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REDUCING DROPPED PACKETS OVERHEAD OF LINK STATE AWARE GEOGRAPHIC OPPORTUNISTIC ROUTING PROTOCOL FOR VANETS

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Abstract— *Vehicular Adhoc Networks (VANETs) are subpart of Mobile Adhoc Network. VANETs are self-organized wireless networks, which are infrastructure less. Due to the high mobility of VANETs and increase the speed of vehicles, the connectivity between vehicles become poor which result in an increase the dropped packets overhead of LSGO routing protocol. LSGO routing protocol is a combination of link state information and geographic location of nodes. LSGO aim to improve the data transmission reliability in high dynamic environment. In this paper, we present the method to reduce the overhead when nodes move out of range. During link failure, source node stop the packet transmission by RERR message send by intermediate node and find another routing path from routing table and again start transmission on new routing path.*

Keywords— *VANET, LSGO, Geographic opportunistic routing.*

1. INTRODUCTION

Vehicular Adhoc Networks contain nodes as vehicles moving freely on the road. Vehicular Communication System (VCS) provide Vehicle-Vehicle (V2V), Vehicle-Infrastructure (V2I) and Infrastructure-Infrastructure communication (I2I). The main goal of communication is to provide the vehicles about surrounding areas information in order to assist the drivers.

VANETs architecture [2] shown in figure 1. VANETs can provide safety and non-safety applications such as accident avoidance, toll payments, traffic information, parking information and infotainment application such as internet access and games. VANETs are the subpart of Mobile Adhoc Networks (MANETs) but both have different characteristics such as VANET have highly dynamic topology, frequently disconnected network, high mobility, unlimited battery power storage, mobility model and interaction with Onboard Sensor. Because of dynamic nature of nodes in network finding and maintaining route is very challenging issue. Routing protocols in VANETs shown in figure 2.

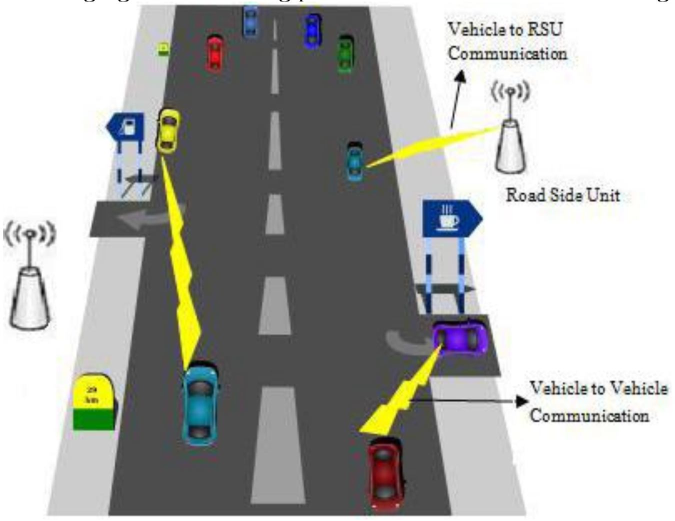

Figure 1 architecture of VANET [2]

Routing protocols in VANETs are necessary for data transmission. VANETs routing protocols are classified into six categories [3]: Topology-based, Cluster-based, Position-based, Geocast based, Infrastructure based and broadcast based.

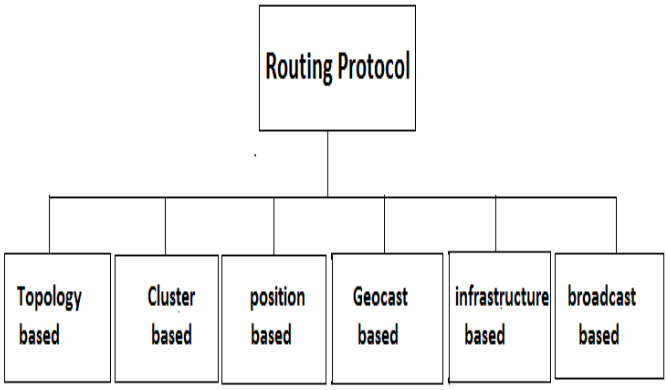

Figure 2 routing protocol in VANET [3]

Topology based routing protocols use the link information that exist in a network and also discover the route and maintain in routing table before the sender sends transmitting the packets.

