

A Novel Algorithm for Optimizing Headway Distance for Connectivity in VANETs

Parul Sharma¹, Simranjit Kaur², Sourabh Mahajan³

M. Tech Scholar, Department of ECE, S.S.C.E.T, Badhani, Pathankot, India¹

Assistant Professor, Department of ECE, S.S.C.E.T, Badhani, Pathankot, India²

Assistant Professor, Department of ECE, S.S.C.E.T, Badhani, Pathankot, India³

ABSTRACT: Vehicular Ad hoc Networks (VANETS) enable the vehicles to communicate with each other as well as with road side units on the other side. The knowledge of vehicle headway distribution is essential for estimating the probability of connectivity in vehicle ad hoc networks. The distribution of vehicles in a single lane has been taken into account that consecutive vehicles have to maintain a minimum safe distance between them. Although minimum headway distance based VANETS has shown better results than other techniques but still suffers from abnormal environmental conditions. This paper proposes technique which utilized dynamic communication and dynamic path selection using artificial bee colony algorithm to enhance the results of VANETS further.

KEYWORDS: Road side units, Genetic algorithm, Dynamic path, VANETS, Artificial Bee colony optimization.

I. INTRODUCTION

Vehicular Ad Hoc Networks (VANETs) are created by applying the principles of mobile ad hoc networks (MANETs) - the spontaneous creation of a wireless network for data exchange - to the domain of vehicles. They are a key component of intelligent transportation systems (ITS). While, in the early 2000s, VANETs were seen as a mere one-to-one application of MANET principles, they have since then developed into a field of research in their own right. By 2015, the term VANET became mostly synonymous with the more generic term inter-vehicle communication (IVC), although the focus remains on the aspect of spontaneous networking, much less on the use of infrastructure like Road Side Units (RSUs) or cellular networks. VANET is one of the impactful areas for the improvement of ITS in order to provide road safety and comfort to people. It enables vehicles to actively communicate with each other and to perceive the road situation such as accidents or traffic jams effectively in their vicinity. VANET enables vehicles to avoid problems either by undertaking preventive actions and safety measures or by alerting other drivers. In ITS, each vehicle plays the role of sender, receiver and router to broadcast information to the vehicular network or transportation agency, which then uses the information to ensure safe, free-flow of traffic. VANET is one of the impactful areas for the improvement of ITS in order to provide road safety and comfort to people.

II. VANETS COMMUNICATION TECHNOLOGY

VANET enables communication between moving vehicles and the fixed Road side units (RSU) via Wireless fidelity (WiFi), Bluetooth and other mobile connectivity protocols. For making communication between vehicles and RSU, vehicles must be equipped with some sort of radio interface or On4 board unit (OBU) that enables short-range wireless ad hoc networks to be formed.

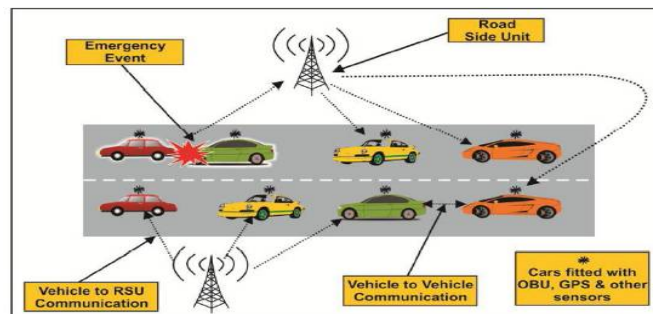


Figure 1: Vehicular network infrastructure

Vehicles can additionally be fitted with hardware that permits detailed position information such as Global positioning system (GPS) or a Differential global positioning system (DGPS) receiver. Fixed RSU, which are connected to the backbone network, must be in place to facilitate communication. The number of RSUs distribution is dependent on the communication protocol to be used. For example, some protocols require roadside units to be distributed evenly throughout the whole road network; some require roadside units only at intersections, while others require roadside units only at region borders.

