Uninterrupted Connectivity between Nodes to Evade from Accident and Traffic Blockage in VANET

[1]Shweta Bondre, [2]Uma Yadav
[1]Assistant Professor, [2]Assistant Professor
[1]Computer Science
[1]G H Raisoni College of Engineering, Nagpur, India

Abstract: Today with the increase in population we can observe the sudden increase in vehicles on road causes accident is the major loss of human life and assets. So to make the driving safer in future vehicular ad hoc network is the technology which put up the vehicle to be linked with each other through a wireless network. At the time of accident a series of collision happens because the driver of the car cannot identify the disaster and take a right decision within a few moments. Traffic blockage takes place just after the accident that affects busy schedule of human.

IndexTerms - **VANETs, Road side unit (RSU), On board unit (OBU), Applications, congestion control, accident avoidance, Routing protocol.**

I. INTRODUCTION

Vehicular ad hoc networking (VANET) is an upcoming technology and it is a part of Mobile ad hoc networking (MANET) and it is a combination of ad hoc wireless network, cellular technology and wireless LAN. VANET is a technology that uses vehicles as a node in a network to create a mobile network. The wireless technology is implemented in vehicles and each vehicle act as a mobile node that can forward packets towards the destination. In VANET nodes or vehicles are highly mobile in nature and even end to end connectivity is not provided. In the figure communication can be done between various nodes like vehicle to vehicle (V2V) and vehicle to infrastructure (V2I) i.e. road side unit (RSU). To form the communication infrastructure there will be road side unit (RSU) in every intersection point of the road and each vehicle can be provided with one on board unit (OBU).

II. APPLICATIONS OF VANET

1. Safety oriented: Safety application includes monitoring of the surrounding road, approaching vehicles, surface of the road, road curves etc. The road safety applications can be classified as:
   a. Real-time traffic: The real time traffic information can be stored at RSU and can be available to them at anytime and anywhere needed.
   b. Co-operative message transfer: Messages between vehicle will be exchanged and co-operate to help other vehicles.
   c. Road danger control notification: Cars notifying other car about road having landslide.
   d. Post crash notification: A vehicle involved in an accident would broadcast warning message about its position to vehicle with a unique Id so that it can take a right decision to overcome the problem of traffic congestion.

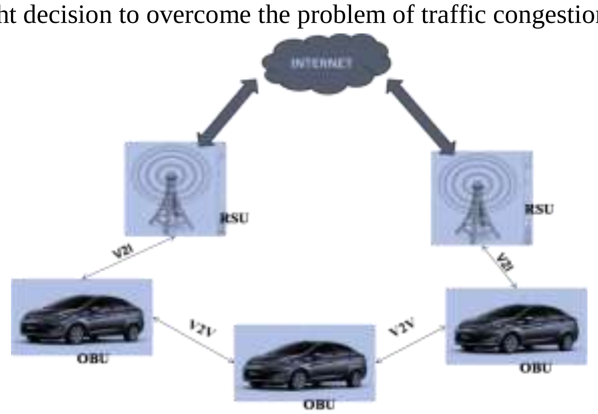

Fig 1.1. Vehicular Adhoc Network

2. Commercial oriented: commercial application will provide the driver with entertainment and services as web access, streaming audio or video. The commercial applications can be classified as:
   a. Internet access: Vehicles can access internet with RSU.
   b. Digital map downloading: Map of regions can be downloaded by the drivers as per the requirement before traveling to the new area for travel guidance.
   c. Real time video relay: The driver can ask for real time video relay of his favorite movie.
   d. Value added advertisement: This is especially for the service providers who want to attract the customer to their stores.
3. Convenience oriented: Convenience application mainly deals in traffic management with a goal to enhance traffic efficiency. The convenience application can be classified as:
   a. Route diversions: Road and trip planning can be made in case of road congestion.
   b. Electronic toll collection: Toll tax can be calculated with the help of OBU of vehicle which works via GPS and the on-board odometer as a back-up to determine how far the Lorries have travelled.
   c. Parking availability: Notifications regarding the availability of parking helps to find the available slots in parking lots in a certain geographical area.
4. Productive oriented: This is intentionally call as productive as this application is additional with above mentioned applications. The productive applications can be classified as:
   a. Time utilization: If a traveler downloads his email, he can transform jam traffic into a productive task and read on-board system and read it himself if traffic stuck. One can browse the Internet when someone is waiting in car for a relative or friend.
   b. Fuel saving : When the TOLL system application for vehicle collects toll at the toll booths without stopping the vehicles, the fuel around 3% is saved, which is consumed when a vehicles as an average waits normally for 2-5 minutes.

