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by Armin Lawi

Proposed Priority Packet Data Dissemination Scheduling Mechanism

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***Abstract*—Communication in a faster moving vehicle under Vehicular Ad-Hoc Network (VANET) is widespread for disseminating packet priority. The dissemination of priority packet data is very important because packet with the higher priority can also be categorized as emergency messages. Message dissemination with priority packet has been researched by many researchers with determining message priority in MAC Layer or when the process of the data dissemination. The standard protocol IEEE 802.11p has supported priority levels that are divided into four access categories. This paper is focused on determine packet priority on MAC layers, then Priority Packet Data Dissemination Scheduling Mechanism is proposed. Packet priority is estimated based on vehicle location and traffic to access the channel. Then, for the effective data dissemination of packet priority, AODV protocol is used. Finally, the results of the experiment show better performances in terms of throughput, PDR and delay even with the higher node density.**

Keywords— VANET, Priority Data Dissemination, Packets scheduling, AODV.

I. Introduction

VANET is constructed for communication between vehicle as Vehicle-to-Vehicle communication (V2V) and Vehicle-to-Infrastructure communication (V2I) for several significant applications [1]–[3]. Challenges faced in VANET are routing, security, maintenance of Quality of Service (QoS) and scalabilities. The main purpose of VANET is to provide security, in the case of any accidents or safety precaution messages are sent (i.e.) emergency data dissemination [2], [4]–[7],[8]. An emergency message also can be determined based on as much as the priority of the message, in [9] emergency messages are assumed to be AC_VO which is the most priority category access level of the standard IEEE 802.11p protocol. Safety based message for the driver such as road status, road obstacle identification, lane change notification, traffic signal warnings, collision warnings, crash alarm, etc. All these emergency messages can be disseminated either through one-hop or multi-hop.

Fig1. illustrates VANET architecture with vehicles moving on two lane road. Communication is held between vehicles for safety purposes. The communication can become one-hop or multi-hop, since the destination vehicle may not be present at its one-hop at all times. Messages disseminated are based on their priority. The priority messages such as critical messages should be disseminated timely for increasing transmission reliability and also reduce redundancy[10],[11].

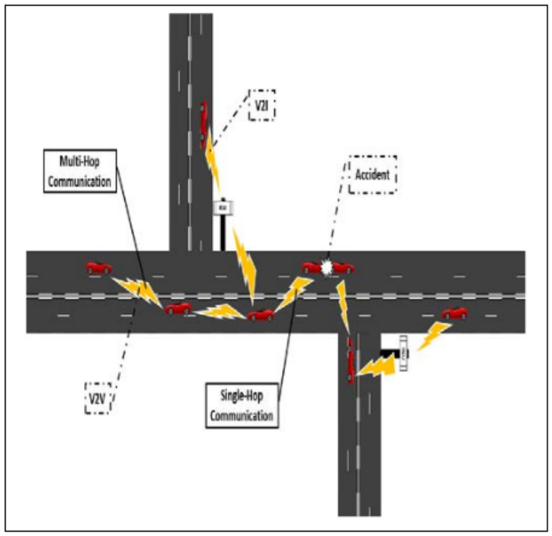

Figure1. VANET Architecture

Some studies related to priority packet selection in MAC has been studied previously, such as in [12] priority packet data was determined by changing the AIFS value calculated based on vehicle's time to leave (TTL) and traffic type to increase throughput when compared with standard CSMA/CA scheme for channel access. However, in this study have not implemented a protocol for the dissemination of packet after the priority packet selection. According to[13], to reduce packet delay, this study proposes a high priority algorithm for cluster head selection, but still uses standard MAC scheme for determining of packet priority.

After determining the packet priority, then improving the reliability in data dissemination. In the study [14], AODV protocol has high reliability if compared with OLSR protocol in terms of data dissemination which implemented use SUMO and

NS3. While according to research [15], AODV has higher reliability compared with OLSR in high-density conditions.

This paper presented a proposed priority packet data dissemination scheduling mechanism. The main contribution of this paper as follows:

- Data scheduling is performed based on priority
- A queue is used when two data packets have a similar priority.
- Data dissemination using AODV protocol.
- Simulation using Omnet++.

The rests of this paper are organized as follows: section II is methodology, section III includes the detailed description of the proposed work, section IV contains experimental result along simulation setup and performance metrics. Finally, section V concludes the proposed paperwork.

