GPS BASED LINK ESTIMATION TIME FOR VANET URBAN ROUTING

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ABSTRACT
In this paper, we propose GPS based LET for urban area routing in VANET. Our main objective is to propose a quality routing in urban area road environment. The attribute of calculating Link estimation time is speed and distance between vehicles. In this method, we use GPS to get latitude and longitude information. It is one of the attribute to use in Link estimation time with speed. To this end, we simulate proposed method with existing method, (i.e.) prediction based Link estimation Time and cross layer based Link estimation time. A comparison study has been done with three Link estimation Time. The simulation result study has been performed and the results show that GPS LET can substantially increase the delivery ratio and delay remarkably

KEYWORDS: VANET, GPS, Link Estimation Time, Routing.

1. INTRODUCTION:
Vehicular Ad-hoc network is an emerging research topic in the latest trends in Ad-hoc network. According to WHO (World Health Organization), millions of people around the world die every year because of vehicular traffic accidents. It is not always the fault of the driver; sometimes the obstructed vision or unexpected obstacles are also responsible for this. To reduce the traffic accidents and manage traffic control of a particular area, computer networks purpose a new networking concept i.e. Vehicular Ad hoc Network (VANET). In VANET, a vehicle acts as the ad-hoc node of a network. The vehicles are connected together using IEEE-802.11p device. The modern 802.11p device communication range is up to 1000m. This device can be used in VANET in two ways. The first use is for effective communication between nodes and acting as network infrastructure on the road. The second use is that a VANET vehicle itself communicates to other vehicle. This type of communication in VANET has several applications such as infotainment, road assist, and internet services. Even though we have used the latest technology, the communication among vehicles is a highly challenging task. The reasons behind the challenges are, frequently changing the network topology that leads to frequently disconnected network.

To solve this problem, we have to find vehicles speed, distance among the vehicles, destination comparison between next hop nodes of the network and link expiry time between the next hop of the network. These are the important parameters of the routing in the VANET. The speed and distance among the vehicles get information from the GPS. The GPS plays the key role in the modern routing in VANET. The normal routing methods can not fit in the VANET environment. It has the specialized routing method; it is called position based routing. This routing method can be categorized into three methods. There are 1) Delay Tolerant Network (DTN) 2) Non-Delay Tolerant Network (Non-DTN) 3) Hybrid network. Even though the VANET uses the above routing methods, the performance of the routing still needs more up gradation in the Link Estimation Time (LET). The LET gives stable connectivity among neighbor vehicle and the duration of communication is dependent on the node (Vehicle’s) mobility in the network. The total routing path duration of communication is also called as Route Estimation Time (RET). The RET value is depends on Link Estimation Time (LET) of each node in the network. To Calculate the LET, it takes different attributes for different approach. Basically, it needs velocity, distance between nodes, SNR values, Transmission range and threshold value. The selection of next hop depends on the maximum value of LET which leads to the long life of the routing path. The speed is one of the parameters that can be calculated by the mean value theorem. The next parameter is the distance to destination calculated using longitude and latitude data. These two values can be obtained from GPS. The next parameter is signal strength. It generally decreases as the vehicle moves further from the adjacent hop vehicle. When the distance between two vehicles is closer, the signal strength is increased. The signal strength is generally dependant on the transmitting and receiving power of the dedicated short range communication device.

2. RELATED WORK:
In inter vehicular communication routing is a major challenge; Researchers have proposed the different types of routing protocols. In VANET routing methods are classified as many ways such as road based routing and communication based routing.
Commonly the VANET routing methods are classified as follows.

**Position based routing:** [6] Position based routing is also known as a geographical routing. The routing path is constructed based on the location. It monitors the location information of the vehicles using Global Positioning System (GPS). This method does not maintain routing table, instead it uses the location information of Source node, next-hop node and destination node to perform routing. The routing is carried out through the following procedures, Path selection: The routing path is constructed based on the Dijkstra algorithm. It computes the shortest path between the source node and the destination node. Position based protocols are classified into Non-delay tolerant network (Non-DTN), delay tolerant network (DTN) and hybrid protocols. Non-DTN protocols aims to transmit a packet from source to destination as soon as possible. This Non-DTN protocols are classified as beacon and beaconless protocols based on the type of messages it uses. DTN protocols derived for improving the performance during continuous disconnectivity of a network. DTN transmits a packet depending on the metrics of a neighbor node. The transmission is processed using Carry-and-Forward method. In Hybrid position based protocol, the packet transmission is based on greedy forwarding and recovery modes.