III. ACCIDENT DETECTION PROCESS

Whenever a car meets to an urgent situation, it must have the capabilities to detect that situation because after detecting the situation the car can generate an emergency message and broadcast the message to its nearby vehicle. Thus the vehicle existing behind the car can take appropriate decision to avoid collision. There are few approaches to avoid accident are discussed here:

Accident detection is not our main center of attention our focus is on the post accident scenario that how to avoid consecutive collision and manage the traffic congestion. The process is described here, assume that every car is provided with an accident detection module and an Air bag system (ABS) installed inside the car. Any kind of unexpected behavior such as sudden increase of velocity, overturn and threshold of hit will be sense by Micro electro-mechanical sensor (MEMS). When any car met with an accident the vibration sensor and crash sensor will sense the situation and open the airbag inside the car. This unit then generates an emergency message and attaches some important details like time of accident, location of accident which is given by the GPU module and also OBU_id to it. Thus, this complete module immediately senses the accident and broadcast the message within a few seconds to the nearest OBU or RSU.

IV. ACCIDENT PREVENTION PROCESS

To prevent accident there are different methods some of them are discussed here:

- Traffic monitoring based accident prevention: In this approach the direction of the vehicle will be calculated to detect if there is any possibility of accident and transmit the information to other vehicles to aware them about the disaster.
- Speed based accident prevention: Traffic density in a specified area will be calculated by calculating the speed of vehicles and after calculating the average vehicle speed the information will be sent to the server for further process.

V. CONGESTION CONTROL PROCESS:

When any disaster occurs this leads to heavy traffic congestion especially in heavy traffic area. So, besides detecting accident it is good to use intelligent system to avoid collision. To avoid congestion an emergency message will transmit faster, hence it will be helpful for VANET to avoid collision and also for controlling traffic congestion. Suppose car A meets to crash with car B then both the car generates emergency message and broadcast to nearby RSU or OBU immediately. After accepting the message from nearest OBU or RSU, the current OBU will check its destination direction whether it is going towards the accident location or not, if so, then it will check for another alternative path and if there is path available it will change its driving direction. Thus it will possible to control the congestion on the road.

VI. ROUTING PROTOCOLS

Routing may be an immense idea employed in MANET and VANET area. Numerous routing Protocols are designed for communication between the nodes in an ad hoc environment. In VANET, routing may be a hard task to realize because of its high quality. Major issues in VANET which needs Routing are network and traffic management, Broadcasting, mobility, topological change, Quality of Service (QoS), rapid information transfer, etc. These are the difficult elements that require cost-effective routing techniques. Routing protocols are separated into Topology primarily based, Position primarily based, Cluster primarily based, Geo cast primarily based and Broadcast Based. Throughout this section, we tend to survey some routing protocols employed in VANET implementations.

AODV

Being a reactive routing protocol AODV uses Traditional routing tables, one entry for each destination and sequence numbers are used to find out whether routing information is up-to-date and to prevent routing loops. It helps in both multicasting and unicasting .AODV makes use of <RREQ, RREP> pair to find the route. The source node broadcast the RREQ i.e. Route Request message to its neighbors to find the route to destination. The RREQ message contains the source and destination address, lifespan of message, sequence numbers of source and destination and request ID as unique identification. The most recent sequence number Received by the source from any route is known as the Destination Sequence Number and the present sequence number to be used for route entry of source node for the route request is known as Source Sequence Number. If any node from a list of neighbors is destination or recognizes the route to destination then it can send RREP message to the source node.

DSR

DSR is a reactive routing protocol. It starts route Discovery only on demand like AODV. DSR stores the entire path to destination in its routing table instead of next hop node unlike AODV. Packet header consist the address of all the intermediate nodes by which the packet needs to move in the direction of the destination node. This kind of routing is called source routing and that's why the name of protocol is: A pair of <RREQ, RREP> Message is used to discover the route similar to AODV. Source node broadcast the RREQ message and the node have route to destination replies with RREP message. If node receiving RREQ message doesn't have Information regarding destination node it rebroadcast the RREQ message after adding its address to source address.

