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RESEARCH ARTICLE

Using Position Based and Cognitive Radio in Vehicular Ad-hoc Network

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Abstract— Over the last few years, VANETs have turned into an important research area. For the roadside equipment, Cognitive Radio protocol allocates multiple channels simultaneously to improve the delay incurred in an emergency situation, thereby providing safety vehicular- infrastructure message communication. In a city environment, due to an uneven distribution of Inter-Vehicle Communication System (IVCS) faces great challenges such as high rising buildings. The proposed scheme position-based routing (A-STAR) extends the WSN lifetime which supports dynamic status update on sinking neighbor's energy levels. Thus the overall network lifetime gets extended which depends on this energy consumption.

Index Terms— Vehicular ad hoc networks, position-based routing, vehicular communications, Anchor based Street and Traffic Aware Routing (A-STAR), Wireless Sensor Network, Cognitive Radio

1. INTRODUCTION

VANETs (Vehicular Ad-Hoc Networks) are distinguished from MANET by their hybrid network architectures, node movement characteristics, and new application scenarios.

1.2 CHARACTERISTICS

Drive behavior, constraints on mobility, and high speeds create unique Characteristics in VANETs. These characteristics distinguish them from other mobile ad hoc networks, and the major characteristics are as follows:

- High mobility and Rapid changing topology
- Geographic position available
- Mobility modeling and predication
- Hard delay constraints
- No power constraint

A Vehicular Ad-Hoc Network provides communication between vehicles and nearest fixed equipment, usually described as Roadside Equipment. The VANET provides safety message to passenger and need small electronic device inside the vehicle which will provide Ad-Hoc Network connectivity for the passengers and it can relay and receive others messages through the wireless network. In vehicular Ad-Hoc network using different networking technologies such as WI-FI, WI-MAX, Bluetooth etc... For making a simple communication between vehicles on dynamic mobility.

2. ROUTING INFORMATION USED IN PACKET FORWARDING

This class is divided into two subclasses:

1. topology-based
2. Position-based routing protocols.

2.1 TOPOLOGY-BASED ROUTING PROTOCOLS:

Topology-based routing protocol it use to store information in the routing table as a basis to forward packets from source to destination; it commonly categorized into three categories Proactive (periodic), Reactive (on-demand) and Hybrid.

2.1.1 REACTIVE ROUTING PROTOCOLS

Reactive routing protocol (also called as On-Demand) reduce the network overhead by maintaining routes only when needed, that the source node start a process of route discovery and made a route request message to the destination. After the message received by destination it will send a route reply message to the source node

2.1.1.1 AD-HOC ON-DEMAND DISTANCE VECTOR

AODV is a reactive routing protocol, and it ll be reducing memory size and routing tables will keep recent active entries for routes, and also keeps next hop for a route. AODV using destination sequence number to adopt the route condition dynamically and also eliminate looping in routes. However, it cause a delay in route discovery, so it leads to the route failure and it require a new route discovery to avoid the delay for decreasing the data transmission rate and increase the network overhead

2.2 POSTION-BASED ROUTING PROTOCOLS

Position routing protocol is based on routing process where the source sends a packet to the destination using the positional information rather than network address. When the source node send a packet to the destination it will stores the information in packet header and it will be helpful in forwarding the packet to destination without route maintenance, discovery or even awareness of the network topology.

2.2.1 CHALLENGES OF POSITION-BASED ROUTING IN IVCS

The challenges of position-based routing in a city environment Suppose node *s* wants to send a packet to node *d*. Greedy forwarding will fail in this case as there is no neighbor of *s*, which is nearer to *d* than *s* itself. Such a situation is what is commonly known as *local maximum*. Following the strategy in GPSR, the packet enters into perimeter-mode, using the right hand rule to travel through each node on the dotted route, including nodes *a*, *b* and *c*. At *b*, it is found that *c* is nearer to *d* than *s*, at which the packet enters into perimeter-mode. Thus, the packet switches back to greedy mode at *b*, and then reaches its destination *d* through *c*. It can be seen that this route is very long in terms of hop count. In fact, *s* can reach *a*, and *a* can reach *b*, both in one hop.

