International Journal of Technical Innovation in Modern Engineering & Science (IJTIMES)
Impact Factor: 5.22 (SJIF-2017), e-ISSN: 2455-2585
Volume 4, Issue 8, August-2018

A priority based broadcasting using Fast and Reliable Warning Messages dissemination mechanism for Inter Vehicular

Rituraj[1], Deepak Kumar Xaxa[2]

[1]M.tech. Scholar, Department of Computer science, MATS University, Raipur, Chhattisgarh, India.
[2] Assistant Professor, Department of Computer science, MATS University, Raipur, Chhattisgarh, India

Abstract*— Vehicular Ad Hoc Networks (VANETS) differ from Mobile ad hoc networks (MANETs) in that they have high mobility and rapidly changing network topology. In addition, the topic of broadcasting emergency messages within a VANET has received considerable attention recently. Vehicles can periodically exchange their status with their neighbours, transmitting information collected via the Global Positioning System (GPS) in their On-Board Unit (OBU). In this paper, a priority based broadcasting of messages is used with Fast and Reliable Warning Messages (FRWM) mechanism for inter vehicular communications. The experiment would be conducted with VANET highway scenario would be analyzed. The whole method is concerned with safety broadcasting among inter vehicular communications. The highway VANET scenario is considered for up to 100 vehicles with 3 lanes. The priority is given according to ambulance, police and ordinary vehicles. The simulative experiment is conducted using network simulator 2. The proposed method is compared with Appropriate Vehicular Emergency Dissemination (AVED) method in terms of parameters like reception rate, delay time and number of forwarding counts. The simulation results showed the improved performance of proposed FRWM method over AVED method.

***Keywords*— VANETs, Priority Scheme, Delay Time, Network Simulator 2, Routing Protocols .**

I. Introduction

VANET is a collection of vehicles and each vehicle acts as a vehicle or wireless router. These vehicles can communicate between 300 and 1000 meters of each of the other vehicles and create a wider network range. Vehicles in a particular coverage area can exchange information with each other through radio communications. A vehicle that falls from the cover in an area can enter the coverage area of another vehicle. An intelligent transport system (ITS) provides efficient communications between vehicles.

VANET is also called vehicle communication (IVC) or vehicle-vehicle communication (V2V). VANET allows the driver of a vehicle to communicate with drivers of other vehicles in the field of radio communication. If the vehicles are out of reach, they can communicate with each other through multi-hop networks. Compared to mobile vehicles, VANET offers advantages in terms of wider coverage, low latency and no service costs. Many different applications have already been developed in the field of intelligent cars, for precise automatic control and in a simple environment for drivers. These applications are mainly based on the exchange of information, which ensures communication between vehicles. Currently many car manufacturers, researchers are more interested in this V2V communication, and are studied in several research projects.

