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EFFICIENT DATA TRANSMISSION AND SECURE COMMUNICATION IN VANETS USING NODE-PRIORITY AND CERTIFICATE REVOCATION MECHANISM

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Abstract - *Vehicular Adhoc NETwork (VANET) is a technology that uses moving vehicles as nodes in a network, to create a mobile network on roads. Greedy Perimeter Stateless Routing (GPSR) is one of the best position-based protocols, where each node needs to know only its neighbors' positions. Major drawback of GPSR is void routing problem. An Improved GPSR provides better performance in handling void routing problem with the help of a Node-Priority forwarding strategy. Security issue plays a major role in VANETs. Accuracy and integrity of the information should be guaranteed in vehicles. The Certificate Revocation mechanism is proposed for efficient security framework. NS2 simulator is used to show the results, that the proposed strategy have realized better packet forwarding and efficient packet transmission in VANETs in terms of packet delivery success ratio and end-to-end delay together with more secured communication between vehicles.*

Key Words: VANET , GPS , Node Priority, Certificate Revocation

1. Introduction

The greedy forwarding method is based on the position based routing scheme. In this method neighbor nodes which is closest to the destination is selected as the forwarder. For void routing, different algorithms has been approached. All those approaches are simple solution, which is not suitable for VANETs. Even though GPSR[6] protocol appears to be comprehensive solution for VANETs it suffers from the following drawbacks.1)Greedy forwarding is often restricted because direct communications between vehicles may not exist due to obstacles such as truck and trees, which leads to routing loop and too many hops.2)If building first the routing topology by the planarized graph and then return greedy of face routing on it, the routing performance will degrade. Especially, in a sparse network condition where a packet reach a node that does not have any neighbors closer to the destination than itself, the performance decreases. This condition is called void routing. Existing methods deals with the void routing, but most of the methods are perimeter forwarding-based .

In Improved Greedy Perimeter Stateless Routing[3] , along with greedy perimeter the node priority mechanism has been proposed. Every vehicle is capable of determining its own position and mobility by data fusion and using existing technologies such as GPS, map matching and accelerator meters. Vehicles are able to verify direct neighbors with direct line of sight using radio strength signal and share a table of neighboring. Every vehicle has a unique identity. Based on the analysis above, for position-based routing, the conventional strategy handled the void routing is blindness, thus the Node-priority mechanism based opportunistic routing is proposed.

The overview of the Improved GPSR scheme is followed: on the perimeter of void region, the neighbor node competes by those advantages to be selected as the next-hop, which is able to refrain from the blindly forwarding that resulted in excessive routing ,further, the proposed scheme makes the overhead.

At first, the packet is transfer by the greedy forwarding model, assume that the intermediate node receives the packet, that intermediate node is not capable of searching a node that is closer to destination than itself due to the void routing. In this situation, the node broadcasts the beacon which includes the address of the destination of the packet, the beacon was marked as ADP (Address- Destination-Packet), which is available to all nodes, and the priority-parameters for every node were calculated, respectively. The higher the priority, the more likely it is that the node is considered as the next-hop.

Certificate Revocation[2] happens when problematic certificate encountered. Road Side Units(RSU) checks message for correctness, if the message is correct then RSU assi gns Valid Certificate(VC) vehicle or else assigns as Invalid Certificate(IC) and adds that particular vehicle to Certificate Revocation List(CRL).

2.Literature Review

2.1. Edge Node Based Greedy Routing for VANET with Constant Bit Rate Packet Transmission [10]

EBGR (Edge Node Based Greedy Routing), a greedy position based routing approach to forward packet to the node present in the edge of the limited transmission range of forwarding node as most suitable next hop, with consideration of nodes moving in the direction of the destination. The EBGR algorithm has three basic functional units as follows: Neighbor Node Identification (NNI) algorithm, Node Direction Identification (NDI) algorithm and Edge node Selection (ENS) algorithm.