They are divided into proactive, reactive and hybrid protocols. Topology based protocols depend on the dynamic topology of the network which suffers from routing break so they are not suitable for VANETs. Cluster based routing protocols make the cluster of vehicles and each clusters has one cluster head as coordinator which acts as a temporary base station within its cluster. Election algorithm is used for the selection of cluster head (CH) these protocols perform inter and intra-cluster management function. Position based routing protocols use the location of the vehicles to select the next forwarding node. Geocast based routing protocol use the neighbouring information to forward the packets to all nodes. Infrastructure based routing protocols depend on the fixed infrastructure of the network for their routing. Broadcast base routing protocols use the broadcast mechanism to forward packets to all nodes, which has high network overhead.

Greedy forwarding strategy is used in geographic routing and node transmitting its packets to neighbor if it is close to destination. If the neighbour is not close to destination then this strategy can fail. In this situation, established link is unstable and signal strength reduced which increase packet dropping rate and increase end to end delay.

To solve this problem LSGO protocol use expected transmission count (ETX) which reduce the no of retransmission. Limitation of ETX is that it does not consider the high dynamic network environment so we have to modify the ETX. Now we use forwarding strategy is opportunistic routing which improve the reliability of data transmission by using broadcast mechanism. We take a combination of geographic location of the nodes and link information which proposed Link State aware Geographic Opportunistic routing protocol (LSGO). In this approach we use ETX to measure link quality, candidate node selection and priority scheduling algorithm which give priority to nodes and improve the data delivery ratio.

The rest of the paper is as follows: Section 2 present related work. Section 3 explains existing LSGO protocol, Section 4 explain proposed system, Section 5 represent Simulation Setup, Section 6 represent Simulation Result and Section 7 represent Conclusion.

2. RELATED WORK

Opportunistic Unicast and Multicast Routing Protocol for VANET, Zhizhong Jie *et al.*[2]Proposed trust opportunistic forwarding model for security of routing in VANET and calculate the degree of trust using algorithm. We can calculate the minimum cost opportunistic routing by choosing optimal forwarder and prioritize each node in its trust forwarding list by calculating its cost distance to destination. It proposed trusted minimum cost opportunistic unicast routing protocol (TMCOR) and a multicast routing protocol (TMCOM). TMCOR and TMCOM have good throughput, average delay and security. Location based opportunistic routing protocol [12] takes the advantages of geographic routing and broadcast nature of wireless medium. Geographic opportunistic routing protocol has opportunistic nature and geographic information present in navigation system of vehicles. Navigation system assist the driver until it reach to destination. GeOpp routing protocol calculate the nearest point. Using NP (nearest point) calculate the estimated time of arrival of vehicles (ETA). It also calculates the utility function to forward the packets to nearest vehicles. Link State aware Geographic Opportunistic routing protocol (LSGO) For VANETs, Xuelian Cai *et al.* [1] LSGO routing protocol improve the data transmission reliability by combine the link state information and geographic location of the nodes. Opportunistic routing protocol improves the reliability of routing using by using broadcast mechanism. It makes the packets have opportunity to be received. In the existing opportunistic routing protocol some pay attention on cost, hop count and distance to destination to destination for forwarding mechanism. Few of them consider the link state information and geographic location of nodes. Performance of LSGO routing protocol compare with greedy traffic aware routing protocol (GyTAR) and greedy perimeter stateless routing protocol (Gpsr) using network simulator ns2 and VanetMobiSim simulator. Simulation result show that LSGO's packet dropping rate is reduced and the network

