International Journal of Engineering, Applied and Management Sciences Paradigms, Vol. 21, Issue 01
Publishing Month: February 2015
An Indexed and Referred Journal
ISSN (Online): 2320-6608
www.ijeam.com

Optimal Message Dissemination in Vehicular Ad-hoc Network(VANET)

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Abstract

Vehicular Ad hoc networks (VANETs) are self-organizing networks. They are the upcoming wireless network environment for intelligent transportation systems (ITS). VANETs can significantly improve the traffic safety without requiring fixed infrastructure or centralized administration. However, data dissemination in VANET environment is a challenging task, mainly due to: rapid changes in network topology, the high dynamic of the network topology, different traffic type, and mobility patterns. For safety and emergency message applications, reliable message dissemination is an important key factor. In this paper, a new reliable message dissemination protocol in vehicular ad hoc networks is proposed. This protocol optimizing message dissemination. The efficiency of this protocol is measured in terms of reliability message, delivery ratio, overhead and latency . The simulation results had show that the advantage of the proposed protocol is increment the broadcasting rate to 100%,while it enhances congestion by 43% and delay by 93% respectively.

Keywords: cluster, *OCG, VANET, unicast, broadcast.*

1. Introduction

Vehicular networks are part of mobile ad hoc networks, which enables vehicles to communicate with each other to exchange information required by providing a network of self organizing environment without needing a fixed infrastructure or centralized management. In the future it is expected will use VANET networks across the compounds in a wide range due to the increasing number of vehicles equipped with communications technology. One of the important applications in VANET is safety, in case of occurrence of a collision between two vehicles with each other on the highway it is necessary to notify the cars coming in this way the occurrence of this incident at the earliest so as to avoid the collision and congestion . The main performance goal in the deployment of warning messages is high reliability, rapid spread. It is difficult to achieve these goals due to the different traffic density. the traffic information generally has a broadcast-oriented nature[11],Prefers to use the broadcast protocol instead of using unicast protocol Guidance in disseminating information on traffic, Because the benefits of a group of users, rather than a single user, and feature core protocol broadcast that is the vehicle does not need to know the vehicle address they want to send a particular piece of information and this leads to the cancellation of the complexity of Topology in mobile networks, such as VANET[11]. A major contrast between these two types of protocols is in the way that the information packets are spread in the network. In multi-hop broadcasting, a packet propagates through the network by way of flooding. In single-hop broadcasting, vehicles do not flood the information packets. Instead, when a vehicle receives a packet, it keeps the information in its on-board database. Periodically, each vehicle selects some of the records in its database to broadcast. The the single-hop broadcasting protocols is divide into two categories, which are the fixed broadcast interval protocols and the adaptive broadcast interval protocols. While the main focus of the fixed

broadcast interval protocols is only on the selection and aggregation of information, an adjustment of broadcast intervals is also taken into consideration in the adaptive broadcast interval protocols.

2 Vehicular Ad hoc network

Vehicular Ad hoc Networks (VANETs) belong to a subcategory of traditional Mobile Ad hoc Networks (MANETs). The main feature of VANETs is that mobile nodes are vehicles with sophisticated "on-board" equipment, traveling on constrained paths (roads and lanes), and communicating with each other via Vehicle-to-Vehicle (V2V) communication protocols, and between vehicles and fixed road-side Access Points , or Vehicle-to-Infrastructure (V2I) communications [13].VANETS are considered as one of the most prominent technologies for improving the efficiency and safety of modern transportation systems, vehicles can communicate detour, traffic accident, and congestion information with nearby vehicles early to reduce traffic jam near the affected areas. VANETs applications enable vehicles to connect to the Internet to obtain real time news, traffic, and weather reports. VANETs also fuel the vast opportunities in online vehicle entertainments such as gaming and file sharing via the Internet or the local ad hoc networks[14].Applications such as safety messaging are near-space applications, where vehicles in close proximity, typically of the order of few meters, exchange status information to increase safety awareness[12],and traffic and congestion monitoring require collecting information from vehicles that span multiple kilometers.

