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Research paper

An Efficient Emergency Message Forwarding Technique with Improved Rebroadcast Suppression for VANETs

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Abstract

Vehicle Ad Hoc networks are important because they can provide communication for moving vehicles without the need of infrastructural services being deployed on the road. To avoid drastic results of accidents on highways the moving vehicles need to be aware of the traffic situation by sending emergency messages using the wireless broadcast channel. The efficiency of such methods implemented to forward emergency messages needs to be elevated for their reliability by considering the vehicle density and broadcast nature of the wireless channel. Rebroadcast protocols need to perform with minimal delay and generate less traffic in terms of duplicated emergency messages. The current paper studies the use of zone based broadcast suppression method to establish its prominence in reducing congestion.

Keywords: *Flooding, Contention Window, Forwarding, Broadcast protocol, Vehicle-to-Vehicle communication, Vehicular ad hoc networks, VANET*

1. Introduction

A Vehicular Ad-Hoc Network (VANET) is a wireless system, which facilitates data exchange, security and solace among the vehicles within a broadcasting range by using some of the static equipment. Ad-Hoc Network is available for the travelers inside the mobile vehicle without any entangled association and server correspondence by using an electronic gadget. Every vehicle furnished with VANET equipment is a hub in the Ad-Hoc network that can receive and hands-off messages by the remote system. In vehicular Ad-Hoc system utilization of distinctive appointed administration advance must be indispensable among the vehicles. (e.g: Accessibility of Wi-Fi for simple, exact, powerful and basic correspondence among vehicles on element versatility). In the wireless protocols Wireless Access in Vehicular Environments (WAVE) is meant for communication between vehicular nodes within the direct communication range (~1000m). Emergency applications are essential in a large distance (e.g. traffic status warning). A technique to perform multi-hop packet delivery to one or more nodes is one of the main tasks.

The industry has been working on intelligent driver assistance and safety systems with vehicular wireless networks. Basic and Emergency messages are the required message types to send or receive the data among vehicles in wireless environment, which is one of the pure Adhoc communication. Emergency applications have a vital role for detection of potential alarming situations by utilizing basic messages and eliminate accidental situations occurred with a peak and unpredictable traffic conditions. Manual methods to handle traffic accidents are less practical and effective. Hence the use of new technologies is recommended to make it autonomous [1].

The Institute of Electrical and Electronics Engineers (IEEE) has approved Vehicular network communication protocols such as IEEE 802.11p for vehicle-to-vehicle and vehicle-to-roadside communication is familiar as the Wireless Access in Vehicular Environment (WAVE).

WAVE is used to evaluate the performance of the proposed protocols [9].The Adaptive Probabilistic Broadcast with Adjusted Contention Window for Progressive Data Dissemination of Safety Messages for WAVE based vehicular networks is proposed after a comprehensive study on message relying scheme and evaluated by a well-established network simulator. To classify the proposed work as a stochastic scheme, rebroadcast is used as a parameter to help in suppressing broadcast messages to other vehicles by using vehicle position information through a mechanism representing the use of Global Positioning Systems (GPS).

The rest of this paper is organized as follows: Section 2 provides literature survey of broadcast protocols. The proposed rebroadcast suppression scheme for message relay highlights in section 3. Section 4 presents the proposed model and validation by extensive simulations. Finally, comparison of the schemes and a discussion on results in section 5.

1.1 Vanet

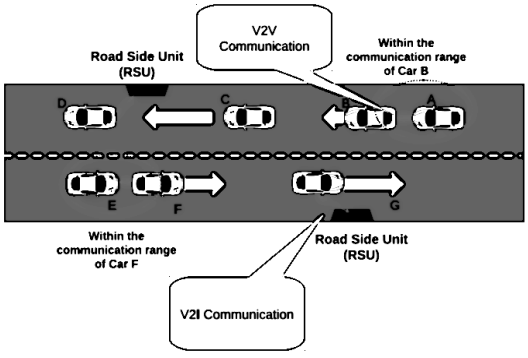

Fig. 1: VANET Structure

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Figure 1 depicts a complete VANET structure with message broadcasting system vehicle to vehicle and RSU (Road side unit) to vehicle. The message propagation among the vehicles or vehicle to RSU is accomplished through a new protocol called WAVE (Wireless access in vehicular environments). Such strategy of correspondence is able to provide an extensive variety to the users and empowers so many applications to improve the security for a pleasant trip. The major framework parts are: Application Unit (AU), OBU(On board unit) and RSU. Generally, RSU has an application that provides administration to the OBU, is a companion gadget which works according to the administrator. The application may be either in RSU or OBU.

