© 2015 IJEDR | Volume 3, Issue 4 | ISSN: 2321-9939

An Overview of Routing Protocols Performance for VANETs with Real World Map Data: A Survey

[1]Narendra Baghel, [2]Chandrakant Mahobia
[1]M.Tech. Scholar, [2]Assistant Professor
[1]CSE Department,
[1]School of Engg. & IT, MATS University, Gullu-Aarang Campus, Raipur(C.G.), INDIA

***Abstract* - VANETs stand for Vehicular Ad Hoc Networks where a very short lifetime network is formed among the vehicles. All the vehicles itself are acting as the nodes within the network. Since such network is formed by vehicles so node speed is limited by the factors like road structure, traffic conditions, traffic rules and infrastructure. These factors arise many research challenges in VANETs, and also consist critical design of an efficient routing protocol for VANETs. In such a network, there are two kinds of communication are involved i.e. between vehicle to vehicle and vehicle to roadside unit (RSUs) communication. Therefore, the performances of such communication depend on the various protocols like AODV, DSR, DSDV etc. Since the performance of protocol should be considered for realistic traffic and road side conditions. In this paper we present comparative analysis of VANETs routing protocol based on different parameters like packet delivery fraction, E2E delay and routing overhead. This analysis is to find the suitability and functionality of these routing protocols for vehicular area networks under real world map data or under realistic road side conditions.**

***Index Terms* -Vehicular Ad Hoc Networks (VANETs), Routing Protocols, AODV, DSR and DSDV.**

I. INTRODUCTION

Either Traffic Accident or Traffic Jam are most challenging issue in the 21th century. In present time, governments are facing troubles with an increasing number of vehicles. The country like INDIA, which is a developing country, this issue is much more critical where there is no balance between the improvement of road infrastructure and the growth of traffic conditions. Furthermore, statistics show that only relying on the construction and expansion of transport infrastructure cannot be the ultimate solution for this problem. Consequently, there is a need to find ways to decrease optimize and manage considerable costs of traffic jam for governments & citizens and to find ways for having safe, quick and convenient transportation [1].

There are different solutions for this problem, and one of the novel approaches is intelligent transportation system (ITS). ITS is a novel idea to manage and mitigate traffic issues. ITS includes variety of novel technologies trying to evaluate, observe and analyze traffics among vehicles and integrate various technologies to obtain following aims like : traffic efficiency, cost saving, energy efficient, safety environment and reducing time [2]. An ITS system involves a wide range of systems such as portable systems, standalone systems installed on vehicles, systems that enable vehicle-to-vehicle (V2V) and vehicle-to-infrastructure(V2I) communication, and finally cooperative systems [1]. In short, an ITS system is very effective and appropriate to establish a safe and convenient environment for drivers and a supportable connection between vehicles.

A wireless ad hoc is a decentralized wireless network [3] which does not depend on pre-existing infrastructure like routers in a wired network or an access point in a managed wireless network. In other words, a wireless ad hoc network is an answer to novel wireless structures that are self healing and self organizing in which each node can participate in routing and all of devices have equal status in the network. The term "ad-hoc networks" is usually associated with a form of operation of IEEE 802.11 wireless networks [4].

There are various types of ad hoc networks and one of them is called VANET [5]. Vehicular Ad Hoc Network (VANET) is a branch of Mobile Ad hoc Network (MANET). MANET and VANET have some common characteristics such as low bandwidth, self organization in nature and sharing radio transmission range of other nodes. The main duty of VANET is the provision of vehicle-to-vehicle wireless communication and vehicle-to-infrastructure communication (e.g., between vehicles and road side units), and these connections can be established without central access. The communication between vehicles has some specifics such as high speed and mobility, and that is the key feature of vehicular ad-hoc networks that makes them unique in the context of MANETs [4].

By using vehicle to vehicle communications, drivers can be notified of important traffic data such as the condition of roads, traffic jams and accidents. Such information will improve drivers' decisions in hard conditions. Moreover, vehicular communications will help to monitor and manage traffic distribution and to improve vehicle fuel economy.

