A Modified Evolving Graph for Reliable Bi-Directional Routing on Highways in VANET

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ABSTRACT:

Wireless ad hoc network is a distributed type of network where it forms and deforms the network spontaneously and automatically. One of the types of ad hoc network is a Vehicular ad-hoc networks (VANETs), a promising technology enable communication among the vehicles and between vehicle and road side units. Vehicles are travelling with a high speed so, the communication links are highly vulnerable to disconnection. This paper has focused the reliable routing on highways scenario. Link reliability model is developed to calculate the reliability between the vehicles and estimate the most reliable path from source to destination. VANET have the problem of frequent disconnection of communication links and recurrent changes in topology. For an efficient routing assumed that vehicles are moving in same directional. This paper proposes a red rover algorithm for vehicles are moving in bi-directional. Simulation results shows that proposed protocol outperforms the existing protocols.

Keywords

VANET, Reliable routing, topology, Red rover algorithm

1. INTRODUCTION

Averting the Road accidents is the foremost Dispute in world. With the Hasty increase of Vehicles, driving becomes more challenging and dangerous. In this modern world, accidents are also increasing hurriedly. In the year of 2010, nearly 1.24 million was died and gets injured due to accidents around the world. In our country, during the year of 2011, severity of the accidents will increased up to 28.6 when compared with the Previous year of 2010 this has the severity of 26.9. This would make to develop an emerging and promising technology, Vehicular Ad-hoc Networks (VANETs).VANET is a technology in which vehicles communicating themselves and road side units. VANET, a special form of MANETs, are the assortment of vehicles equipped with wireless technology such as Wi-Fi, WiMax, Bluetooth, zigbee, IRA as Inter Vehicular Communication (IVC) can be engaged. It prevents road accidents and improve road safety by publicize the road side information to all the vehicles. The principles behind the VANETs are "Multi-Hop Relaying". In order to collect the real time data on traffic and road conditions, VANET technology uses variety of on board sensors. Application of sensors include services of safety warning systems, traffic control, real-time traffic, re-routing by intelligent transportation management systems (ITS). Sensors can provide information about speed and location of the vehicles [1]. Sensor in the vehicles or Road Side Units sense the information happening on the road side activities and vehicles then disseminate the information to all the nearby vehicles. So that, driver can aware of that information that makes the

passengers to be a comfort and safety. Besides, it can have some application includes Electronic toll collection, Multimedia, Gaming, Vehicle to home communication, travel and tourism management [2]. To achieve these application routing should be reliable. High mobility is the most inimitable features of VANET when compare with MANET.

The rest of the paper is organized as follows: Section II overviews the related work in this field. Section III presents the proposed algorithm and Section IV presents the reliable routing protocol (VoEG-RAODV). Section V shows the simulation results and performance metrics to be evaluated. Finally Section VII concludes the paper.

2. RELATED WORKS

VANET are the special form of MANET. But, VANET have the characteristic of high mobility when compared to MANET. Due to high mobility of vehicles, there will be frequent changes in network topology. In paper [5] Evolving Graph concept has been proposed to capture the network topology. This concept is applied directly to MANET. As the VANET are the highly dynamic networks, so Evolving Graph has been modified to VANET oriented Communication Graph (VoEG) capture the topology changes.

In paper [7] reactive protocol like AODV is proposed. AODV create a route an on-demand basis. This saves the network bandwidth. Before a source node sends data packets, it will initiate the route discovery process by flooding the Route Request (RREQ) message. The RREQ message carries the

sequence of hops it passed through in the message header. Any nodes that received the same RREQ message will not broadcast it again. Once a RREQ message reaches the destination node, the destination node will reply with a Route Reply (RREP) message to the source. The RREP packet will carry the path information obtained from the RREQ packet. When the RREP packet traverses backward to the source, the source and the traversed nodes will know the route to the destinations. Each node uses the route cache to record the complete route to desired destination. Route failure is detected by the failure of message transmissions. Such a failure will initiate a route error message they will erase all the paths that use the broken links from their route. In [9] proposed a Prediction based routing (PBR) protocol for VANET. It predicts the route lifetime and concludes the reliable routes pre-emptively before the existing one gets fail.

In [8] MOPR algorithm is proposed .Suppose, there are several routes between source to destination vehicle,

choosing the most stable route when considering the movement conditions of the intermediate nodes with respect to the source and destination nodes. The intermediate nodes can be either other vehicles or stationary nodes gateways.