The application inside the gadget is known as supplier and utilization of it is referred to client. Every vehicle must be an OBU and arrangement of sensors to process and propagate the message to the vehicles or RSUs through a remote medium. It can send a single or multiple AUs whose utilization applications are relying on OBU association abilities. The RSU, that able to interface with the internet or a server can accept AUs from different vehicles to associate with the Internet.

2. Related Work

In vehicular networks, a vehicle sends a warning message to its neighbors as soon as identification of a risky situation. A multichip broadcast scheme to deliver alert messages in an accident is proposed by Tseng et al. [2]. MANETs can monitor the number of broadcast packets by using a counter value c with the threshold C [23]. Rebroadcast is prohibited if $c \geq C$ [11]. In the distance-based scheme, the packet is rebroadcasted based on the distance'd', between transmitting and receiving vehicles which can be exempted while vehicles are near. Slotted and weighted p-persistence schemes are the storm reduction broadcast techniques based on probabilities, where vehicle with high priority is allowed to use the channel for less time.

Specifically, such type of techniques is conceived for broadcast storm alleviation in VANETS [11]. Particularly UV-CAST protocol is dedicated to reduce broadcast-storms while solves communication issues in urban region and its algorithm selects diverse mechanism for message dissemination in VANETs, which differentiates between connected and disconnected networks. Vehicles in a well connected networks rebroadcast incoming messages by waiting until redundant free under disconnected regimes that decide suitability to store and forward the message with the meet latest neighbors.

The Connected Dominating Set (CDS) by Ros et al. uses periodic beacon messages to calculate information about local positions to improve the dissemination process and determine whether the vehicles belong to a CDS benefit from shorter retransmission waiting periods or not [5]. Broadcast messages identifiers are included into the beacons as piggybacked acknowledgments. Sommer et al. presented the Adaptive Traffic Beacon (ATB), is a completely distributed message dissemination protocol and employed two key metrics to adapt beaconing: channel quality and message utility. In comparison to flooding-based approaches, adaptive beaconing provides better dissemination [8]. The goals of this scheme are: sending beacons frequently to exchange information stored in knowledge bases and achieve a congestion-free wireless channel. Yuanguo et al. proposed the Cross Layer Broadcast Protocol (CLBP) [12], a dissemination scheme that selects suitable forwarding vehicles considering the channel conditions, the geographic positions, and speed of the vehicles. Reliable transmissions in CLBP are achieved by sending Broadcast Request to Send and Broadcast Clear to Send messages. The aim is to reduce the transmission delay, but it is intended to work in single-direction in highway scenarios and is not tested with urban environments.

A protocol that intended for VANETs communications in urban environments was introduced by Sanguesa et al. [4]. Vehicles location closer to the geographic coordinates of any junction in the map are allowed to forward warning messages to obtain the information from positioning devices. The NJL scheme does not provide optimal performance in a sparse scenario. Optimum solutions can be accrued from the environment by referring a high density vehicular network, where broadcasting rate is reduced to obtain similar type of output in EMDR and ESBR schemes[6]..

A protocol is designed spherically for utilization of topological characteristics and the effect of obstacles in wireless communications, which considers vehicles, must be waiting until rebroadcast of the alert messages [3]. Unlike other existing proposals, vehicles store warning messages until facilitation of a better communicating situation arises. According to the scheme each vehicle must be maintain a neighborhood list, which is the updated beacons exchanged by the vehicles, and information provided by the GPS to decide whether a vehicle is near an intersection or not. The Neighbor Store and Forward (NSF) scheme is similar to JSF, but it requires neighbors list to update the information by means of one- hop beacons spread among vehicles. Each vehicle determines the position of neighbor as soon as receiving a warning message before rebroadcast. The vehicle waits until it finds a new neighbor (not in the neighbor list) to rebroadcast the message. The updated neighbor list must forward to the new neighbor. JSF concentrates on finding and informing new areas of the topology by additional retransmissions at street junctions, in other hand NSF is intended to inform new vehicles as soon as arrival at affected area[9].

