International Journal of Control and Automation
Vol. 9, No. 5 (2016), pp. 199-206
http://dx.doi.org/10.14257/ijca.2016.9.5.19

Study of VANET in Intelligent Transportation System Based on OPNET

Wei Yun[1], Lu Huai Wei[2] And He Zhao Hui[3]

[1]*School of Automation and Electrical Engineering, Lanzhou Jiaotong University,Lanzhou 730070,China*
wei-yun-1@163.com
[2]*School of Mathematics, Physics and Software Engineering, Lanzhou Jiaotong University, Lanzhou 730070, China*
luhw@mail.lzjtu.cn
[3]*Gansu Wanhua Jinhui Information Technology CO., LTD, Lanzhou 730000, China 13321200008@189.cn*

Abstract

Vehicle Ad hoc Network are composed of the vehicle with wireless communication equipment, road construction collecting base station transmission network, background processing server and related acquisition and processing software system. Based on Internet of things simulation console, this paper designs vehicle to vehicle scenarios of Intelligent Transportation System, simulates its communication process , analyzes the simulation data of sending and receiving, evaluates the entire performance of the network, which can offer reference to designing and optimizing the Vehicle Ad hoc Network. In this paper we try to prove: In the low speed motion in vehicle to vehicle scenario of Vehicle Ad hoc Network, as the routing protocol in the network layer, AODV protocol is much better than DSR protocol.

Keywords*: OPNET, ITS, VANET, V2V*

1. Introduction

With the rapid development of city modernization and the sharp surge in car ownership, highway planning and construction are not compatible. City traffic congestion problems are difficult problem in modern city management. It caused serious influence to city environment and citizen. Expert analyses, the main reasons of city traffic congestion are the road traffic infrastructure construction the serious lag. The Internet of things technology is an interdisciplinary field; it will be completely different from a lot of field of professional techniques together. So, the integration of intelligent transportation and the Internet of things will be the future development trend of ITS (Intelligent Transportation System)[1].

2. Traffic Simulation System

2.1. Application of Traffic Simulation System in ITS

The development of ITS promoted the traffic simulation technology progress. From the point of view of ITS application, the requirements of the integration of the whole traffic simulation in Intelligent Transportation. Traffic simulation has been the core components for large application system of intelligent traffic from simply analysis tools to traffic engineering technology.

Traffic Simulation System is a new technology; it has contact closely with

ISSN: 2005-4297 IJCA

the technical disciplines, management science, economics and the social sciences. Traffic simulation refers to the use of simulation technology to study traffic behavior; the technique described is tracking the change on the traffic movement with time and space. Traffic simulation is a technique of analysis means. Although the traffic simulation technology has many advantages, it also has many limitations [2].

(1)The simulation model is needed to transport facilities, network and behavior of a large number of aspects such as the input data, these data for practical problems, it is difficult or impossible to obtain.

(2)Simulation models require verification, calibration, test effectively, ignore it, the simulation results will be inconsistent with the facts.

(3)The establishment of simulation model not only need a lot of knowledge, such as traffic flow theory, computer programming, probability theory, the need of road transportation system on research to fully understand, with traffic engineering practice and application of experienced..

(4)If only used traffic simulation model, is not clear for the constraint on the model and the basic assumptions, is likely to lead to a wrong conclusion.

(5)Traffic simulation technology has a very strong dependence on the system model, the system model is built on the real system must be simplified and abstracted, inevitably cause some distortion, and road transportation is a stochastic, dynamic, complex system.

2.2. Classification of VANET Modeling Method

VANET (Vehicle Ad hoc Network) are composed of the vehicle with wireless communication equipment, road construction collecting base station transmission network, background processing server and related acquisition and processing software system. Ad hoc wireless networks are inherently self-creating, self-organizing and self-administering. VANET differs from usual ad hoc networks by its vehicular environment, distributions, movement and applications. VANET includes three types of basic communication mode: V2V (vehicle to vehicle); V2I (vehicle to infrastructure) and V2P (Vehicle-to-people). VANET will play an important role in improving the capacity and coverage of future wireless networks via [3].