3 Problem Statement

One of the most determinant factors in the dissemination process is the topology of the road map, that affects the average distance between the sender and the receiver, as well as the different obstacles .Another critical factor is packet collisions caused by simultaneous forwarding, usually known as broadcast storm packet collisions caused by simultaneous

4 Proposer Solution

This paper presents an reliable and optimal message dissemination protocol. In order to ensure high reliability and optimal Dissemination a combination of two broadcast mechanism are proposed the first one is a Geocast mechanism to carry out the solution of broadcast storm problem and Over head problem by using adaptive broadcast. , and the second is

5 Objectives

The main objectives , is that the dissemination protocol Send many safety messages -1 proposed should be able to Achieve optimal and reliable message -2 . with low delay This is objective can be achieved by divided th.Dissemination

6 Methodology

The proposed protocol exploit the vehicles in the road in to sub groups (cluster). there are different types of vehicles in any cluster , depend to it is position and speed on cluster .The proposed protocol assume that Each cluster in the VANET have unique identifier ID this ID is the medium access control address (Mac address) of coordinator vehicle and each node have unique identifier ID is the Mac address of itself, vehicles equipped with embedded computers, table of messages class, GPS receivers and are aware of their position and have two channel: channel one to communicate inside cluster and channel two to communicate with other cluster, Also the road is considered as bilateral.There are three types of vehicles : the first one is a coordinator vehicle and the seconded and third vehicles are relay vehicles(head vehicle and tail vehicle) ,and the rest of vehicles in cluster work as slave vehicles .Fig(1) show how the protocol works .The vehicles in the road divided in cluster as shown in fig(1) the blue vehicle is coordinator, amethystine vehicle in the direction of flow is head vehicle and the vehicle in the opposite direction of flow is tail vehicle, yellow vehicle is the coordinator vehicle ,the circle with gray color is the transmission range of coordinator and the grid rectangular shape is the vehicle cluster and the distance between two vehicle cluster is the gab region.

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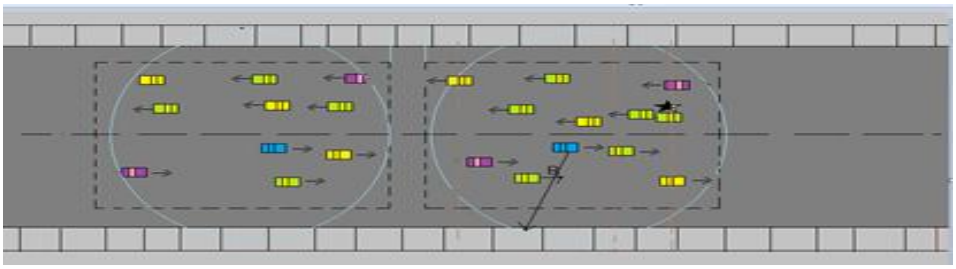

Figure (1) broadcast scheme model

The **Head node vehicle:** is the vehicle at bounder of the cluster or has been leaving the cluster in front. The **Tail node vehicle** :is the vehicle leaving the cluster in opposite direction

Election Process

The election process is the process of determine the coordinator ,head and tail vehicles; according to their speeds, locations and directions.

Coordinator Election

The election of the cluster coordinator based on speed, direction and location .The speed must be medium speed, direction in the direction of flow, and location at the middle of vehicles. That means the vehicle with smallest value of d_i is the coordinator vehicle. The rule to calculate the distance d_i is:

$$d_i = \min\left(\sum_{j=1}^{n} D_{ij}\right) \quad (1)$$

Where D_{ij} =the distance between vehicle i and vehicle j

$$D_{ij} = P_i - P_j \quad (2)$$

P_i = position of vehicle i

P_j = position of vehicle j

n=number of vehicles in cluster

The figures (2),(3),(4),(5),(6) , show the functional flow chart of algorithm , in case of , the coordinator and other relay vehicles election , also show the transmission process of each vehicle , and its message destinations scheme .