Distributed Vehicular Broadcast (DV-CAST) protocol is based on information of local topology which mitigates the broadcast storms and network problems simultaneously, without increasing overhead [10]. This protocol lets the neighbors to decide whether messages are rebroadcast by adapting dissemination process based on the density of neighbor vehicles, their position, and direction. Function-Driven Probabilistic Diffusion (FDPD) is a probabilistic message dissemination protocol with a propagation function to be employed between communicating vehicles[10]. It takes under consideration of target zones and messages from selected routes. The given function tries to determine which vehicles are most suitable for forwarding messages to minimize broadcast storms.

Broadcasting is a basic mechanism in the VANET to exchange emergency messages are classified as

- Plain flooding
- Stochastic flooding methods
- Probability based flooding methods
- Node Position based methods
- Node Neighborhood based methods

These four methods are able to provide various levels of execution complexities with reduction in the rebroadcast phenomenon in different situations. Simple flooding based methods require received message to be rebroadcast by all the vehicles at-least once. It is an easiest way of implementation though overhead is highest in terms of duplicate messages. Stochastic flooding based methods have variations in broadcast among the vehicles. Higher overhead of message duplication in comparison to the naive method of plain flooding are meant to provide reliable rebroadcast. Probability based flooding is another mechanism to offer rebroadcast with lesser overheads in comparison to the previous methods which performs well in high density vehicular networks like junctions in the urban environments. Node position based methods utilizing vehicular node positions of a GPS device can be categorized as distance-oriented or location-oriented scheme. In distance oriented scheme the vehicle rebroadcasting method depends on distinguishable distance-priorities whereas location-based scheme relies on vehicular-position-priorities. Node neighborhood based flooding methods use beacons to rebroadcast packets effectively.

Another group based crisis message spread calculation is star postured for vehicular systems. The scientific model named diagnostic pecking order process (AHP) is used to compute the weight an incentive for every hub by considering the measurements including relative speed, separate thought about availability, and reciprocal mean expected transmission tally, and so forth., and the hub with the littlest weight esteem is picked as the bunch head in the

area. After the bunch formation, the crisis message dispersal component is acquainted with help well being applications.

A group based multi-channel plot is proposed to decrease channel clog and meet the QoS necessities of communicate benefits ina DSRC-based V2V correspondence organize. In the plan, vehicles moving in the same course are assembled into groups. In the inter cluster correspondence convention, the transmissions of the messages among bunches happen through two IEEE 802.11 PC based channels, while the intra-bunch coordination and correspondence star tool utilize.

A vehicular multi-bounce organize is displayed as an advancing diagram, and the issue of ideal information dispersals over the system is defined regarding least number of transmissions in a dynamic vehicular system. In the plan, the figuring of the base telecom structure is ended up being a NP issue, and after that a simple to-actualize estimate calculation is introduced by considering the quantity of various sub graphs and the symphonious number of the level of the developing chart, which empowers the proposed calculation to benchmark a condition of-the-workmanship correspondence convention.

A stable associated overwhelming set (CDS)-based directing convention is proposed to choose the steering ways with low end-to-end delay. The convention exploits the worldwide system topology, and constructs stables pines over street sections by considering vehicle speed and spatial circulation. At crossing points, the spines are associated by means of extension hubs that keep an up-to-date organize topology. The convention wipes out the nearby most extreme issue and balances information activity among all conceivable directing ways.