The NNI algorithm is responsible for collection of information of all nodes present within the transmission range of source/forwarder node at any time. NDI algorithm is responsible to identify the direction of motion of nodes which is moving towards the direction of destination. The ENS algorithm is responsible for selection of the specific edge node within limited transmission range for further forwarding of a particular packet. The general design goals of EBGR algorithm are to optimize the packet behavior for adhoc networks with high mobility and to deliver messages with high reliability. Number of assumptions to be made which is not an easy task. Provides better performance in high density traffic but does not work in void region.

2.2. A Cluster Based Enhancement to AODV for Inter-Vehicular Communication in VANET [1]

Ad-hoc On-Demand Distance Vector (AODV) routing protocol is the most commonly used topology based routing protocol for VANET. On demand routing protocol mainly involve two processes namely Route Discovery and Route Maintenance. During the route discovery and maintenance processes AODV broadcasts three types of control messages such as route request message (RREQ), route reply message (RREP) and route error message (RERR). It creates many unused routes between a source and a destination node. The proposed algorithm for clustering in VANET can be done using three basic steps: Cluster Formation, Cluster Maintenance and Clustered Routing. Here the performance of AODV is improved by enhancing the existing protocol by creating stable clusters and performing routing by Cluster Heads and Gateway nodes. Effectively reduces the total number of control packets and unused routes generated during the route discovery process. Thus the overhead of network in routing packets is highly reduced and protocol efficiency is improved. Void routing problem is not overcomed.

2.3. The Enhanced Optimized Routing Protocol for Vehicular Adhoc Network [8]

An OLSR finds optimal effective value or communication cost for the real world scenario with best configuration. The main motivation behind the idea of routing protocols is to provide more efficient and accuracy in the creating of the communication cost in order to improve throughput and efficiency. It mainly involves two steps, suitable configuration extraction and deployment of it. In the configuration extraction part, the features of the OLSR are extracted. Features are parameters of the optimal link state routing protocol, which is considered to be an important in configuration and generating optimal communication cost. The optimal combination of certain factors may lead to improve the PDR or efficiency or throughput using automatic selection by using optimization algorithm. Greedy algorithm is replaced with the new optimized link state routing protocol with Necessity First Algorithm (NFA). Necessity First Algorithm is useful in avoiding the traffic load over network. Overall performance of OLSR and system is improved because of this new algorithm in standard OLSR. Best suitable for highly dynamic vehicular network and the performance is enhanced because of automatic selection of optimal configuration but does not work well in void region.

3. System Architecture Design

Initially topology is created with number of nodes as vehicles. For each node in the topology, neighbors are found and updated in the neighbor table. Source node initializes route discovery process and follows Greedy Forwarding algorithm to transmit the message to destination. If void region is detected greedy algorithm fails. Later Perimeter Forwarding together with Node-Priority mechanism is followed for efficient and successful message transmission in vehicles.

In order to provide security, Certificate Authority issues certificates for vehicles. Routing happens based on valid certified vehicles. If any problematic certificate is encountered then Certificate Revocation procedure is followed.