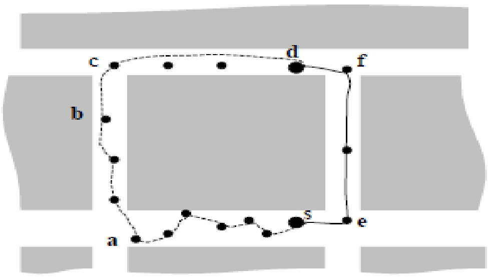

Fig 1 Challenges of position-based routing in IVCS

This shows that the perimeter-mode which packet employs to recover from local maximum is very inefficient and time-consuming. Another observation is that the packet can actually travel from *s* to *d* via a route that passes through *e* and *f* (shown as solid line), which is much shorter. However, this route is not exploited because the perimeter-mode of GPSR based on right hand rule is biased to a specific direction when selecting for the next hop. It should be noted that in a city environment, the constrained mobility and frequently encountered obstacles can effectively force GPSR to run into perimeter-mode frequently. As a result, the performance of GPSR could deteriorate dramatically, and therefore may not be suitable for IVCS.

2.2.2 ANCHOR-BASED STRRET AND TRAFFIC AWARE ROUTING

A-star search algorithm is a widely used graphic searching algorithm. It is also a highly efficient heuristic algorithm used in finding a variable or low cost path. It is considered as one of the best intelligent search algorithms that combines the merits of both depth-first search algorithm and breadth-first algorithm.

A-star path searching algorithm uses the evaluation function (usually denoted f (n)) to guide and determine the node to visit in order for each search in the tree. The evaluation function is given as:

$$f(n) = g(n) + h(n)$$

where g(n) is the actual cost from the initial node (start node) to node n (i.e. the cost finding of optimal path), h(n) is the estimated cost of the optimal path from node n to the target node (destination node), which depends on the heuristic information of the problem area. Generally, A-star algorithm maintains two lists, an OPEN list and a CLOSE list. The OPEN list is a priority queue and keeps track of the nodes in it to find out the next node with least evaluation function to pick. The CLOSE list keeps track of nodes that have already been examined. Initially, the OPEN list contains the starting node. When it iterates once, it takes the top of the priority list, and then checks whether it is the goal node (destination node). If so, the algorithm is done. Otherwise, it calculates the evaluation function of all adjacent nodes and adds them to the OPEN list. After the A-star algorithm is completed, it will find a solution if a solution exists. If it doesn't find a solution, then it can guarantee that no such solution exists. A-star algorithm will find a path with the lowest possible cost. This will depend heavily upon the quality of the cost function and estimates provided.

A-star algorithm may be expressed as following:

1) Put the source node s0, f (s0) attached, into the OPEN list. Let the CLOSE list is empty.
2) If the OPEN is empty, exit, and the search is fail.
3) Move out the first node N form the OPEN list, which has the smallest f (.) in the list, and put it into the CLOSE list; number the node as n.
4) If the node N is the goal node, the search is finished, exits.
5) If the node N cannot spread, turn to step 2.
6) Spread the node N, there will be a group of nodes, all of which are f (n) attached; add the nodes to the OPEN list, then turn to step 3; Especially, for the gotten nodes in this step, some processing will be done as follows:
    a) Examine the OPEN list and the CLOSE list to find whether (some of) the nodes have been included in them. For the nodes that have been included, if they are ancestor node of the node N, delete them; If they are not (the ancestor node), delete them too, but for they are spread on the second time, it is needed to review them and find whether the corresponding f (n), the back pointers of the nodes and even those of the corresponding descendant nodes are needed to be changed. The rule of such changing is "choosing the short path based on f(n)."
    b) For the nodes that have not been included in the OPEN lit and the CLOSE list, put them into the OPEN after assigning the back pointer that points to the node N, then, based on f(n), sort all the nodes in the OPEN list in ascending order.

3. RELATED WORK

3.1 IMPLEMENTATION OF A-STAR

In the new routing method, the base station prepares the routing schedule and broadcast it to each node. A-star algorithm which is used to find the optimal route from the node to the base station is applied to each node. A-star algorithm creates a tree structure in order to search optimal routing path from a given node to the base station.

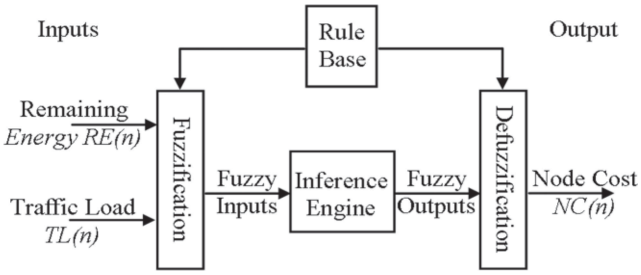

Fig 2. Fuzzy structure with two inputs (remaining energy and traffic load) and one output (node cost)