II. ROUTING PROTOCOLS IN VANET

A routing protocol governs the way in which communication takes place between different entities to exchange the desired information in the considerable amount of time. Fig.1 illustrates the hierarchy of these VANET routing protocols which can be classified as following:

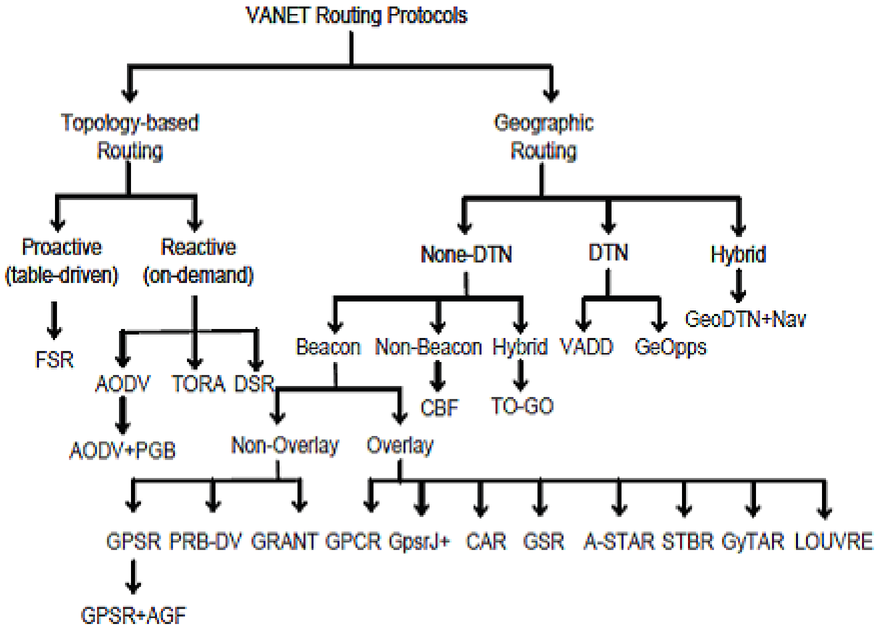

Fig 1: VANETs Routing Protocols[28]

In this paper we focused on only some basic featured routing protocol for VANETs.

A. *DSDV Routing Protocol*

DSDV stands for Destination Sequence Distance Vector. This is a kind of proactive routing protocol in which every node maintains a table of information in the presence of every other node in the network [6]. It updates the routing table periodically when change occurred in the network. It broadcast to every node in the network whenever any change occurs in the network.

B. *AODV Routing Protocol*

AODV stands for Ad hoc on Demand Distance Vector. This is a kind of reactive routing protocol which establishes a route to a destination when there is a demand occurs for the transmission of the data [7]. AODV routing protocol consists < RREQ, RREP> pair of message to find the route. AODV updates the relevant neighboring node(s) instead of broadcasting every node of the network.

C. *DSR Routing Protocol*

DSR stands for Dynamic Source Routing. This is also a kind reactive routing protocol as AODV. Every neighbor in DSR enables to maintain the entire network route from source to the destination [8].

D. *ZRP Protocol*

The Zone Routing Protocol (ZRP) merges the desirable features of the both proactive and reactive protocols by maintaining an up-to-date topological map of a zone centered on each node; routes are immediately available within the zone. ZRP employs a route discovery procedure for destinations node outside the zone which can benefit from the local routing information of the zones [21].

E. *GPSR Protocol*

GPSR (Greedy Perimeter Stateless Routing) makes greedy forwarding decisions using router's immediate neighbor's information in the network topology. When a packet arrives at a region where greedy forwarding is unfeasible, the greedy algorithm retrieves by routing around the perimeter of the region. By trusting state only about the local topology, GPSR protocol does improved performance in per-router state compared to shortest-path and ad-hoc routing protocols while increasing the number of network destinations. In frequent changing topology due to mobility of nodes, GPSR protocol uses local topology information to find correct new routes speedily [22].