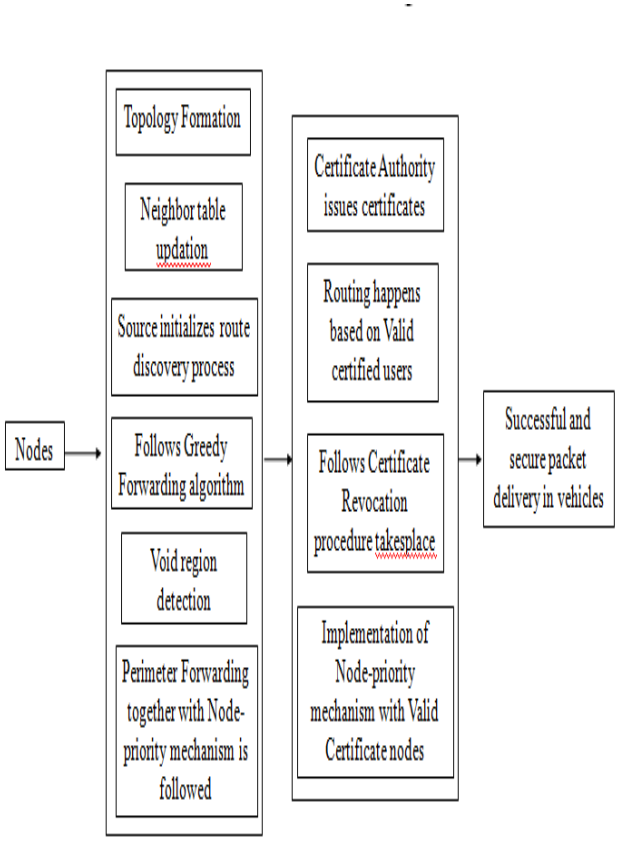

Figure 1: Architecture Diagram

4. Proposed Work

Certificate authority which is responsible for registration of the vehicle and issuing keys and vehicular node registers with CA to get its ID and key. Game theory has been used for the VANETs for sensing the attack action. However it is not enough for the VANETs security requirements. This recently proposed mechanism is aimed at generating an appropriate security framework with support of defensive mechanism for VANETs to enhance VANETs security. The vehicles behavior is monitored by the neighbor vehicle and nearest RSU(Road Side Unit).Vehicles are attached with tamper proof device and it has to check the certificate validation of the vehicle.

Certificate revocation happens when a problematic certificate is found. It revokes the certificate which avoids other vehicles receiving the message from these problematic certificates. Currently, Road Side Unit (RSU) is responsible for tracking the vehicle and revoking of the certificates by broadcasting Certificate Revocation List (CRL). However, the current strategy will cause high overhead on RSU and CRL will cause control channel consumption. In certificate revocation method, when a vehicle receives a message, it will check the sender's certificate validity. If the sender does not have a valid certificate (VC), the message will be ignored. Moreover, if the sender does not even hold a certificate, the receiver will report the sender to RSU. RSU will check the correctness of the message. If it is correct, RSU will assign a VC to the sender. Otherwise, RSU will give an invalid certificate (IC) to the node, and register the vehicle's id to the CRL.

4.1 Module Description

1) Topology Formation

Network simulation setup has been created. Vehicle ad-hoc network is formed by vehicles. Each vehicle updates its neighbor vehicles. Then the vehicles share hello message and its information with its neighbor. Communication between various nodes takes place based on the neighbor table information.

2) Greedy Forwarding Algorithm Implementation

Each vehicle periodically updates its neighborhood details. Source vehicle finds the shortest path to the destination vehicle by enabling route discovery process. Greedy Forwarding algorithm is implemented to transfer the message by finding the node that is closest to the destination.

Pseudocode for GPSR

```
if n ∈ N: Distance (n, D) ≤ Distance (R, D) then
   {Greedy forwarding}
   n = Min_Distance(N, D)
   Forward_packet (p, n)
   Return
else
   {local-maximum, use right-hand rule}
   n = Right_Hand_Rule(N)
   Forward_packet (p, n)
   Return
End if
```

Above pseudocode describes that source finds the shortest path to reach the destination by following Greedy Forwarding algorithm. Else if the sender vehicle itself is close than all its neighbors and destination not reachable by one hop i.e., attains local-maximum situation then right hand rule is followed to forward packets. As per this rule, if node n receives a packet from edge E, it sends packet through its next edge counter-clockwise about n.

3)Perimeter Stateless Routing with Node-Priority

Void region is created along the network and routing for data transmission is established by finding the node with highest priority using Node-Priority mechanism. The higher the priority, the more likely it is that the node is considered as the next hop.

4) Security with Certificate Revocation mechanism

The Certificate Revocation happens when a vehicle having VC behaves inappropriate. CA will then replace the VC with IC. The Certificate Revocation will taken place when more than one vehicle report to the RSU that a VC issued vehicle sends incorrect data.

5. Implementation and Results

The algorithm is implemented using NS2 simulator[11] and the results are realized using the same.