The communicate control unit (BC Unit) is exhibited for dependable and low dormancy wellbeing applications in vehicular systems. In BC Unit, a beneficiary autonomously calculates the back off time to diminish parcel crashes in the wake of accepting communicate emergency message. The processing of the back off time depends on beneficiary's speed and its separation to the transmitter without the trade guide message. Therefore, the overhead because of control or coordination among vehicles is disposed of, and the autonomous BC Unit can be possibly incorporated into DSRC gadgets. An occasion driven communicate calculation is introduced for helpful crash shirking in the two-way multilane parkway situation. The plan tries to choose a proper for-warding hub for message retransmissions by misusing the position, bearing, and speed data of hubs in light of situating gadgets, for example, worldwide positioning framework (GPS), and remote gadgets, for example, Wi-Fi, lastly empowers ascending hub to rebroadcast the crisis or activity data to different hubs rapidly and dependably.

A comparative proposition utilizes check procedure to diminish the redundancy and sending methodology to pick the following reasonable sending hub utilizing the situation of the vehicles.

The position-based multi-jump communicate (PMB)convention is proposed by considering the distinctions of transmission extend among vehicles, and backings cautioning message spreads with the assistance of hubs from distinctive paths. To decrease the quantity of sending hubs to rebroadcast cautioning bundles, PMB chooses a rebroadcast hub in light of extra scope region of neighboring hubs by taking the transmission scopes of hubs and the between vehicle dispersing into account. What's more, it ensures the unwavering quality of caution message disseminations by adaptively embracing the verifiable ACK and express ACK components, the communicate control unit (BC Unit) is exhibited for dependable and low dormancy wellbeing applications in vehicular systems. In BC Unit, a collector autonomously calculates the back off time to diminish parcel crashes subsequent to accepting a communicate emergency message. The registering of the back off time depends on collector's speed and its separation to the transmitter without the trade signal message. Therefore, the overhead because of control or coordination among vehicles is dispensed with, and the autonomous BC Unit can be practically coordinated into DSRC gadgets.

An occasion driven communicate calculation is introduced for agreeable impact evasion in the two-way multilane roadway situation. The plan tries to choose a fitting for-warding hub for message retransmissions by misusing the position, heading, and speed data of hubs in light of situating gadgets, for example, worldwide positioning framework (GPS), and remote gadgets, for example, Wi-Fi, lastly empowers ascending hub to rebroadcast the crisis or activity data to different hubs rapidly and dependably. A comparative proposition utilizes check methodology to diminish the redundancy and sending system to pick the following reasonable sending hub utilizing the situation of the vehicles.

The position-based multi-jump communicate (PMB)convention is proposed by considering the distinctions of transmission extend among vehicles, and backings cautioning message spreads with the assistance of hubs from distinctive paths. Keeping in mind the end goal to lessen the quantity of sending hubs to rebroadcast cautioning parcels, PMB chooses a rebroadcast hub in view of extra scope region of adjoining hubs by taking the transmission scopes of hubs and the between vehicle dispersing into account. Furthermore, it ensures the dependability of caution message disseminations by adaptively receiving the certain ACK and express ACK systems.

A position and versatility data helped pandemic communicate with attractor determination steering convention is proposed to adjust to the very powerful nature of vehicular systems. By using the ongoing data on vehicle position and portability, the convention proposes a versatile probabilistic contamination and a versatile restricted time sending for the plague broadcasting, and makes an exchange off between message reachable and message proficiency, which empowers the proposed to accomplish the proficiency and quality as far as message reachable, conveyance inactivity and directing expense.

A neighbor scope based probabilistic rebroadcast convention is proposed to decrease directing overhead. By abusing the neighbor scope information, a novel rebroadcast delay is computed to decide the rebroadcast request, and after that exact extra scope proportion is gotten. In the proposition, availability factor is characterized to give the hub thickness adjustment. From there on, sensible rebroadcast likelihood is acquired by joining the extra scope proportion and the availability factor. The proposed approach exploits the neighbor scope information and the probabilistic instrument, and fundamentally decreases the quantity of retransmissions.

To productively use the remote asset, three versatile multi-bounce communicate proposition are outlined which dole out a telecom probability to portable hubs as indicated by the system parameters (e.g., the degrees of the hubs, separation of the hubs from each other). Therefore, the exhibited novel 3-stage handshake tattling conventions including separation based handshake tattling, valence-based handshake tattling, and the normal valence-based handshake tattling create less copies.

