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Performance of D-LAR on the basis of Average Hop Count in VANET

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Abstract

VANET (Vehicular Ad Hoc Network) can perform vast number of applications like active safety, create warning messages by wireless vehicular communications without using fixed infra-structure. Due to VANET characteristics such as dynamic nature, repeated fragmentation and continuously changes in network topologies, performance of routing algorithms can be a challenging task. Thus, greedy based approach provides the most suitable solutions for routing in VANET. In this paper, D-LAR (Directional Location Aided) protocol performance is discussed which will give us more accurate location of moving vehicles as compared to the other location aided protocols on the basis of average hop count.

Keywords: Hop Count, Probability, Routing Protocols, VANET (Vehicular Ad Hoc Network)

1. Introduction

Vehicular Ad Hoc Networks (VANETs) can turn every involved vehicle into a wireless network router or node and allow node connectivity in range of 100 to 300 meters of each other and then form a network within a specific wide range[1]. If the cars coming out of the network zone, then other can join the network in order to maintain the mobile network. Firstly, this system was used by the police for the safety purpose of the vehicles. VANET has two distinct things: Vehicles and the roadside infrastructure[2]. Road side infrastructure vehicles are fixed and behave like mobile nodes hence act as dissemination points for the vehicles. VANET having huge number of application but for the safety process for example, passenger comfort etc. is the main application. It is recent and advanced technologies that they draw attention of the academic areas and the industry. However, VANETs also come with several challenging characteristics, such as potentially large scale and high mobility[3]. Nodes in the vehicular environment are much more dynamic because most cars usually are at a very high speed and change their position constantly. The high mobility also leads to a dynamic network topology, while the links are temporary[4]. Besides, VANETs have a potentially large scale which can include many participants.

2. Routing Protocols in VANET

The major constraint in the design of vehicular network is the increase in nature of a dynamic routing protocol. As routing is the best path to transmit data from one vehicle to others[5]. However the challenge remains same as how to prevent delay linked with exchanging the information from one point to another. To provide the safety or comfort zone to the individual, exchanging of messages should be done with inter-vehicle communication[6]. Routing in VANET is more challenging than the MANET because of highly dynamic topology characteristics. So maintaining the best paths of communication in desirable environment is the most difficult task in VANET.

The routing protocols can be fall into different categories, such as:

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- Topology Driven.
- Location Based.
- Cluster Based.
- Broadcast Routing.
- Geocast Routing.

Due to high mobility constraints and dynamics nature of the VANETs, the architecture and enactment of reliable protocols is a demanding quest. For the safety applications such as position and direction of the vehicles, D-LAR routing protocol in VANETs is used for broadcast the information efficiently[7]. Therefore, D-LAR is linked with two protocols:

- Location-Aided Routing (LAR) uses the position information with GPS which limits the area in a smaller request zone for discovering a new route.
- Directional routing uses the direction nearest to the source and destination with minimum angle.

2.1 Location Aided Routing (LAR) Protocol

LAR works on the same algorithm principles such as AODV and DSR (on demand routing protocol). It utilizes position information of mobile nodes to decrease the routing overhead. LAR scheme only forward the packets in the request zone. It uses position information to send a Route Request Packet (RREQ) to destination in given request zone. Consider a node S (Sender) has to find a route to node D (Destination). The node can only transmit the data to the other node if it belongs to the request zone. If node wants to send the packet to others, then area should be the expected zone[8]. Otherwise packet will only transmit in the request zone. In LAR, there are two zones present: Expected zone and request zone described in Figure 1. In the circular area, the sender needs to send the forwarded packets, known as expected area. The location is determined based on the position information which is provided via sender at particular interval t0. Thus in the rectangular area of the request zone, radius R = v (t1-t0)). This defines the range in which the packet is forwarded.

Thus, the RREQ is provided to the node within the request zone and then pass the packets in normal way and drops the packet in alternative way. This leads to reduction in packet overhead.

3. D-LAR (Directional-Location Aided Routing) Protocol

The network performance depends on the number of vehicles in the vehicular network. So, according to this probability for selecting the next acceptable node which forwards packet to the desired destination depends upon the number of nodes present in the network. If the link between networks is damaged, another possible node can be chosen instantly depending upon the lowest delay cost thus number of nodes can be increased which leads to highest packet delivery ratio[9]. So, there should be some technique to find the exact location of nodes from source to destination in highly dense mobile network (VANETs). The packet overhead should be lowest. Using minimum angle sender node can select the next hop. To find the stable node D-LAR protocol selects the next-hop node in the forwarding node. Therefore, in request zone, a message from node is pass to the next-hop node which minimizes the angle. Within the same transmission, angle of the nodes can be calculated in the request zone. In Figure 2, the distance can be calculated as[7,10].

$$d = \sqrt{((x_2 - x_1)^2 - (y_2 - y_1))^2} \quad (1)$$

Similarly, the angle can be calculated as:

$$\theta = \tan^{-1} \tan^{-1}[(y_2 - y_1 / (x_2 - x_1)] \quad (2)$$

Node A is selected as a next forwarding hop node of source node S due to the minimum angle between the source and the destination. Providing the minimum angle node A is selected as the next-hop node. Similarly, for further transmission, B is selected as a next forwarding hop node of A. Finally, node C delivers the packet to the destination node D which is having minimum angle.

