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Efficient Approach to Deliver Messages to Far Vehicles in VANET

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ABSTRACT: In Vehicular Ad hoc NETworks (VANETs) it is needed to provide timely and accurate information to drivers and authorities for road safety. To achieve the timely dissemination of messages, various routing protocols for VANETs have been recently proposed. We will use roadside units (RSUs) to efficiently and reliably route packets in VANETs. The Proposed framework uses carry and forward messages in which the messages are firstly send from source vehicle to nearby RSU and if needed route these messages through the RSU network and, finally send them from an RSU to the destination vehicle. To achieve this we will use an algorithm CAN DELIVER so that messages from source vehicle can be delivering to the far destination vehicle.

Keywords – Vehicular Ad hoc Network (VANETs), Carry and forward, Road side units (RSUs), Geographic forwarding, Routing.

1. INTRODUCTION

Recent year's there is quick development in automobile and its technologies, the wireless communication had made new type of Ad-hoc networks which known as the Vehicular Ad-hoc Network (VANET) for transportation.Wireless Ad-Hoc Network (WANET) has many categories such as wireless mesh network, (WSN) wireless sensor network and Mobile Ad-Hoc Network (MANETs) as shown in Fig 1. VANETs is a subset of MANETs with a unique characteristic of dynamic nature or node mobility, infrastructure less nature, frequent exchange information, self-organizing, real time processing, low volatility and distance. It is to be considered the first commercial vehicles of MANETs [1]. In the VANETs there are two type of communication mechanism one is vehicle to vehicle (V2V) communication in which vehicle communicate with other vehicles in the network second is vehicle to infrastructure (V2I) communication in which vehicle will communicate with access points i.e. Road Side Units to get required information [2].

A VANET is a group of vehicles that are equipped with wireless communication devices, positioning systems, and digital maps. VANETs allow vehicles to connect to roadside units (RSUs), which are connected to the Internet and may also be connected with each other via a high-capacity mesh network. VANETs routing is limited to vehicles few hops away. But, communicating data to far vehicles is also important and due to this multihop routing protocol is used to send a data to far vehicles. In some case unicast routing protocol is used in VANET and in some case position based greedy approach is use that collect the information of vehicles from geographic condition to find the good route. Some other protocols are used in which carry and forward technic is used to route packets in sparse VANETs called as delay tolerant algorithms. Position based protocols use a dense condition in which vehicles finds a neighbor to forward a packet whereas delay-tolerant algorithms do not perform well in dense cases. The proposed approach utilizes RSUs to route packets to far locations. A vehicle S requesting to send a packet P to a far vehicle D can send P to its nearest RSU (R1), which, in turn, sends P to the nearest RSU to D (R2) with the help of the RSU network RSU2 then sends P to D through multi hop [3].