throughput is improved and overhead of network increase. An Intersection Based Traffic Aware Routing With Low Overhead in VANET, Lakshmi Ramachandran *et al*.[3] proposed intersection based routing protocol with low overhead and consider the traffic light affect the design of routing protocol. This paper proposed Shortest Path Based Traffic Aware Routing protocol (STAR) which introduce more overhead in network. This problem solve by new intersection based routing protocol with low overhead.
A Group Based Key Sharing and Management Algorithm for Vehicular Ad Hoc Networks, Zeeshan Shafi Khan *et al.[*4] proposed media mixing algorithm share keys among nodes to reduce overhead. A Novel Approach to Reduce Routing overhead in Multi-Hop Scenario in VANET, Chetan Ajudiya *et al*.[5] proposed a novel approach to reduce routing traffic in multihop scenario by counter based, distance based, location based scheme and algorithm. When a node rebroadcasts a message, the neighboring nodes have already received it, and these results cause a large number of redundant messages. Novel approach reduces the routing overhead. The Dynamic Counting Broadcast in Vehicular Networks, Sarah Omar Al-Humoud *et al*.[6] proposed broadcasting scheme with intelligent neighbourhood sensing for reduce transmission. It introduced the Dynamic Counter-Based broadcast Algorithm which uses neighbourhood information by the information of current neighbour to select counter threshold. Simulation result show the city and highway model scenario. A Survey of Coverage-Based Broadcast for Reducing Routing Overhead in Mobile Ad Hoc Networks, V.V.V. Pradeep Sastry *et al*.[8] obtain coverage ratio by sensing neighbour coverage knowledge. This paper combine coverage ratio and connectivity factor which set the rebroadcast probability. Using neighbour coverage and probability mechanism reduce the retransmission and also reduce the overhead of network so the performance of routing improves. Improving frequent link
Failure Detection in VANET [13] proposed temporary parallel path between nodes during link failure. Before the link failure packet buffers, after setting the new parallel paths before the packets stored in the buffer via the destination newly created path. It reduces the overhead of network via temporary parallel path.

3. LSGO ROUTING PROTOCOL

We propose a Link state aware Geographic Opportunistic routing protocol is an opportunistic routing protocol. Opportunistic routing protocol becomes very popular recently. The difference between opportunistic routing and traditional routing is that it is not use a fix route but relay node self select the node as a forwarder. Opportunistic routing protocol make the packets have more opportunity to receive than traditional routing. The aim of this routing protocol is to improve the data transmission reliability and to reduce number of transmission and transmission delay. The aim of this protocol is to reduce the transmission delay and the number of transmission. LSGO use ETX to find the link transmission rate of the channels. The performance of this protocol compare with GyTAR and GpsrJ protocol. The protocol includes three parts: estimation of link quality, candidate node selection mechanism and priority scheduling algorithm. LSGO routing protocol use broadcast mechanism. Different broadcast schemes are: probability based scheme, location based, counter based, distance based. Simple flooding strategy is also used for broadcasting mechanism but in this strategy nodes broadcast the packets when they receive first time this strategy cause problem is called broadcast storm problem. In this protocol , source node transmitting hello packets to all neighbour nodes to know the link transmission rate of the channel but when the link failure occur between nodes then the hello packets get wasted these hello packets cannot detect the link failure and also packets are dropped which cause network overhead problem. LSGO consist three parts: estimation of link quality, candidate node selection mechanism and priority scheduling algorithm.

A. The estimation of link quality

Link quality is measured using expected transmission count (ETX). ETX is the predicted number of data transmissions required to send a packet over the source to the destination link. The main purpose of ETX is to reduce the number of retransmission. ETX metric does not consider the high dynamic nature of VANETs. So we use LSGO protocol which improve the ETX by each node broadcast the hello packets periodically and estimate the link transmission rate.