DSDV

The Destination-Sequenced Distance-Vector (DSDV) Routing Protocol uses the traditional Bellman-Ford Routing Algorithm with some VANET related improvements. Every vehicular node maintains a routing table which enlists the destinations along with the number of vehicular nodes or road side units to arrive at the destination node and the sequence number assigned by the destination node. The sequence number is used to isolate the stale routes from new ones to avoid the formation of loops.

AOMDV

As we know, link break down occurs very repeatedly in VANET because of high mobility of vehicular nodes. AOMDV makes it possible to calculate multiple routing paths for a single destination during the route discovery Phase. It overcomes the drawback of AODV in which the route discovery is used after each link failure. When all available paths fail to send a packet from source node to destination node only then route discovery is done by the AOMDV routing protocol.

VII. SIMULATION

A. *Simulation Environment*

Using NS 2.34 and vehicular ad hoc network, the Simulation environment is set up. The NS 2.34 is Chosen because it is an open source simulator

B. *Performance Metrics*

Various performance metrics are available to check the Performance of routing protocols. In our study, we have chosen end to end delay, packet delivery ratio, and throughput.

7.1 Average end to end delay

When a data packet is sent by the source node to the
Destination, then the time taken by the data packet to achieve the destination from source node is known as end to end delay. The average end to end delay for all successfully delivered packets is calculated by taking its mean value.

$$\text{End to End delay} = \frac{\sum_{1}^{n}(\text{Reception Time} - \text{Send Time})}{\text{Number of Packet Successfully Delivered}} * 1000 \qquad (1)$$

7.2 Packet Delivery Ratio

The ratio of data packets received by the destination node to the data packet sent by the source node is defined as the packet delivery ratio.

$$PDR = \frac{\text{Packet Received}}{\text{Packet Sent by the Source none}} * 100\% \quad (2)$$

7.3 Average Throughput

This is the measure of the rate at which data being successfully delivered over a communication channel. It is usually calculated in bits per second (kilo bits/sec or kbps).

$$\text{Average Throughput} = \frac{\text{Number of Received Packets}}{\text{Total Simulation Time}} * \text{Packet Size} \quad (3)$$

7.4Packet Loss

This metrics measure the number of data packets Created by the source node but never been reached to the destination node.

$$\text{Packet loss} = \frac{\text{Number of Send Packets} - \text{Numberof ReceivedPackets}}{\text{Numberof Send Packets}} \quad (4)$$

C. *Simulation Results*

First, average end to end delay of the AODV, AOMDV, DSR and DSDV routing protocols are analyzed by varying the velocity of vehicles as given in table

Table 7.1
End to End Delay

Velocity (m/s)	AODV	AOMDV	DSR	DSDV
10	4.87375	4.82485	2.5182	4.8268
20	4.87387	4.5611	2.9465	4.4231
30	4.83141	4.6937	2.8803	4.6245
40	4.88671	4.7661	2.8826	4.6364
50	4.80451	4.7696	2.8795	4.9364
60	4.88221	4.6111	4.8856	4.8364

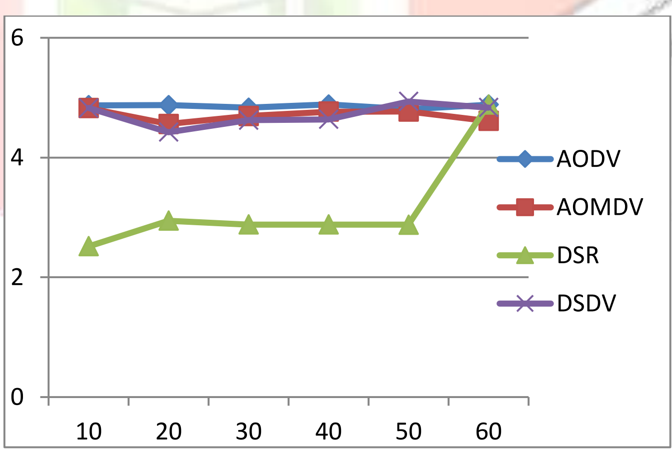

Fig. 7.1: Average end to end delay

Second parameter is the average throughput which measure the data sent successfully over the network.