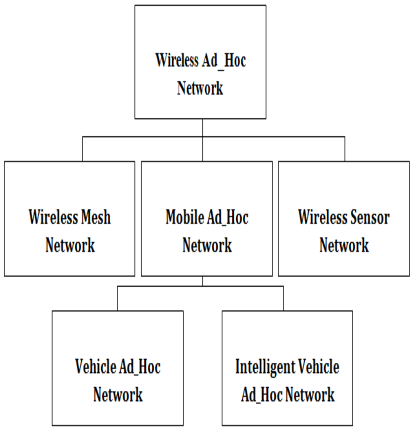

Fig.1. Classification of WANET

The reason we are using RSUs to route packets is that RSUs are a fixed infrastructure. It is so easy to transmit a packet to a fixed target than to a remote moving target. However, the delay of sending the packet through the fixed RSU network is much less than through the VANET. In this we will focus on carry and forward mechanism for dependable message delivery in VANET using RSUs (CAN DELIVER). The design of system will be dividing into two basic parts: the first part governs routing from a vehicle to its nearest RSU, and the second part handles routing from RSUs to vehicles.The applications that utilize great from our routing scheme include queries about road conditions in far-away locations. For example, consider a vehicle heading from one place to another new place, the person who is driving might request from an RSU on the road in which he is heading to information about the road condition and the amount of traffic in certain streets or information about some weather variables, or even request road navigation information from a point to another new place based on the expected traffic conditions [4].Dedicated Short range Communication is better suited to vehicle to vehicle communication than 3G and4G. Since the cost of cellular data communication is high and expensive for unlimited plans. The impressive perspectives promised by Vehicular Ad hocNetworks (VANETs) have made it a worldwide focal area of research. Ubiquitous connectivity on roads, improved safety of driving, and reduced traffic congestion along with many enterprise applications are just a few to name when it comes to what VANETs have to offer. Most of the VANET applications critically rely on routing protocols. Thus, an optimal routing strategy that makes better use of resources is crucial to deploy efficient VANETs that actually work in volatile networks.

2. LITERATURE REVIEW & RELATED WORK

2.1 Topology-based RoutingProtocol:-

Traditionally, topology-based routing protocols were initially proposed for MANETs, and were applied to VANETs because they have many common properties such as node mobility, distributed and self-organizing topology, non-existence of central control, etc. However, VANETs can be distinguished from MANETs because of their specific characteristics such as very high node mobility, limited degrees of freedom in mobility patterns which can be somewhat predictable, since vehicles move in rural or urban areas consisting of roads, highways, buildings, etc.

The most common MANET routing protocol that has been applied to VANET is the Ad hoc On-demand Distance Vector (AODV) protocol. The route discovery method of AODV is based on routing tables which store the routes toward multiple destinations. Each destination is indicated using only the next hop node to reach this destination. The source disseminates a Route REQuest (RREQ) to its neighbours which in turn sends the same packet to their neighbours and so on, until the final destination is reached [5]. Once the route request reaches the destination or an intermediate node which knows the path toward the destination, a Route REPlay(RREP) is sent back to the source node through the reverse route.AODV uses a sequence number to discover fresh paths and to prevent routing loops. Abedi et al. extended AODV to apply it to VANET using directions and positions of the source node and the destination node obtained from GPS to find routes. Basically, source and destination directions are used for the next hop selection. To do this, an intermediate node can be selected as the next hop in the requested route if it is located and moves in same direction as the source and/or destination. This modified AODV routing protocol for VANET uses the mobility model of vehicles to support the various characteristics of VANETs. This reactive protocol establishes updated routes only when required. However, the intermediate nodes could indicate inconsistent routes if the sequence number is not updated and, the idea to choose the next hop in same direction of source and destination does not guarantee the optimality of the route found. In addition, the network can be flooded by multiple RREQ and RREP in addition to unnecessary bandwidth consumption due to periodic beaconing [6].

2.2 Geography-based RoutingProtocol:-

Geography-based routing protocols have also been applied to VANET. They are also called position-based routing protocols in which the node positions are used to route data between vehicles. They perform a recovery strategy to overcome the void case when there is no routing progress based on nodes' position data [7]. A strong feature of these protocols is that the packets are routed to the destination without the knowledge of the network topology or a prior route discovery. In contrast, the source should determine its own position in addition to the position of the destination. One of the most commonly used geographic-based protocols is the Greedy Perimeter Stateless Routing (GPSR) proposed for wireless networks. It consists of two methods: the Greedy forwarding method which is used wherever the forwarding of packets is possible, otherwise, the Perimeter Forwarding method is invoked. To achieve these goals, GPSR uses the positions of vehicles in its transmission range, and the destination to make its packet forwarding decision. In the case of greedy forwarding, the transmitter node chooses the optimal neighbour as the next hop which is the closest geographic node to the destination selected in a greedy manner. In other words, based on the neighbours' positions, the transmitter selects the closest neighbour as its local optimal choice. It will be considered as the next hop to the packet's destination. GPSR also uses a beaconing process to update its neighbours' data (such as positions, etc.). If there is no intersection between the transmitter node and the destination node, the perimeter forwarding method is executed. It is based on the right hand rule in which, each node forwards packet through the perimeter to its first neighbour counter clockwise about itself. It is worth pointing out that under frequent topology changes resulting from the high mobility of vehicles, GPSR can use the local topology information to find the correct new routes quickly. This protocol was simulated over a full IEEE 802.11 and was compared with DSR in terms of routing overhead and the number of data packets delivered. The results showed GPSR's scalability on densely deployed wireless networks. However, its greedy forwarding algorithm can fail if an interior node does not possess a neighbour in 2P/3 angular sector. In addition, the perimeter forwarding algorithm finds a non-optimal route from the source to the destination which takes a longer time and is less efficient [8].