II. METHODOLOGY

A. IEEE 802.11p Protocol

In Vehicular ad-hoc Network (VANET) there is an IEEE standard protocol designed to support wireless access in vehicular environments (WAVE)[16] i.e. IEEE 802.11p protocol[17]. This Protocol uses Enhanced distributed channel access (EDCA) mechanism with several parameters used for Quality of Service (QoS) in terms of transmission in Medium Access Control (MAC[17].

TABLE I. PARAMETER SETTING FOR DIFFERENT APPLICATION CATEGORIES IN IEEE 802.11P [17].

Access Category	AIFSN	CWmin	CWmax
AC_BK	9	15	1023
AC_BE	6	15	1023
AC_VI	3	7	15
AC_VO	2	3	7

Table 1 shows the priority levels provided for different types

of applications in standard protocol of IEEE 802.11p

B. Ad-hoc On-demand Distance Vector (AODV) Routing

Protocol

There are several kinds of Traditional Ad-Hoc routing protocol used in VANET, that are table driven or proactive protocols, on demand or reactive protocols, and hybrid routing protocols[18].

AODV routing protocol included in the classification of reactive routing protocols that simply request the route when needed and does not store the route cache as it does in other

reactive protocol such as DSR[19]. AODV is a general development from Destination-Sequenced Distance Vector (DSDV) and Dynamic Source Routing (DSR) routing protocols aimed at minimizing overall system broadcasting requirements [18].

Routing protocol on AODV use Route Request (RREQ) and Route Reply (RREP) mechanism that included into route discovery mechanism while Route Error (RERR) mechanism that included into route maintenance mechanism, are shown as follows[20]:

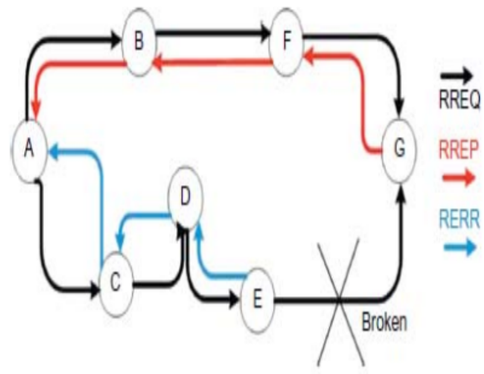

Figure2. Routing Mechanism in AODV

The RREQ concept is used when the source node wants to build a route to the destination node. If the node that receives the RREQ has route information to the destination node then that node sends back the RREP packet to the source node. If there is damage in the network during data transmission that causes a node cannot be addressed by using the information in the routing table, then the RERR concept is used to send a message to its neighbor node and its neighbor node will send back the RERR to source node[20].

C. Performance Metrics

1. Packet Delivery Ratio

Packet delivery ratio is defined as the ratio of packets which can be delivered successfully and this metric is estimated with using mathematical formulation. Packet delivery ratio in short PDR can also be defined as the ratio of the sum of data packets received with the sum of the data packets sent. Hence, this metric is given as:

$$PPDDD = \frac{SSSSSS\ oooo\ tthee\ ddddttdd\ ppddpppppeettpp\ rreeppeerrrreedd}{ppSSSS\ oooo\ tthee\ ddddttdd\ ppddpppppeettpp\ ppeesstt}$$

D =

This metric is significant in a network, so if this metric is improved then the network performance definitely improves.

2. Throughput

In short, throughput can be defined as the rate at which data are transferred from one end-user to another. This metric can be computed as follows:

$$TThrrooSSrrhppSS = \frac{NNSSSSNNeerr\ oooo\ PPddpppppeettpp\ ppeesstt}{TTrrSSee\ ttddppeess}$$

tt =

A. Overview

III. PROPOSED

This paper is focused on determining of packet priority through VANET. Priority of the packet is determined where highest priority is the most important packet. In two cases or more packets that have the same priority value then the packet will be put into the queue. Vehicle's priority is provided based on traffic and distance between vehicles. Then, the packets are disseminated using the AODV protocol.

Data dissemination is a key concept involved in VANET for providing safety over high speed moving vehicles on roadways. First is estimate the priority and then perform data dissemination.

The process is initiated with the estimation of priority for organizing the packets into the certain order. Then the vehicle is checked based on the priority and finally AODV protocol is performed for data dissemination. The Sequential processes are shown in figure 2 as the flowchart. The initial step is with determining vehicle's priority, and then a packet with the highest priority is disseminated first in the network.