F. *LAR Protocol*

Location-Aided Routing (LAR) bound the search for a new route to a smaller "request zone" of the ad hoc network. This feature makes a significant reduction in the number of routing messages [23].

G. *ALERT Protocol*

ALERT with dynamism divides the network field into zones and randomly chooses nodes in zones as intermediary relay nodes, which form a non distinguishable anonymous route. In addition, it hides the data sender/receiver among many senders/receivers to toughen source and destination anonymity protection. Thus, ALERT recommends anonymity protection to sources, destinations, and routes. It also has proposed action to effectively counter intersection and timing attacks [24].

H. DYMO Protocol

The routing protocol DYMO (Dynamic MANET) showed that for small amounts of payload data to be transported, ad hoc networks of vehicles and static highway infrastructure can be profitably setup, maintained, and used with well known protocols from the Internet protocol suite alone. Under low node densities and sparse access point deployment adequate to support routine polling of information via an Internet gateway, e.g. the checking of a POP3 mailbox. Predominantly at larger node densities, which commonly happen in traffic-jams, the routing and transport protocol behavior lead to a drastic increase in network load [25].

I. CBF Protocol

CBF (Contention-Based Forwarding) [26] Protocol does not make use of beacons. CBF protocol work well if there has a data packet to send, the sending node will broadcast the packet to all neighbors directly & these neighbors will select out among themselves that which will forward the packet.

J. LOUVRE Protocol

LOUVRE (Landmark Overlays for Urban Vehicular Routing Environments) [27] is a geo-proactive overlay routing protocol which make certain to obtain an obstacle-free routing on the overlay links and also minimize the chances of falling into a local maximum.

Although there are lot of other protocols are also developed, but all those protocols could not be covered regardless of their cons and pros. So, above protocols are explained to understand the different approaches of designing the particular routing protocol.

III. RELATED WORK

This section will try to sum up some author's work regarding protocol performance with real world map data or realistic road side conditions for VANETs architecture.

Very few comparative studies [9], [10], [11], [12] have been conducted to evaluate performance of both proactive and reactive routing protocols in VANETs. With reference [9] the performance of AODV, DSR, TORA and FSR is evaluated. The simulation was carried out an urban scenario; it shows that AODV performed better than others protocols. The routing protocol TORA suffered due to high routing overhead, resulting in low throughput. The routing protocols DSR and FSR showed approx similar performance specifically that DSR had higher average delay than FSR protocol. This research article did not considered an important proactive routing protocol OLSR. Also this paper was focused on urban scenario.

With reference [10], another study was carried out comparison of AODV and OLSR in urban environments and found that OLSR performs better than AODV in VANETs. This research article used many performance metrics such as Packet Delivery Ratio (PDR) against average velocity, Constant Bit Rate (CBR) data generation, node density, Routing Overhead Ratio (ROR) against CBR data generation and node density, delay and average number of hops, etc. and evaluated protocols performance using them. The routing protocol OLSR was able to cope with node density, end-to-end delays and has less ROR and high PDR than AODV. Also this paper focused only on the urban scenario and they fail to analyze the effects of emergency events during communication.

With reference [11] AODV, DSR and OLSR protocols are simulated to measure their performance in urban environment with traffic signals and stop signs. The simulator SUMO is used to create both urban and rural topologies. The simulated result showed that OLSR outperforms both AODV and DSR in the urban environment. The routing protocol OLSR have better performance of throughput, little or no delay and jitter over other ad hoc routing protocols.

With reference [12] authors have discussed ad-hoc, geographic based and clustered-based routing protocols. Urban scenario is setup for simulation with high obstacles such as buildings. Throughout simulative performance, it was found that geographic routing protocols perform better than ad-hoc routing protocols.

