Performance Evaluation of ANT Routing Algorithm with AODV Protocol in VANET

Radhika Kochhar

Research Scholar, I .T. Department, G.B. PANT University of Agriculture and Technology
Pant Nagar, Uttarakhand INDIA
kochharradhika8@gmail.com

Hardwari Lal.Mandoria

Professor & Head, I.T. Department, G.B. PANT University of Agriculture and Technology
Pant Nagar , Uttarakhand INDIA
drmandoria@gmail.com

ABSTRACT

Vehicular Ad-hoc Network (VANET) is a mobile network which holds the concept of forming a network of vehicles. The nodes which act as routers in the network exhibit high mobility, high dynamic behavior and formation of random network topologies. These are basic features of VANET. Ant based routing is a bio-inspired communication and is more popular these days because of its adaptive and dynamic nature. In this paper, we study the performance evaluation of VANET using Ant routing algorithm. The vehicle’s velocity, moving pattern and distance between the vehicles have been taken into consideration. Thereby an ant environment has been created using NS-2 and evaluation is done on the basis of number of vehicles per scenario.

Keywords- AODV, Ant Colony, ACO, VANET.

I. INTRODUCTION

Vehicular Ad-hoc Network is wireless network where all the vehicles act as the nodes of the network. It is a network in which all the nodes are mobile and move freely in the environment. Basically VANET is a type of MANET. Mobile ad-hoc network is a collection of mobile nodes which communicate with each other.[1] In VANET the vehicles move freely in the city area. But VANETs have mobility characteristics that distinguish them from the other MANETs [2].The communication criteria which VANET holds are Vehicle to Vehicle communication and Vehicle to Infrastructure. In Vehicle to Vehicle communication the vehicles which are nearby exchange the information through short range wireless technologies which have special devices that allow the exchange of data, example of such technologies is Wi-Fi. In Vehicle to infrastructure communication vehicles are connected to the road side infrastructure through long range wireless technologies. The VANET technology presents the opportunity to develop powerful car systems capable of gathering, processing, and distributing information which could be applied in various applications. For example, blind crossing, emergency accident information relaying, turning assistance etc [3][20]. There are number of protocols which have been proposed for VANET environment. Some of the suggested protocols are Ad Hoc On Demand Distance Vector (AODV), Optimized Link State Routing (OLSR), Ad Hoc On Demand Multipath Distance vector Routing (AOMDV) and Dynamic Source Routing (DSR). The evaluation of VANET most often requires the simulators because the functioning which includes the management and operation of large number of vehicles in a real world could be very expensive. Exchanging up-to-date information is so very important in VANET, if some accident takes place over the network, the neighbor node sends information to the other entire node and the information is flooded all over the network.

Nature inspired algorithms have proved quite beneficial for mobile ad hoc networks. These algorithms are inspired by the insect for example ACO which can be efficiently used for routing technique in the network. The algorithm focuses in finding the shortest path from the source to destination, sharing the local information for future routing decision which reduces the routing overhead. Our proposed algorithm makes effective use of the distance and moving pattern of the vehicles. ANT environment has been created and analysis has been done on different VANET scenarios with different number of vehicles. We should always remember that the algorithm developed for MANET cannot be used for VANET because of high mobility of VANET’s node and frequently changing topology.

II. ANT COLONY OPTIMIZATION

The basic idea behind ACO algorithm for routing is the acquisition of routing information through the sampling of paths using small packets, which are called ants. The ants are generated for the concurrent and independent working at the nodes, and the task is to test all the paths between the source node and the destination node.[4] Each ant collects the information about the different paths and updates the information at the intermediate nodes and the source node. The routing tables contain for each destination a vector of real-valued entries, one for each known neighbor node. These entries may be used to judge the goodness of the working on the way to the destination. These are called pheromone variables, and are continually updated according to path quality values calculated by the ants. The ants use the routing tables to define which path they will follow to reach the destination node. At each node they choose a next hop, giving higher probability to links with higher pheromone values. In this process routing and pheromone tables are also used. Like the real ant colonies the artificial ants are autonomous agents, and through the updating and following of pheromone tables they participate in a stigmergic communication process. .The transition rule used in original ant system is defined by Dorigo [5][18]