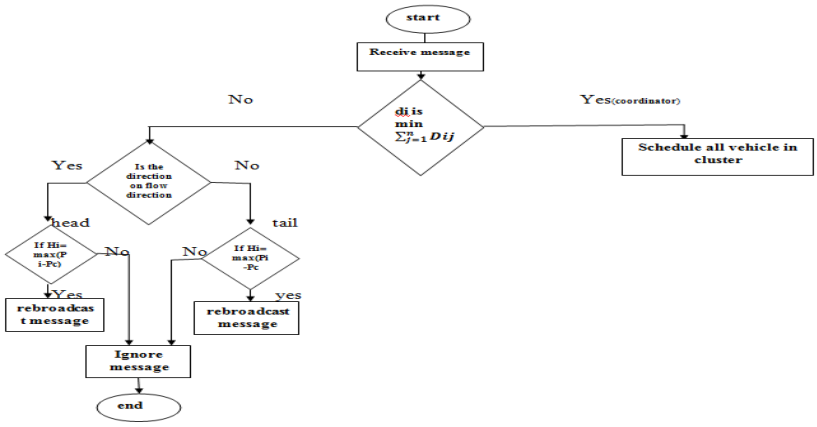

Figure (2) dissemination scheme flow chart

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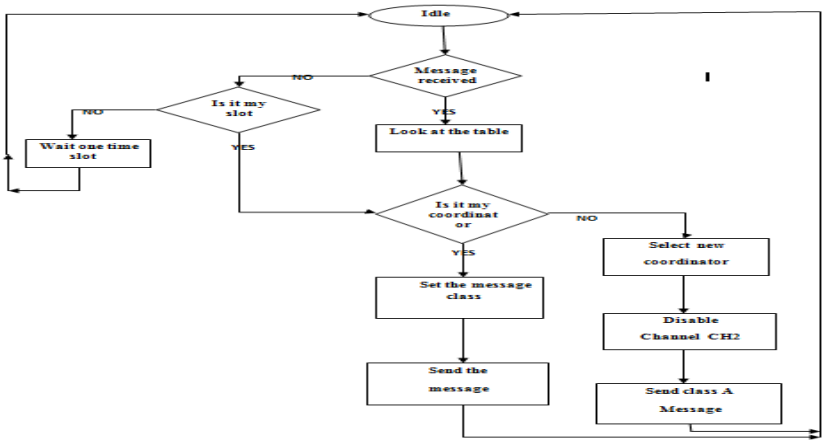
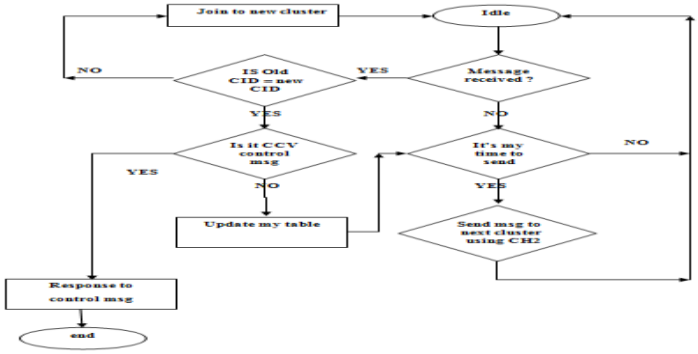
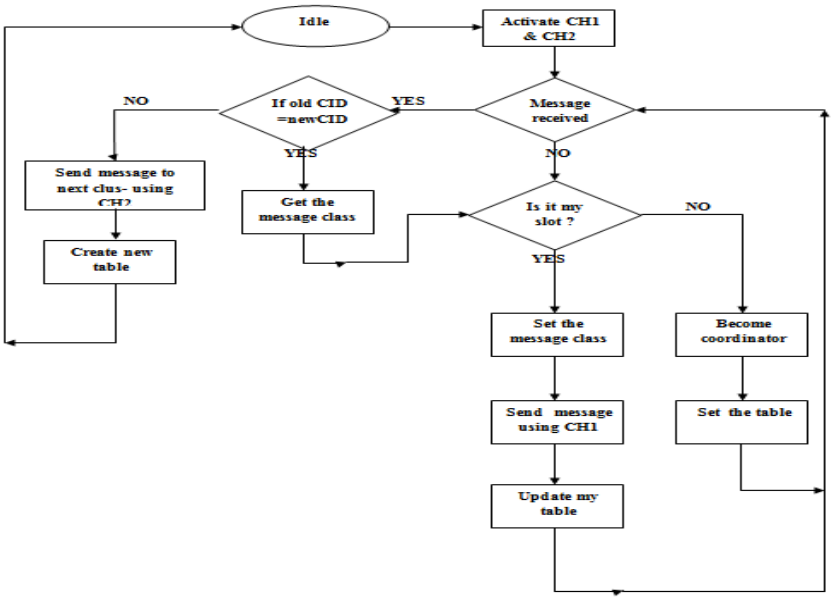