The three groups of message transmission existent in VANET are RSU-to-OBU/ Infrastructure-to-Vehicle (I2V), OBU-to-RSU/ Vehicle-to-Infrastructure (V2I) and OBU-to-OBU/Vehicle-to-Vehicle (V2V) communications (Fig.1.3). Sichitiu & Kihl (2008) have contributed a complete description of the V2V communications. The VANET communication which happens between groups of vehicles directly is termed as ‘one-hop’ interaction or node re-transmits data via ‘multi-hop’ interaction. In order to expand the communication strength, the deployed RSUs act as a gateway to the internet for collecting, processing and storing information. For effective communication, VANET are likely to employ a myriad of wireless technologies.

III. CHALLENGES IN VANETS

The main characteristic of decentralization backed by self management is the cause of security, dissemination and mobility challenges that surface while designing VANET. The difficulty in facing these challenges amplifies further because of the short-range communication. The challenges that VANET tend to face are discussed below.

1. Medium Access Control Protocols

There is a need to design MAC protocols for handling quickly changing services, allocating shared channel access and alleviating the medium access delay for ensuring increased reliability. Further, these protocols should give more priority to event-driven messages instead of periodic messages ensuring comfort. These are actually the two types of messages circulated in the CCH. The periodic messages contain beaconing status to nearby vehicles, such as position, speed and direction. On the other hand, event-driven messages are emergency ones sent to other vehicles, time. Another problem is of hidden terminals that hinder the performance in VANET. This problem arises when the nodes are out of radio range to each other and may try to access the medium simultaneously due to which the receiving channels witness data collision. The major drawback of the hidden terminals in VANET is that, there is no common definition for the problem when a broadcast ad hoc network is considered. Moreover, signals undergo fading in a real system and therefore it is hard to define “communication range” and when two nodes are “out of radio range”.

2. Mobility Management

When VANET applications offer internet-based services, the access is facilitated by the Internet gateways (IGW) that are deployed along the RSU. However, the highly mobile vehicles tend to change the IGW often while accessing the services. This makes it essential to have powerful ensuring smooth access anytime and anywhere. Although the communication stack implements the IPv6, the ad hoc communication does not support it to ensure mobility management. Seamless communication is crucial in terms of QoS to ubiquitous computing application particularly in real time services. Mobility management protocols in VANET are envisioned to support mobile nodes i.e., vehicles,

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

with seamless communications, in which service continuity is guaranteed while vehicles are roaming through different RSU with heterogeneous wireless technologies.

3. Information Dissemination

Distributing information over long distances in VANET is a very challenging task. It can be executed only when the inherent characteristics and limitations described in section 1.3 are taken into consideration for all components of the system. The message dissemination is difficult due to the following challenges:

- Obtain information - how to convert the local observations into a data basis for the application.
- Transport the information - how to deliver the information to interested parties in other parts of the network.
- Summarize measurements - how to combine very similar attributes to reduce redundancy among participating nodes.
- Aggregate information - how to accumulate information on larger geographical area.