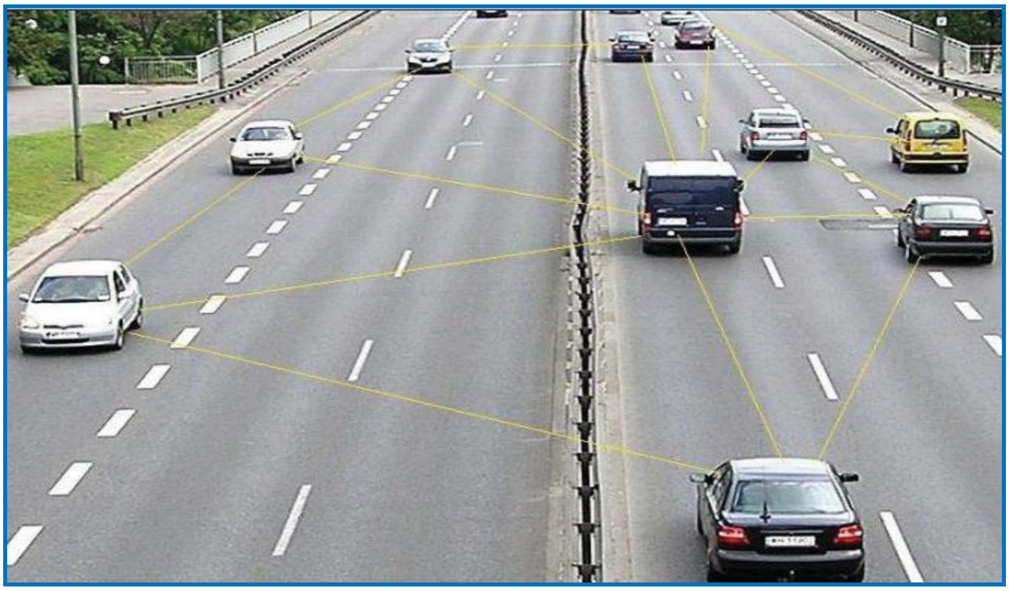

Figure 1: Vehicle to Vehicle Communication (Tech Radar)

The V2V communication is shown in Figure 1. In this, a vehicle uses multi-hop transmission to send information to a group of vehicles. There are two types of forwarding used in V2V, simple forwarding and smart forwarding. In simple forwarding, vehicles periodically transmit emergency messages. This forwarding generates a large number of broadcast messages, which increases the collision rate; delivery times are slow and reduce delivery rates. In intelligent forwarding, vehicles use a selection algorithm to select the next vehicle to transmit the message instead of the entire vehicle that transmits the same messages. This limits the number of messages issued for an emergency event, reduces the speed of message collisions and uses network resources to transmit different messages. If a vehicle receives the same message from more than one source, it will react only to the first message.

Figure 2 (Bidi et al 2013) shows the V2R communication, which is a one-hop transmission in which the Road Side Unit (RSU) sends a broadcast message to all vehicles equipped in the specific area. It uses a wide bandwidth for communication between vehicles and RSU. In V2R, the infrastructure plays a coordinating role by collecting global or local information on traffic and road conditions and therefore suggests or imposes certain behaviours on a group of vehicles. MSWs suggest vehicle speeds and accelerations and vehicle distances based on traffic conditions and traffic speeds that also transmit messages such as accident zones, weather conditions and ambulance warning messages. It also transmits request or warning messages to vehicles that violate the speed limit.

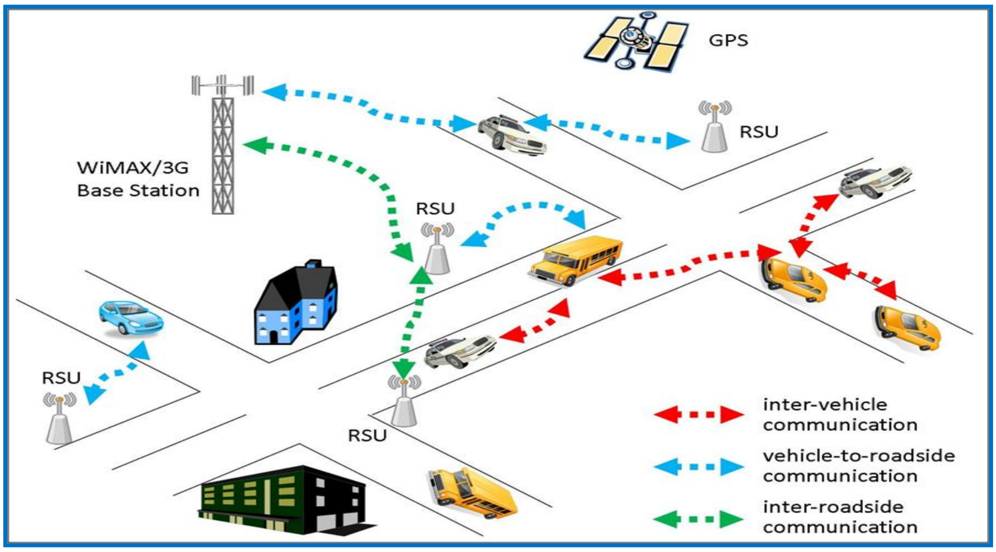

Figure 2: Vehicle to Road Side Communication (reu2015)

II. RELATED WORK

Chunxiao Li et.al. (2014) [1] presented a scheme to select a subsequent ad hoc vehicle jump (VANET) to propagate and transmit emergency message networks. When incidents or hazards are detected, emergency messages will spread to nearby vehicles immediately. Choosing a suitable next jump is very important for the rapid dissemination of messages. In this document, a next jump selection scheme based on time-distance is proposed. Compared to the conventional scheme based on distance, the results of the simulation indicate that the proposed scheme is much better than the conventional scheme performance.