Figure(3) coordinator flow chart



Figure(4) Head vehicle flow chart



Figure(5) Tail vehicle flow chart

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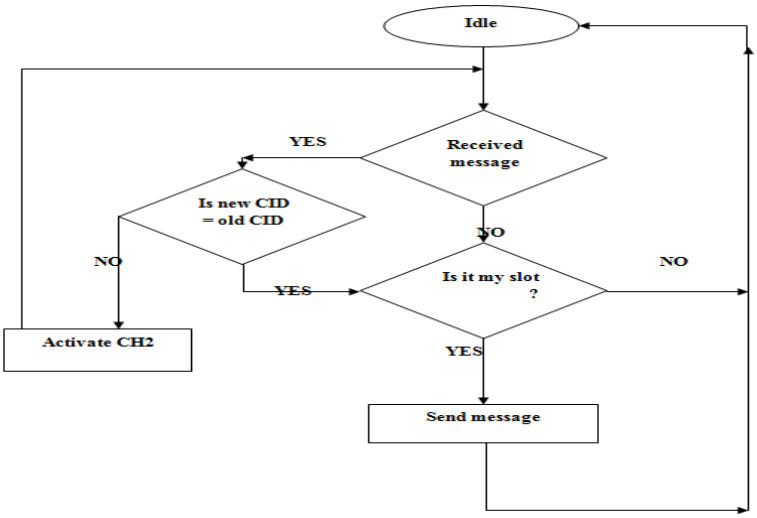

Figure(6) Slave vehicle flow chart

7. Simulation Model and Results

In this paper MATLAB is used as simulation tool ,parameters of the proposed protocol are adjusted as in table (1). In the simulation 20 to 200 mobile nodes move randomly in bidirectional highway with one lanes per direction . this thesis assume that each vehicle move at a speed ranging between 18km/h to 80km/h. The simulation experiments are conducted using two protocols: Optimized Abiding Geocast [OAG] protocol and our proposed protocol Optimal Clustered Geocast (OCG) .

Table(1):show parameter of simulation

Simulation parameter	Value
Simulation	MATLAB
Topology size	1500m*1500m
Transmission Range	250m
Bandwidth	2MHz
Traffic type	CBR
Packet Size	100bytes

7.1 Average Delay

Average Delay for OCG Is define as the end-to-end delay averaged over all delivered data packets for each source/destinations pair. the equation (3) show the delay is proportional with the transmission range of vehicle ,that means if the transmission range increase the delay is increase ,and if the transmission range decrease delay decrease

$$Delay\,(ED) = \frac{nR}{ETT * (n+1) * L}$$

(3)
Where:
n =the number of vehicle(nodes)
R =the transmission range
L=bandwidth of the link
ETT=expected transmission time

$$ETT = \frac{s}{L}$$

(4)
Where:
S =size of packet
L=bandwidth of the link
The Average Delay for OAG is determinate through the equation(5).

$$delay = \frac{\sum_{i=1}^{A} T_i}{A}$$

(5)

Where:

T = the time when approaching vehicle i was informed

A = the number of informed approaching vehicles.

7.2 Data Overhead

Data Overhead for OCG protocol define as the ratio of the number of data packets transmitted by all nodes to the number of data packets received at the destinations. the equation (6) can used to determine the overhead of OCG it shows that the overhead is proportional with the number of vehicles transmit(transmit and retransmitte) but the number of retransmit vehicle is constant and maximum equal three (from 1 to 3)

$$overhead = \frac{N_t + N_{\Re}}{N_r}$$

(6)

Where:

N_t = number of vehicles transmit

$N_{\Re}$ = number of vehicles retransmit(rebroadcast)

N_r =number of vehicles receive

Data Overhead for OAG protocol is represents the number of broadcasted messages during the lifetime of the emergency. the lifetime of the event is 500s.the equation (7) determine overhead for OAG protocol is show overhead of OAG depend of number of transmit vehicles not on the receive vehicles

$$overhead = \frac{N_{tr} + N_{\Re}}{500}$$

(7)

N_{tr} =number of vehicles transmit

$N_{\Re}$ =number of vehicles retransmit

Network Reliability for OAG in order to overcome network distribution of nodes over the area, the give a uniform distribution of the various value of relay vehicle has to broadcast the warning message defer time in [0, max-defer-time].The value of max-defer- periodically according to a period , The wait time of a relay vehicle for the next broadcast variable (that takes values of order ms) is calculated using equation (8) :

$$\theta = \frac{R + cur_{loc} - saftyline}{S_{max}}$$

(8)

where:

ɵ=wait time for a relay leaving or approaching the event

S_{max} maximum allowable speed S .