The result is a collective learning behavior, which states that individual ants have low complexity and little importance, while the whole swarm together can collect and maintain up to date routing information. The pheromone information is used for routing data packets, more or less in the same way as for routing ants packets are routed,, giving higher probability to links with higher pheromone values. Like this, data for a same destination are spread over multiple paths, resulting in load balancing. For data packets, mechanisms are usually adopted to avoid low quality paths, while ants are more explorative, so that also less good paths are occasionally sampled and maintained. If enough ants are sent to the different destinations, nodes have up-to-date information about the best paths and automatically adapt their data load spreading.

III. RELATED WORK

A. VANET

Ram Shringar Raw et al.[6] proposed SECURITY CHALLENGES, ISSUES AND THEIR SOLUTIONS FOR VANET states some of the technical and support challenges for VANET as VANET has become a key component of intelligent transport system. Different types of attacks along with the secure routing protocol have been discussed. The paper concluded that among all requirements authentication and privacy are the major issues in VANET , whereas confidentiality is not required in the VANET because generally network packets do not contain any confidential data.

A. N. Mahajan et al.[7] proposed ANALYSIS AND COMPARISON OF VANET ROUTING PROTOCOLS USING IEEE 802.11p AND WAVE which explains the basics of Vehicular Ad-hoc Network. MANETs and VANETs are infrastructure less networks, where they are similar in characteristics. It states that the main purpose of VANET is to provide ubiquitous connectivity. The different routing protocols have been compared on the basis of different parameters. It concludes that AODV can perform better and has better throughput and packet delivery ratio for IEEE 802.11 P than WAVE. On the other hand DSDV is better choice if delay is main concern , whereas it is worst for dropped packets.

B. ANT ROUTING ALGORITHM FOR VANET

Uday Mane et al. [3] proposed QUALITY OF SERVICE BASED ROUTING ALGORITHM (QoS)identifies the need for QoS improvement in VANETs. Survey of related work depicts that, an efficient routing strategy plays a very important role, to improve the QoS parameters. Heuristic algorithms like the ant algorithm, can improve upon the Quos parameters, such as end to end delay in routing protocol.

Himani Rana et al. [12] proposed MAZACORNET Mobility Aware Zone based Ant Colony Optimization Routing algorithm makes use of the vehicle’s movement pattern, vehicle density, vehicle velocity and vehicle fading conditions to develop a hybrid, multi-path ant colony based routing algorithm. The process is divided into two phases that are Route discovery within the zone which deals with the fact that when the data is to be transferred within the zone. The Intra zone routing table is used for route discovery here. The other is Route discovery between the zones which deals with the fact that when the vehicle fails to find the destination within the zone, Inter zone routing table is used to identify the new route using the boundary vehicles [8]. As a result when the performance of this routing algorithm is compared to others on the basis of end to end delay, we come across the conclusion that the algorithm produces the best results comparatively.

Rodrigo Silva et al. [13] proposed AntRS It is Heuristic Algorithm Based on Ant Colony Optimization for Multi-objective Routing in Vehicle Ad Hoc Networks. The study of this algorithm states that in a real VANET network, it is possible to have obstacles between two or more vehicles. These obstacles fade the signal transmitted and hinder the communication. Therefore, it is necessary to find alternative paths of communication for the vehicles in these conditions. Therefore, this paper proposes a multi objective heuristic routing algorithm for VANET named AntRS.

Seytkamal Medetov et al.[15] proposed A BEE-INSPIRED APPROACH FOR INFORMATION DISSEMINATION IN VANETS which states a bee-inspired algorithm for information dissemination in VANETs. The goal is to provide each vehicle with the required information about its surrounding and assist drivers to be aware of undesirable road conditions Honey bees communicate with each other only in bee hives. The proposed algorithm exploits bee communication principles to allow vehicles communicating with each other.

