ISBN 978-93-5156-328-0
International Conference of Advance Research and Innovation (ICARI-2015)

Analysis of Location and Zone Based Routing in Vanet Using IEEE802.11P

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Article Info
Article history:
Received 9 January 2015
Received in revised form
15 January 2015
Accepted 20 January 2015
Available online 31 January 2015

Keywords
Vehicular adhoc Network,
MANET,
Zone Routing Protocol,
Location Aided Routing,
Intelligent Driver Model,
VanetMobiSim,
ns2

Abstract

Vehicular ad hoc network (VANET) is an emerging field which is a sub-category of MANET, where vehicles communicate with each other. Because of constraint pattern of roads and high speed of vehicles, path finding is a challenge in vehicular ad hoc networks. Most of the papers analyzed the performance of topology and position based routing protocols. This paper analyzed the performance of location aided routing (LAR) and zone routing protocol (ZRP) for city and highway scenarios. Vehicle's traces are obtained by VanetMobiSim, an intelligent driver model (IDM) based traffic simulator. Metrics for analysis of routing performance like packet delivery ratio, delay and normalized routing protocols re investigated and observed using ns2 with IEEE802.11p.The simulation results are analyzed using AWK programming script.

1. Introduction

Vehicular network formed by vehicles like car, bus, truck, cab, patrolling vehicles etc. plays an important role to convey some valuable information to neighbor vehicles and road-side units. These vehicles are assumed to have computing devices, event recording process running component, navigation unit, GPS system and transceivers. VANET make possible for vehicles to use safety application [1], collision control warning, Internet surfing and advertisement while moving on the road. Because vehicles move on regulated roads, they have a restricted mobility path [2]. In VANET environment mostly topology-based protocols AODV [3], DSR [4] are compared with location-based protocol LAR [5], distance effect protocol DREAM [6] and zone based protocols. These protocols need the geographical location of the vehicles.

In this paper performance analysis of LAR and ZRP in city as well as in highway environments are presented. An extended version of intelligent driver model (IDM) [7] based traffic simulator is used to provide realistic vehicular traffic movements.

2. Related Work

Routing protocols for VANET applications are categorized in topology and location based [8]. The routing performance of GSR, AODV and DSR protocols studied with a city vehicular network by Lochert et al in [9]. GSR is a hybrid concept combining topology and location based routing protocols. With delivery ratio and delay metrics GSR outperforms DSR and AODV. Authors in [10] did analysis of TORA, FSR, DSR and AODV in city scenario with IDM mobility model and observed that TORA is not suitable at all. Husain et al.[11] analyzed the performance of topology as well as location based protocols in VANET for city and highway network. Bakhouya et al. [12] did simulation of ZRP protocol using MOVE [13, 14] with

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simulation of ZRP protocol using MOVE [13, 14] with traffic simulator TraNS [15] and found that it is suitable for VANET but showing average performance. Ko et al. [16] perform the simulated study of LAR routing protocol with IDM and it shows that LAR is reasonably good candidate for VANET, because it uses geographical location of the nodes.

Nidhi and D.K. Lobiyal [17] consider the JNU real map and divide into smaller routes to study the mobility impact in VANET . In this paper, AODV protocol with clustering of traffic light is used at road intersections for regularization of the traffic in various directions. C. Tee and A. C. Lee [18] analyzed the routing performance of GPSR, AODV and DSR using NS-2 and IDM. From this research article authors concluded that GPSR performed better in VANET. Multi-path doppler routing protocol (MUDOR), DSR and DSDV has been simulated by S.Xi et al.[19] and found that MUDOR is best in VANET environment. Simulation of position and topology based protocols done by M. Azarmi, M. Sabaei, and H. Pedram [20] and position based routing protocols found better.

3. Location And Zone Based Routing Protocols

3.1 Location Aided Routing (LAR)

The main objective of LAR [16] is to lower the overhead caused by routing process, for which this protocol uses information about location of the nodes with the help of GPS or some other location service. By the use of location of the nodes, flooding is bounded to a limited region called request zone due to that route request packets are reduced. When finding the location of destination, LAR limit the search to a small area called expected zone where chances of being destination nodes are high, which reduces the overhead packets required for discovery process.