S_{self} =vehicle speed

R = transmission range

cur_{loc} current location

***Data Delivery Ratio:** Data Delivery Ratio for OCG is define as the ratio of the number of data packets received at the destinations to the number of data packets sent by the sources .the equation (12) shows the data delivery of OCG depend on the number of vehicles transmit and receive .

$$data\ delivery = \frac{N_r}{Nt + N_{\Re}}$$

(9)

N_t = number of vehicles transmit

$N_{\Re}$ = number of vehicles retransmit(rebroadcast)

N_r =number of vehicles receive

Data Delivery Ratio for OAG represents the ratio of the approaching vehicles that receive the message to the total number of approaching vehicles. the equation (10)show the data delivery depend on number of vehicles receives message .

$$Data\ delivery = \frac{N_r}{N_{tot}}$$

(10)

:Where

number of vehicles receive message= N_r

number of total vehicles= N_{tot}

Figure (7) shows that the delay in OAG protocol increase according to number of vehicles increase , this is fact because the OAG doesn't limit rebroadcast that is cause collision in network and the result of this appears in delay.

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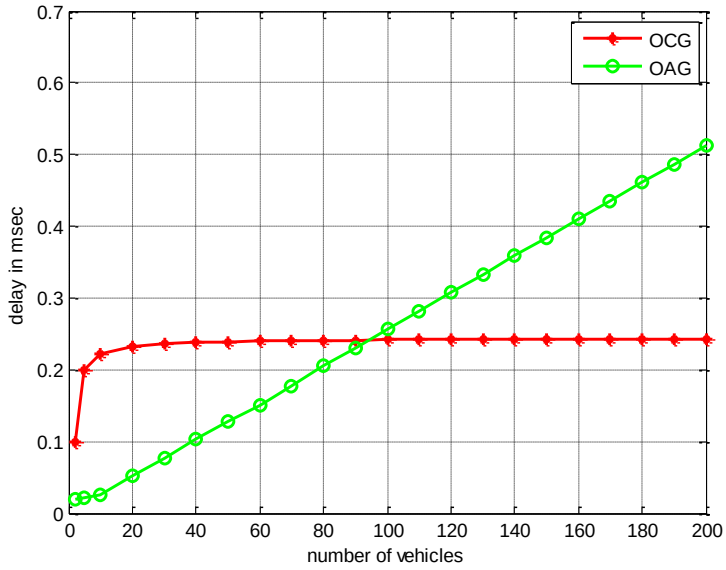
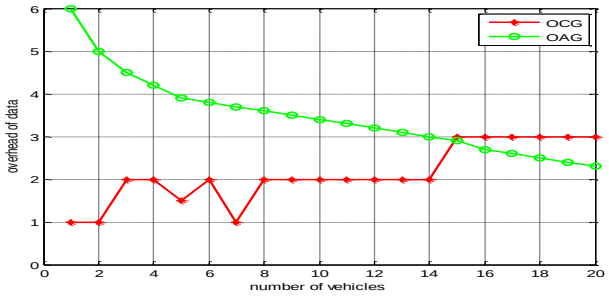


figure(7) :average delay(R=250m)

In figure(8) OCG shows better performance(43%) than OAG for most numbers of vehicles . This justified by the OCG limit the rebroadcast, and the OAG doesn't limit broadcast.



Figure(8):data overhead

Figure(9) is shows that OCG Reliability is better than OAG because ,OAG depend on relay vehicles in delivering data to other vehicles ,and in the OCG the coordinator vehicle is queried to delivery message to vehicles in the transmission range (cluster),head and tail vehicles is queried to delivery message to vehicles out of the cluster and this is confirm the message is delivery by high reliability.

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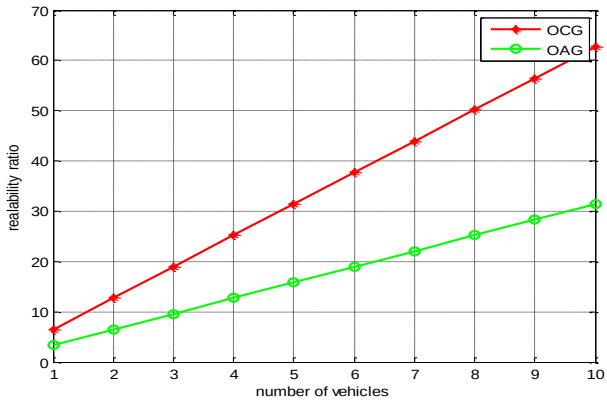

Figure(9) :reliability ratio

Figure(10) show the OCG have 100% delivery rate because the cluster coordinator is divided the time slot equals between all vehicles and ensure the delivered message for each vehicles, also We can remark that OAG achieve 100% delivery rate for all densities. This is justified by the relays availability in dense networks and by the initiator periodic broadcasts in sparse networks.