IV. SIMULATION

In this study, network simulation tool NS2.35 [11][19] has been used as a simulation platform. There are many simulators such as OPNET, NetSim, GloMoSim and NS-2 etc. We used NS2 version 2.35 for simulation purpose. NS-2 is a discrete event simulator developed at UC Berkeley and written in C++ and OTc and used in network research. It is UNIX base. It provides substantial support for simulation of TCP, routing, and multicast protocols over wired and wireless networks,

A. Network performance parameters

Following performance metrics are used to analyze the simulation results:

1. Average End-to-End Delay (E2E Delay): It is defined as the average time taken by a data packet from source to destination. It also includes the delay caused by route discovery process and the queue in data packet transmission. Only those data packets are counted which are successfully delivered to destination.

2. Packet Delivery Ratio (PDR): Packet delivery ratio (PDR) is considered as the ratio of the number of delivered data packets to the destination. It also illustrates the level of delivered data to the destination. The greater value of packet delivery ratio means the better performance of the protocol.

3. Normalized Routing Load (NRL): In the field of networking, Normalized Routing Load (NRL) is defined as the total number of routing packets transmitted per data packet.

4. Number of packet dropped: In the field of networking the total number of packet received per total number of packet send.

Routing protocol is more privileged for lower value of E2E Delay and NRL metrics while higher value of PDR metric.

B. Simulation Parameters

To evaluate the performance of both the protocols following parameters i.e. AODV and ANT are considered:

S.NO	PARAMETERS	VALUES
1.	Simulator	NS-2(VERSION 2.35)
2.	Channel type	Channel/wireless channels
3.	Radio propagation model	Propagation/TwoRayGround
4.	Network interface type	Phy/WirelessPhyEXt
5.	MAC type	Mac/802.11
6.	Interface queue type	Queue/DropTail/PriQueue
7.	Traffic type	CBR(constant bit rate)
8.	Antenna	Antenna/Omni Antenna
9.	Simulation time	999ms
10.	Simulation area(m*m)	852*652
11.	Number of vehicles	15,20,25,30,35,40,45,50
12	Vehicle speed	40 m/sec
13.	Routing protocol	AODV/AntNet
14.	Transport protocol	UDP

V. SIMULATION RESULTS AND DISCUSSIONS

For the simulation Ant environment is created by making changes in the common NS-2 files. VANET scenario has also been created with different number of vehicles. The performance of the proposed Ant algorithm which itself act as a protocol is compared with the basic AODV protocol in terms of average end to end delay, packet delivery ratio, network routing load and number of dropped packets. Simulation results are shown as follows:

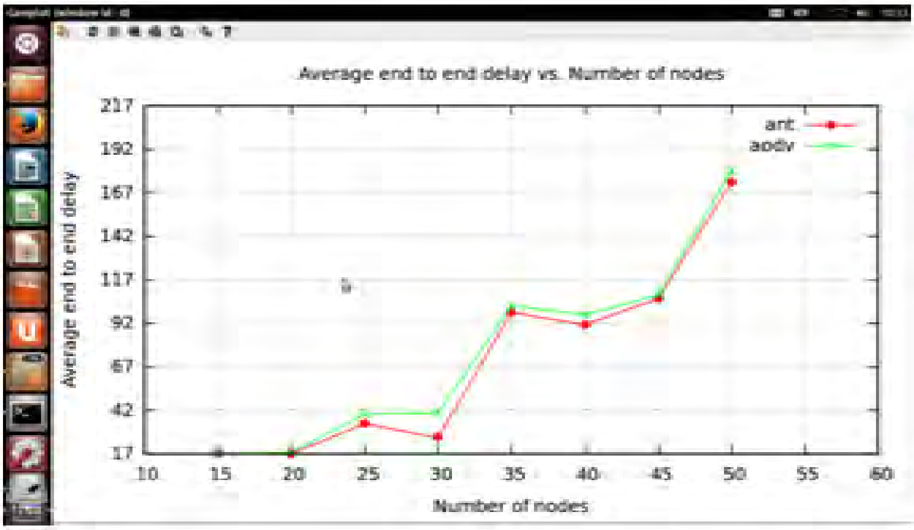

Figure 1: Average end to end delay

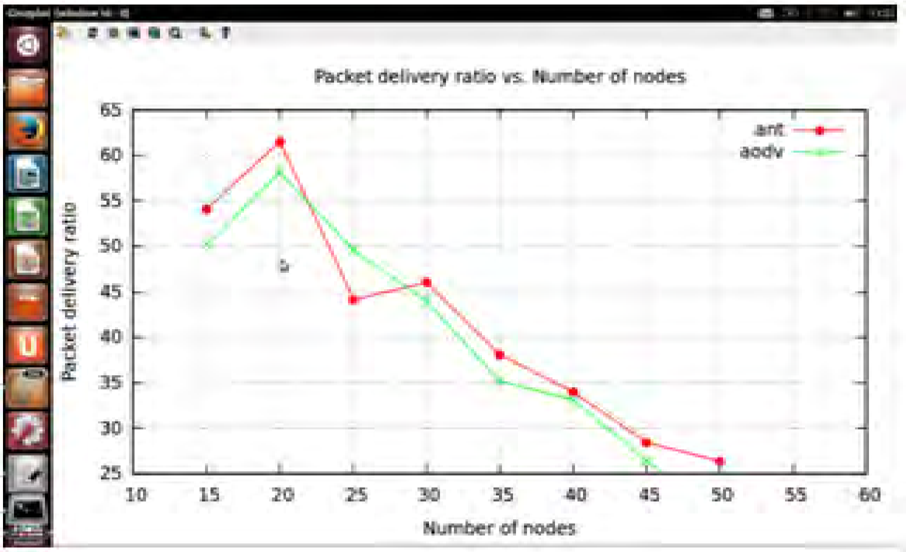

Figure 2: Packet Delivery Ratio

In figure 1 the Average END-to-End Delay of AODV and Ant Routing algorithm against the vehicle density is shown. The average time taken by the data packet from source to destination is much higher in case of AODV protocol as compare to Ant Routing algorithm. So, it can be concluded that our Enhanced AODV perform much better in terms of Avg. End-to-End delay, which is a crucial factor in terms of VANET. Figure 2 the efficiency of data Packet Delivery Ratio (PDR) for AODV protocol as well as our Ant Routing algorithm has been measured using different vehicles density. Initially we take 15 vehicles in which efficiency of PDR is high and there is a sudden fall as we go on increasing the vehicle density.