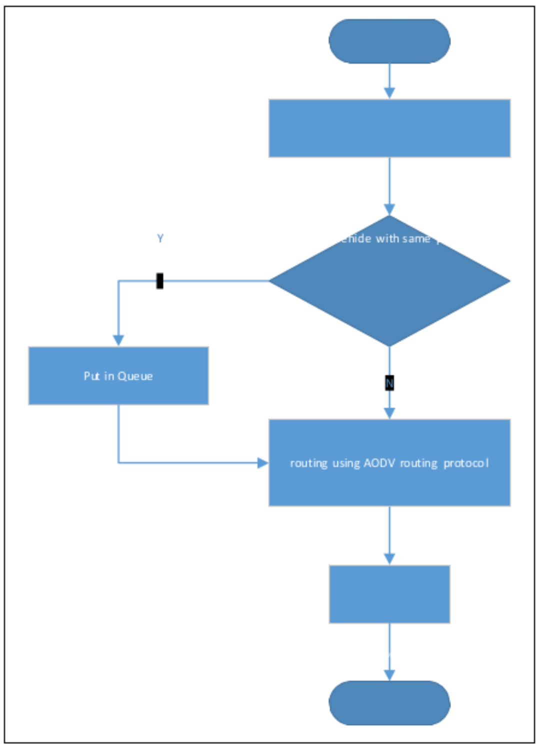

Figure3. Proposed Flow Chart

B. Priority Based Scheduler

Scheduling is performed to improve the entire performance of data dissemination. Priority is given to each vehicle with respect to their position and the traffic they have to transmit. Time-To-Leave (TTL) is considered since the coverage range of each vehicle depends on their mobility.

Figure 4. represents the priority of data packet from the vehicles. The Packet is arranged relate with the priority. Priority to every vehicle of data packet use calculation as follows:

Based on the coverage of each vehicle, TTL [12] is estimated as:

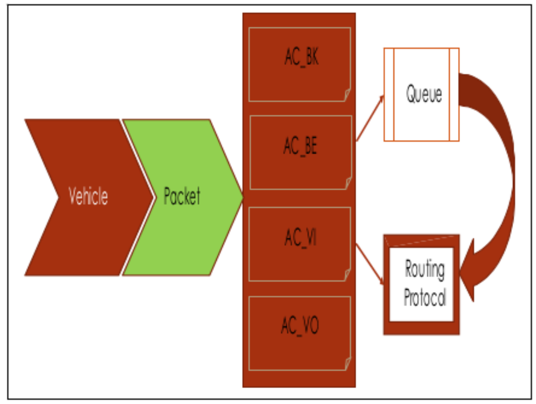

Figure4. Scheduling

$$TTTTTT(rr) = \frac{\sqrt{[(\max xx - xx(ii^2))+(mmmmxx\, yy - yy(ii^2))]}}{VVVVVVVVVV\ VVttVVyy(ii)} \quad (1)$$

TTL is estimated from the distance coverage of the vehicle and its velocity, so the distance is computed by:

$$DDrrpp = \sqrt{[(SSddmm\, mm - mm(rr^2)) + (SSddmm\, yy - yy(rr^2))]} \quad (2)$$

Further, estimate the priority of the vehicle with respect to the TTL and traffic type (i.e.) given as:

$$VV(rr) = TTTTTT(rr) * \frac{TTTTmmTTTTiiVV\ VVyyttVV\ (ii)}{TTVVVVmmVV\ VVTTmmTTTTiiVV\ VVyyttVVtt} \quad (3)$$

With (3) the traffic priority is given as:

$$TT(rr) = VV(rr)/150\mu\mu pp \quad (4)$$

Next, determine the waiting of each vehicle to access the control channel with 'T(i)' and Short Interframe Space (SIFS) Time. A slot time is taken as '13 µs'. Waiting time of a vehicle 'WT(i)' is given as follows:

$$WWTT(rr) = \frac{TT(ii)}{13\mu\mu tt} + \alpha\alpha\ SSSSSSSS\ TTrrSSee \quad (5)$$

By estimating the priorities, data packets is organized into specified order in which data packets with the highest priority will be disseminated first through a network. A queue is maintained in the case when more than one vehicle said has the similar priority. This queue will improve effective data dissemination in the network. With the completion of priority estimation, data packets with the higher priority then will perform using AODV routing protocol.

IV. SIMULATION AND RESULT

A. Simulation Setup

The proposed work has been simulated using OMNeT ++ environment. To show a better visualization of VANET, OMNeT ++ has been integrated along with SUMO, since SUMO supports with real world map from Open Street Map. With using C++ programming language, then the proposed protocol is generated in VANET architecture. For simulation, the map of Makassar city is used and determine the certain parameter to improves the proposed mechanism.