IV. RELATED WORK

Wisitpongphan et al. (2007) [1] represents vehicular ad hoc network (VANET) may exhibit a bipolar behaviour, i.e., the network can either be fully connected or sparsely connected depending on the time of day or on the market penetration rate of the wireless communication devices. Vehicular safety applications, a new ad hoc routing protocol will be needed as the conventional ad hoc routing protocols such as Dynamic Source Routing (DSR) and Ad Hoc On-Demand Distance Vector Routing (AODV) will not work with such long re-healing times. Abdalla et al. (2007) [2] represents Vehicular Ad Hoc Networks (VANET) should upon implementation, collect and distribute safety information to massively reduce the number of accidents by warning drivers about the danger before they actually face it. The standardization work and researches related to vehicular networks and discuss the challenges facing future vehicular networks. Toor, Yasser, et al. (2008) [3] shows a comprehensive survey of the state-of-the-art for vehicle ad hoc networks. It analyzes their advantages and shortcomings and provides our suggestions for a better approach. We also describe the different methods used to simulate and evaluate the proposed solutions. Harri, Jeromeet et al. (2009) [4] introduces VANET MobiSim, a freely available generator of realistic vehicular movement traces for networks simulators. The traces generated by Vanet MobiSim are validated first by illustrating how the interaction between featured motion constraints and traffic generator models is able to reproduce typical phenomena of vehicular traffic. Then, the traces are formally validated against those obtained by TSIS-CORSIM, a benchmark traffic simulator in transportation research. Leung et al. (2010) [6] represents mobile ad-hoc networks that consist of buses moving in urban area, and examine the implications for transport-related services. Buses have a unique set of behaviour characteristics, such as fixed routes, schedules, bus stops, specific priorities, etc which gives rise to distinct impact on node connectivity in the communication network. Kesting et al. (2010) [8] Inter-vehicle communication (IVC) enables vehicles to exchange messages within a limited broadcast range and thus self-organize into dynamical vehicular ad hoc networks. The wireless communication consists of two "transversal" message hops across driving directions. Since direct connectivity for transversal hops and a successful message transmission to vehicles in the destination region is only a matter of time, the quality of this IVC strategy can be described in terms of the distribution function for the total transmission time. Martinez, et al. (2011) [9] has discussed that wireless communication technologies have greatly impact on daily lives. From indoor wireless LANs to outdoor cellular mobile networks, wireless technologies have benefited billions of users around the globe. There are VANET mobility generators, network simulators, and VANET simulators. Finally, while each of the studied simulators provides a good simulation environment for VANETs, refinements and further contributions are needed before they can be widely used by the research community. Saleet et al. (2011) [10] shows a class of routing protocols for vehicular ad hoc networks (VANETs) called the Intersection-based Geographical Routing Protocol (IGRP), which outperforms existing routing schemes in city environments. Geographical forwarding is used to transfer packets between any two intersections on the path, reducing the path's sensitivity to individual node movements. To achieve this mathematically formulate the QoS routing problem as a constrained optimization problem. Specifically, analytical expressions for the connectivity probability, end-to-end delay, hop count, and bit error rate (BER) of a route in a two-way road scenario are derived. A genetic algorithm is proposed to solve the optimization problem.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

V. GAPS IN LITERATURE

1. The effect of safe distance between cars on congested traffic phase is ignored in existing literature.
2. The use of dynamic communication range in VANETS is also ignored.
3. The effect of abnormal environment condition is also ignored by existing researchers in VANETS.

VI. RESULTS

RESULTS METHODOLOGY

1. Deploy VANETS.
2. Here after deploying VANETS, connectivity path is defined.
3. In this step, Genetic Algorithm based on Dynamic Communication based headway distance has been evaluated.
4. In this step, Dynamic path selection on the basis of genetic algorithm is applied.
5. Connectivity probability is evaluated
6. Evaluate results.