ETX is calculated shown in equation 1.

$$ETX=\frac{1}{df \times dr} \quad (1)$$

Here $df \times dr$ is the probability of successful transmission.
One way link transmission rate is r(t) so calculate the ETX as

$$ETX=\frac{1}{r2(t)} \quad (2)$$

B. Candidate node selection mechanism

LSGO routing protocol select the neighbour nodes as candidate nodes to forward packets. Consider source node S want to send packets to destination node D but there is no direct link between source and destination. For example source node is S, destination node is D and neighbour nodes is N, relay nodes are P and Q, r(t) is the link transmission rate and n is the candidate nodes. Figure 3 explain overview of this mechanism.

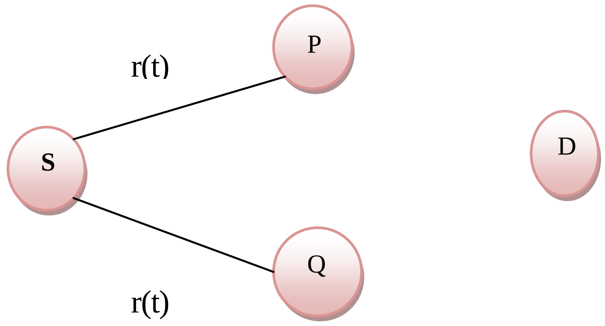

Figure 3 S sends packets to D via relay nodes P and Q.

Candidate node satisfies the condition shown in equation 3,4,5.

$$1 - \prod_{i=1}^{n}\left(1 - ri(t)\right) \geq r \qquad (3)$$

$$d1(t) < d2(t) \ldots < dn(t) < dn + 1(t) \ldots < dN(t) \qquad (4)$$

$$dn(t) < S(t) \qquad (5)$$

Where dn (t) is the distance between destination node to neighbour node and S (t) is the distance between source node to destination node .If dn (t) is less than the S (t) then node is select as candidate node. If the network is sparse then condition (1) is not satisfied. After the candidate node selection sending node record the ID of candidate nodes and their priority number that include in the packet header. In the network environment packet header is change rapidly.

C. Priority scheduling algorithm

LSGO protocol uses Priority scheduling algorithm to give priority to candidate nodes. The node which has high priority send packets first and other nodes cannot send packets during transmission channel is busy. If the timer goes out and higher priority node is not transmitting packets then other nodes start transmitting of packets. The main drawback of this algorithm is to increase the end-end delay. Timer based scheduling algorithm is quite simple and easy to implement and there is no additional overhead but drawback of this algorithm is that it introduce waiting time so end to end delay increase. Efficient scheduling algorithm is solve the problem of timer based algorithm and reduce the waiting time by two ways: assign the nodes priority correctly so the optimal forwarding node has the highest priority which increase the probability of selecting high priority node forwarding the packets and reduce the retransmission and secondly setting the reasonable waiting time for each node.

In our protocol, current node assign the priority to every node which consider the distance between the candidate nodes and destination. Suppose candidate nodes i and its priority assign by the equation 6.

$$\frac{Dsd - Did}{ETX^{2}i} \qquad (6)$$

Here Dsd is the distance between source node and destination node and Did is the distance between the candidate node and destination node and ETXi is ETX of the link which formed by current node and candidate node i.

After the candidate node selection sender node calculate the value of each candidate node by the equation 6 and assign the priority according to these value which node has the high calculation it assign with high priority. If high priority node will fail for sending packets then low priority node forward the packets.

4. PROPOSED SYSTEM

Detail work flow of proposed system shown in figure 4. First step is route discovery. Broadcast RREQ to all nodes and find the shortest distance path with ETX value which the ratios of transmission range and distance between source and destination. All routing path between source and destination store in routing table of each node. Source node selects the shortest path and sends packets on this path. The problem arise when nodes move out of range at that time intermediate node send REER message to source node and stop the transmission. Source node checks the routing table for another path if the path is available then takes the path and again starts transmission on this path. This process is continues until routing path is available on the routing table.

