MESSAGE PRIORITIZATION OF EMERGENCY VEHICLES USING IMPROVISED DYNAMIC CLUSTERING AND GATEWAY MANAGEMENT IN VANET-3G INTEGRATED NETWORK

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Abstract— Vehicular Ad-hoc Network (VANET) is growing wireless communication technology developed to achieve safety and intelligent transport. VANET is integrated with wired infrastructure to reach internet. Clustering based Multi-metric Mobile Gateway Management (CMGM) mechanism clusters vehicles on road and select optimal mobile gateways. CMGM offers internet access for all vehicles with same priority, in situation where fast internet access is absolutely necessary for emergency vehicle CMGM work inefficiently and CMGM uses reactive routing protocol AODV which does not check integrity of total communication. As emergency vehicles plays vital role in disaster recovery and rescue services packets from emergency vehicle are supposed to reach internet first compare to ordinary vehicles and data packet loss may cause information loss. This paper proposes Improvised CMGM (ICMGM) mechanism for providing fast internet access in emergency vehicles service through priority mapping and performance is analyzed in terms of Data Packet Delivery Ratio (DPDR) and data packet integrity is achieved using Acknowledge packet (ACK) in AODV protocol.

Index Terms— VANET, 3G, CMGM, Clustering, Gateway management, Emergency vehicle, AODV

I. INTRODUCTION

VANET is emerging wireless technique used to share and provide data services to vehicles moving at high speed on roadway. VANET is a subtype of Mobile Ad-hoc Network (MANET). Vehicle equipped with On-Board Unit (OBU) can communicate with the other vehicles moving on roads having VANET interfaces or Road-Side Unit (RSU). Hence there are two types of Vehicle to Vehicle (V2V) and Vehicle to Infrastructure (V2I). VANET is beneficial because it allows short medium range communication, less deployment cost, support short message delivery, minimum latency of communication link. But shortcomings like high mobility, dynamic topology changes but predictable because of road constraints, self-organized nodes, fragmented network makes maintenance of network critical. Vehicle applications typed as safety and non-safety applications. Safety communication allow vehicle to get traffic jam, congestion information, alarm and warning messages, toll payment, parking assistance, audio/video streaming, data sharing from nearby vehicles. Non-safety application allow vehicle to connect to internet to get real time news, weather reports, gas and fuel station locations, entertainment applications such as gaming and

interactive work like file sharing, video-on-demand, web browsing, eAdvertisement, internet access [1].

IEEE 802.11p forms the standards for Wireless Access for Vehicular Environment (WAVE) based VANET uses 5.850-5.925 GHz band for the use of public safety and private applications with communication range of 300m and data rate up to 27 Mbps [2].

Need of Heterogeneous network architecture: Generally a VANET is integrated with the other wired network to couple high data rate with wide range communication network which give internet access to vehicles anywhere, anytime. Coupling two different kinds of networks is challenging research today. VANET is integrated with various wireless or cellular techniques such as WiMax, Wi-Fi, 3G, and LTE.

Universal Mobile Telecommunication Systems (UMTS) network offers data services up to 8 to 10 km with data transfer rate of 2 Mbps to 7 Mbps and 1.925 GHz band allocated for uplink and 2.115 GHz band allocated for downlink. UMTS is widely deployed and used today in tremendous applications [3].

Importance of Emergency Vehicles (EV) and Internet access requirement in EV:

Emergency Vehicle (EV) like ambulances, fire trucks, police cars plays crucial role in natural disasters like earthquakes, tsunami, storms etc. when this kind of incidents occur wired communication modes gets damaged and hence VANET kind of network because of its ad-hoc nature would help. Today availability of internet access in emergency vehicle helps in different situations like

1) A reliable high speed internet connection in ambulances allows medical staff to share critical information of patient to hospital, which will enable hospital staff to stay prepare for patient arrival and treatment.
2) At an accident place, medical staff from ambulance can be guided through video streaming which help to give initial treatment to injure human.
3) Internet access gives police officers on scene access to departmental applications and resources like criminal record, vehicle registration, maps.
4) Crime analyst uses internet access to mine data to discover patterns and trends in criminal behavior.
5) Rescue vehicles able to create and share incident reports, send/receive e-mails and retrieval information from police databases about suspects, missing person, criminals, photos and live or recorded footages.
6) Real time and instant information to emergency vehicle enable emergency vehicles team to make rapid and well form group decision.

Existing system researched on connecting each car on roadway or each car part of VANET to internet using various mechanisms which are detailed related work in section II. Section III discusses system architecture and design. Section IV discusses result and performance analysis. Section V concludes paper with Acknowledgement in section VI.

II. RELATED WORK

VANET integrated with existing deployed cellular networks, use of RSUs, static gateway mechanism, mobile gateway mechanism, to make efficient gateways more research has been done which has evolved clustering, gateway selection mechanism, gateway handover mechanism, routing protocols and gateway discovery protocols.