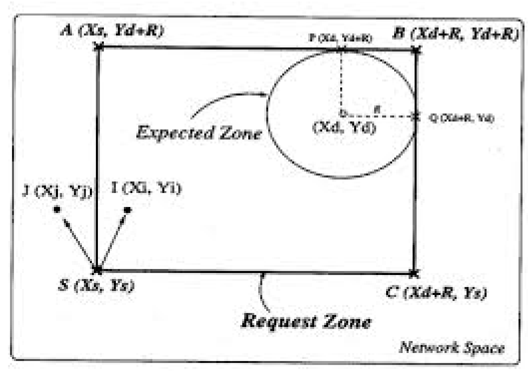

Figure 1. Request and expected zones in LAR.

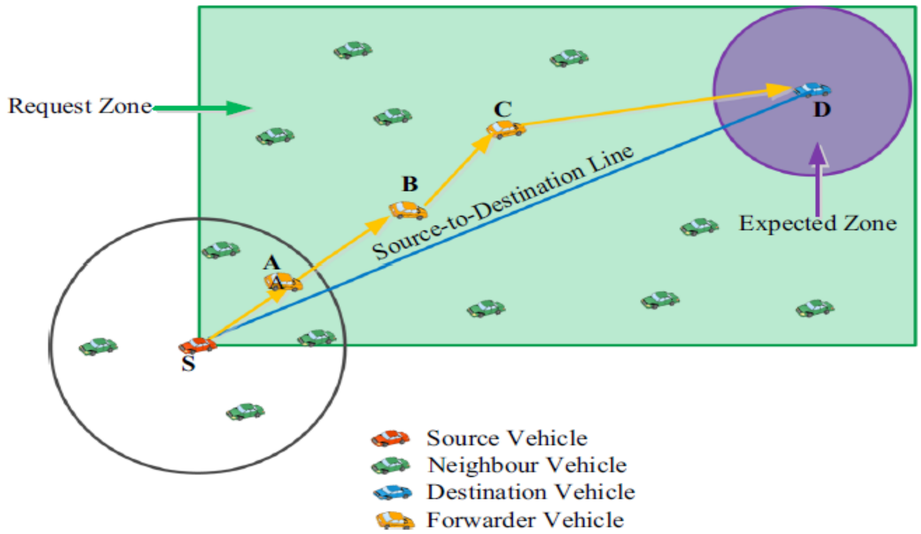

Figure 2. Directional-location aided routing scheme.

In D-LAR, route discovery algorithm is same as LAR protocol scheme.

Therefore, next hop node must be in one fourth circular region of S.

Where nodes follow the Poisson distributed process (λ). According to Figure 3, no. of nodes in shaded area can be given as:

$$n = \lambda \pi R^{2/4} \quad (3)$$

Hence, the probability of selecting nodes can also be determined:

$$P(n, A) = \frac{(\lambda A) \wedge n.e^{-\lambda A}}{n!} \quad (4)$$

$$P(n, A) = \frac{\left(\lambda \pi R \wedge 2/4\right) \wedge n.e^{-\lambda \pi R \wedge 2/4}}{n!} \quad (5)$$

Therefore, the probability of k nodes within the shaded area is:

$$P(n, A) = \sum_{n=0}^{k=1} \frac{\left(\lambda \pi R \wedge 2/4\right) \wedge n.e^{-\lambda \pi R \wedge 2/4}}{n!} \quad (6)$$

Local monitoring is used to observe the behavior of neighborhood node using the method of Collison detection based neighbor discovery which is aimed at improving the broadcasting rate[11].

4. Results and Discussion

We found the feasibility and performance evaluation of the D-LAR protocol. These results are carried out in MATLAB simulation. The network nodes are taken random in nature provided within the simulation area. We considered that nodes are following Poisson distributed with parameter, where λ can be defined as the node density per unit area. R denotes the transmission range and every node having same transmission range.