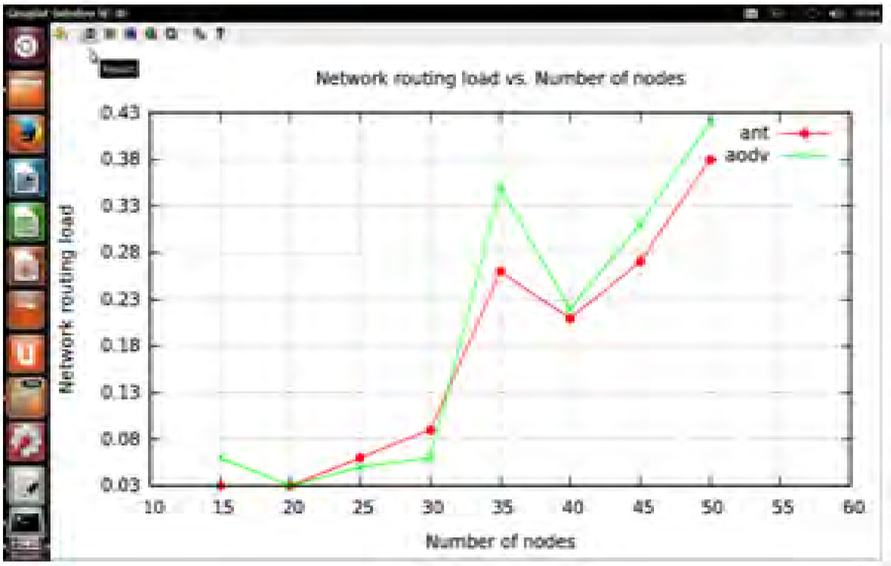

Figure 3: Network routing load

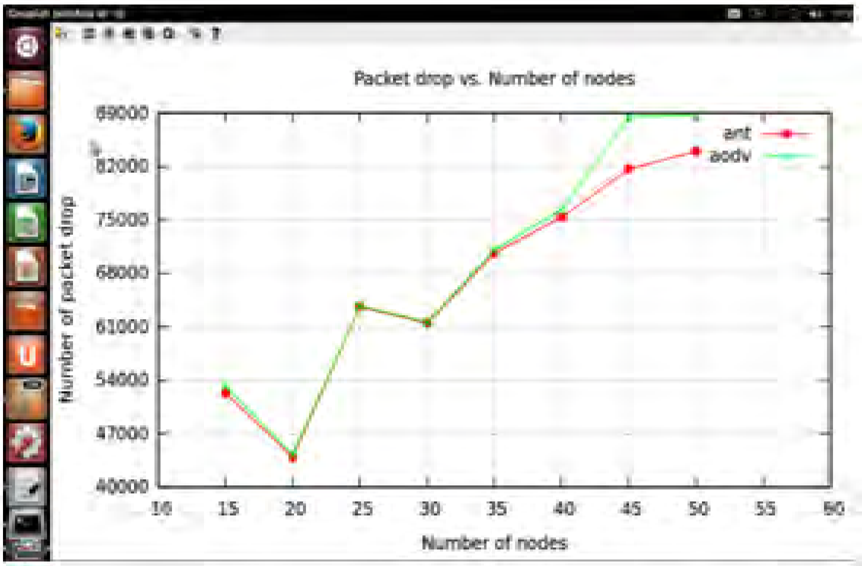

Figure 4: Number of packet drop

Figure 3. depicts that when we increase the number of vehicles overhead is increases in VANET because of its highly dynamic nature. In starting, when we take 15vehicles, overhead become very less i.e. 0.03. When we take more number of vehicles the overhead is increasing up to 0.38 (in case of 60 vehicles). As we compare our Ant Routing algorithm with AODV protocol we can say that as compare to AODV, Ant Routing algorithm gives low network overhead. So, it can be concluded that the Ant Routing algorithm gives better results as compare to AODV protocol. In figure 5.2, we show the graph in which we compare both in terms of NRL.

Figure 4. shows the result of the packet drop against the vehicle density. The number of packet drop is much higher in case of AODV protocol as compare to Ant Routing algorithm.

VI. CONCLUSIONS

The work done by us focuses on the improved data transfer technique in VANET environment. The ANT Routing Algorithm designed by us, use different VANET scenarios with different number of vehicles. The result of the algorithm shows that the algorithm when compared to other existing algorithms and protocols proved to be more efficient in terms of packet delivery ratio, end- to-end delay, NRL. Algorithm is suitable for urban scenarios or dense networks which may include about 50 nodes in our simulation We have used vehicle speed and distance between vehicles to create the mobility or the moving pattern of the vehicles. Our algorithm is scalable in nature and has better network connectivity between vehicles compared to others.

VII. REFERENCES

[1] Baguna Renu, Mandoria Hardwari Lal, Tayal Pranavi " Routing protocol in mobile ad-hoc network-A Review" QSHINE 2013 LNICST 155, pp 52-60 2013.

[2] Jing Wu and YuhaoWang."Performance study of multi-path in VANETs and their impact on routing protocols" Wireless Engineering and Technology, 2(3):125–129, July 2011.