Multiple Metric Gateway Selection Algorithm (MGSA): Research paper [4] proposes multiple gateway selection mechanism based on metrics like residual energy, mobility and number of hops. Proposed mechanism do not consider clustering, the entire vehicle moving on roadway can be selected as gateway. It uses AODV+ protocol for gateway discovery. As

clustering is not considered number of nodes considered for gateway selection increases which affect time to select optimum gateways and increases complexity. Clustering Based Multiple metric Gateway Selection (CMGM): Research paper [5] proposes clustering mechanism before gateway management which reduces complexity in gateway selection and number of possibilities of gateways; hence minimum optimum gateways are selected. A reactive routing protocol AODV is used which do not check data integrity. Gateway will be overloaded with request from entire vehicles in range and there is no provision for rescue service vehicles. FleetNet [6] is government project held on Japan developed for internet access in cars. It uses static infrastructure or RSU as gateways. Because of static nature of gateways link stability between vehicle and RSU was a bottleneck due to low transmission range of RSU. Research paper [7] proposes integration architecture of MANET, WLAN with 3G network to increase data access range. Authors in paper [8] detailed and studied different discovery techniques in MANET and VANET. Paper [9] [10] details and compare various routing protocols. Author reviews different gateway discovery protocols in MANET. This paper compares and discusses drawbacks of protocols also. Research paper [11] proposed integration architecture of VANET with LTE.

III. ARCHITECTURE AND DESIGN PROPOSED APPROACH ICMGM

As explained in CMGM [5] integration of VANET-3G network takes place in two steps dynamic clustering and gateway management.

A. Dynamic Clustering: Clustering organizes network nodes into small set of vehicles called clusters in hierarchical manner. Vast network of nodes is converted into small network nodes subset where for each cluster has cluster head which groups its local vehicle together and acts as relay point for members and members of other clusters. Utility function algorithm based on multiple metric selections is used to cluster vehicles. Metrics used are

1) Direction movement
2) UMTS RSS
3) IEEE802.11p transmission range

After clustering nodes cluster head for each cluster is selected.

B. Gateway Management: It is collection of gateway selection, gateway discovery and gateway handover algorithms collection.

Gateway selection: From available cluster heads optimal numbers of mobile gateways are selected by source using Simple Additive Weighing (SAW) method.

Gateway discovery: Whenever source need access from UMTS it will call this procedure to find serving gateway there are three types of discovery proactive, reactive and hybrid.

Gateway Handover: When serving gateway loses its optimality then it handover its role to some other cluster heads. And new gateway is selected which will serve further requests.

C. Existing issues in CMGM:

1) CMGM protocol provides internet access for all vehicles with same priority.
2) In situation where emergency vehicle need internet access efficiently this protocol work poorly.
3) Reactive routing protocol AODV does not check integrity of packets.
4) Data packet delivery ratio of CMGM for EV can be improved further using following proposed system

D. Contribution to paper:

1) Improvisation of CMGM protocol to support emergency vehicle message prioritization
2) Improving data packet delivery ratio with data integrity through AODV protocol ACK packets.

Emergency vehicles moving on roadway has crucial communication requirement hence if all the messages from them are given higher priority compared to other vehicle then time to serve their request will be less. Data transmission towards emergency vehicle and from emergency vehicles can be carried with less operational delay. If in situation where gateway currently transferring data from ordinary vehicle and a group of emergency vehicle send GW_SWL message then a gateway has to drop bandwidth allocated to ordinary vehicle and allocate it to emergency vehicles. That is messages from emergency vehicles are given high priority over other vehicle request and messages from EV transferred on priority as depicted in fig. 1.

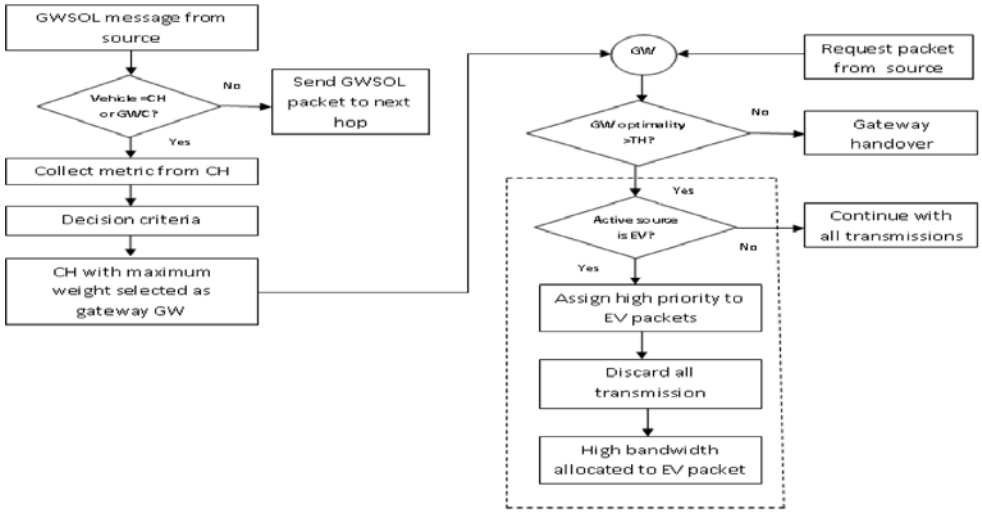

Fig-1

IV. RESULT

NS3-17 is open source discrete event network simulation tool built in c++ and bindings in python. It is used to create an open network environment for networking simulation provides logging, tracing, debugging features. For simulation multiple type of nodes are considered like gateway node, gateway candidate node, ordinary node, emergency vehicle or node and a UMTS base station node and different routing protocol's module are used. Simulation tool install on Linux.