Lim Jae-Han et al (2014) [2] proposed and analysed using a distributed channels framework exploits the advantages of the DSRC and TVWS spreading MED bands under the existence of PBM. The scheme uses the algorithm to meet the TVWS channel (TCRA, for its acronym in English), ensuring that vehicles within a broadcast area select the same channel with the sender of the MES. To compensate for the ESM errors that receive a TVWS band, our scheme adopts bidirectional recovery algorithm (TWRA) using the DSRC and TVWS bands for ESM retransmission. They also established an analytical delivery report model considering a time delay to a selection of the optimal ESM parameters. As far as we know, this is the first attempt to propose a scheme using distributed channels that exploit TVWS and DSRC bands to spread security messages. Through a deep simulation study, they showed that the proposed regimen meets the conditions for ESM latency and delivery packages, and exceeds the foregoing approaches in various vehicle scenarios.

Behnam Hassanabadi et.al. (2014) [3] proposed a sub layer in the WAVE stack application layer to increase the reliability of security applications. The project uses the retransmission of encrypted security messages on the network, which greatly improves overall reliability. It also addresses the problem of synchronized collision established in the IEEE 1609.4 standard, as well as the problem of congestion and loss of vehicle-to-vehicle channel. They proposed a discrete phase type distribution to model the temporal transitions of a node state. Based on this model, an upper limit of probability of loss adjusted for the network encoding algorithm is derived. The numerical results based on our analysis and on the ns-2 simulations show that our method exceeds the previous repetition-based algorithms.

Ali Rakhshan et.al. (2015) [4] investigated the need to identify vehicular communications in order to improve collision warning systems for a road scenario. By linking communications and traffic studies, our goal is to reduce road traffic accidents. As it is known, this is the first document that shows how to customize vehicle communications with driver characteristics and traffic information. They proposed to develop VANET protocols that selectively identify relevant collision information and personalize the communication of such information based on the assigned safety index of each driver. In this document, first, they derived the probability of success of the package that takes into account multi-user interference, loss of path and fading. Then, using Monte Carlo simulations, they demonstrated how the chances of access to the channel that meet the safety application delay requirements result in a noticeable improvement in performance.

Nabeel Akhtar et.al. (2015) [5] provided a realistic analysis of the characteristics of the VANET topology over time and space for a road scenario. In this analysis, they integrated real-time road topology and real-time data extracted from the motorway performance measurement system (PeMS) database into a microscopic mobility model to generate realistic traffic flows across the highway. In addition, they used a more realistic, recently-modelled obstacle-based channel model and compared the performance of this sophisticated model with the most common and simplistic channel models, including the shader disk and lognormal disk models. Key metric research reveals that disk drive and lognormal models do not provide realistic VANET topology characteristics. Therefore, they proposed a coincidence mechanism to adjust the parameters of the lognormal model based on vehicle density and a correlation model to take into account the evolution of link characteristics over time. It has been shown that the proposed method provides a good combination with the computationally expensive and difficult to implement obstacle-based model. The parameters of the proposed model have been validated so they depend only on the density of vehicular traffic based on actual data coming from four different roads in California.

Hanaa S. Basheer et.al. (2016) [6] examined important aspects in VANET and commonly encountered problems. The goal is to present a model to correctly spread a warning message among the vehicles and make a trustworthy decision to ensure the integrity of the message before retransmitting it more. The model improves vehicle-vehicle communications avoiding three problems of VANET, the problem of the storm of diffusion, the problem of the hidden node and the collision of incoming messages on the receiving nodes. A comparison was made with the efficient directional diffusion protocol (EDB) for the dissemination of messages to evaluate the results of our model.

Yiwen Shen et.al. (2016) [7] proposed a CASD framework (Contextual Security of Context Security). In vehicular networks, vehicles communicate with each other and share a variety of information. Using this capability, CASD provides vehicles with a class-based safety action plan that considers three situations, such as line of sight, insecurity of line of sight and safety situations, to be unsafe. In the unsafe situation of Line-of-Sight, a hybrid action scheme is provided. If human action fails, the vehicle will take over management to guarantee the minimum risk. Time for vehicle control is based on an optimized threshold by examining context information. Furthermore, a planning scheme of dynamic trajectory manoeuvres is suggested to avoid a real-time collapse. Driving safety can be substantially improved with the CASD.