The vehicle since its inception in twentieth Century, scientists have tried tore produce the movement patterns of vehicles. In a realistic test environment, it is important to test V2V and V2I network application.

When the design of network simulation, through the movement of the vehicle model definition suitable, it can reflect the real vehicle mode of motion. According to the scope of the functions and features of vehicle movement, the vehicle mobility models are divided into five categories: Random mobility modeling; Flow modeling; Traffic modeling; Behavior modeling; the path or based on a survey of modeling. As shown in Figure 1.

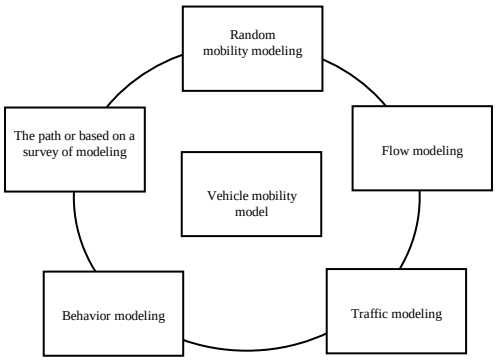

Figure 1. The Classification of the Vehicle Mobility Model

2.3. IEEE Communication Based on 802.11p

IEEE 802.11 defines two MAC sub layers: the Distributed coordination function (DCF) and Point coordination function(PCF).In October 1999, the Federal Communications Commission (FCC) allocated the 5.9 GHz band for DSRC-based ITS applications and adopted basic technical rules for DSRC (Dedicated Short-Range Communications) operation. The 5.9 GHz band consists of seven ten-megahertz channels which includes one control channel and six service channels. DSRC PHY uses OFDM modulation scheme to multiplex data [4].

V2I related information communication can make the vehicle at any time was informed that the surrounding facilities, to provide various kinds of service information and data network access. Relative to the vehicle road communication in V2I system, V2V system can provide communication between vehicles without any infrastructure.

3. Modeling and Simulation of VANET

In this paper, our laboratory is about basics of using Optimized Network Engineering Tools (OPNET).The OPNET is a very powerful network simulator. Main purposes are to optimize cost, performance and availability.

3.1. OPNET Software

OPNET Modeler is commercial network simulation software, is currently the most widely used network simulation software. OPNET Modeler Include a variety of fields: End to End Network Architecture Design; System Level Simulation for Network Devices; Protocol Development and Optimization Network Application Optimization and Deployment Analysis. OPNET Modeler simulation can be roughly divided into 6 steps: Topology; Traffic; Statistics; Simulation; Re-simulation and Report [5].

3.2. Simulation Scenario

We build a vehicle consisting of nine nodes workshop communication network model, double lane, four cars from the west to the East and five cars from east to west in the exercise using OPNET Modeler simulation platform.

The average speed of vehicle is 30km/h. The ground wireless accesses points are AP1, AP2, AP3, AP4……AP7.Road side unit (RSU) are Server-1、Server-2 and Center server. We use the 100BaseT link to ground wireless access point; the server is connected with the corresponding router. We emphases to establish a simulation network model, network routing protocol can be applied to V2V. DSR protocol and AODV protocol can be used in the nine vehicle nodes respectively, and comprise of the two wireless communication network performance in VANET. The simulation time is ten minutes, the network topology as shown in Figure 2.