2.3 Cluster based Routing Protocol:-

In the CBRP routing is done using source routing. But this protocol uses also route shortening. When a node receives the reply of the destination to the source, it tries to find the farthest node in the route that is its neighbor. With this principle the route between source and destination can be reduced. If source node has to send data to the destination node, Source node sends route requests to all the neighboring cluster-heads, and only to the Cluster-heads. When a cluster-head receives the route request, it checks if the destination node is in his cluster. If this is the case, the cluster-head sends the request directly to the destination, but when Destination isn't in the cluster, it sends the route request to all the adjacent cluster-heads. All cluster-head saves his address in the packet, so when a cluster-head receives a route request where his address is saved in the packet, it discards this packet. When the route request packet arrives at the destination, it replies back with the route that had been recorded in the request packet. When the source doesn't receive a reply from the destination within a time period, it tries to send a route request again [5].

2.4 Existing System:-

The existing system CAN DELIVER depends on the system of RSUs to relay packets to the distinct locations. In VANET it is assumed that each member is equipped with a positioning system (e.g., GPS), has access to digital maps of its locality, and equipped with a navigation system that maps GPS positions. In CAN DELIVER location service cannot be require instead it uses a method that enables a vehicle to know the positions of nearby vehicles. Following are the methods which are used to find the position of nearby vehicles.

Each vehicle periodically sends Hello packets to its neighbors, and maintains a list *L* of pseudonyms which contains positions, speeds, directions, and timestamps of vehicles in its vicinity. The list *L* is built and updated as follows: Initially, each vehicle V adds its own location (geographic coordinates), speed, direction, and timestamp (LSDT) to the first Hello it sends to its neighbors. Each neighbor adds the data of V to its *L*. After this, each vehicle includes in a Hello its LSDT as well as the data it has in *L*. Each vehicle that receives a Hello will add an entry in the Hello to *L* if the distance between itself and the vehicle of the entry is less than a threshold *d*th (vicinity threshold).The timestamp allows vehicles to delete entries when they become old. Fig. 2 shows an example of the vicinity of a vehicle.

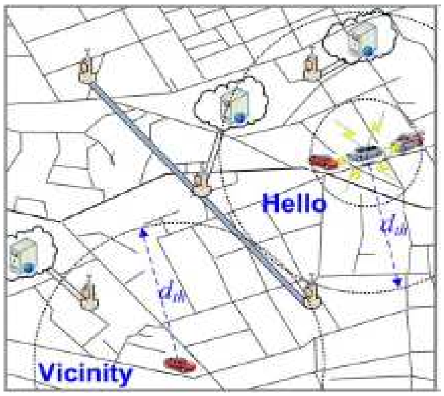

Fig.2. Vehicle's vicinity and Hello packets

Similarly, each RSU receives periodic beacons from all vehicles in its vicinity. A beacon contains the LSDT of a vehicle V and is unicasted by V to its nearest RSU. The vicinity of an RSU R can be described as a circle with R in the center and a radius equal to the distance to its farthest RSU neighbor. An RSU uses the LSDTs to send packets to the vehicles. Vehicles that forward beacons can aggregate LSDTs from several beacons into one beacon to reduce traffic [See Fig. 3]. Although in CAN DELIVER many control packets (Hello and beacons) are exchanged, they do not produce large overhead since they are small in size and no fixed routing paths are cached.