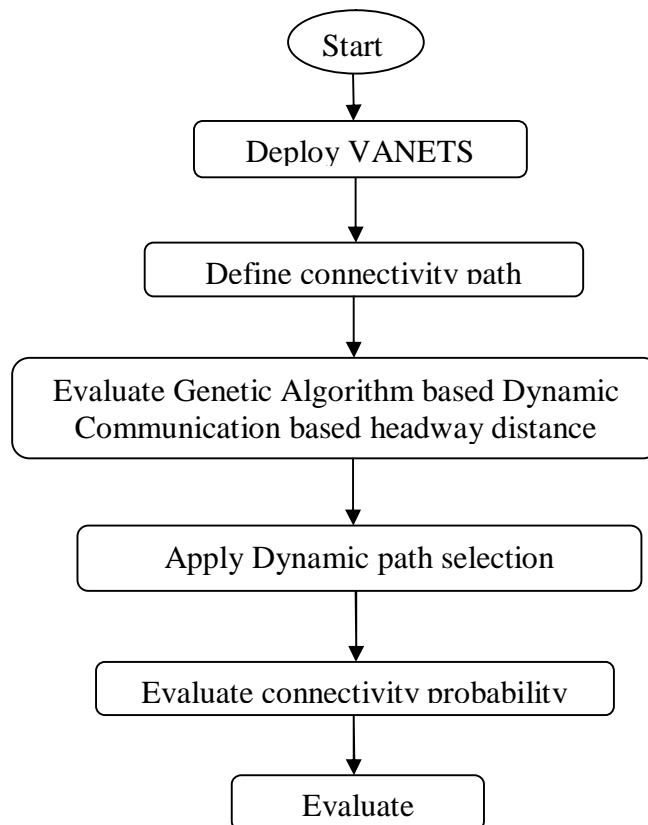


Fig 2: Proposed Methodology

B. PERFORMANCE ANALYSIS

This paper has designed and implemented the proposed technique in MATLAB tool u2013a. The evaluation of proposed technique is done on the basis of following metrics i.e. time to live and pit time. In order to implement the proposed algorithm, design and implementation has been done.. These parameters are standard values used as benchmark for VANETS. In order to implement the proposed algorithm, design and implementation have been done.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

1) Time To Live

This shows value in an Internet Protocol (IP) packet that tells a network router whether or not the packet has been in the network too long and should be discarded. Table 1 shows the comparative research of the Time to live, where it represents various numbers of nodes according to these nodes different values of TTL taken in existing and proposed technique respectively.

Table1. Time to Live

S.NO	Time To Live1	
	Existing Result	Proposed Result
1	0.9258	0.9167
2	2.4996	2.6046
3	3.4916	3.5455
4	4.4451	4.5893
5	5.3806	5.1221
6	6.3110	5.9362
7	7.2259	6.9030
8	8.1242	7.8392
9	9.0236	8.4173
10	9.9118	9.2987
11	10.7893	10.1739
12	11.6726	11.0898
13	12.5449	11.9108
14	13.4148	12.7241
15	14.2844	13.2339

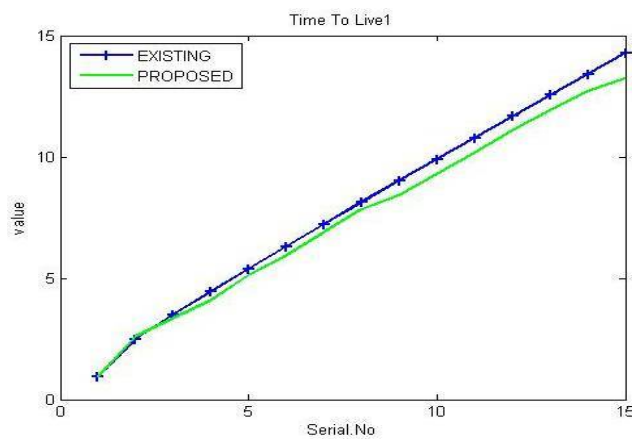


Fig 3: Packet delivery ratio

The above fig.3 represents the comparison of TTL between existing and also the proposed technique where serial no represents the number of nodes and value represents the TTL. Here, green line shows the proposed technique and blue line shows the existing one. In our case the proposed TTL are comparatively lower than the existing one.

2. Pit Time

It shows the comparative research of the PIT Time, where table 2 represents various numbers of nodes according to these nodes different values of PIT Time taken in existing and proposed technique respectively.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

Table 2. Pit Time

PIT Time 1		
S.NO	Existing Result	Proposed Result
1	0.9429	0.8638
2	1.7568	1.2551
3	2.5664	1.7535
4	3.3748	2.5738
5	4.1878	3.1430
6	5.0060	3.9402
7	5.8251	4.6591
8	6.6364	5.0321
9	7.4456	5.8149
10	8.2695	6.4915
11	9.0774	7.3033
12	9.8953	7.9281
13	10.7058	8.6305
14	11.5168	9.0502
15	12.3303	9.4800