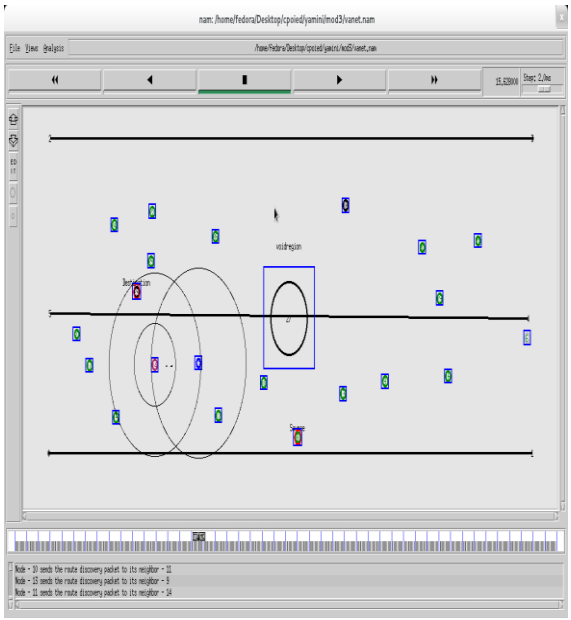

Figure 2: Void region creation and implementation of Node-Priority mechanism

Void region is created along the network. Using Node-Priority mechanism node with higher priority is found, using that corresponding node message transmission takes place between source and destination.

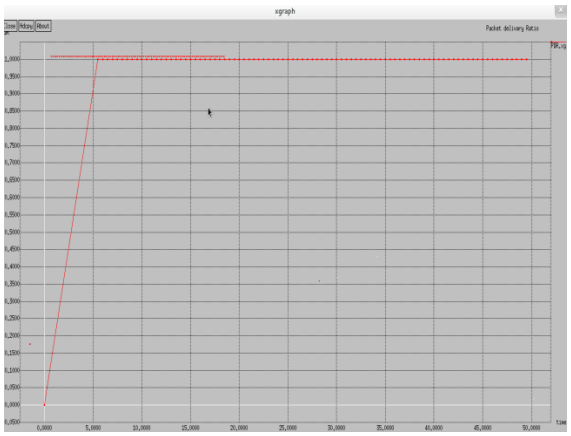

Figure 3: Graph generated for packet delivery ratio vs time

The graph is generated to show that the Improved GPSR provides successful packet delivery ratio. Also packet delivery ratio increases gradually with time.

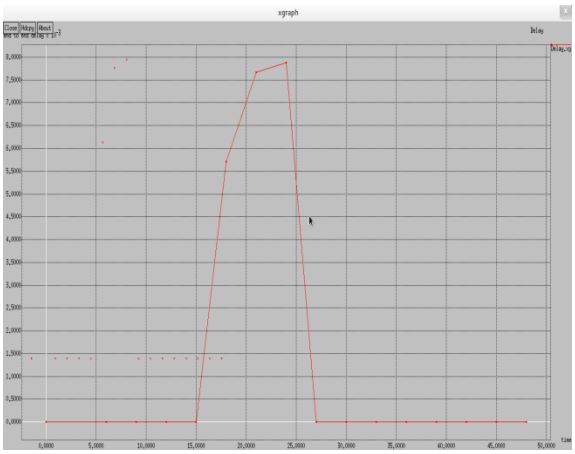

Figure 4: Graph generated for end-to-end delay vs time

The graph is generated to show that the Improved GPSR provides reduced end-to-end delay. Also end-to-end delay gradually decreases with time.

6. Conclusion

GPSR forwards the packets using greedy forwarding algorithm where ever topology allows it. Where greedy forwarding impossible, GPSR uses perimeter forwarding to recover and reach a region where greedy forwarding can resume. In such case an Improved GPSR presents Node-Priority strategy to overcome the void routing problem. Priority for each node is calculated with respect to the destination. Higher the priority, more likely the node is considered as the next hop. Added to that

as a part of proposed work, secured communication among vehicles with the help of Certificate Revocation mechanism is under process. Using NS2 simulator the results are visualized and the graphs are generated to show that the Improved GPSR provides increased successful packet delivery ratio, reduced end-to-end delay. Implementation to achieve secure communication during packet transmission is under development.

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