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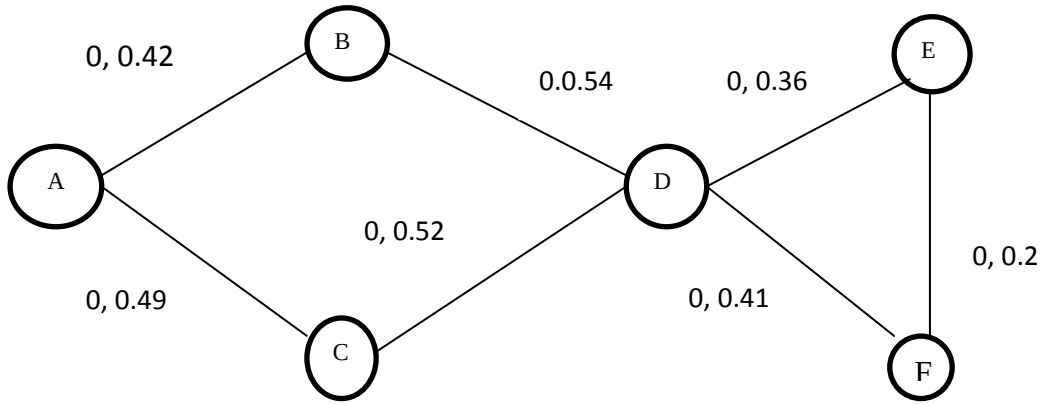

Fig.1 VoEG model at t=0sec

3. RED ROVER ALGORITHM

The proposed redrover algorithm is an efficient algorithm for bi-directional routing. It is simple. The network is divided in to two equally set of k nodes (i.e.) 0 to k/2-1 as one set and k/2 to (k-1) as the other. One group will send messages along some virtual channel say A and the other group will send the messages along with another channel say B until they reach the destination. Advantages of red rover algorithm over other are it does a better job of utilizing the available resources, it significantly reduce the message latency.

4. VANET ORIENTED EVOLVING GRAPH-RELIABLE ADHOC ON-DEMAND DISTANCE VECTOR ROUTING PROTOCOL

VoEG model is used to formalize the communication graph of VANET. In this paper VoEG-RAODV, a new protocol is designed for reliable routing in VANET.

MRJ:

Dijkstra's algorithm is used to find the shortest path between source to destination. It has been applied in VANET. so, Dijkstra algorithm is modified as EG-Dijkstra's algorithm, used to find the most reliable journey from source to destination.

EG-MRJ:

Input: A VOEG and a source vehicle (s_r)
Output: Array RG that produce the most reliable route from source to all the other vehicles.
Variables: A set of u unvisited vehicles
Set rout reliability RG (s_r) =1 and RG (q) =ϕ for all the other vehicles
2. Initialize array U by inserting s_r
3. While u is not empty do
(a) Y <---- the vehicle with the highest reliability value in U;
(b) Mark y as visited vehicles
(c) For each open neighbor v of y do
If Trav (d) is true
1. Set RG (q) <------r_t (e) x RG(y)
2. Insert v if not visited in u;
(d) Close y;
4. Return the array RG;

Route discovery process in VoEG-RAODV:

When source vehicle has attempting to send data to destination, it calculates the reliability value for each link on the VoEG.Then, by using EG- Dijkstra's algorithm finds the shortest path and data packet forwarding has starts to progress.Source vehicle create a routing request message (RREQ) and assigns the MRJ as extension to the RREQ. In EG-RAODV by utilizing the information in the RREQ, intermediate nodes are able to forward the routing request to the next neighbor node.

In the VoEG-RAODV, the intermediate vehicle is not within the communication range of either source vehicle or destination vehicle then intermediate vehicle might be outdated.

Pseudo code of VoEG-RAODV:

INPUT: A VoEG and a source vehicle $s_{r,}$ destination vehicle are $d_{e,}$ intermediate vehicle $I_{r,}$ Variable x and communication range $C_{r.}$

OUTPUT: The MRJ from s_r to d_e

1. using the prediction algorithm, get the current status of VOEG

2. Calculate the reliability value for all links in VOEG.

3. MRJ<------ EG-Dijkstra (VoEG),

4. While the MRJ is not empty

(a) X<----first node from the MRJ;

(b) Record x in RREQ header as extension

(c) Remove x from MRJ;

5. Set X_{min} = 0m, X_{max} =1000m;

6. If C_r is from X_{min} to X_{max}

7. Then I_r might not be outdated

8. Else

9. I_r might be outdated

10. Send an RREQ from s_r to d_e, along MRJ;

11. While an RREP is not admitted, wait

12. Start sending data

5. SIMULATION RESULTS

The following results show the performance of various protocols.