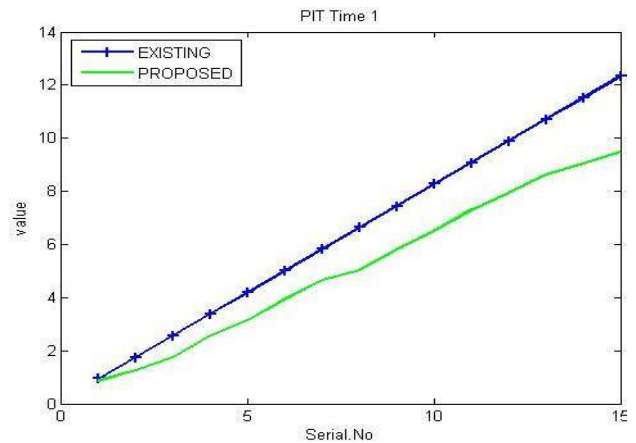


Fig 4: Pit Time

The above fig.4 represents the comparison of PIT Time between existing and also the proposed technique where serial no represents the number of nodes and value represents the PIT Time. Here, green line shows the proposed technique and blue line shows the existing one. In our case the proposed overhead are comparatively lower than the existing one.

VII. CONCLUSION

Vehicular ad hoc networks (VANETS) have been envisioned to play an important role in the future wireless communication service market for safety communications as well as for information and entertainment applications. The knowledge of vehicle headway distribution is essential for estimating the probability of connectivity in vehicle ad hoc networks. The distribution of vehicles in a single lane has been taken into account that consecutive vehicles have to maintain a minimum safe distance between them. The proposed technique is designed and implemented in the MATLAB 2013a by using wireless communication and data analysis toolbox. This paper has proposed The proposed technique has utilized dynamic communication and dynamic path selection using artificial bee colony algorithm to enhance the results of VANETs further. The comparative analysis clearly indicates that the proposed technique outperforms over the available methods.

REFERENCES

- [1] Wisitpongphan, Nawaporn, et al. "Routing in sparse vehicular ad hoc wireless networks." *IEEE journal on Selected Areas in Communications* 25.8 (2007): 1538-1556.
- [2] Abdalla, Ghassan MT, Mosa Ali Abu-Rgheff, and Sidi Mohammed Senouci. "Current trends in vehicular ad hoc networks." *Proceedings of UBIROADS workshop*. 2007.
- [3] Toor, Yasser, et al. "Vehicle ad hoc networks: applications and related technical issues." *IEEE communications surveys & tutorials* 10.3 (2008): 74-88.
- [4] Härrri, Jerome, et al. "Vehicular mobility simulation with Vanet MobiSim." *Simulation* (2009).
- [5] Buchenscheit, Andreas, et al. "A VANET-based emergency vehicle warning system." *2009 IEEE Vehicular Networking Conference (VNC)*. IEEE, 2009.
- [6] Leung, Kin K. "IMPACT OF TRANSPORT MODELS ON CONNECTIVITY OF VEHICULAR AD-HOC NETWORKS." July 11-15, 2010
- [7] Jin, Wen-Long, and Bruce Wang. "Connectivity of vehicular ad hoc networks with continuous node distribution patterns." *University of California Transportation Center* (2010).
- [8] Kesting, Arne, Martin Treiber, and Dirk Helbing. "Connectivity statistics of store and forward intervehicle communication." *IEEE Transactions on Intelligent Transportation Systems* 11.1 (2010): 172-181.