**Topology based routing:** Topology-based routing protocol is usually MANET routing protocol. It uses the Link's information stored in the routing table, and this link information is forwarded as packet from source node to destination. It requires the IP addresses of the source and the destination. It commonly categorized into three categories Proactive (periodic), Reactive (on-demand) and Hybrid.

**Cluster based routing:** In Cluster based routing protocol, groups of vehicles are formed as clusters, where each cluster is managed by a Cluster Head(CH). The CH is responsible for coordinates the vehicles in inter-cluster, intra-cluster structure and sending the packets to a next-hop node during the routing. Different approaches are proposed to choosing a CH. This routing method gives high scalability. The existing MANET cluster based protocols are not suitable in VANET due to high mobility. Therefore, new routing protocols are proposed for use in VANET such as CBR, COIN and LORA_CBF.

**Geocast routing:** Fundamentally, Geocast routing is a position coordinate based, multicast routing. This routing method sends the packets to all vehicles located in specific location or region using Zone of Relevance (ZOR). It reduces the network overhead and reliable packet delivery.

**Broadcast routing:** Broadcast routing topology sends the packets to all nodes, when the destination is outside of the communication range. Intelligent Transport System (ITS) mostly uses the Broadcast and Geocast routing for sharing climate, traffic and emergency warning to all vehicles. Using this method reliable packet transmission is ensured and the network overhead is minimized. The packet replication is made by sending the packet to all nodes in the network.

**Multicast routing:** In Multicast routing topology the source node sends packet to multiple destinations. This routing is performed in tree based and mesh based routing structure. Tree structure gives low performance, because network topology changes dynamically. Mesh based routing, the communication is same as mesh topology, but the node is connected with each other. In this method there is much more network overhead.

**Link Estimation Time (LET):** The LET is the challenging role in the VANET. It decides the performance of the routing protocol. In VANET environment, routing is based on the Link Estimation Time, speed and distance. We already studied and analysed the Link Estimation Time. We have analysed three types of LET based on their vehicular environment. The three types are, Position based LET [3]: Position based routing supports V2V communication. The LET calculation for this routing depends on position, speed and distance. The position of the vehicle is deployed on the graph plane. Prediction based LET [2][8]: Prediction based LET scheme supports, V2I communication. In VANET road side units are installed at function points. Here the road side unit is also called anchor unit. This LET method is calculated using speed and distance. Cross layer based LET [1][3][7]: Cross layer based LET supports V2V communication. This LET is calculated through the ‘physical layer information’. The information in transmission power and receiving power will be in the form of SNR. The comparison of the 3 methods of LET calculation is given below.

**Table 1: Comparison of various LET**

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Position Based Estimation</th>
<th>Prediction Based Estimation</th>
<th>Cross Layer Estimation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Infrastructure</td>
<td>V2V</td>
<td>V2I</td>
<td>V2V</td>
</tr>
<tr>
<td>Cross Layer design</td>
<td>Not applicable</td>
<td>Not applicable</td>
<td>applicable</td>
</tr>
<tr>
<td>Dependency</td>
<td>Speed, Velocity and angle</td>
<td>Speed, Velocity and Range</td>
<td>SNR, Distance</td>
</tr>
<tr>
<td>Threshold value</td>
<td>No</td>
<td>No</td>
<td>Depends on it</td>
</tr>
<tr>
<td>Topology</td>
<td>Any</td>
<td>Any</td>
<td>Any</td>
</tr>
<tr>
<td>GPS</td>
<td>Need</td>
<td>Need</td>
<td>Need</td>
</tr>
<tr>
<td>Digital Map</td>
<td>No Need</td>
<td>No Need</td>
<td>Need</td>
</tr>
</tbody>
</table>

3. **GPS based Link Estimation Time**

In a typical urban scenario, the vehicles movement is in various speeds and direction of the vehicle changes frequently. Due to this reason, the routing path is not stable. The proposed plan is increase the stable state of a routing path. The main factor of the stable routing is choosing the next hop node. The proposed system is mainly focused on choosing next hop. This can lead to improvement in the performance of packet delivery ratio and end to end delay. To select the next hop node, requires various parameters such as distance, speed and Link Estimation time.