Dedicated short-range communications (DSRC) yields set of protocols and standards for medium-range wireless communication channels specifically designed for traffic management [13]. DSRC uses 75 MHz of spectrum in the 5.9 GHz band [13]. IEEE 802.11p [14] standard is used for wireless access in the vehicular environment (WAVE) [13]. IEEE 802.11p supports data communication between vehicles, in turn supports Intelligent Transportation Systems (ITS). The channel capacity is 10 MHz and Radio communication range is about 300 to 1000 meters and data rate is 6 to 27 Mbps [13 and 14].

With References [15] and [16] describe ad-hoc network implementation using NS2. Reference [17] and [18] explain mobility generators for VANET. Authors of [19] and [20] explore routing performance for VANET. This paper deals with analysis of existing routing protocols for VANET using real world city map like Bangalore. The routing protocol GPSR shows better performance and suits well for the considered city map.

Different Approaches	AODV	DSR	LAR	GRID	TMNR	GPSR	CBF
Fraction of Packet Delivery	GOOD	FAIR	GOOD	FAIR	AVG.	AVG.	GOOD
End-to-End Delay	AVG.	GOOD	FAIR	FAIR	FAIR	FAIR	GOOD
Normalized Routing Load	FAIR	GOOD	FAIR	GOOD	FAIR	FAIR	GOOD
Packet Duplication	LOW	LOW	LOW	LOW	LOW	LOW	HIGH

Fig 2: Performance tradeoffs of each routing protocol

Fig.2 shows the performance tradeoff of different VANETs routing protocols which works on real world map data.

IV. CONCLUSION & FUTURE WORK

Vehicular Ad-hoc Networks (VANETs) suffer from high speed of nodes mobility, subsequently network route path changes frequently and depends on urban road infrastructure. This situation makes it necessary to consider realistic and specific road map topology. After looking out the comparative tradeoffs of routing protocols, one can suggest to use AODV or CBF routing protocol for the city road map considered in this analysis work. Future work includes implementation & simulation of a real world related complex network that could combine not only ad-hoc communication but also infrastructure communication like ITS (Intelligent Transportation System). It is highly desirable that the developed applications and protocols should be tested under realistic road traffic conditions like real world map data.

REFERENCES

[1]. FEMA Position Paper, 2011, “Intelligent Transport Systems (ITS)”.

[2]. SHENG-HAI AN, B.-H. L. DONG-RYEOL SHIN, 2011, “A Survey of Intelligent Transportation Systems”, Third International Conference on Computational Intelligence, Communication Systems and Networks, CA 795-895.

[3]. Chai Keong Toh, 2002, “Ad Hoc Mobile Wireless Networks”, Prentice Hall Publishers.

[4]. C. Siva Ram Murthy and B. S. Manoj, May 2004, “Ad hoc Wireless Networks: Architectures and Protocols”, Prentice Hall PTR.

[5]. FAN, L, YU, W, 2007, “Routing in vehicular ad hoc networks: A survey”, Vehicular Technology Magazine, IEEE, 2, 12-22.

[6]. Dharmendra Sutariya, Shrikant Pradhan, “Evaluation of Routing Protocols for Vanets in City Scenarios” 978-1-4577 IEEE, 2011.

[7].C. Perkins, E. Belding-Royer, S. Das, "Ad hoc On-Demand Distance Vector (AODV) Routing", RFC 3561, July 2003.

[8]. D. Johnson, D. A. Maltz, Y.-C. Hu, “The Dynamic Source Routing Protocol for Mobile Ad Hoc Networks (DSR)"}, IETF Internet Draft, work in progress, draft-ietf-manet-dsr-09.txt, April 2003.

[9]. Jaap, S. Bechler, M., and Wolf, L., "Evaluation of Routing Protocols for Vehicular Ad Hoc Networks in City Traffic Scenarios, “In Proceedings of the 5th International Conference on Intelligent Transportation Systems Telecommunications(ITST), Brest, France, June 2005.

[10]. Haerri, J., Filali, F., and Bonnet, C., "Performance Comparison of AODV and OLSR in VANETs Urban Environments under Realistic Mobility Patterns," In Proceedings of the 5th IFIP Mediterranean Ad-Hoc Networking Workshop, pp 14--17, Lipari, Italy, June 2006.