Performance Parameters:

Parameters following are used to estimate the performance of the protocol

1. Packet Delivery Ratio (PDR): It represent the average ratio of packets received by the destination to the successfully to the packets send by the destination.

2. Link Failures: It represents the average number of link failure during routing.

3. Routing Request Ratio: It is the ratio of total transmitted routing request to the total successfully received routing packets at the destination.

4. Average End to End (E2E) Delay: It represents the average delay between packets send by the source node and received by destination node.

5. Route Lifetime: It represents the average lifetime of the route. If the route has a longer lifetime, then the route will be reliable one. In fig.2.VoEG-RAODV achieves highest packet delivery ratio when compared to EG-RAODV. The reason is VoEG-RAODV successfully finds the reliable route from source to destination with the help of Vanet oriented evolving graph. Moreover, it attains steady PDR performance when compared to EG-RAODV.

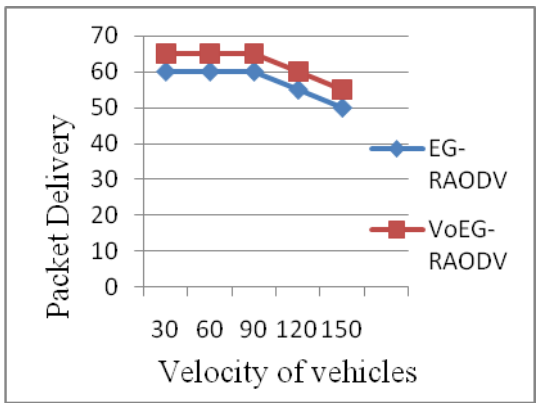

Fig 2: Packet Delivery Ratio

When the velocity of the vehicle increase, link between two vehicles gets failed also increased. This will reduced in VoEG-RAODV when compared to EG-RAODV as shown in figure.3.

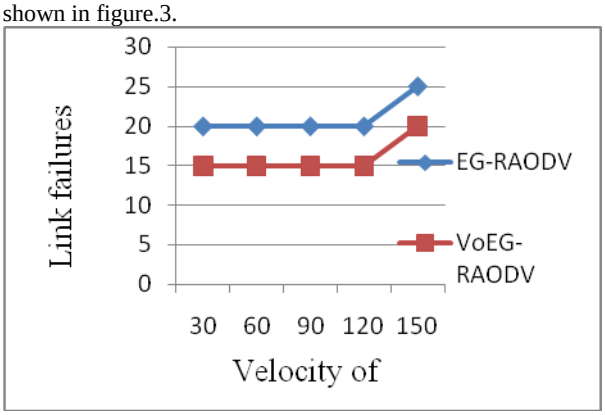

Fig 3: Link Failures

Then more number of routing request is generated for the route discovery process because of high delivery failures in EG-RAODV. This will be significantly less in VoEG-RAODV as shown in figure.4.

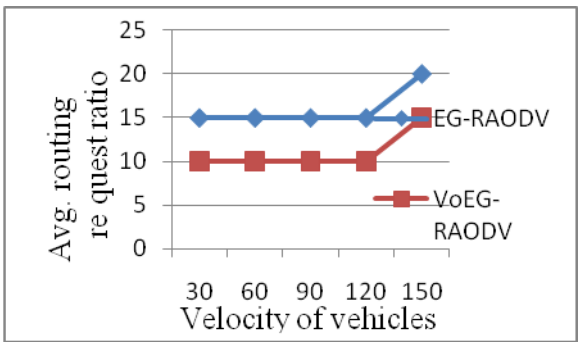

Fig 4: Average routing request ratio

6. CONCLUSION

VANET distribute safety message to all the vehicles to prevent collision. Due to high mobility of the VANETs, Communication links get breaks regularly. Flooding the safety message in the networks need some reliable link. In traditional AODV, routes often break and create a new route when an on-demand. So data packet may be lost and it will need some significant amount of time to establish a new route. For creating a new route, it will send Route Request (RREQ) message procedure. so, there will be a delay. To avoid this, Prediction based routing (PBR) protocol has been proposed, it predict the lifetime of the links and create a new route before the existing get breaks. So, Packet lost ratio, delay and routing request ratio gets decreased. To improve the performance metrics, EG-RAODV protocol has been proposed. It will find the reliable routes then data packet will be send through the reliable route. So, it improves the high successful packet delivery ratio with low delay.

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