3.2 Zone Routing Protocol (ZRP)

Zone Routing Protocol (ZRP) [28] is a hybrid protocol which is designed by combining the best properties of both

ISBN 978-93-5156-328-0

proactive routing protocol as well as reactive routing protocol. The Zone Routing Protocol is based on the idea of creation of zones. For each node routing zone has been defined. The radius of the routing zone is expressed in hops. The zone includes the nodes, whose distance from the particular node is at most the radius of the zone i.e.; the number of hops.

4. Simulation Model

Mostly routing protocols are simulated using network simulators like ns-2 [21],OMNeT++[22], J-SIM [23], and JiST/ SWANS[24]. Movements of vehicle patterns are generated using traffic simulators like CORSIM, VISSIM, SUMO, and VanetMobiSim. VanetMobiSim is most suitable for vehicular network because it is integrated with components for intersection management (IDM_IM), lane changing (IDM_LC) and traffic lights. Analysis of LAR in this paper is done using the network simulator ns-2.33 with IDM_IM based VanetMobiSim [25-27] traffic simulator in VANET environment.

4.1 System Model

The parameters for vehicles mobility of VanetMobiSim simulator are shown in Table 1. IEEE 802.11p MAC/PHY protocol is implemented in ns-2.33 for the vehicles to communicate with road-side units or other vehicles.

Table: 1. Parameters Used in Mobility Model

Parameter	Value
Vehicle length	5 m
Jam distance	2m
Safe headway time	1.5s
Safe deceleration	4 m/s^2
Maximum acceleration of movement	0.6 m/s^2
Politeness factor of driver	0.5
Threshold acceleration	0.2 m/s^2

The transmission range is taken to be 250 meters. The traffic light period is kept constant at 60 seconds. Simulations are repeated varying the speed, that is, 20 km/h (city) and 115 km/h (highway) and varying the node density.

Table: 2: Parameters Used in Network Simulator

Parameter	Value
Simulation tool	NS-2 version 2.33
MAC protocol	IEEE802.11p
Vehicles Mobility model	IDM
Communication range	250 m
VANET area	1000m x 1000m
Type of Channel	Wireless
Type of Antenna	Omni-directional
Simulation duration	900s
Size of packet	512 Bytes
Rate of data transmission	8 packets/s
Pause time	10s
Bandwidth	2 Mbps
Type of Traffic	Constant Bit Rate(CBR)
Vehicular speed	20km/hr(city) and 115km/hr(highway)
Interface queue	Priority Queue
Size of Interface queue	50 packets
Density of vehicles	5 to 40
Routing protocols	LAR and ZRP

5. Result and Discussion

The following performance metrics are considered to evaluate and analyze the performance of LAR and ZRP routing protocols:

5.1 Packet Delivery Ratio (PDR)

PDR is the ratio of the total number of data packets successfully delivered divided to the total data packets transmitted by all the nodes in a network. Mathematically, packet delivery ratio (PDR) = Sa / Sb

Where, Sa = Sum of the data packets received by each destination

Sb = Sum of the data packets generated by each CBR source

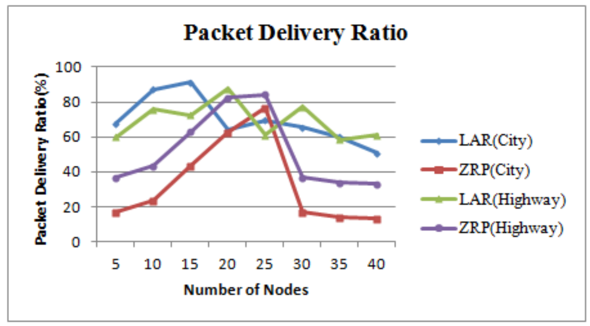

Fig: 1. Packet Delivery Ratio in City and Highway Scenario

Figure1 represents the ratio of packets that are transmitted during simulation by ns-2. It is observed that the performance of LAR is better than ZRP in city as well as in highway scenario. When node density is less than 10 nodes, packet delivery ratio of all the protocols is below 60% except LAR in city scenario and for the density between 15 to 30 nodes it is above 70%. For node densities beyond 30 nodes, the PDR starts to decreases.

5.2 Delay

Delay is the sum of buffering time, queuing time, MAC layer retransmission time of packets and delay in propagation.

