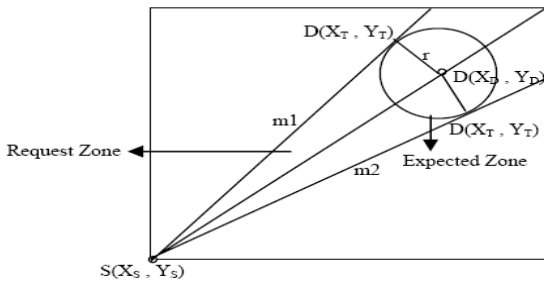

Figure 10. Representation of zones for Source and Destination

(6)   Updates the paths clearance status between S and D after 5minutes of time interval or 1minutes or whatever time is fixed to know the status. Time depends on the distances covered by the ambulance. This status will be done with the help of road side electrical poles as well as vehicles to-and-fro near and far of source and distanced vehicles or IoT devices.

(7)   Traffic control stations (TCS) will keep-on eye on this activity and responsible for providing the source to destination route traffic free in advanced. The TCS will get the status of all vehicles and the ambulance through the intermediated vehicles or smart vehicles if they are connected on LTE or LTE-A type of service provider network or on the same network called IoT devices else there could occur a great delay of receiving the packets spread in the environment.

This station will act as a medium for S and D, each and every instant of time updation will be provided simultaneously ambulance and destination hospital.
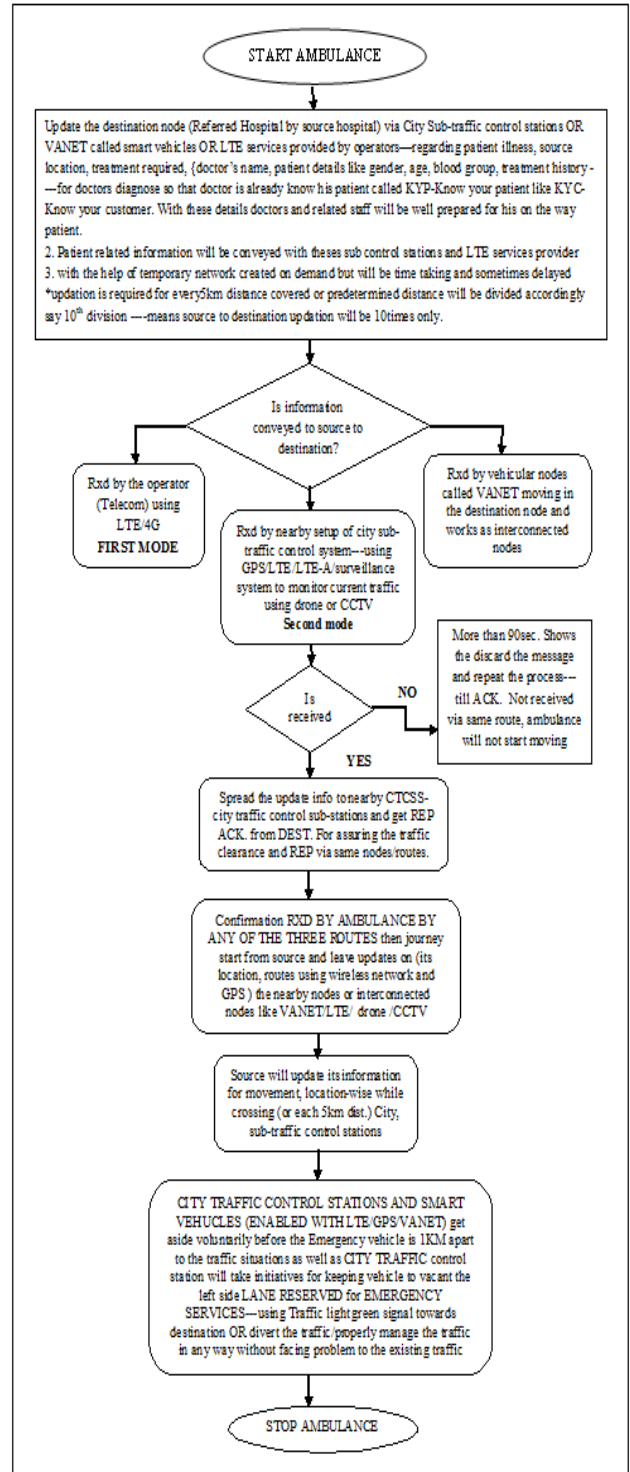

Figure 11. Proposed flowchart

5.2   Algorithm for ambulance

Under this stage, writing algorithm for ambulance (vehicles or IoT) will be assumed on the same Wi-Fi network to share information and equipped with GPS as well as necessary equipment like display, alarm, compass for directions, calling and messaging facility etc. Now the following points can be elaborating the process:

(1) Before the ambulance start its journey, it (SOURCE-Ambulance) will ensure and collect these details like its current location place, Loc ID (with the help of GPS), Vehicles ID or IoT ID (means vehicles identity), patient ID

(created by current hospital –includes complete disease or symptoms or history of patient so that doctors will get it online at Destination end), Destination ID (Hospital -where to be admitted), recipient ID (Doctor appointed for this patient), Estimated time to reach destination with distance, and details of members with patient and ambulance with driver.

(2) When the patient reached at destination then there will be authentication process under the supervision of recipient doctors and Source node members and then there will be a message or packet sent to the Source Hospital for confirming the safe journey. To avoid misuse, at the destination end, there will be authentication on the patient's mobile no. using OTP for checking the patient's information about disease for doctors. Using OTP show the doctors is monitoring the patient with his or his family member's acceptance.

5.3 Algorithm for interconnected system in source to destination

Here interconnected system consists of the following parameters:-
(1)   Intermediate vehicular nodes
(2)   IoT (like electrical poles based antennas, mobile, tablets etc.)
(3)   Traffic control Stations, cameras for surveillance
(4)   Infrastructure and infrastructure-less networks
(5)   Controlling station
(6)   GPS

6   CONCLUSIONS

This paper concludes that the proposed work can be implemented practically to make the city smart or intelligent in terms of vehicles traffic jams. The implementation work includes both infrastructure and infrastructure less networks so cost increases due to LTE-A technology used to make the city smart. As many other countries are upgrading their existing traffic system to make their traffic control system smart called ITS-intelligent transportation system. Using the ITS system reduces wait time, wastage of unnecessary fuel release at the traffic lights and saves the environment generating less pollutions every day. As discussed in this paper, without the VANET system cannot be made it possible signal free traffic not only for the emergency services but general use also for the city people. With the new technology of VANET-LTE Advanced helps more efficiently by spreading prior message about traffic in a certain paths so that new vehicle do not meet in the existed traffic. All connected vehicles in the network will get overall traffic reports update which reduces the no. of vehicles in the upcoming traffic.

7   FUTURE SCOPE

VANET is a vast area for making the transportation system more efficient and simple. With the application of the LTE-A, VANET makes the transportation system smart whether the vehicles are at a far distance can join or leave the network but only using VANET it has its limitation for the coverage area. If all the vehicles are in-built with VANET-LTEA-GPS

along with display facility then it could be a revolutionary in the automobile industry, but pros and cons will be there. With the introduction of the future concept no vehicles will be theft and one can discuss about searching of stolen vehicles presence or activity.

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