TABLE II. SIMULATION PARAMETERS

Parameters	Ranges
Simulation Area	1000m × 1000m
Number of Vehicles	25
Speed	25 m/s
Number of Road Side Unit	2
Road lane	Two lanes
Sensitivity	-85 dBm
Transmitter Power	2mW
Carrier Frequency	2.4 GHz
Standard	IEEE 802.11p
Data Dissemination Protocol	AODV

Table2. gives the simulation parameters that are involved in simulating the proposed work. The significant parameters used are listed up. The standard IEEE 802.11p is specifically designed for Vehicular Ad-hoc Networks communication that is enabled to support Intelligent Transportation Systems (ITS) and this standard includes Wireless Access in Vehicular Environments (WAVE).

B. Result

1) Packet Delivery Ratio: Packet Delivery Ratio has been defined in the previous section. This is a significant metric to predict the performance of protocol used in a network.

Figure 5. Illustrates significant performance metric plot where improvement with the recession of total vehicle rising. Packet delivery ratio is considered to be one of the Quality of Service improving metric. This improvement shows that the proposed mechanism has better performance. In data dissemination, packet delivery ratio plays a significant role which the priority packets are broadcasted to another vehicle within a short period of time.

2) Throughput: Throughput is also a significant metric in deciding Quality of Service. Throughput is efficient in determining the data rate with the time taken to transmit those data packets. Figure 6 illustrates the throughput performance of the proposed work. This metric is considered to be more important in any type of network, herewith efficiency of data transmission is analyzed with the improvement of throughput.

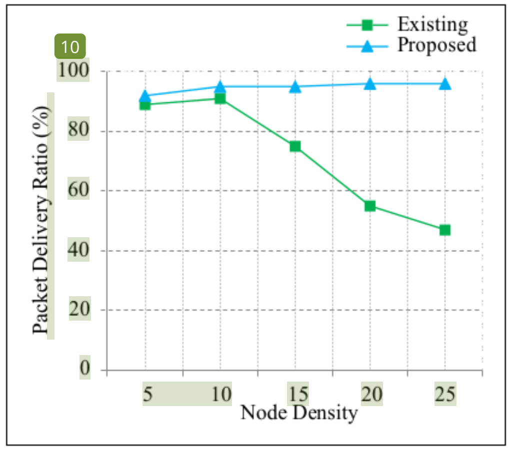

Figure5. Packet Delivery Ratio

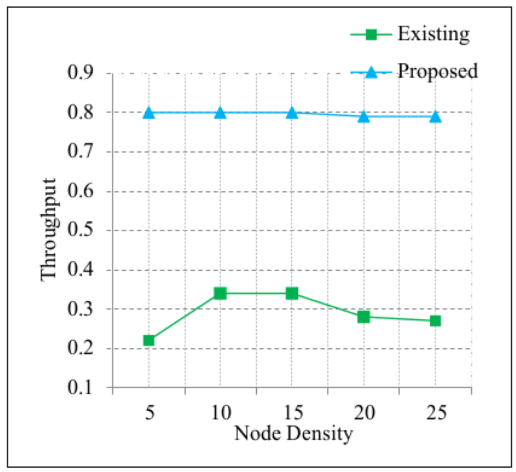

Figure6. throughput

Throughput improvement is tremendous and also at the higher number of users, Constant bit rate has been achieved without any reduction. On using AODV routing protocol for data dissemination in VANET tends to increase with the performance metrics. An increase in PDR and throughput will tend to a maximization of network performance.

3) Delay: Delay is defined as the time needed for transferring packet. In this work, the delay can be interpreted as the time required to send the priority packets from source to destination.

The proposed work reduces mean delay as shown in Figure 7. However, the delay will be high and tend to be higher as the number of user increases. Improvement in this parameter implies that decrease of delay on the whole when the priority message is disseminated.

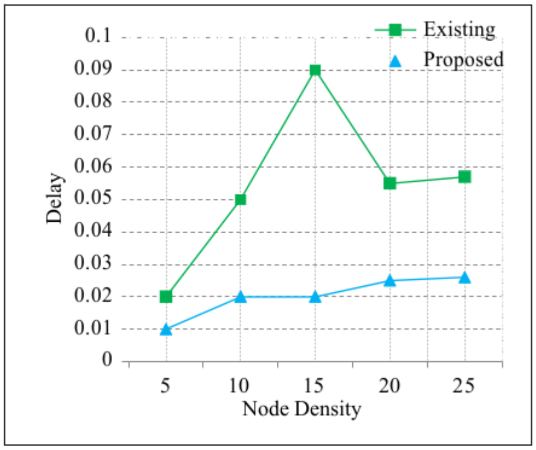

Figure7. delay

V. CONCLUSION

The proposed work is focused on the effective priority packet data dissemination in VANET. Here, the process has been initiated with determining priority for each vehicle based on their TTL and distance. In case, if the priority of two vehicle's data packet is similar, then they are put into a queue. Then, from the queues, they will be disseminated using Ad Hoc On-Demand Distance Vector (AODV) routing protocol. This Protocol is only to support the process of data dissemination, but the most emphasis on this work is the process of priority packet selection. The purpose of this paper is to increase throughput, packet delivery ratio and also reduce the delay. Priority packet data dissemination has been successfully designed in VANET. Future research will consider to design more effective queuing algorithm when two packets have the similar priority.