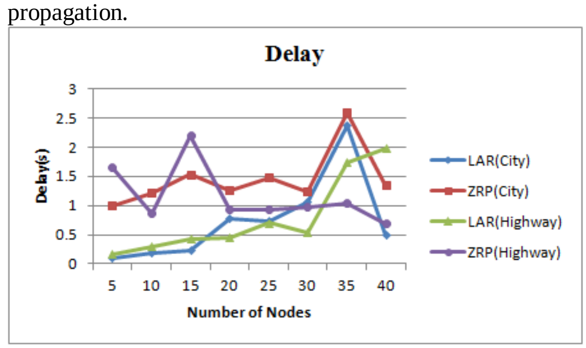

Fig: 2. Delay in City and Highway Scenario

Mathematically, average end-to-end delay = S / N

Where,

S = Sum of time spent to deliver packets for each destination, and

N = Number of packets received by all the destination nodes.

Figure 2 summarizes the variation of end to end delay by varying node density. It is also evident that average delay increases with increasing the number of nodes. At low node density, ZRP in highway scenario consistently presents the highest delay. This may be explained by the fact that its route discovery process takes a relatively more time. LAR in city scenario has the lowest delay compared to ZRP in both scenarios..

5.3 Normalized Routing Load (NRL)

Normalized routing load includes the number of route request packets transmitted, number of route reply packets transmitted, number of route error packets transmitted, number of route errors resent packets.

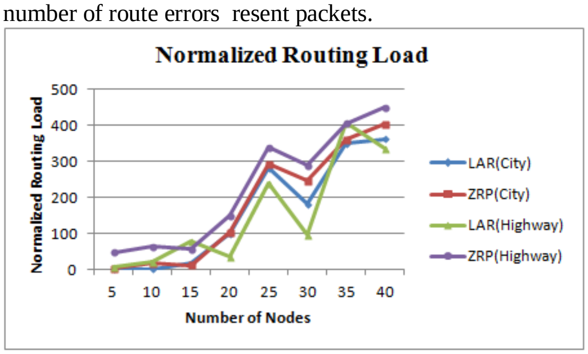

Fig: 3. Routing Overhead in City and Highway Scenario

Mathematically, Routing overhead load (ROL) = St/ Sr

Where,

St = Sum of routing packets transmitted by each source and destination

Sr = Sum of data packets received by each destination.

As shown in Figure 3, ZRP in highway scenario causes the highest routing overhead as compared to LAR in both scenarios and ZRP in city scenario. It is observed from the Figure 3 that routing overhead load increases as the wireless channel is shared by more and more nodes. LAR in both scenarios showed the lowest overhead in comparison to ZRP. It shows that LAR outperforms in both city as well as highway scenario.

6. Conclusions

This research paper, analyzed the ZRP and LAR routing protocols in vehicular ad hoc considering various metrics in city and highway scenarios. For the analysis, ns-2.33 with an advanced intelligent driver model (IDM_IM) of VanetMobiSim which is a traffic simulator is used to generate realistic mobility patterns in VANET. It is observed that LAR performs better than ZRP protocol in VANET for most of the metrics.

References

[1] X. Yang et al., A vehicle-to-vehicle communication protocol for cooperative collision warning," in The IEEE First Annual International Conference on Mobile and Ubiquitous Systems (MOBIQUITOUS): Networking and Services, Boston, Massachusetts, USA, 2004, 114-123

[2] J. Bernsen, D. Manivannan, Unicast routing protocols for vehicular ad hoc networks: A critical comparison and classification, Pervasive and Mobile Computing, 5, 2009, 1-18

[3] C. E. Perkins, E. M. Royer, Ad-hoc on-demand distance vector routing," in Second IEEE Workshopon Mobile Computing Systems and Applications, New Orleans, Louisiana, USA, 1999, 90-100

[4] D. B. Johnson, D. A. Maltz, Dynamic source routing in ad hoc wireless networks, in Mobile computing, ed: Springer, 1996, 153-181

[5] T. Camp et al., Performance comparison of two location based routing protocols for ad hoc networks, in Proceedings of Twenty-First Annual Joint Conference of the IEEE Computer and Communications Societies. New York, NY, USA, 2002, 1678-1687