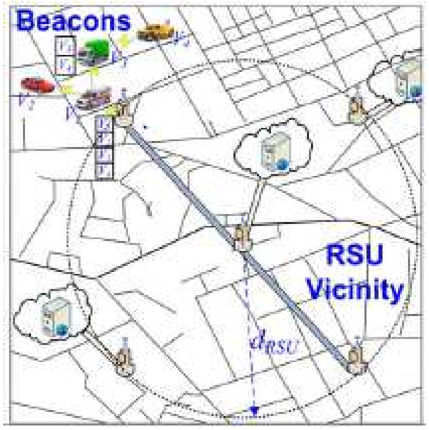

Fig.3. RSU vicinity and beacons

For the RSU of the sender to know which RSU the destination is currently connecting to, in this case users register with the RSU network. After a user registers, he obtains a unique username. For a user to communicate with another, he should know his username. In such case of CAN DELIVER a DHT is use that distributes, among all RSUs which contains the usernames of users and their current RSUs. When a source vehicle S needs to send a packet P to destination vehicle D, it checks whether it has the location of D in *L*. If yes, S estimates the number of hops *h* between itself and D by dividing the distance between S and D by the transmission range and then S broadcasts packet P to D. An example is "Case 1" in Fig. 4.If S does not have the location of D in *L*, it sends P to its nearest RSU R1. If the latter has the location, indicating that D is in its vicinity, it sends P to D. An example is "Case 2" in Fig. 4.If R1 does not have the location of D, it uses a hash function. Each RSU maintains a list *Lu* that contains two fields: username, current RSU. When a user of username *u'* connects to a new RSU R', the latter uses *H*(*u'*) to obtain *RSU*(*u'*) and sends it a "New-Hash" message that contain s*u'*, thus prompting *RSU*(*u'*) to update its *Lu* with the entry<*u'*,*R'*>. When another RSU *R**wants to send a packet to *u'*, it uses *H*(*u'*) to send a query message to *RSU*(*u'*), which replies with the current RSU of *u'*.R1 receives P from S, it uses *H*(*D*) to obtain *RSU*(*D*). R1 then obtains from *RSU*(*D*)the current RSU of D (R2). R1 forwards P to R2, which in turns ends P to D. An example of this case is "Case 3" in Fig. 4,where vehicle S sends a packet P destined to another vehicle D to its nearest RSU R1. R1 uses *H*(*D*) to obtain *RSU*(*D*),which is R4. R1 requests from R4 the current RSU of D, and R4replies with R2, thus prompting R1 to forward P to R2, which in turn sends it to D.

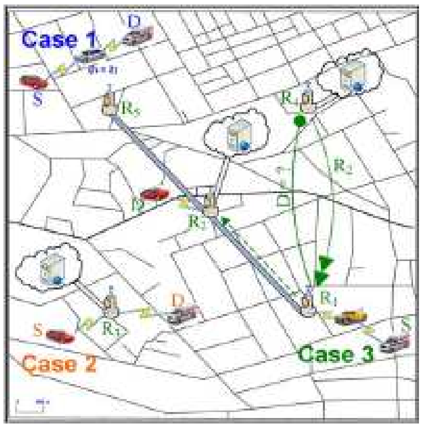

Fig.4. Three scenarios in CAN DELIVER

3. PROPOSED WORK

In this paper, we proposed utilization of RSUs to route packets to far locations. A vehicle S requesting to send a packet P to a far vehicle D can send P to its nearest RSU (R1), which, in turn, sends P to the nearest RSU to D (R2) with the help of the RSU network RSU2 then sends P to D through multi hop.

