ISSN: 2278-0181
Vol. 2 Issue 11, November - 2013

A Comparative Study of Routing Protocols in Intelligent Transportation System

S.Sathya Karthika[1], J. Rethna virgil Jeny[2], J. Albert Simon[2]

[1]PG Scholar
[2]Assistant Professor
Department of Computer Science and Engineering, SRCE, Tamil Nadu, India

Abstract:

VANET is an emerging technology to achieve intelligent inter-vehicle communications, flawless internet connectivity resulting in improved road safety and essential alerts. The Dedicated Short Range Communication (DSRC) technology is currently being standardized by the IEEE to enable a range of communication-based automotive safety applications. VANET needs efficient and effective protocols to run even in high speed and mobility conditions. In this paper we present a comparative survey of some recent routing protocols with Adaptive and Mobility Based Algorithm to estimate the vehicle density and change their transmission parameters based on their current average speed for improving the performance of VANET.

KeyTerms: *VANET, EDCA, DSRC, Broadcast, CSMA/CA, Vehicle to Vehicle Communication.*

1. Introduction

VANET is a self organizing network that works on both inter vehicle communication and vehicle to vehicle infrastructure communication. The main objective of VANET is to provide road safety measures where information about vehicle's current speed, location coordinates are passed to all the nearby vehicles. Vehicles are equipped with wireless transceivers to communicate with other vehicles to form a wireless networks, known as vehicular ad hoc networks or VANETs. It is used for enhancing safety for drivers and to provide the comfortable driving environment. Wang et al proposed Dedicated Short Range Communications (DSRC) protocol [10], which is developed based on IEEE 802.11 WLAN [15] technologies for the purpose of exchanging information among the vehicles.

The field of Inter Vehicular Communications, including both vehicle-to-vehicle communications (V-V) and vehicle-to-roadside communications (V-R), is recognized as an important component of Intelligent Transportation Systems. The IEEE 802.11p medium access control (MAC) [6] uses carrier sense multiple access with collision avoidance and Enhanced Distributed Channel Access (EDCA) to differentiate packets using different priorities and maps them to specific Access Classes that are buffered in separate queue at a station. EDCA contains four Access Classes with different Arbitration Inter Frame Space Numbers (AIFSN).Inter Frame spaces is used to provide idle period on the medium after each frame transmission. IFSN provides less waiting time for high priority packets.

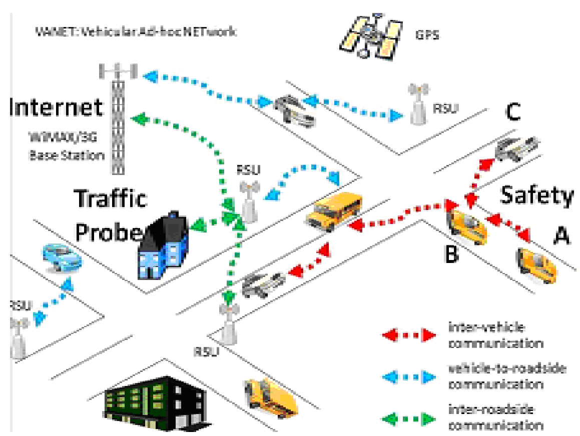

Fig 1. VANET: Vehicular Ad-hoc NETwork

In IEEE 802.11p, acknowledgements are not sent for the broadcasted packets. Therefore, the transmitter could not identify the lost packets and retransmit them. It tends to serious problem in collision warning applications where all the vehicles behind the accident have to receive the warning message successfully in a short time to avoid chain collision. The rest of the paper is described as follows. In section 2 we present the DSRC protocol. We present a comparative study of VANET routing protocols in section 3. We finally conclude in section 4 by showing that AMBA is better than other protocols.