Yuanguo Bi et.al. (2016) [8] proposed an urban protocol for multi-jump transmission (UMBP) to disseminate emergency messages. To reduce the delay in the transmission of emergency messages and reduce message redundancy, UMBP includes a new selection scheme for forwarding nodes using iterative partition, mini-slots and black bursts to quickly select neighboring nodes and a node forwarding one is successfully chosen from the asynchronous contention between them. Thus, bidirectional transmission, multidirectional transmission and directional transmission are designed based on the locations of the emergency message senders. Specifically, in the first hop, bidirectional transmission or multidirectional transmission simultaneously executes the forwarding node selection scheme in different directions and a single forwarding node is selected successfully in each direction. Thus, the directional transmission is adopted in each jump in the propagation direction of the message until the emergency message reaches an intersection area where the multidirectional transmission is again performed, which finally allows the emergency message to cover the area of problem-free destination The results of the analysis and simulation show that the proposed UMBP significantly improves the performance of multi-hop transmission in terms of a hop delay, message propagation speed and message reception speed.

Ali Rakhshan et.al. (2017) [9] investigated the need to identify vehicular communications in order to improve the safety of a road scenario. Adapting an ad hoc vehicle network to the characteristics and traffic conditions of its individual driver allows intelligent transmission to other vehicles. This radical improvement is now possible thanks to advances in ad hoc vehicle networks (VANET). In this document, they initially derived the probability of success of the package for a chain of vehicles that took into account multi-user interference, loss of course and fading. Therefore, when considering the delay restrictions and the types of potential collisions, the probability of optimal access to the channel is approximated. Finally, they proposed an algorithm to customize the probabilities of access to channels in VANET. The results of the Monte Carlo simulation show that this approach achieves a reduction of more than 25% in the probability of collision of the traffic compared to the case with probability of access to the same channel in its optimal range. Therefore, it has a great advantage over other non-optimal systems.

Yao-Hsin Chou et.al. (2017) [10] proposed a stability function to estimate the reliability of the transponder. The procedure for completing this proposed method assigns waiting times appropriate to different freight forwarders. The proposed scheme is implemented with an NS2 simulator based on WAVE / DSRC standards. The results of the simulation show that the proposed protocol exhibits exceptional performance in terms of forwarding counts, packet loss and delay times in different environments. Furthermore, the protocol maintains stability in different vehicle density scenarios so that each vehicle receives emergency messages and has low latency to ensure that the driver has adequate safety response time to improve traffic safety.

III. PROBLEM IDENTIFICATION

Although the AVED method is efficient for vehicular ad hoc networks, but this method has some limitations also, which is described below:

i. From the literature survey it is found that the use of wireless communication to inform the presence of priority vehicle and the destination of the same to regular vehicle will be of great help in efficiently broadcasting safety messages. This concept is not considered in AVED Method.

ii. In the AVED method, Re-routing of vehicles is not adopted based on vehicle-to-vehicle communication.

iii. Future work of vehicular ad hoc network-related research has focused on reducing forward counts and delay times.

iv. The reliability issues those vehicles should reach at accidental place could be adopted in existing AVED method.

IV. PROPOSED RESERACH METHODOLOGY

The main target of this research work is to know the behaviour of routing protocols which are emergency broadcast in nature for VANETs. Whole methodology is simulated by using Network simulator, NS-2. It is a technique in telecommunication based research when the behaviour of a network is modelled either by calculating the interaction between the different network entities (client, host, routers, data links, packets, etc) using mathematical formulas. This section discusses the implementation specifics related to the FRWM method and the various components of the simulation environment.

```
INPUT: FRWM Method
Output: Reliability factor with Prioritized vehicles to reach at Accident Place
Step 1: Cooperative Awareness Message (CAM) distributed among vehicles.
Step 2: Assign priorities to all vehicles accordingly :
        1. Priority 1- Ambulance vehicle
        2. Priority 2 – Police Van
        3. Priority 3 -Ordinary Vehicle
Step 3 : If accident occurs,
    >>> Broadcast EWM (Emergency Warning Messages) by accidental vehicle.
    >>>Receiving vehicles then collects Neighbor IDs and their priorities.
    >>> Do communication and go to step 4.
Step 4: Check Priority of vehicles...?
    >>> If Priority 1 or Priority 2 found..
    >>> They changes path to reach at accidental place fastly.
    >>>Broadcast EWM messages.
    >>> goto step 6.
Step 5 : Else if
    >>>Priority 3 found.
    >>>Vehicles are not able change path. i.e. not reliable in real scenario.
    >>>Broadcast EWM messages.
Step 6: Stop.
```