TABLE 7.2
AVERAGE THROUGHPUT

Velocity	AODV	AOMDV	DSR	DSDV

10	828.13	1000.14	2000.48	940.04
20	738.26	686.91	1515.14	920.65
30	747.26	700.4	1820.12	916.64
40	761.14	715.8	1833.94	915.63
50	747.67	618.19	1844.17	917.55
60	713.43	534.99	1841.59	905.57

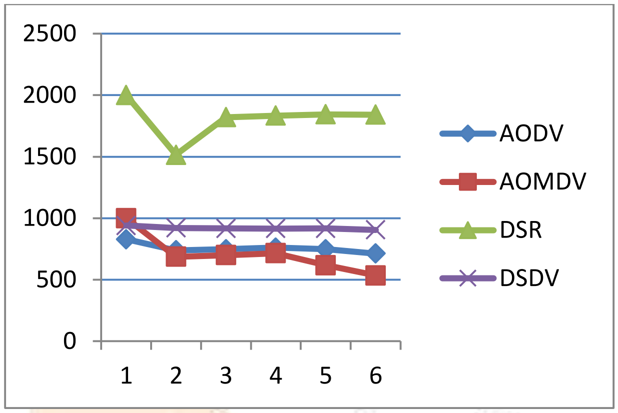

TABLE 7.2

PACKET DELIVERY RATIO

Velocity (m/s)	AODV	AOMDV	DSR	DSDV
10	90.13	90.36	86.48	89.18
20	90.2	89.25	86.99	88.31
30	90.28	87.64	63.97	86.9
40	90.4	89.57	60.97	85.5
50	90.27	90.07	61.56	85.19
60	99.26	89.41	50.33	86.54

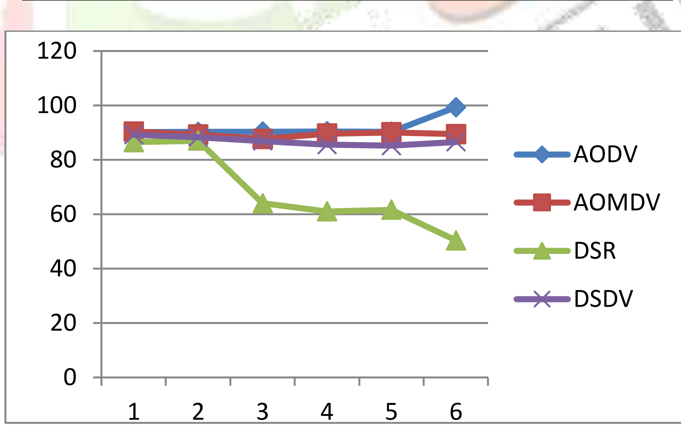

Fig. 7.3: Average end to end delay

As shown in Fig.1 end to end delay of DSR is almost half as compared with other protocols. This is true until the vehicle is moving below 55 m/sec after which the performances of all the protocols are just equal to each other. As shown in Fig7.2 the average throughput which measures the data sent successfully over the network. Table II gives the values of average throughput of various routing protocols.Third parameter, packet delivery ratio of various routing protocols is analyzed by varying velocity of vehicles as given in table .

All protocols shows similar behavior till 20 m//sec. But after that AOMDV, AODV and DSDV have similar packet delivery ratio, as shown by figure 7.3. It means AODV, AOMDV and DSDV are better than DSR in terms of packet delivery ratio.

VIII. CONCLUSION

Topology based routing protocols are most widely used in the vehicular communication. We have analyzed AODV, AOMDV, DSRR and DSDV. The simulation was performed to compare these in NS 2.34 by varying the velocity of vehicles on the road. Simulation results shows that end to end delay and throughput is better in DSR but it has more packet loss and lesser NRL. Whereas AOMDV and AODV having better packet delivery ratio and minimal packet loss. So depending on the significance of parameters in particular scenario, the specific routing protocol could be selected. In future, the performance of these protocols can be evaluated when the density of vehicular traffic changes. Other performance metrics such as jitter, delivery cost etc. can be considered for detailed analysis of these routing protocols.

REFERENCES

[1] Andreone L, Ricerche C. Activities and Application of the Vehicle to Vehicle and Vehicle to Infrastructure Communication to Enhance Road Safety. The 5th European Congress and Exhibition on ITS 2005, Hannover, Germany, 2005:345-352.

[2] Zhang W B, Tan H S, Steinfeld A, etl. Implementing Advanced Vehicle Control and Safety Systems (AVCSS) for Highway Maintenance Operations. Proceedings of the 6th Annual World Congress on ITS, Toronto, Canada, 1999:235-241.

[3] Fatima Batool, Shoad A Khan, Traffic Estimation and Real Time Predication Using Ad Hoc Networks. Proceedings of IEEE International Conference on Emerging Technologies 2005, Islamabad, Pakistan, 2005: 321-329.