3. Proposed Rebroadcast Suppression Protocol

Broadcast suppression is a basic tool to improve the efficiency of broadcast protocols in VANETs. At the same time, it is necessary for reliable message delivery in urban areas where the packet delivery over degrading channels are prone to fading and other propagation manifestations prevalent is challengeable. A hybrid rebroadcast protocol which can be helpful in reliability through message duplication in inevitable scenarios of disconnected vehicular clusters is proposed in this paper. The scheme of zone based priority for message is employed to forward messages when the vehicular density at a given instance of time is specified with the threshold. The threshold is measured by the broadcast messages received from neighborhood vehicles. This aggregate of the information is calculated by addition of two successive values with the comparison of threshold to obtain the variation.

A. Working of the Proposed Protocol

The Proposed protocol works in 2 phases. The first phase is based on the contention window based adjustment method which modifies waiting time to rebroadcast a received message based on the distance of the receiver from the sender as shown in the algorithm below. If the message is received for the first time it is scheduled for rebroadcast after a time-out inversely proportional to its distance from the sender. If it receives another copy of the same message during this phase it cancels the rebroadcast because receiving another copy of the same message ensures that the message was already forwarded by another neighboring node. If the node does not receive another copy within the waiting time interval it enters the second phase. In this phase, it makes use of the zone based method as shown in algorithm part-3. Zones near the originator are given lesser priority and farther zones are given higher priority.

B. Algorithm Part-1

Step1. Procedure initialize CW( )
Step 2. If distance to sender is high
Step 3. CW= Low
Step 4. End if
Step 5. Else CW= High

Algorithm Part-2

Step 1. Procedure Rebroadcast Timer ( )
Step 2. If (rebroadcast Timer Expired)
Step 3. If (forwarder in near zone to source vehicle)
Step 4. Rebroadcast with less probability
Step 5. Else Rebroadcast with high probability
Step 6. Else Continue Rebroadcast Timer ( )

Algorithm Part-3

Step 1. Procedure ZBCW ( )
Step 2. If (Message is new) then
Step 3. Initialize CW ( )
Step 4. Rebroadcast Timer ( )
Step 5. End if
Step 6. Else
Step 7. Cancel Rebroadcast( )

4. Performance Evaluation

The vehicular network implemented in this paper considers the simulation parameter as given in Table-1

Table 1: Simulation Parameters

Value	Parameter
1000 meters	**Warm-up distance**
10mW	**mac1609_4.txPower**
6Mbps	**mac1609_4.bitrate**
-84dBm	**phy80211p.sensitivity**
APCW, CW	**applType**
30, 35, 40, 45, 50 veh/km/lane	**Vehicular Density**
Krauss	**Car_Following_Model**
Gaussian_Exponential_Mixture	**Vehicle_InterArrival**
Simple Obstacle Shadowing	**Obstacles_Model**

Table 2: Simulation Result delay in seconds and number of packets for received broadcasts

Name of the broadcast method	Delay in Secs	Sent Packets	Received Broadcasts
CWBM(Contention Window Based Method) + Probabilistic Based Method	0.0065826	36	2455
CWBM + Zone Based Method	0.0093486	89	1584

From the table 2 the network is designed with the proposed algorithm (CWBM + Zone based method) and the performance is evaluated and compared with CWBM +Probabilistic based method i.e from existing method. From the simulation results, it is evident that the proposed algorithm improves throughput by 59.5% and the number of broadcasts required is reduced as shown in Table-2. However, in the proposed method, the delay exhibited by the network is increasing as the zone based method chooses the longest distant node for the transmission of packets.
In Figure 1 as the vehicular density increases in the network, the zone based technique adds delay in the network.