5. SIMULATION SETUP

Performance of Proposed LSGO (PLSGO) routing protocol evaluate by SUMO, MOVE and NS2. Simulation set up shown in figure.

Table 1. Simulation Parameters

Parameter	Value
Routing protocol	LSGO, PLSGO
Simulation Area	652 m × 252 m
Transmission Range	230 m
No of vehicle nodes	20,50
Channel Capacity	64 kbps
Vehicle speed	20 m/s,40 m/s
Simulation Time	441s

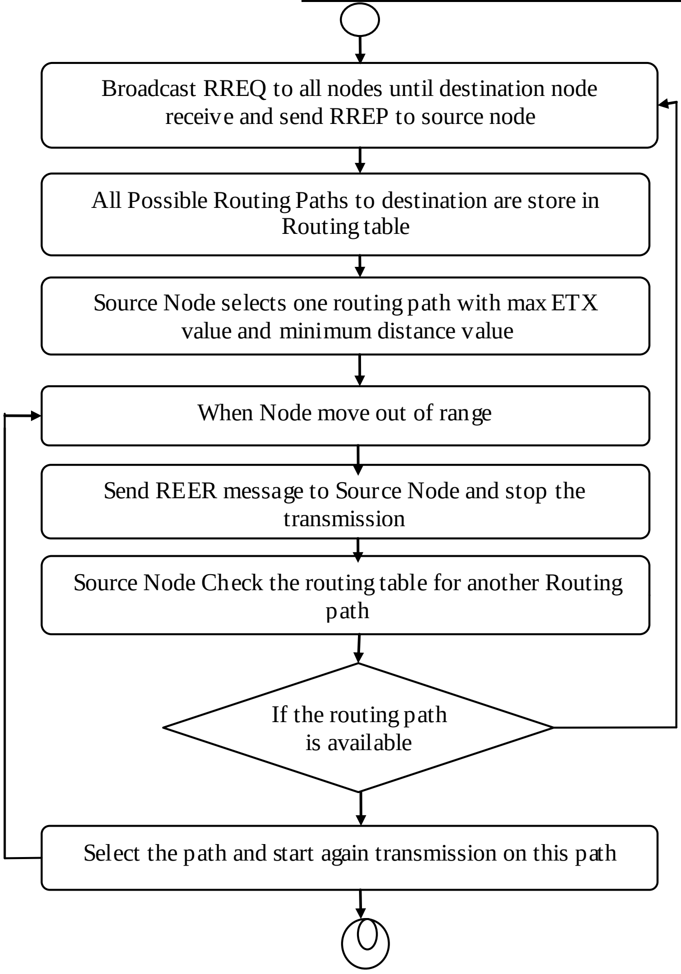

Figure 4. Workflow of reducing drop packets

5.1 Performance metrics

Performance parameter like packet delivery ratio, throughput and dropped packets are compared.

5.1.1 Packet Delivery Ratio:-

The ratio of received data and send data.

5.1.2 Throughput:-

$$\text{Throughput (byte/sec)} = \frac{\text{total no of packet received} \times \text{packet size}}{\text{total simualtion time}}$$

5.1.3 Dropped Packets:-

Packets are dropped when node move out of range or communication link become weak during data transmission.

5.1.4 Average end-to-end delay

It is defined as the average time taken by the data packets to propagate from source to destination. This includes all possible delays caused by buffering during routing discovery latency, queuing at the interface queue, and retransmission delays at the MAC, propagation and transfer times.

6. SIMULATION RESULT

Simulation result of proposed LSGO routing protocol for 20 nodes and 50 nodes shown in figure.