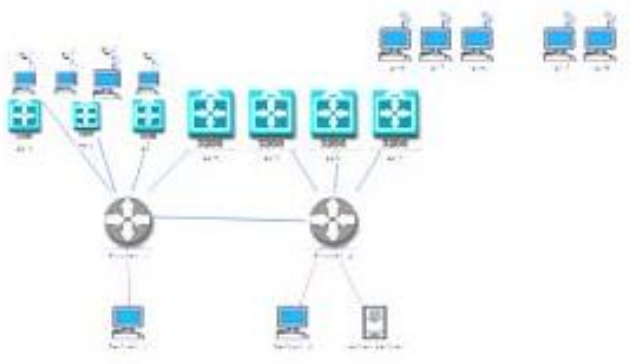

Figure 2. The Network Topology Structure

3.3. Performance Evaluation Criteria

The main performance is evaluated according to the following evaluation standard:

(1) Wireless LAN Throughput(bits/s);
(2) Wireless LAN Delay(s);
(3) Wireless LAN Load(bits/s);
(4) Wireless LAN Packet Drop Rate (bits/s);

3.4. Simulation Parameters

The simulation based on the application of highway traffic and describes the ideal scene without interference, the main simulation parameters as shown in Table 1.

Table 1. Main Simulation Parameters

Simulation Parameters	Value
Network simulation platform	OPNET Modeler 14.5
Simulation range(m^2)	3000*3000
Simulation time(s)	600
AP Coverage(m)	100
Data Rate(Mbps)	11
AP number	9
The speed of mobile vehicle (km/h)	30
Packet Size(Kbytes)	512

3.5. Simulation Results

(1) Figure 3 show Wireless LAN Delay for the DSR protocol and AODV protocol: The average delay of DSR protocol is bigger than AODV protocol. So, AODV protocol has better than DSR protocol. Because AODV protocol not only use serial number, effectively improves the routing effectiveness, but also reduces the probability of packet retransmission [6].

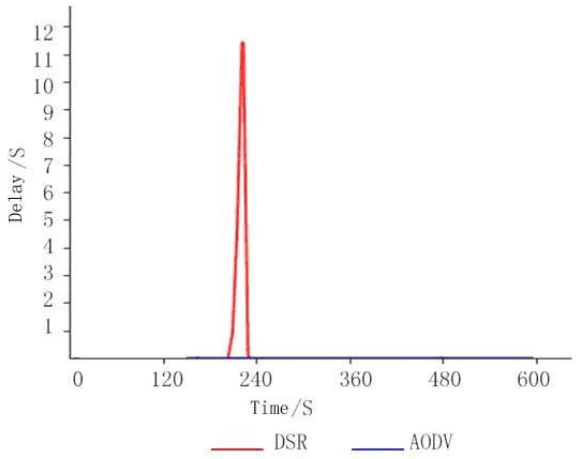

Figure 3. Wireless LAN Delay

(2) Figure 4 shows Wireless LAN Throughput for the DSR protocol and AODV protocol: From the chart we can see that the throughput of the AODV protocol is better than that of DSR protocol. Because the AODV protocol associate the DSR protocol with DSDV protocol.

AODV protocol can improve the utilization rate of network bandwidth, the throughput characteristics is better than DSR protocol.

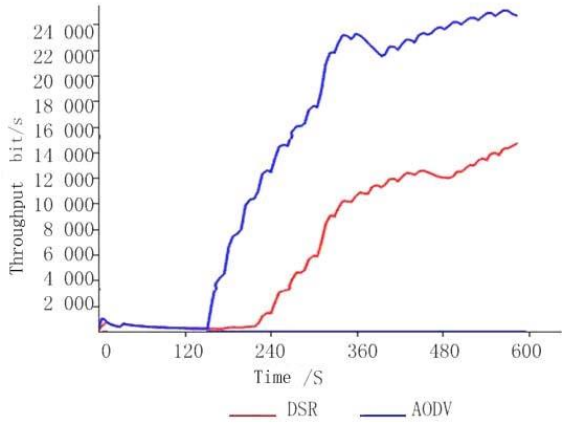

Figure 4. Wireless LAN Throughputs

(3)Figure 5 shows Wireless LAN Load for the DSR protocol and AODV protocol: From the chart show that the DSR protocol is significantly less than the AODV protocol. Because the DSR protocol routing load is mainly RREP and RERR packet, to establish multiple to the destination node route. The DSR protocol uses the cache technology and hybrid acceptable way and listens the route request packet, so as to minimize the route load.