Figure 3: Pseudo Code for FRWM algorithm

The main objective of the proposed scheme is providing a reliable rebroadcasting and avoiding unnecessary data flow in the network. Thus, this proposal gives an intelligent forwarder selection method for the next hop message forwarder. It will perform the following operations.

Step 1: Identify the distance between the senders to the target region using Euclidean norms given by the equation.

$$Distance=\sqrt{(x2-x1)^2+(y2-y1)^2}$$

where distance is the distance between the sender position to the target position.

Step 2: Calculate the vehicles priority using following order of priority function

Priority = Ambulance (Emergency) ≫ Police (Defense) ≫ Ordinary vehicle

where priority function decides the priority of the vehicles. The highest priority is given to the Ambulance (Emergency) vehicles. The next priority is given to Police (Defense) vehicles and then to ordinary vehicles.

The ordinary vehicles are stopped at particular position near accidental place of vehicles but higher priority vehicles do not stop to their appropriate position , they try to reach out to the accidental place as soon as possible, so this occurrence must be happen in reliability based VANETs. Hence, this method names as "FAST RELIABLE WARNING MESSAGES.

Step 3: Calculate the distance between the source and the neighbors using following equation

Source Neighbor Distance=√ ((〖Source.x - Neighbor.X)〗^2+(〖Source.Y- Neighbor.Y)〗^2)

Step 4: Find out the hop count whose distance is less than the neighbor vehicle. Collect these neighbors and form a subset called hop count given by following equation.

hop count set = {neighbor1, neighbor2….neighbor N } ∀ neighbor list; distance > HOP

Step 5: Choose a neighbor vehicle whose priority is higher. If there is more than one vehicle in this category, then select a vehicle which has highest priority (i.e. ambulance vehicle). This selected neighbor is the next forwarder and the ID of this neighbor will be returned to the message preparation.

V. PERFORMANCE PARAMETERS

The goal of this research work to study the relative performance of selected safety broadcasting protocol named as AVED and FRWM protocol with respect to varying traffic loads i.e. number of vehicles.

A. Packet Reception Rate (PRR)

It is the output of total number of received packets divided by total number of sent packets, mathematically it is calculated as:

PRR= (No. of Received Data Packets) / (No. of Sent Data Packets)

The higher the PRR metric lead to the higher rate of delivering routing packets and consequently the higher the efficiency of the protocol.

B. Delay Time

It is calculated as the total delay duration of all successfully transmitted data packets from source node to destination node. It is measured in seconds or milliseconds. The higher the end-to-end delay metric is, the higher the delay in routing packets and consequently the lower the efficiency of the protocol. It is given by following equation:

Delay Time (t) = N ((L)/R)

Where, N is total number of senders sending packets,

L is length of packets and

R is transmission rate.

C. Forwarding Counts

It is calculated as total number of packets forwarded by neighbor nodes involved communication path between sender and destination. This metric should be as smaller as possible. It is calculated by following equation:

Forwarding Counts = (No. of Forwarded Data Packets)/ (Total No .of Nodes)

VI. SIMULATION SETUP & RESULTS

This section gives the input parameters used in simulation like method names, number of nodes, simulation time, packet size and type etc. Following table 1 gives the simulation parameters set to experiment in NS-2.