[11]. Chan, W., Sim, M., and Lee, S., "Performance Analysis of Vehicular Ad Hoc Networks with Realistic Mobility Pattern," In Proceedings of the 2007 IEEE International Conference on Telecommunications and Malaysia International Conference on Communications, pp 14-17, Penang, Malaysia, May 2007.

[12]. Ho, Y. H., Ho, A. H., and Hua, K. A., “Routing Protocols for Inter-Vehicular Networks: A Comparative Study in High-Mobility and Large Obstacles Environments”, In Computer Communications Journal – Elsevier- Special Issue on Mobility Protocols for ITS/VANETpp. 2767-2780. 2008.
[13]. Roberto A. Uzcátegui “WAVE: a tutorial” IEEE Communications Magazine , 2009, pp.126-133.
[14]. Daniel Jiang “IEEE 802.11p: towards an international standard for wireless access in vehicular environments”, Vehicular Technology Conference, May 2008, pp.2036-2040.
[15]. Network Simulator:NS2 http://www.isi.edu/nsnam/ns.
[16]. Aliff Umair Salleh and Zulkifli Ishak, “Trace analyzer for NS-2”, Research and Development, June 2006, pp. 29-32.
[17]. J. Haerri, F. Filali, C. Bonnet, “Mobility models for vehicular ad hoc networks: a survey and taxonomy”. IEEE Communications Surveys and Tutorials, vol. 11, 2009, pp.19-41.
[18]. Feliz Kristianto Karnadi and Chien-Ming Chou “Realistic mobility models for vehicular ad hoc network (VANET) simulations”, Wireless Communications and Networking Conference, March 2007, pp.2506-2511.
[19]. Fan Li and Yu Wang “Routing in vehicular ad hoc network : a survey”, Vehicular Technology Magazine, IEEE , vol.2, June 2007, pp.12-22.
[20]. C. Siva Ram Murthy and B.S.Manoj “AD-HOC Wireless Networks architecture and protocols" Pearson Education, 2011.
[21]. Nicklas Beijar “Zone Routing Protocol (ZRP)” Nicklas Beijar Networking Laboratory, Helsinki University of Technology P.O. Box 3000, FIN-02015 HUT, Finland.
[22].Brad Karp and H. T. Kung “GPSR: Greedy Perimeter Stateless Routing for Wireless Networks”,Mobicomm 00 Proceedings of 6th annual international conference on mobile computing and networking , pages 243-254,year-2000, ISBN : 1-58113-197-6.
[23].Young-Bae Ko and Nitin H. Vaidya “Location-Aided Routing (LAR) in mobile ad hoc networks”,Wireless networks (2000),volume 6 , issue 4, pp 307-321, Online ISSN 1572-8196 .
[24]. Haiying Shen and Lianyu Zhao “ALERT : An Anonymous Location Based Efficient Routing Protocol in MANETs”, Mobile Computing, (2012)IEEE Transactions on (Volume:12 , Issue: 6), PP: 1079-1093,ISSN: 1536-1233.
[25]. Christoph Sommer and Falko Dressler “The DYMO Routing Protocol in VANET Scenarios”, Vehicular Technology Conference, 2007,VTC-2007 Fall IEEE 66th, Page-16-20, ISSN : 1090-3038.
[26]. F¨ußler, H., Hannes, H., J¨org, W., Martin, M., Wolfgang, E. (2004), “Contention-Based Forwarding for Street Scenarios,” Proceedings of the 1st International Workshop in Intelligent Transportation (WIT 2004), pages 155–160, Hamburg, Germany, March 2004.
[27]. Lee, K., Le, M., Haerri J., and Gerla, M. (2008), “Louvre: Landmark overlays for urban vehicular routing environments,” Proceedings of IEEE WiVeC, 2008.
[28]. Maheshwari Khushbu, “Network Coding Based Multi-copy Protocol to Anycast Information in VANET”,IJEDR, Volume 2, Issue 2 | ISSN: 2321-9939,2014.