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REFERENCES

[1] V. Kumar, S. Mishra, and N. Chand, "Applications of VANETs : Present & Future," vol. 2013, no. February, pp. 12–15, 2013.

[2] J. A. Sanguesa, M. Fogue, P. Garrido, F. J. Martinez, J. Cano, and C. T. Calafate, "A Survey and Comparative Study of Broadcast Warning Message Dissemination Schemes for VANETs," vol. 2016, 2016.

[3] S. Rehman, M. A. Khan, T. A. Zia, and L. Zheng, "Vehicular Ad-Hoc Networks (VANETs): An Overview and Challenges Vehicular Ad-Hoc Networks (VANETs) - An Overview and Challenges," no. March 2016, 2013.

[4] H. S. Dawood and Y. Wang, "An efficient emergency message broadcasting scheme in vehicular Ad hoc networks," *Int. J. Distrib. Sens. Networks*, vol. 2013, 2013.

[5] M. A. Javed, D. T. Ngo, and J. Y. Khan, "A multi-hop broadcast protocol design for emergency warning notification in highway VANETs," *EURASIP J. Wirel. …*, pp. 1–15, 2014.

[6] W. Zhu, D. Gao, C. H. Foh, W. Zhao, and H. Zhang, "A collision avoidance mechanism for emergency message broadcast in urban VANET," *IEEE Veh. Technol. Conf.*, vol. 2016–July, pp. 1–5, 2016.

[7] Y. Bi, H. Shan, X. S. Shen, N. Wang, and H. Zhao, "A multi-hop broadcast protocol for emergency message dissemination in urban vehicular ad hoc networks," *IEEE Trans. Intell. Transp. Syst.*, vol. 17, no. 3, pp. 736–750, 2016.

[8] P. Tomar, B. K. Chaurasia, and G. S. Tomar, "State of the Art of Data Dissemination in VANETs," vol. 2, no. 6, pp. 957–962, 2010.

[9] C. Suthaputchakun, Z. Sun, and M. Dianati, "Trinary Partition Black-Burst based Broadcast Protocol for Emergency Message Dissemination in," pp. 2244–2249, 2013.

[10] S. S. Bhagat, "Partitioned Multihop Broadcast Protocol for Time Critical Emergency Message Dissemination in VANET," pp. 409–412.

[11] A. S. Anees and B. V. Kurien, "Time Critical Emergency Message Dissemination in VANETs," vol. 3, no. 4, pp. 22–28, 2015.

[12] C. Tripti, J. K. M. G, and R. Manoj, "Priority based Control Channel Access Scheme for Throughput Improvement in VANET," no. September, pp. 4–5, 2015.

[13] A. Upadhyay, "Cluster Head Selection for CCB-MAC Protocol by Implementing High Priority Algorithm in VANET," pp. 107–112, 2016.

[14] G. Sallam and A. Mahmoud, "Performance Evaluation of OLSR and AODV in VANET Cloud Computing Using Fading Model With SUMO and NS3," pp. 1–5, 2015.

[15] T. E. Ali and L. A. Khalil, "Review and Performance Comparison of VANET Protocols: AODV, DSR, OLSR, DYMO, DSDV & ZRP," 2016.

[16] I. Transportation and S. Committee, "Draft Guide for Wireless Access in Vehicular Environments (WAVE) Architecture," no. July, 2016.

[17] L. A. N. Man and C. Society, *IEEE Standard for Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements*, vol. 2007, no. June. 2007.

[18] S. Benkirane, S. Mostafa, M. L. Hasnaoui, and A. Beni-hssane, "A New Comparative Study of Ad hoc Routing Protocol AODV and DSR in V ANET Environment Using Simulation Tools," pp. 458–461.

[19] E. Nikola and D. Centre, "Throughput Comparison of AODV-UU and DSR-UU Protocol Implementations in Multi-hop Static Environments."

[20] *A Study of Black Hole Attack Solutions A Study of Black Hole Attack Solutions On AODV Routing Protocol in MANET.*

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