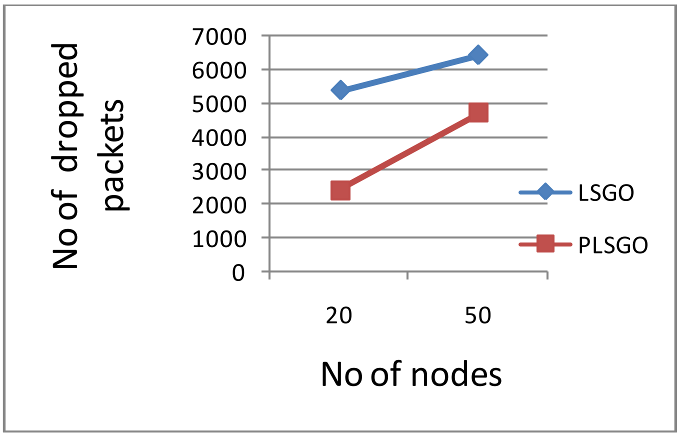

Figure 5. Dropped packets graph

PLSGO reduce the dropped packets compare to LSGO routing protocol.

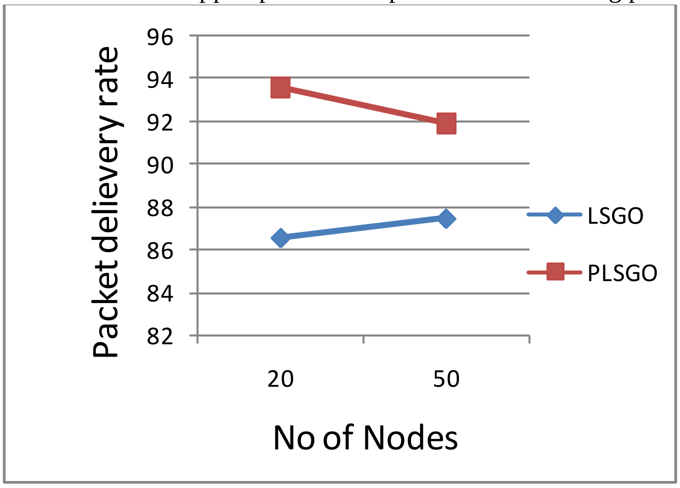

Figure 6. Packet delivery rate

PLSGO increase the packet delivery rate compare to LSGO routing protocol.

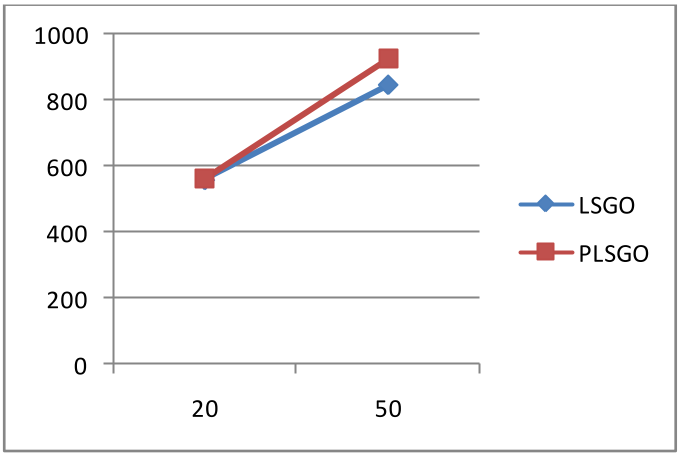

Figure 7. Throughput

Proposed LSGO protocol improves the throughput compare the LSGO.

7. CONCLUSION

LSGO use broadcasting mechanism improves the data transmission reliability. Hello packets are used for link estimation and maintain neighbor relationship between nodes. Nodes broadcast hello packets to their neighbor nodes to know their link transmission rates. All possible routing paths to destination store in routing table. Source node that have a packets select one routing path with a high ETX value and minimum distance value, transmit the data packets on that path. When node move out of range, sending REER to source node and stop the transmission and select another routing path and retransmit data on the another path.

Compare the result with proposed LSGO we are getting better packet delivery ratio, reduce the drop packets and throughput.

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