Table 1: Simulation parameters setup

Parameters	Value
Simulator Version	Network Simulator 2.35
Mobility Model	Random Way-point
Performance Parameters	forwarding Counts, Delay Time, Reception Rate
Methods Analysed	AVED and FRWM
Number of Nodes	20,30,40,50,60,70,80,90 and 100
Simulation Time	100 seconds
Traffic Type	CBR
Environment Area	1000 x 1000 meters square
Transmission Range	250 meters
No. of Lanes	3 (Highway Scenario)

Figure 4 shows the delay time graph for different values of CAM intervals for both AVED method and FRWM method. It could be easily seen that FRWM method achieved lesser delay time than AVED method. Approximately 5.3 % of improvement in delay time is achieved using FRWM method.

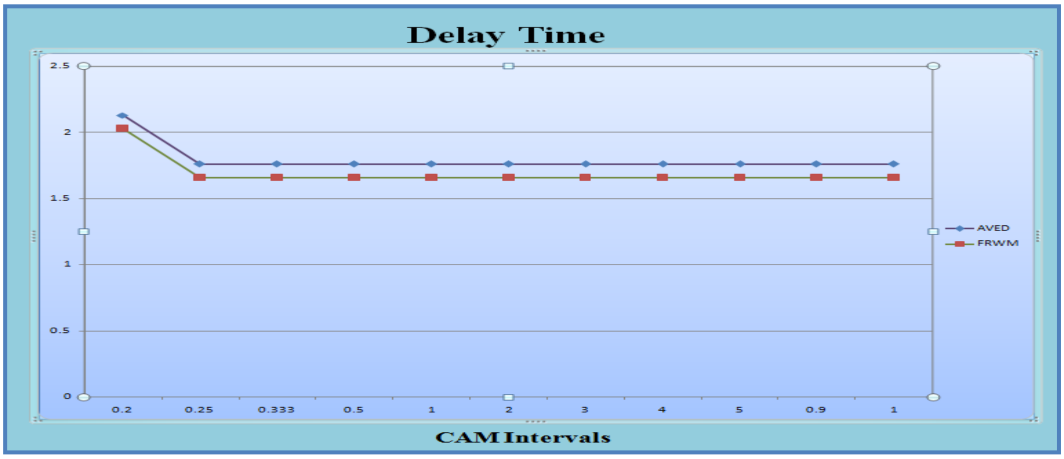

Figure 4: Delay time graph for different values of CAM intervals

Figure 5 shows the delay time graph for different values of Epsilon for both AVED method and FRWM method. It could be easily seen that FRWM method achieved lesser delay time than AVED method. Approximately 5.78 % of improvement in delay time is achieved using FRWM method.

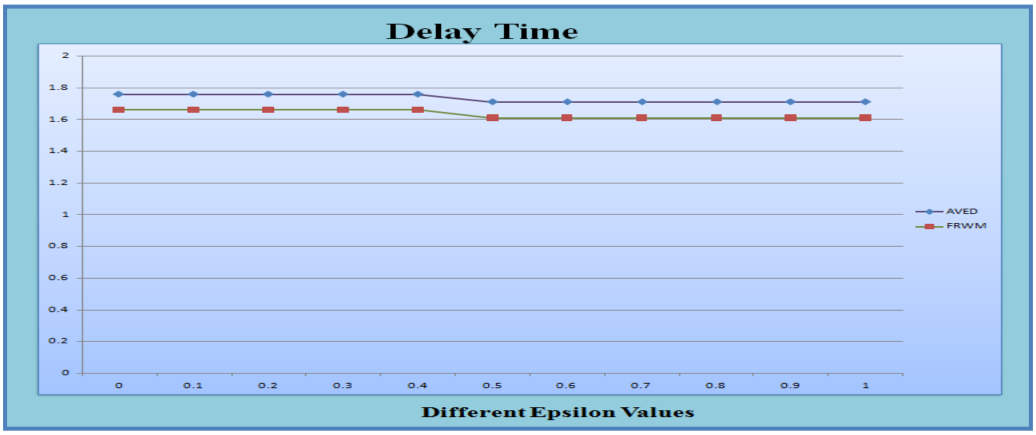

Figure 5: Delay time graph for different values of Epsilon

Figure 6 shows the delay time graph for different values of vehicles density for both AVED method and FRWM method. It could be easily seen that FRWM method achieved lesser delay time than AVED method. Approximately 6.32 % of improvement in delay time is achieved using FRWM method.