Fig.1 and Fig. 2 ICMGM performance is compared with CMGM using DPDR metric and delay in servicing request.

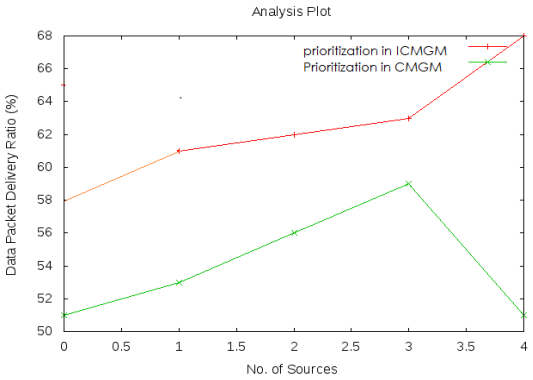

Fig. 2

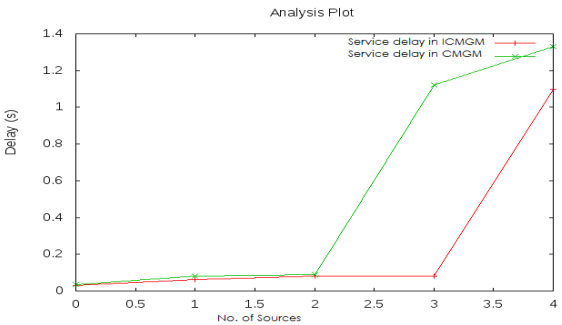

Fig. 3

VI. CONCLUSION

In this paper we implemented improvised CMGM mechanism for providing efficient and instant internet access and other VANET applications. Performance is analyzed in terms of DPDR of emergency vehicles and other vehicles. Results are compared with CMGM system using DPDR and delay parameters. We have found improvised result for emergency vehicles with respect to existing system.

VII. REFERENCES

[1] M. Gerla, L. Kleinr ock, "Vehicular networks and the future of the mobile internet", Comp ut. Netw. (2011) ,doi: 10.1 016/j.comnet. 2010.10 .015

[2] Daniel Jiang, Luca Delgrossi, " IEEE 802.11p: Towards an International Standard for Wireless Access in Vehicular Environments", Mercedes-Benz Research & Development North America, Inc.

[3]"Overview of the Universal Mobile Telecommunication Systems", http://www.umtsworld.com/technology/overview.htm

[4] F.P. Setiawan, S.H. Bouk, and I. Sasase, "An Optimum Multiple Metrics Gateway Selection Mechanism in MANET and Infrastructure Networks Integration", In Proc. IEEE WCNC, Las Vegas, NV, Mar. 2008.

[5] Abderrahim Benslimane, Senior Member, IEEE, Tarik Taleb, Senior Member, IEEE and Rajarajan Sivaraj," Dynamic Clustering-Based Adaptive Mobile Gateway Management in Integrated VANET – 3G Heterogeneous Wireless Networks" IEEE Journal On Selected Areas In Communications, Vol. 29, No. 3, March 2011

[6] R. Kruger, H. Fuler, M. Torrent-Moreno, M. Transier, H. Hartenstein, and W. Effelsberg, "Statistical analysis of the FleetNet highway movement patterns", University of Mannheim, Mannheim, Germany, Tech. Rep. TR-2005-004, Jul. 2005.

[7] Manoharan. R, Rajarajan. S, Sashtinathan. S and Sriram. K , "A Novel Multi-hop B3G Architecture for Adaptive Gateway Management in Heterogeneous Wireless Networks" IEEE International Conference on Wireless and Mobile Computing, Networking and Communications, 2009.

[8] Rafi U Zaman, Khaleel ur Rahman Khan, A.Venugopal Reddy "A Survey of Adaptive Gateway Discovery Mechanisms in Heterogeneous Networks "I. J. Computer Network and Information Security, 2013, 7, 34-42 Published Online June 2013, DOI: 10.5815/ijcnis.2013.07.04.

[9] Yun-Wei Lin, Yuh-Shyan Chen And Sing-Ling Lee "Routing Protocols in Vehicular Ad Hoc Networks: A Survey and Future Perspectives", journal of information science and engineering 26, 913-932 (2010).

[10] Deepak Kumar Patel, Rakesh Kumar, "A Review of Internet Gateway Discovery Approaches for Mobile Ad-hoc Networks", International Journal of Computers &Technology Volume 4
No. 2, March-April-2013, ISSN 2277-3061.

[11] G. Araniti, C. Campolo, M. Condoluci, A. Iera, A. Molinaro " LTE for Vehicular Networking: A Survey" IEEE communications Magazine, vol.51, no. 5, pp. 148-157, May 2013 .