2. Dedicated Short Range Communication Protocol

Dedicated Short Range Communication Protocol [5] is a dedicated routing protocol for VANET is developed to help the drivers to travel safely in the road by preventing road accidents. For DSRC applications, 75 MHz of spectrum in the 5.9 GHz frequency band has been allocated. Out of the 75 MHz spectrum, 5 MHz is reserved as the guard band and seven 10-MHz channels are defined. The spectrum is configured into 1 control channel (CCH) and 6 service channels (SCHs). The CCH is used to carry high-priority short messages [2], and the other messages are the SCHs. DSRC is one of the most effective means to deliver rapidly changing information to all the nearby vehicles. Traffic information is enhanced by using DSRC to collect vehicle link times and deliver this local traffic information back to all the participating vehicles. The goal of DSRC is to enable the driver of a vehicle to receive information about their surrounding environment.

2.1. Medium Access Control

The aim of Medium access control [12] is to prevent conflicts by ensuring that objects or users can only reach physical media if they have current access rights (i.e) to arbitrate the access to the shared medium, which in this case is the wireless channel. If no method is used to coordinate the transmission of data, than a large number of collisions would occur and the data sent would be lost. The ideal scenario is a MAC that prevents nodes within transmission range of each other from transmitting at the same time and no collision occur. MAC [7] mechanisms could be categorized as contention-based and contention-free. Contention-based approaches rely on carrier sensing, back-offs and retry schemes, while contention-free approaches rely on time division multiple access and synchronization schemes. Contention-based MAC method could also suffer from unbounded access delays. Contention-free MAC methods have the advantages that a QoS can be guaranteed and the performance is better under increased loads. They require more coordination to perform allocation, especially when the network configuration changes rapidly and portions need to be allocated and re-allocated frequently. It is widely accepted that contention-free MAC schemes exhibit better channel utilization.

2.2. Carrier Sense Multiple Access/Collision Avoidance

CSMA/CA is a Media Access Control (MAC) protocol that defines how network devices respond when two devices attempt to use a data channel simultaneously and encounter a data collision. The CSMA/CA rules define how long the device should wait if a collision occurs. When the medium becomes idle, the data node next in line is able to transmit data. The data node next in line waits for the medium to be idle again and then transmits its data. After each data node transmits data, the transmission order is updated to reflect what data nodes have already transmitted, moving each data node through the queue. Hidden Terminal Problem occurs when a node is visible from a wireless access point (AP), but not from other nodes communicating with that AP. This leads to difficulties in media access control. CSMA/CA can optionally be supplemented by the exchange of a Request to Send (RTS) packet sent by the sender S, and a Clear to Send (CTS) packet sent by the intended receiver R. This alerts all nodes within range of the sender, receiver or both, not to transmit during the duration of the main transmission. This is known as the IEEE 802.11 RTS/CTS exchange. Implementation of RTS/CTS helps to partially solve the hidden node problem that is often found in wireless networking.

3. Comparative Study of VANET Routing Protocols

3.1 Adaptive and Mobility Based Algorithm

AMBA [1] is used for enhancing reliability of DSRC control channel to transmit safety related messages in vehicular ad hoc network. In some cases, due to the large number of vehicles, the message could be propagated to all recipients in a multi hop fashion which may increase the time the message could spend on the MAC layer before it can be delivered without collisions. When a vehicle encounters an emergency situation such as an accident, lane change or slowing down below a certain threshold speed is analyzed. The vehicle that is involved in an emergency situation will send an emergency packet to all vehicles behind it who will select another vehicle as a relay node to rebroadcast the message to its neighbors. The emergency message continues to propagate until it reaches a certain distance *D* defined within the message itself. The vehicle uses the high priority access class (*AC*3) to send the emergency message after sensing an idle channel for an *AIFSN*. In order to increase the success packet reception, vehicles have to change their sending rate, communication range, carrier sense range (*LCS*) and minimum contention window size. When the vehicle density increase ,the effective range and success rate will decrease. At the same time the status packet delay will increase resulting in decreasing the system reliability. Increasing the carrier sense range will increase the contention region and decrease the hidden terminal region.