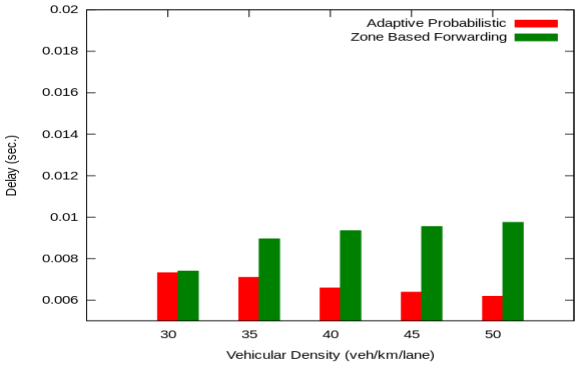

Fig. 1: Bar Graph Representation of Table 1 Comparison of Delay between Adaptive Probabilistic and Zone Based Forwarding

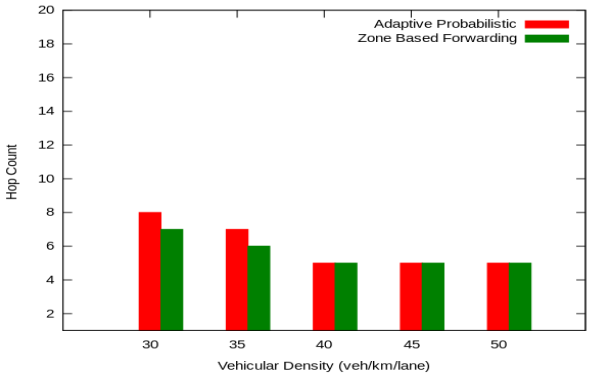

Fig. 2: Vehicular density Adaptive Probabilistic Number of hops vs Zone Based Forwarding

From figure 2 the number of hops in the proposed technique is comparatively low at lower vehicular density. As the density increases ,however the proposed and the previous methodologies merge in their performance as shown in Figure 2.

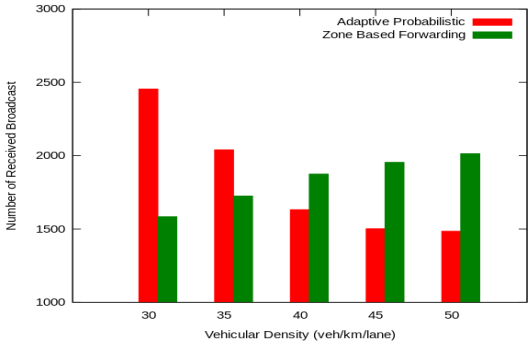

Fig. 3: Adaptive Probabilistic Number of Received Broadcast packets vs Zone Based Forwarding

Comparison of Number of Received Broadcast

In vehicular network in urban environment (High vehicular density), it is evident that the number of broadcast packets have been reduced as shown in Figure 3.

Comparison of Number of WSMP Packets Sent:

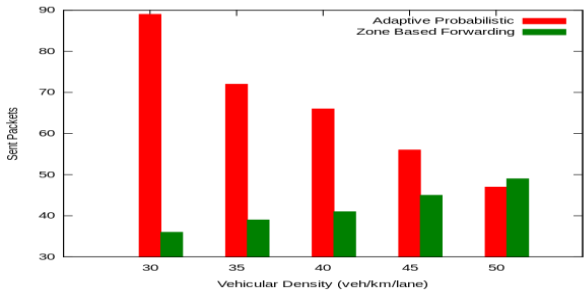

Fig. 4: Adaptive Probabilistic Sent packets vs Zone Based Forwarding

In the same urban environment, the number of packets sent is improved for the proposed zonal based method as shown in Figure 4.

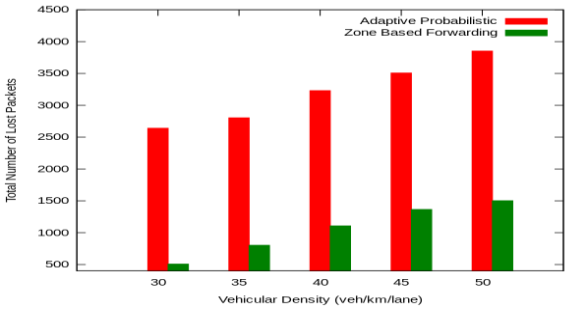

Fig. 5: Adaptive Probabilistic Total Number of lost packets vs. Zone Based Forwarding

Zonal based method for urban scenario outperforms adaptive probabilistic method in terms of packet drop as shown in Figure 5. Hence a reliable transmission is guaranteed with the zonal based method.