[3] UdayMane and Dr. S.A Kulkarn "QoS Realization for Routing Protocol on VANETs using Combinatorial Optimization"IEEE31661

[4] Radhika Kochhar, Hardwari lal Mandoria "Performance Study of VANET Using Ant Based Routing Algorithms" INDIACom-2015; IEEE Conference ID: 35071 2015 2nd International Conference on "Computing for Sustainable Global Development" ISSN 0973-7529; ISBN 978-93-80544-14-4 pages 8.216-8.219 ,March 11-13 2015,New Delhi (INDIA)

[5] M.H.Afshar " A new transition rule for ant colony optimization algorithm: application to pipe network" Department of civil engineering, Iran University of Science and Technology, Narmak, Tehran, 16844, Iran Published online 25 Jan 2007

[6] Ram Shringar Raw, Manish Kumar, Nanhay Singh "security challenges, issues and their solutions for vanet" International Journal of Network Security & Its Applications (IJNSA), Vol.5, No.5, September 2013.

[7] A. N. Mahajan1, Dimple Saproo, Rakhi Khedikar "analysis and comparison of vanet routing protocols using ieee 802.11p and wave" International Journal of Engineering Research and Applications (IJERA) ISSN: 2248-9622 Vol. 3, Issue 4, Jul-Aug 2013, pp.1556-1561

[8] D.B Johnson and D. A. Maltz." Dynamic source routing in ad hoc wireless networks", volume 353, chapter 5, pages 153–181. KluwerAcademic Publishers, Boston, 1996.

[9] Guangyu Pei, Mario Gerla, and Tsu-Wei Chen. Fisheye " routing's routing scheme for ad hoc wireless networks". In Proceedings of IEEE International Conference on Communications, pages 70–74, New Orleans, USA, June 2000.

[10] MimozaDurresi, ArjanDurresi, and Leonard Barolli. "Emergency broadcast protocol for inter-vehicle communications" In Proceedings of 11th International Conference on Parallel and Distributed Systems, volume 2, pages 402–406, Fuduoka, Japan, July 2005.

[11] Mahesh K. Marina and Samir R. Das. On-demand multipath distance vector routing in ad hoc networks. In Proceedings of 9th IEEE International Conference on Network Protocols, pages 14–23, California, USA, Nov. 2001.

[12] HimaniRana, ParimalaThulasiraman, and Ruppa K. Thulasiram" MAZACORNET: Mobility Aware Zone based Ant Colony Optimization Routing for VANET" 2013 IEEE Congress on Evolutionary Computation June 20-23, Cancun, México

[13] Rodrigo Silva, HeitorSilve´rio Lopes and Walter GodoyJunior "A Heuristic Algorithm Based on Ant Colony Optimization for Multi-objective Routing in Vehicle Ad Hoc Network" IEEE Computer society 2013 BRICS Congress onon Computational Intelligence

[14] J. Singh, "Wireless LAN Performance Under Varied Stress Conditions in Vehicular Traffic Scenarios," IEEE Vehicular Technology 7 . Conference, 2002

[15] Seytkamal Medetov, Mohamed Bakhouya, Jaafar Gaber, Khalid Zinedine£, Maxime Wack "A Bee-Inspired Approach for Information Dissemination in VANETs" 978-1-4799-3824-7/14/$31.00 ©2014 IEEE

[16] S Husain, SC Gupta, M Chand, H.L Mandoria "A proposed model for Intrusion Detection System for mobile adhoc" network-International Conference on Computer and Communication Technology (ICCCT), 2010

[17] Anuj K.Gupta,Harsh Sadawani and Anil K. Verma "Computation of Pheromone value in AntNet algorithm" I.J.Computer Network anf Information Security, 2012,9,47-54.

[18] S. Goss, S. Aron, J.L Deneubourg, and J. Pasteels. "Self-organizedshortcuts in the argentine ant.", 76(12):579–581,Dec. 1989

[19] Ingo Ltkebohle. NS-2.35 source code. http://nsnam.isi.edu/nsnam/index.php/User Information, 2011

[20] J. Broch et al. "A Performance Comparison of Multi-Hop Wireless Ad Hoc Network Routing Protocols", In Proc. ACM MOBICOM 98, Dallas, TX, October 1998