3.2. IEEE 802.11e EDCA

IEEE 802.11e EDCA [13] mechanism is used for prioritized access of safety messages over non-safety messages. This mechanism not only reduces the channel access time but also improves reception rates. In this scenario the probability of reception is measured using a two way ground model and the Nakagami model. Using a two way ground model large gains were achieved in the reception rates of emergency messages. Using the Nakagami model [13] the reception rates were much worse. Multi hop relaying and retransmission strategies are used to increase the reception rate of emergency messages. More realistic radio models are need for the simulation of wireless ad hoc networks. Topology control mechanisms need to be created for non deterministic models, such as varying the power level of a node. More insight into why the results were much worse with nondeterministic model are needed, such as determining if radio power fluctuation or node mobility were the main contributor to the poor results.

3.3. D-FPAV

Distributed Fair Power Adjustment for Vehicular environments (D-FPAV) [8] is used to control the load of status messages on the channel. D-FPAV provides Emergency Message Dissemination for Vehicular environments (EMDV) for fast and effective multi hop dissemination. Therefore, there is an improvement in probability of successful reception rate.

3.4. IEEE 802.11p/WAVE

IEEE 802.11p/WAVE [11] is used to get acknowledgement and retransmission of broadcast data in case of failure. This model is used to broadcast traffic prioritization on the CCH of an 802.11p/WAVE vehicular network with the aim of understanding the potentialities and limits of this timely technology. The focus has been on periodic broadcast messages, like beacons and WSAs, which are expected to be frequently and massively transmitted in a vehicular network under normal operating conditions, unlike event-based safety-critical messages that are transmitted only in the case of an emergency. There is no reliability in transmitting packets.

3.5. OLSR

Frequent topology changes and network fragmentations are generated due to limited coverage of Wi-Fi and high mobility. For these reasons that there is no central manager, routing packets through the network is a challenging task. OLSR [3] is a well-known mobile ad hoc network routing protocol to find optimal configurations automatically. The performance of the network under automatically optimized OLSR [4] is accurately defined. The disadvantage of this model is it works only under larger urban and highway VANET instances.

3.6.TraCI

TraCI [9] is the interface for interlinking road traffic and network simulators. This kind of interlinking of two simulators is required to perform realistic evaluation of VANET applications. This method allows us to control the behavior of vehicles during simulation runtime. The basic control commands for the road traffic simulation is generated and have implemented this commands as interfaces for that two open source simulators SUMO [14] and ns2 developed by different research communities. Using the TraCI interface one can even evaluate complex VANET scenarios, such as accidents or simulating hazardous road conditions (e.g., by modifying the speed of vehicles which have directly 'witnessed' such conditions). The disadvantage of this model is TraCI not supported for all road traffic simulators.

Comparative Table

PARAMETERS/ ALGORITHMS	OPERA	D-FPAV	WAVE	EDCA	TraCI	AMBA
Prior Forwarding	No	Yes	Yes	Yes	No	Yes
Chain Collision	Yes	Yes	No	No	No	No
Hidden Terminal Problem	Yes	No	No	No	No	No
Acknowledg-ement and Retransmission	No	No	Yes	No	No	Yes
Delay	Yes	Yes	Yes	Yes	No	No

Table1-Performance Analysis of Algorithms

4. Conclusion

Routing is an important component in vehicle-to-vehicle (V2V) and infrastructure-to-vehicle (I2V) communication. This paper discusses various algorithms of VANET for designing an efficient routing protocol. When compared to OPERA, D-FPAV, WAVE, EDCA Algorithms, AMBA algorithm is an efficient algorithm to implement VANET, By this AMBA algorithm, vehicles are able to calculate the vehicle density approximately and change their transmission parameters based on their current average speed to enhance VANETs' performance.

REFERENCES

[1] Khalid Abdel Hafeez, Lian Zhao, Bobby Ma, Jon W. Marky," Performance Analysis and Enhancement of the DSRC for VANET's Safety Applications" IEEE Transaction. Vehicular Technology ., vol.62, Sep 2013.

[2] C. Campolo, A. Molinaro, A. Vinel, and Y. Zhang, "Modeling prioritized broadcasting in multichannel vehicular networks," IEEE Trans. Vehicular Tech., vol. 61, no. 2, pp. 687 –701, Feb. 2012.

[3] T. Clausen and P. Jacquet, "Optimized Link State Routing Protocol (OLSR)," IETF RFC 3626, [online] Available in URL http://www.ietf.org/rfc/rfc3626.txt, United States, 2012.