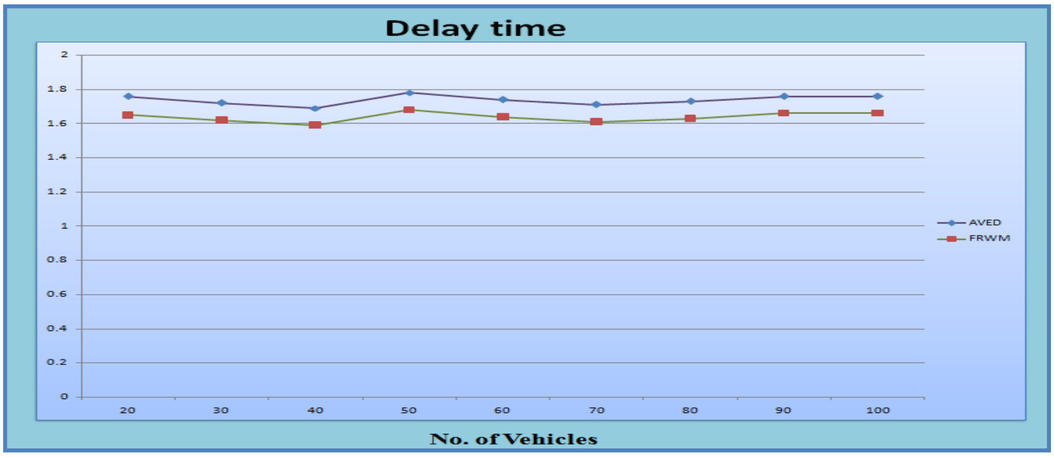

Figure 6: Delay time graph for different values of Epsilon

VII. CONCLUSION & FUTURE WORK

This paper illustrates the working of Appropriate Vehicular Emergency Dissemination (AVED). There are some advantages and disadvantages of the existing method and problem are identified. Although the AVED method works perfectly in VANET-urban scenario, but it could be enhanced with reliability issue and probability based approach. Hence an enhancement of existing system, a novel Fast Reliable Warning Messages (FRWM) is proposed in this research work, which is discussed in previous section.

The proposed method uses the emergency warning system as well as priority based warning system. The three types of priority given to the vehicle; (i) Fire/ Ambulance vehicle-Highest Priority ;(ii) Police/ Defence vehicles and (iii) Ordinary Vehicles. More parameters are taken into consideration like; forwarding counts, reception rate and delay time via receiver node.

Fast and Reliable Warning Messages (FRWM) mechanism is proposed for broadcasting emergency messages based on its nature. The proposed mechanism has three levels of messages with nine unique priority codes. Higher priority is assigned to the human safety ambulance vehicles related messages and low priority is assigned to the service announcements and beacons.

This scheme includes three major steps that is message analysis step, forwarder selection step and broadcasting step. Whenever a vehicle receives a message, message analysis step classifies the message with its priority code. The forwarder selection step then selects a next hop forwarder which has a long transmission range with high speed for priority 1 messages.

This mechanism reduces the number of redundant message broadcasting and aims to broadcast emergency message to all the vehicles by fast retransmission. Finally, broadcasting step uses priority queue for broadcasting.

The simulation scenario designed in network simulator 2. The simulation scenario is designed for highway VANET with 3 lanes. The number of vehicles is varied from 20 vehicles to 100 vehicles. The simulation scenario consists of one accident vehicle which broadcast emergency messages over the vehicular ad hoc networks. At the ends of simulation of proposed FRWM method, where all the vehicles are stopped nearby by the accident vehicle except those vehicles chosen with priority. It could be easily seen that priority level 1 (ambulance) and priority level 2 (police van) reached nearby to accident vehicles while other vehicles are stopped. In a real world scenario it works, and hence the reliability and time factor is considered in FRWM method. The simulation clearly shows the enhancement of existing AVED method in terms of reliability.

The performance parameters are forwarding counts, reception rate and delay time. There are three scenarios have been conducted to give depth research according to different number of vehicles. The scenarios are varied according to vehicle density, different CAM intervals and different epsilon values.

Since both the safety broadcasting methods are very efficient so their performance is also the same. But there is a reliability of prioritized vehicle to reach at accident place, so FRWM method outperforms the AVED method in terms of delay time.