[6] S. Basagni et al., A distance routing effect algorithm for mobility (ZRP), in Proceedings of the 4th annual ACM/IEEE international conference on Mobile computing and networking, Dallas, TX, 1998, 76-84

[7] J. Haerri et al., Performance comparison of AODV and OLSR in VANETs urban environments under realistic mobility patterns, in Proceedings of Fifth IFIP Mediterranean Ad-Hoc Networking Workshop (Med-Hoc-Net-2006), Lipari, Italy, 2006

[8] M. Mauve et al., A survey on position-based routing in mobile ad hoc networks, IEEE Network Magazine, 15, 2001, 30-39

[9] C. Lochert et al., A routing strategy for vehicular ad hoc networks in city environments, in IEEE Proceedings of Intelligent Vehicles Symposium, Columbus, OH, USA, 2003, 156-161

[10] S. Jaap et al., Evaluation of routing protocols for vehicular ad hoc networks in typical road traffic scenarios, in Proceedings of the Eleventh EUNICE Open European Summer School on Networked Applications, Colmenarejo, 2005, 584-602.

[11] A. Husain et al., Performance evaluation of routing protocols in vehicular ad hoc networks, International Journal of Internet Protocol Technology, 6, 2011, 38-45

[12] M. Bakhouya et al., Performance evaluation of DREAM protocol for inter-vehicle communication, in First International Conference on Wireless Communication, Vehicular Technology, Information Theory and Aerospace & Electronic Systems Technology (Wireless VITAE), Aalborg, Denmark, 2009, 289-293

[13] K. C. LAN et Al., Rapid Generation of Realistic Mobility Models for VANET, in IEEE Wireless Communications and Networking Conference (WCNC), Hong Kong, 2007

[14] F. K. Karnadi et al., Rapid generation of realistic mobility models for VANET, in IEEE Wireless Communications and Networking Conference (WCNC 2007) Hong Kong, 2007, 2506-2511

[15] M. Piorkowski et al., TraNS: realistic joint traffic and network simulator for VANETs, ACM SIGMOBILE Mobile Computing and Communications Review, 12, , 2008, 31-33

[16] Y. B. Ko, N. H. Vaidya, Location-Aided Routing (LAR) in mobile ad hoc networks, Wireless Networks, 6, 2000, 307-321

[17] D. Lobiyal, Performance Evaluation of Realistic Vanet Using Traffic Light Scenario, arXiv preprint arXiv:1203.2195, 2012
[18] C. Tee, A. C. Lee, Survey of position based routing for inter vehicle communication system, in IEEE First International Conference on Distributed Framework and Applications (DFmA), Penang, 2008, 174-182
[19] S. Xi, X. M. Li, Study of the Feasibility of VANET and its Routing Protocols, in 4th International Conference on Wireless Communications, Networking and Mobile Computing (WiCOM)., 2008, 1-4
[20] M. Azarmi et al., Adaptive routing protocols for vehicular ad hoc networks, in International Symposium on Telecommunications (IST), 2008, 825-830
[21] K. Fall, K. Varadhan, The network simulator (ns-2), URL: http://www. isi. edu/nsnam/ns, 2007
[22] A. Varga, "The OMNeT++ discrete event simulation system (2005), URL http://www. omnetpp. org/download/docs/papers/esm2001-meth48. pdf.
[23] A. Sobeih et al., JSim: a simulation and emulation environment for wireless sensor networks, IEEE Transactions on Wireless Communications, 13, 2006, 104-119
[24] R. Barr et al., Jist: Embedding simulation time into a virtual machine, in EuroSim congress on modelling and simulation, 2004.
[25] J. Harri, M. Fiore, VanetMobiSim–Vehicular Ad hoc Network mobility extension to the CanuMobiSim framework, Institut Eurécom Department of Mobile Commu, 6904, 2006
[26] J. Härri et al., VanetMobiSim: generating realistic mobility patterns for VANETs, in Proceedings of the Third International Workshop on Vehicular ad hoc networks, 2006, 96-97
[27] VanetMobiSim, available: http://vanet.eurecom.tr.
[28] Z. J. Hass et al., The Zone Routing Protocol (ZRP) for Ad Hoc Networks, Internet-Draft,http://tools.ietf.org/id/draft-ietf-manet-zone-zrp-04.txt,2002