The reason we are using RSUs to route packets is that RSUs are a fixed infrastructure. It is so easy to transmit a packet to a fixed target than to a remote moving target. However, the delay of sending the packet through the fixed RSU network is much less than through the VANET. In this we will focus on carry and forward mechanism for dependable message delivery in VANET using RSUs (CAN DELIVER). The design of our system will be dividing into two basic parts: the first part governs routing from a vehicle to its nearest RSU, and the second part handles routing from RSUs to vehicles [9].

3.1 Routing From a Vehicle to its Nearest RSU:-

When a vehicle S wants to send a packet P to an RSU R, it examines whether R is within its transmission range. If so, S sends P directly through the wireless channel. Else, S depends on other vehicles to carry P to R. First, S uses its digital map to calculate the shortest road path between its current location and the location of R. To reduce the computing complexity, and since the map is usually fixed, so in this case the shortest path between any two intersections can be calculated and stored so that vehicles use them when sending packets so it uses virtual waypoints at each intersection. Fig. 5 shows an example of a map with waypoints. Each vehicle stores a list *Lw* that consists of three fields: (Source Waypoint, Destination Waypoint, Shortest Path). *Lw* contains the shortest path between any two waypoints on the map. For example, in Fig. 5, if the "Source Waypoint" is (WS) and the "Destination Waypoint" is (WD),then the shortest path will be (WS,A,B,C,E, F,G,WD).When a vehicle S needs to send a packet, it calculates using the digital map the nearest waypoint to its location, which will be the "Source Waypoint," and the nearest waypoint to the destination location, which will be the "Destination waypoint."Hence, S will send the packet to neighbors that are nearest to the "Destination Waypoint." For example, in Fig. 5, vehicleV1 wants to send a packet to RSU R. It obtains from its *Lw* the shortest path from its location to R, which consists of the waypoints {WS, A,B,C,E, F,G, and WD}.Next, V1 checks if any of its neighbors are nearer from it to R. For example, suppose in Fig. 5 that V2 and V3 are neighbors of V1. V1 will choose V2 because it is nearer to R than V1.V1 knows the locations of V2 and V3 since neighbors frequently exchange Hello message.

Fig. 5. Defining a path from a vehicle to an RSU

Vehicle to RSU Algorithm:-
Input: P Packet
Source: S Vehicle
Destination: R RSU
Step 1: START
Step 2 : if(R is within S range)
S sends P to R
Goto end
Else
Step 3: S defines total path between itself and R
Step 4: S determines set Sn of neighbors that are nearer to R.
Step 5: if (Sn=ϕ)
Go to Delay routine
Else
S sends P to k neighbors in Sn.
S drops P
End
Delay routine:
After delay ends
Go to step 2

3.2 Routing From an RSU to a Vehicle:-

Consider an RSU R that needs to send a packet P to a vehicle D. First, R gets the location, speed, and direction of D from D's last beacon and R estimates the location of D and chooses the best carriers of P. Here, two cases should be considered. In the top scenario in Fig. 6,V1 was at position (A1) when it sent the last beacon to RSU R. Since the road V1 is moving on does not contain exits, V1 cannot move into another side road. Hence, R is able to estimate the coordinates of V1 after it moves a distance equal to *d*tot. Thus, R estimates that V1 will be at position (B1). This is Case 1.Thebottom scenario shows the other case in which R estimates that after *d*tot, V1 will have passed the next intersection. Depending on the direction V1 continued with, it could be at (B2), (B2'),or (B2"). Since R does not know this direction, it will have to consider all possible locations of V1. This is Case 2.

Fig. 6. Sending a packet from an RSU to a vehicle: Case 1 and Case 2

CONCLUSION

The CAN DELIVER, which is part of a complete system that we are designing for providing car drivers and passengers ,the freedom of access to the required data while on the road. The proposed system uses RSUs to reduce the load on vehicles and to reduce the complexity of getting the required information. The CAN DELIVER deliver the messages to far locations as efficiently and conveniently in dense as well as in sparse network. The CAN DELIVER is very effective and shows better suitability to VANETs, as compared to the other existing routing protocols.

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