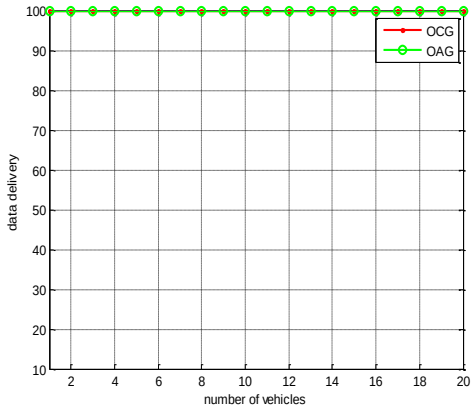

figure (10):data delivery ratio

8. Conclusions

In this paper, we have proposed a method of how to make Reliability optimizing for message dissemination in vehicular network(VANET).In this method, a combination of two broadcast mechanism are proposed the first one is a Geocast mechanism to carry out the solution of broadcast storm problem and Over head problem by using adaptive broadcast , and the second is to reduce the delay by using clustering flooding mechanism .the MATLAB simulation is used as tool of proposed protocol .The proposed protocol Optimal Clustered Geocast protocol (OCG) will improve the latency by 90% and data delivery by 100%.

References

[1] Ihn-Han Bae , "Design and Evaluation of a Hybrid Intelligent Broadcast Algorithm for Alert Message Dissemination in VANETs " International Journal of Grid and Distributed Computing ,Vol. 4, No. 4 , pp. 1- 8 (2011).

[2] Congyi Liu, Chunxiao Chigan ,' Providing robust message dissemination for vehicular ad hoc networks ' , www.elsevier.com/locate/adhoc , Ad Hoc Networks 10 pp.497–511 (2012).

[3] Nicolas Cenerario, Thierry Delot , Sergio Ilarri , ' A Content-Based Dissemination Protocol for VANETs: Exploiting the Encounter Probability '

[4] Aylin Deljavan Ghodrati, Leyli Mohammadkhanli,'A New Cluster-Based Efficient Broadcast Algorithm for Alert Message Dissemination in VANETs', www.irjabs.com,2013.

[5] Wahabou Abdou1,2 , Benoˆ Darties1 , Nader Mbarek1 , ' ADM : A Density And Priority Levels Aware Protocol For Broadcasting In Vehicular Ad-Hoc Networks ', Internal Research Report – LE2I , pp.1-23 (2014).

[6] Amira Benaidja , Samira Moussaoui, Farid Naït-Abdesselam ,'An Optimal Broadcast of Warning Messages in Vehicular Ad Hoc Networks ',International Journal of Computer and Information Technology (ISSN: 2279 – 0764) Volume 02– Issue 05, (2013).

[7] Qiangyuan Yu, Geert Heijenk ,' Abiding Geocast for Warning Message Dissemination in Vehicular Ad Hoc Networks ', National Natural Science Foundation of China under Grant No. 60703022. (2007).

[8] Amira Benaidja , Samira Moussaoui ,' Optimized Abiding Geocast for Warning Message Dissemination in Vehicular Networks ', World Applied Sciences Journal 31 (8): , pp.1468-1477 (2014).

[9] Benslimane.A, ' Optimized Dissemination of Alarm Messages in Vehicular Ad-hoc Networks (VANET)', In Proceedings of the 7th IEEE International Conference, Toulouse, France, (2004).

[10] Veronica Palma , Anna Maria Vegni , 'Optimal Design of a Broadcast Data Dissemination System over VANET Providing V2V and V2I Communications ', journal of telecommunication and information technology, (2013).

[11] Sooksan Panichpapiboon , Wasan Pattara-atikom ,'A Review of Information Dissemination Protocols for Vehicular Ad Hoc Networks ', IEEECOMMUNICATIONS SURVEYS & TUTORIALS , (2011).

[12] Anna Maria Vegni, Mauro Biagi , Roberto Cusani,' Smart Vehicles, Technologies and Main Applications in Vehicular Ad hoc Networks', InTechOpen 2013-02-13.

[13] A. M Vegni, R Cusani, Connectivity Support in Heterogeneous Wireless Networks, in Recent Advances in Wireless Communications and Networks, Edited by Jia-Chin Lin, 978-9-53307-274-6INTECH Publication.