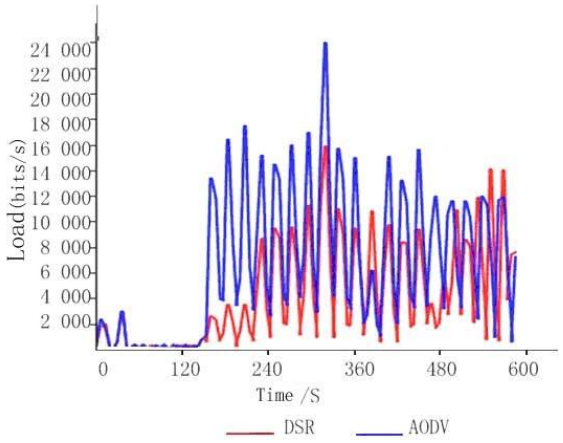

Figure 5. Wireless LAN Load

(4)Figure 6 shows at the beginning the AODV protocol rate is smaller than DSR protocol of packet Drop Rate, changes with the simulation time, AODV protocol and DSR protocol are maintained in a small range, the performance of DSR protocol is always maintained at a relatively stable range. And the AODV protocol is obvious increase with the simulation time.

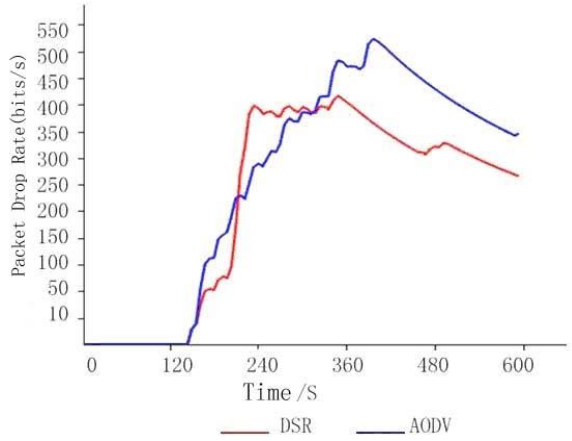

Figure 6. Wireless LAN Packet Drop Rate

4. Conclusion

From the above simulation results we can analysis: For the V2V Scenario of VANET, AODV protocol's performance in the delay, load, throughput and packet loss rate more than the DSR protocol. AODV protocol is more suitable for the actual network communication requirements. In the low velocity motion, because the node of low velocity makes the network topology change a little .In the low speed movement, the wireless communication network mobility is strong; AODV protocol is more suitable than DSR protocol as the routing protocol in the network layer.

But in high speed movement network topology change is fast. The increase of a large number of routing entries by date, need to maintain routing tables, expired routing affects routing accuracy. Therefore, the AODV protocol is not suitable to mobile network topology changes frequently.

Acknowledgements

This work was supported by the Natural Science Foundation of Gansu, China under Grant No.1310RJZA071; and was supported by the Foundation of Lanzhou Jiaotong University Gansu, China under Grant No.ZC2013010.

References

[1] T. Luo , "Vehicle wireless communication network and its application", J.ZTE Communications Technology, vol. 3, no.17, (2011).
[2] H. Hannes and K. P. Laberteaux, "VANET technology and application", Singhua University Press, Beijing, **(2013)**.
[3] I. Ramani and S. Savage, "SyncScan: Practical Fast Handoff for 802.11 Infrastructure Networks", IEEE Computer and Communications Societies, Miami, USA, **(2005)** March 13-17, vol.1, pp. 675-684.
[4] H. M. Liakou, "An overview on transports and ITS", Communications in Computer and Information Science, vol. 112, **(2010)**, pp. 343-345.
[5] Y. Du, "Enhancement of wireless communications in vehicular environment of its based on IEEE 802.11p/1609 protocols", Beijing University of Posts and Telecommunications. **(2011)**.
[6] P. Du, "Communication performance of intelligent transportation system in simple scenarios", Beijing University of Posts and Telecommunications, **(2010)**.