5. Conclusion

A hybrid rebroadcast protocol which enhances the reliability of transmissions through message duplication in inevitable scenarios of disconnected vehicular clusters is proposed in this paper. Minimization the number of hops in the broadcasting is the main goal of this research. A basic broadcast suppression method for reliable message delivery is analyzed and hybrid scheme is presented to cater in highway environment that reflects in propagation delay. From the obtained results, it is proved that the proposed scenario reduces the number of hops and the required number of broadcasts. It is also proved that the number of packets transmitted is improved compared to previous hybrid algorithms. However, this method introduces delay to rebroadcast messages depending on environmental conditions that are determined by the Contention Window and Vehicle density.

References

[1] Anbagi, Irfan, and Hussein T. Mouftah. "WAVE 4 V2G: Wireless access in vehicular environments for Vehicle-to-Grid applications" Vehicular Communications Vol.3. pp.31-42.

[2] Francisco J. Martinez , Chai-Keong Toh, Juan-Carlos Cano, Carlos T. Calafate and Pietro Manzoni"A street broadcast reduction scheme (SBR) to mitigate the broadcast storm problem in VANETs." Wireless personal communications Vol.56, No.3, pp. 559-572.

[3] Jaballah, Wafa Ben, Mauro Conti, Mohamed Mosbah and Claudio E. Palazzi, "Fast and secure multihop broadcast solutions for intervehicular communication." IEEE Transactions on Intelligent Transportation Systems Vol.15, No.1, pp.433-450.

[4] Julio A. Sanguesa, Manuel Fogue, Piedad Garrido, Francisco J. Martinez, Juan-Carlos Cano, and Carlos T. Calafate "A survey and comparative study of broadcast warning message dissemination schemes for VANETs." Mobile Information Systems, Hindwai, Vol.2016 (2016).

[5] Ros, Francisco J, Pedro M. Ruiz, and Ivan Stojmenovic."Acknowledgment-based broadcast protocol for reliable and efficient data dissemination in vehicular ad hoc networks." IEEE Transactions on Mobile Computing Vol.11, No.1, pp.33-46.

[6] Sanguesa, JA, Fogue, M, Garrido P, Martinez FJ, Cano Escribá JC, Tavares De Araujo Cesariny Calafate CM and Manzoni P,"RTAD: A real-time adaptive dissemination system for VANETs." Computer Communications, Vol.60, No.C, pp.53-70.

[7] Slavik, Michael, Imad Mahgoub, and Mohammed M. Alwakeel. "Analysis and evaluation of distance-to-mean broadcast method for VANET." Journal of King Saud University-Computer and Information Sciences, Elsevier, Vol.10, No.2, pp. 134-140.

[8] Sommer, Christoph, Ozan K. Tonguz, and Falko Dressler. "Traffic information systems: efficient message dissemination via adaptive beaconing, IEEE Communications Magazine, Vol.49, No.5, pp. 173-179.

[9] Tong Zhen, Hongsheng Lu, Martin Haenggi and Christian Poellabauer "A stochastic geometry approach to the modeling of IEEE 802.11 p for vehicular ad hoc networks." Submitted to IEEE Transactions on Vehicular Technology, Vol.17, No.5, pp.1448-1458 (2015).

[10] Tonguz, Ozan K, Nawaporn Wisitpongphan, and Fan Bai. "DV-CAST: A distributed vehicular broadcast protocol for vehicular ad hoc networks." IEEE Wireless Communications, Vol.17, No.2, pp. 1536-1284.

[11] Wisitpongphan N, Tonguz O. K, Parikh J. S, Mudalige P, Bai F and Sadekar V "Broadcast storm mitigation techniques in vehicular ad hoc networks." IEEE Wireless Commun. Vol.14, No.6, pp. 84-94.

[12] Yuanguo Bi, Lin X.Cai, Shen X and Zhao H "Efficient and reliable broadcast in intervehicle communication networks: A cross-layer approach." IEEE Transactions on Vehicular Technology, Vol.59, No.5, pp.2404-2417.