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 5, Issue 9, September 2016

- [9] Martinez, Francisco J., Chai Keong Toh, Juan Carlos Cano, Carlos T. Calafate, and Pietro Manzoni. "A survey and comparative study of simulators for vehicular ad hoc networks (VANETs)." *Wireless Communications and Mobile Computing* 11, no. 7 (2011): 813-828.
- [10] Saleet, Hanan, Rami Langar, Kshirasagar Naik, Raouf Boutaba, Amiya Nayak, and Nishith Goel. "Intersection-based geographical routing protocol for VANETs: a proposal and analysis." *Vehicular Technology, IEEE Transactions on* 60, no. 9 (2011): 4560-4574.
- [11] Hao, Yong, Yu Cheng, Chi Zhou, and Wei Song. "A distributed key management framework with cooperative message authentication in VANETs." *Selected Areas in Communications, IEEE Journal on* 29, no. 3 (2011): 616-629.
- [12] Cenerario, Nicolas, Thierry Delot, and Sergio Ilarri. "A content-based dissemination protocol for VANETs: Exploiting the encounter probability." *Intelligent Transportation Systems, IEEE Transactions on* 12, no. 3 (2011): 771-782.
- [13] Lu, Rongxing, Xiaodong Li, Tom H. Luan, Xiaohui Liang, and Xuemin Shen. "Pseudonym changing at social spots: An effective strategy for location privacy in vanets." *Vehicular Technology, IEEE Transactions on* 61, no. 1 (2012): 86-96.
- [14] Toutouh, Jamal, José García-Nieto, and Enrique Alba. "Intelligent OLSR routing protocol optimization for VANETs." *Vehicular Technology, IEEE Transactions on* 61, no. 4 (2012): 1884-1894.
- [15] Al-Rabayah, Mohammad, and Robert Malaney. "A new scalable hybrid routing protocol for VANETs." *Vehicular Technology, IEEE Transactions on* 61, no. 6 (2012): 2625-2635.
- [16] Lu, Rongxing, Xiaodong Lin, Xiaohui Liang, and Xuemin Shen. "A dynamic privacy-preserving key management scheme for location-based services in vanets." *Intelligent Transportation Systems, IEEE Transactions on* 13, no. 1 (2012): 127-139.
- [17] Cheng L, Panichpapiboon S. Effects of intervehicle spacing distributions on connectivity of VANET: a case study from measured highway traffic. *IEEE CommunMag* 2012;50(10):90-7.
- [18] Dang, Duc Ngoc Minh, Choong Seon Hong, Sungwon Lee, and Eui-Nam Huh. "An efficient and reliable MAC in VANETs." *Communications Letters, IEEE* 18, no. 4 (2014): 616-619.
- [19] Shen, Xia, Xiang Cheng, Liuqing Yang, Rongqing Zhang, and Bingli Jiao. "Data dissemination in VANETs: A scheduling approach." *Intelligent Transportation Systems, IEEE Transactions on* 15, no. 5 (2014): 2213-2223.
- [20] Feng, Cheng, Zhijun Li, Shouxu Jiang, and Rui Zhang. "Data Aggregation and Routing Guidance with QoS Guarantee in VANETs." *International Journal of Distributed Sensor Networks* 2014 (2014).
- [21] Mittal, Narendra Mohan, and Savita Choudhary. "Comparative Study of Simulators for Vehicular Ad-hoc Networks (VANETs)." *International Journal of Emerging Technology and Advanced Engineering* (ISSN 2250-2459, ISO 9001: 2008 Certified Journal, Volume 4, Issue 4 (2014).
- [22] Chen, Chen, Yanan Jin, Qingqi Pei, and Ning Zhang. "A connectivity-aware intersection-based routing in VANETs." *EURASIP Journal on Wireless Communications and Networking* 2014, no. 1 (2014): 1-16.
- [23] Molina-Gil, Jezabel, Pino Caballero-Gil, and Cándido Caballero-Gil. "Aggregation and probabilistic verification for data authentication in VANETs." *Information Sciences* 262 (2014): 172-189.
- [24] Da Cunha, Felipe Domingos, et al. Data communication in VANETs: a survey, challenges and applications. Diss. INRIA Saclay; INRIA, 2014.
- [25] Jia, Dongyao, Kejie Lu, and Jianping Wang. "On the network connectivity of platoon-based vehicular cyber-physical systems." *Transportation Research Part C: Emerging Technologies* 40 (2014): 215-230.
approach." In *ITS Telecommunications (ITST), 2011 11th International Conference on*, pp. 27-32. IEEE, 2011.