[4] Subir Biswas, Raymond Tatchikou, Francois Dion. Vehicle-to-Vehicle Wireless Communication Protocols for Enhancing Highway Traffic Safety. IEEE Communications Magazine, January 2006: 74-82. [5] Tarik Taleb, Mitsuru Ochi, Abbas Jamalipour, etl. An Efficient VehicleHeading Based Routing Protocol for VANET Networks. Proceedings of IEEE WCNC 2006, Las Vegas, USA, 2006: 2199-2204.

[6] Fabrizio Granelli, Giulia Boato, Dzmitry Kliazovich. MORA: A Movement-Based Routing Algorithm for Vehicle Ad Hoc Networks. Proceedings of 1st IEEE Workshop on Automotive Networking and Application, San Francisco, USA, 2006: 256-265.

[7] Perkins C E, Bhagwat P. Highly Dynamic Destination Sequenced Distance–Vector Routing (DSDV) for Mobile Computers. Proceedings of ACM SIGCOMM 1994, London, UK, 1994: 234-244.

[8] Johnson D B, Maltz D A. Dynamic Source Routing in Ad Hoc Wireless Networks. Mobile Computing, Kluwer, 1996: 153-181

[9] Tracy Camp, Jeff Boleng, Vanessa Davies. A Survey of Mobility Models for Ad Hoc Network Research, Wireless Communications and Mobile Computing, 2002, 2(5): 483-502. [14] Ehssan Sakhaee, Abbas Jamalipour. The Global In-Flight Internet, IEEE Journal on Selected Areas in Communications, Vol. 24, No. 9, September 2006: 1748-1757

[10] S.-I. Sou and O. K. Tonguz, “Enhancing VANET connectivity through roadside units on highways,” IEEE Trans. Veh. Technol., vol. 60, no. 8, pp. 3586– 3602, Oct. 2011.

[11] F. Li and Y. Wang, “Routing in vehicular ad hoc networks: a survey,” IEEE Vehicular Technology Magazine, vol. 2, no. 2, pp. 12–22, 2007.

[12] J. Zhao and G. Cao, “VADD: Vehicle-Assisted Data Delivery in vehicular ad hoc networks,” IEEE Transactions on Vehicular Technology, vol. 57, no. 3, pp. 1910–1922, 2008.

[13] K. Shafiee and V. C. M. Leung, “Connectivity-aware minimum-delay geographic routing with vehicle tracking in VANETs,” Ad Hoc Networks, vol. 9, no. 2, pp. 131–141, 2011.

[14] J. N. G. Isento, J. J. P. C. Rodrigues, J. A. F. F. Dias, M. C. G. Paula, and A. Vinel, “Vehicular delaytolerant networks? A novel solution for vehicular communications,” IEEE Intell. Transp. Syst. Mag., vol. 5, no. 4, pp. 10–19, 2013.

[15] K. Lee, M. Le, J. Haerri, and M. Gerla, “LOUVRE: Landmark Overlays for Urban Vehicular Routing Environments,”IEEE Vehicular Technology ConferenceCanada, September 2008.

[16] J. Nzouonta, N. Rajgure, G. Wang, and C. Borcea, “VANET routing on city roads using real-time vehicular traffic information,” IEEE Transactions on Vehicular Technology, vol. 58, no. 7, pp. 3609–3626, 2009.

[17] K. Prasanth, K. Duraiswamy, K. Jayasudha, and C. Chandrasekar, “Minimizing end-to-end delay in vehicular ad hoc network using edge node based greedy routing,” in Proceedings of the 1st IEEE International Conference on Advanced Computing (ICAC '09), pp. 135–140, Chennai, India, December 2009.

[18] End-to-End Performance for SCF-Based Vehicular Routing Over Multiple Communication Gaps Sok-Ian Sou, Member, IEEE, and Yinman Lee, Member, IEEE 2014

[19] B Karp, HT Kung, GPSR: Greedy perimeter stateless routing for wireless networks, in Proceedings of the 6th Annual International Conference (ACM, New York, 2000), pp. 243–254

[20] V. N. G. J. Soares, J. J. P. C. Rodrigues, and F.Farahmand, “GeoSpray: a geographic routing protocol for vehicular delay-tolerant networks,” Information Fusion, vol. 15, pp. 102–113, 2011.