**Distance calculation:** [4] The distance between the two vehicles needed to find the position of both vehicles. The position of vehicle is provided by GPS. The GPS is used to give the information about the
The main objective of this algorithm is to select the minimum number of neighbour node of the particular source node. The first step of the algorithm, checks if the destination node lies in the source node range. If the first step is true, the remaining steps of the algorithm need not be executed. The destination node does not lies in the source node communication range then the step 2 will be executed. The step 2 has three
conditions, each one minimizes the number of neighbour node and choosing the next stable hop neighbour node. In the first condition, the distance between the source node to neighbour node is calculated. It is to check the distance for the entire set of neighbour node which is in between T_{distance} and T_{resistance}. Those nodes which satisfy the first condition, then are tested with the second condition for checking speed of the vehicles. The neighbour node speed should be the average speed of the source node. After minimizing the minimal number of neighbour node, the node is tested with the third condition. The condition compares the destination point of the source nodes latitude and longitude. First the small boundaries of the latitude and longitude of the source node are formed. It is done by adding and subtracting some content values of the latitude and longitude of the source node. After that, the next hop node destination point lies into the boundary range then both nodes are travelling towards the same destination. So that the link failure path surely can't have occurred at the most. When all the three conditions are satisfied it means the neighbour nodes are in minimal range. In that case we will choose one at randomly.

4. PERFORMANCE ANALYSIS

In this chapter, we present the performance analysis of the proposed system. There are several attributes that can be used to measure the performance of a link estimation time. We examine three link estimation times with GPSR[12] routing protocol. Objective of this analysis is to show that GPS based Link estimation time improves performance significantly compared to position based LET and prediction based LET.

Experimental setup:
The three Link estimation time types are implemented in ns-3 [11] with 802.11p, with a transmission rate of 3 mbps and transmission range of 500 m. The traces were generated by SUMO™ with use of OpenStreetMap. The OpenStreet Map[13] will give the realistic road map of an urban scenario example Chennai city. The SUMO[13] shows the better realistic vehicle mobility. We Plot the 200 vehicles in the Tambram via Guindy Chennai road by using OpenStreetMap. The length of the road segment is 5000m. But we cannot examine till Guindy. The SUMO can be executed with given vehicles, which the traces of movement pattern. The NS3 executes simulation using SUMO mobility traces.

The urban topology is a realistic Chennai map from retrieved in Openstreetmap. All roads have single lane and the speed limit is 80 km/hr. Three experiments were executed, the first experiments is the GPSR GPS based LET with 200 nodes. The placement of the node is frequently broken scenario. The experiment is repeated for 50 runs. Each run consists of different source and destination node. The second experiment is the GPSR position based LET with same 100 nodes and also placement. It is also repeated for 50 runs. The third experiment is the GPSR prediction based LET and is repeated for 50 runs, same as the above two experiments.

Experimental result:
The graph shows, the PDR of [12]GPSR-GPS based LET, GPSR-Position based LET and GPSR-Prediction based LET. An average delivery ratio is obtained in the same scenario executed the above three methods.

The GPSR-GPS based LET shows the consistent performance compared to other link estimation times. During initial stages, the performance is slowly growing but in the 32-70km in the speed axis, the performance is very good comparing to the other link estimation times.

Graph 1: PDR Vs Average Speed
The measurement is taken for every speed change of 5km/hr, the adjustment of speed is only possible in SUMO, as it gives the data in the format of trace file. It cannot be adjusted in NS3. After getting the trace file, simulate can be performed in NS3. The NS3 gives packet delivery ratio and end-to-end delay. This experiment didn’t take node density. But this system examined and select neighbor node with use of destination point. Other two link estimations are very low because the correct neighbor node cannot be chosen and the destination point cannot be predicted those two estimations.

Graph 2: E2E Vs Average Speed
The graph shows, the E2E of three LETs an End-to-End delay obtained for the same scenario executed by three methods. The End-to-End delay is also very stable because the average speed and distance is taken, so that the entire vehicles in the routing path are consistent, because of selecting neighbor nodes with the same speed and exact distance. This leads to a tremendous packet transmission rate and reduces the delay.

5. CONCLUSION

This paper proposes a GPS based LET, specially designed for urban vehicle environment. The proposed method relies on GPS information and speed of the vehicle. We compare position based link estimation time with cross layer based link estimation time and our proposed system illustrates remarkably better performance in the urban environment in terms of packet delivery ratio and end-to-end delay. Our results suggest that use of GPS information can increase PDR and decrease in E2E

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