The distribution of n nodes in the shaded area of the circular region as described in Figure 4 and Figure 5 is given by:

N = λR^2/4

Where, we have assumed the node density (λ) 0.002 and 0.003 respectively.

Thus, probability of selecting at least H nodes in circular area is:

Figure 4 states the probability of finding at least H node of source node in the transmission range.Therefore, selecting at least H nodes in the shaded area is computed as:

According to these, we can say that in the shaded region (Figure 5), there is less number of nodes as compared to the circular region of the source node (Figure 4). Hence, probability of finding neighbor vehicles in the shaded area is high. We can increase the individual reachable neighbors in shaded area because of less number of

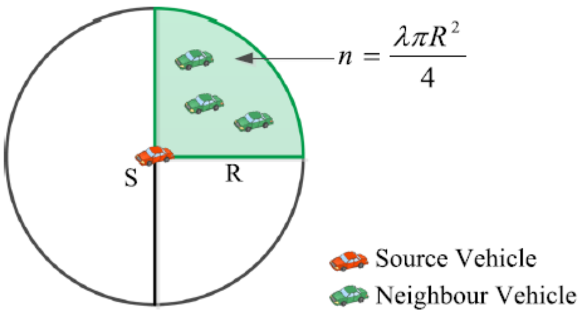

Figure 3. Shaded area of the circle.

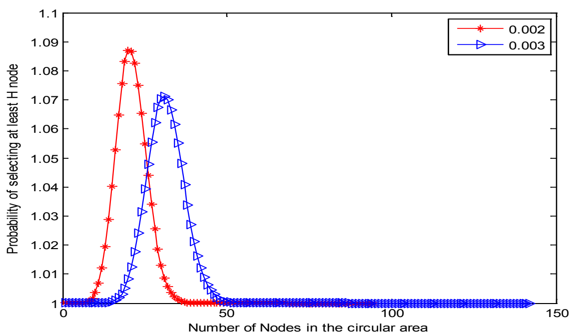

Figure 4. Probability of selecting at least H nodes in circular area.

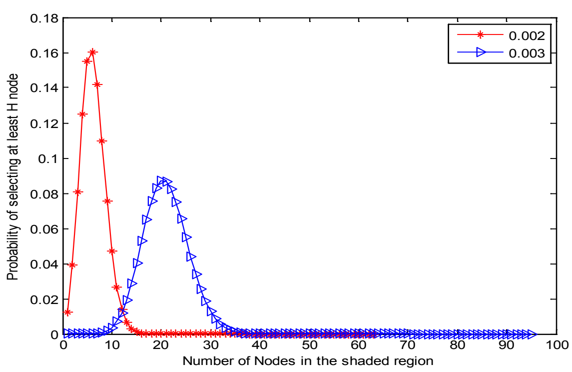

Figure 5. Probability of selecting at least H nodes in shaded region.

nodes. Thus it will lead to enhance the link between nodes in the network. Now, as we know that calculating number of hops count is very important parameter in any mobile networks which improve the network performance.

Figure 6 shows the approximation to the average number of hops from source to destination located in the transmission range. As the connections between the

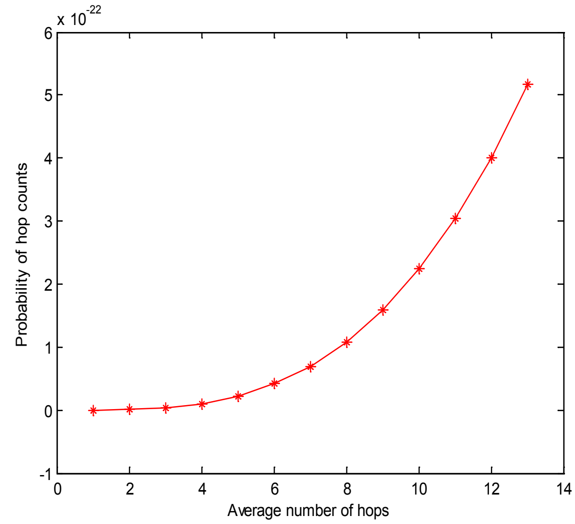

Figure 6. Probability of average number of hop count.

nodes are increased, the probability of finding the next hop count increases.

5. Conclusion

In this paper, we examined the D-LAR performance and feasibility. This routing protocol is effective in order to find the next-hop count node in the same request area or zone. Calculation for the next hop node is done by providing minimum angle between source and destination by drawing straight line between them. This process is much similar to the DIR. The LAR scheme is used to find the route between nodes in D-LAR. This protocol is more applicable for high density vehicular networks, e.g. city traffic environment, where at random time period huge amount of vehicles are present. We have evaluated analytical and mathematical models (in dense network scenario) of the D-LAR protocol.

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