The following table shows the percentage of improvement of FRWM method as compared to previous method AVED in terms of delay time.

.

Table 2: Percentage of Improvement

Parameter	AVED Method time (ms)	FRWM Method time (ms)	Percentage of Improvement
CAM Interval	1.76	1.66	**5.3 %**
Epsilon Values	1.74	1.64	**5.78%**
Vehicle density	1.74	1.63	**6.32%**

The proposed schemes in this paper is simulated and evaluated and proven to be an efficient. However, there are certain limitations which can be improved in future. First, the network scenario is considering only vehicles moving around with predefined static direction. This can be tested for dynamic topology. The simulation can be tested for real time data. Different security management schemes like key management, intrusion detection are given in the literature.

REFERENCES

[1] Manuel Fogue ; Piedad Garrido ; Francisco J. Martinez ; Juan-Carlos Cano ; Carlos T. Calafate ; Pietro Manzoni, "An Adaptive System Based on Roadmap Profiling to Enhance Warning Message Dissemination in VANETs", Electronic ISSN: 1558-2566, IEEE/ACM Transactions on Networking (Volume: 21, Issue: 3, June 2013).

[2] Chunxiao Li ; Dawei He ; Zhenni Pan ; Mei Sun ; Bin Li, "A next-hop selection scheme for emergency message propagation in VANETs", Electronic ISBN: 978-1-4799-1291-9, 2014 IEEE International Conference on Consumer Electronics (ICCE), IEEE 2014.

[3] Jae-Han Lim ; Wooseong Kim ; Katsuhiro Naito ; Ji-Hoon Yun ; Danijela Cabric ; Mario Gerla, "Interplay Between TVWS and DSRC: Optimal Strategy for Safety Message Dissemination in VANET", Print ISSN: 0733-8716, EEE Journal on Selected Areas in Communications (Volume: 32, Issue: 11, November 2014).

[4] Behnam Hassanabadi ; Shahrokh Valaee," Reliable Periodic Safety Message Broadcasting in VANETs Using Network Coding", Print ISSN: 1536-1276, IEEE Transactions on Wireless Communications (Volume: 13, Issue: 3, March 2014).

[5] Ali Rakhshan ; Hossein Pishro-Nik ; Mohammad Nekoui, "Driver-based adaptation of Vehicular Ad Hoc Networks for design of active safety systems", Electronic ISBN: 978-1-4799-8428-2, 2015 49th Annual Conference on Information Sciences and Systems (CISS), IEEE 2015.

[6] Nabeel Akhtar ; Sinem Coleri Ergen ; Oznur Ozkasap, "Vehicle Mobility and Communication Channel Models for Realistic and Efficient Highway VANET Simulation", Electronic ISSN: 1939-9359, IEEE Transactions on Vehicular Technology (Volume: 64, Issue: 1, Jan. 2015).

[7] Hanaa S. Basheer ; Carole Bassil ; Bilal Chebaro, "A Framework for Disseminating Trusted Safety Message in V2V Communication", Electronic ISBN: 978-1-5090-2461-2, 2016 30th International Conference on Advanced Information Networking and Applications Workshops (WAINA), IEEE 2016.

[8] Yiwen Shen ; Jaehoon Jeong ; Tae Oh ; Sang Hyuk Son, "CASD: A Framework of Context-Awareness Safety Driving in Vehicular Networks", Electronic ISBN: 978-1-5090-2461-2, 2016 30th International Conference on Advanced Information Networking and Applications Workshops (WAINA), IEEE 2016.

[9] Yuanguo Bi ; Hangguan Shan ; Xuemin Sherman Shen ; Ning Wang ; Hai Zhao, "A Multi-Hop Broadcast Protocol for Emergency Message Dissemination in Urban Vehicular Ad Hoc Networks", Electronic ISSN: 1558-0016, IEEE Transactions on Intelligent Transportation Systems (Volume: 17, Issue: 3, March 2016).

[10] S. Oh ; M. Gruteser ; D. Pompili, "Coordination-free Safety Messages Dissemination Protocol for Vehicular Networks", Electronic ISSN: 1939-9359, IEEE Transactions on Vehicular Technology (Early Access), IEEE 2017.