[4] C. G´omez, D. Garc´ıa, and J. Paradells, "Improving performance of a Vehicular ad hoc network by tuning OLSR parameters," in ISCC '05: Proceedings of the 10th IEEE Symposium on Computers and Communications. Washington, DC, USA: IEEE Computer Society, 2011, pp. 16–21.

[5] J. He, Z. Tang, T. O'Farrell, and T. M. Chen, "Performance analysis of DSRC priority mechanism for road safety applications in vehicular networks," Wireless Communication and Mobile Computing (Wiley), vol.11, no. 7, pp. 980–990, July 2011.

[6] M.I. Hassan, H.L. Vu, and T. Sakurai, "Performance analysis of the IEEE 802.11 MAC protocol for DSRC safety applications," IEEE Trans. Vehicular Tech., vol. 60, no. 8, pp. 3882 –3896, 2011.

[7] ASTM International, "IEEE Draft Standard for Information Technology Telecommunications and information exchange between systems Local and metropolitan area networks Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications, Amendment 6: Wireless Access in Vehicular Environments. IEEE Std 802.11p," July 2010.

[8] M. Torrent-Moreno, J. Mittag, P. Santi, and H. Hartenstein, "Vehicle to vehicle communication: Fair transmit power control for safety critical information," IEEE Trans. Vehicular Tech., vol. 58, no. 7, pp. 3684–3703, 2009.

[9] Axel Wegener, M. Piorkowski, M. Raya, H. Hellbruck, S. Fischer, and J.P. Hubaux, "TraCI: An interface for coupling road traffic and network simulators," Wireless Communcations and Mobile Computing, WILEY, pp. 813–828, 2009.
[10] Z. Wang and M. Hassan, "How much of DSRC is available for non safety use?," Proceedings of the fifth ACM international workshop on Vehicular Inter-NETworking, pp. 23–29, 2008.
[11] IEEE P802.11p/D0.21, "Draft Amendment for Wireless Access in Vehicular Environments (WAVE)", Jan. 2006.
[12] IEEE Standard for Information technology, "Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications Amendment 8: Medium Access Control (MAC) Quality of Service Enhancements," IEEE Std. 802.11e-2005 Amendment to IEEE Std 802.11.
[13] M. Torrent-Moreno, D. Jiang, and H. Hartenstein, "Broadcast reception rates and effects of priority access in 802.11-based vehicular ad-hoc networks," Proceedings of the 1st ACM international workshop on Vehicular ad hoc networks, pp. 10–18, 2004.
[14] D. Krajzewicz, G. Hertkorn, C. Rssel, and P. Wagner, "SUMO (Simulation of Urban MObility). ; An open-source traffic simulation.," In 4th Middle East Symposium on Simulation and Modelling (MESM2002),Sharjah, United Arab Emirates, pp. 183–187, Sept. 2002.
[15] G. Bianchi, "Performance analysis of the IEEE 802.11 distributed coordination function," IEEE J. Select. Areas Communications, vol. 18, no. 3, pp. 535–547, 2000.

S.Sathya karthika received her B.E degree in Computer Science and Engineering from Anna University, Chennai in 2012. She is currently doing M.E in Computer science and Engineering at Anna University. Her research interest includes Vehicular Ad-hoc NETworks in Networking.

J.Rethna Virgil Jeny received her B.E and M.E degrees in Computer Science and Engineering from Bharathidasan University, Trichy in 1997 and Annamalai University in 2005 respectively. She is currently doing Ph.D in wireless sensor Networks at MS University. She has received Lady Engineer Award by IEI. She is a member of IEEE, ACM, ISTE, IEI, IAENG and a senior member of IACSIT. Her research interests include Energy aware routing and Cross layer routing in Wireless Sensor Networks.

J. Albert Simon received his B.E. in Computer Science and Engineering from Anna university, Tirunelveli with Distinction in 2011 and ME in Computer Science and Engineering from Anna university, Chennai with distinction in 2013.He has secured fifth rank in Anna University M.E Examination. He has presented papers in International and National Conferences. His research interest includes Wireless Mesh Networks and Network Security.