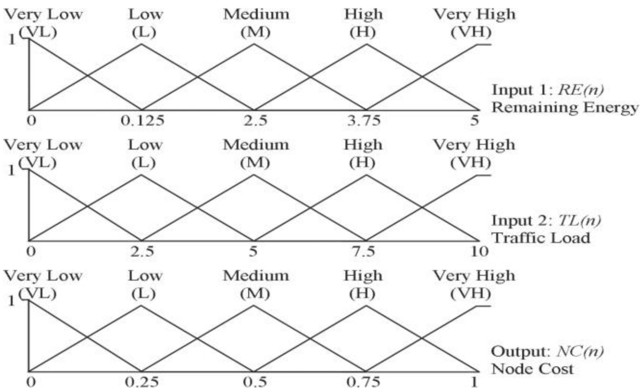

Fig 3 Membership graph for the inputs (remaining energy and traffic load) and the output (node cost)

The tree node is explored based on its *evaluation function f(n)*. The function we used is given as:

$$f(n) = NC(n) + (1/MH(n)).$$

Where *NC (n)* is the node cost of node *n*, which takes value [0…1], and can be calculated by the fuzzy approach. The fuzzy approach is considered for the remaining energy and the traffic load of node *n* to calculate the optimal cost for node *n*. *MH (n)* is the short distance from node *n* to the base station. As a result, the node *n* that has largest *f (n)* value will be chosen as the optimal node.

3.2 COGINITIVE RADIO

Cognitive radio is used for passing message from roadside unit to vehicles with an access point. The beacon message has been used for each area to obtain the information of moving vehicles in that area. So that cognitive radio maintains access point for each and every vehicle information in that region. The safety message between the vehicles avoids the emergency event occurred in that area. By making use of this method, the driver will slow down the vehicles to avoid accident and traffic in that place.

They use ETX and ETT in combination of WCETT using OLSR routing protocol for finding vehicles information and used a terms are

ETX

ETX, Expected Transmission Count is used to send or resend the packet for the receiving node, so it counts the numbers of times a nodes receives

ETT

ETT, Expected Transmission Time, is done with the ETX. Expected Transmission Time will estimate the time and multiply with the ETX for sending a packet in with the size of the packet divided by the link capacity, so that the packets including the resends if needed.

4. PERFORMANCE EVALUATION

Energy Model, as implemented in *ns*, is a node attribute. The energy model represents level of energy in a mobile host. The energy model in a node has a initial value which is the level of energy the node has at the beginning of the simulation. This is known as initialEnergy_. It also has a given energy usage for every packet it transmits and receives. These are called txPower_ and rxPower_. EnergyModel(energy) requires the initial-energy to be passed along as a parameter.

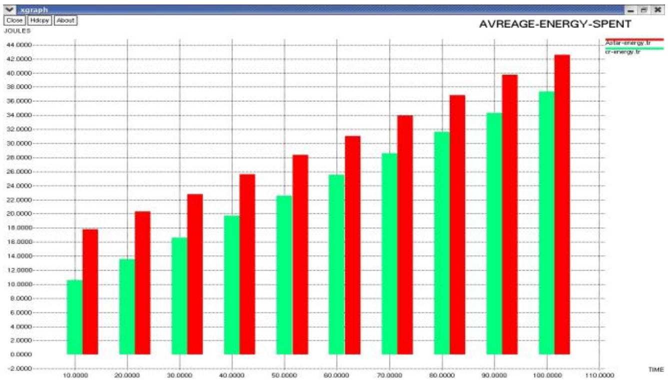

Fig 4 Energy Estimation for A-STAR and Cognitive Radio

The other class methods are used to decrease the energy level of the node for every packet transmitted (DecrTxEnergy(txtime, P_tx)) and every packet received (DecrRcvEnergy (rcvtime, P_rcv)) by the node. P_tx and P_rcv are the transmitting and receiving power (respectively) required by the node's interface or PHY. At the beginning of simulation, energy_ is set to initialEnergy_ which is then decremented for every transmission and reception of packets at the node. When the energy level at the node goes down to zero, no more packets can be received or transmitted by the node. If tracing is turned on, line

Likewise the performance is made for delay, throughput and packet delivery ratio between A-STAR and Cognitive Radio to show the better performance of A-STAR because A-STAR will check the high efficient node in the network to deliver the packet to the destination so that energy can be saved for the remaining nodes in the network

The end-to-end delay of data packets is made between sources to destination. We vary the simulation time to calculate end to end delay. We run these simulations for A-STAR and CR individually; the number of nodes is 50. The simulation time is 10, 20, 30, and 100 seconds. Figure 5 shows the plot for average end-to-end delay versus simulation time when number of nodes is 50, the comparison is made between A-STAR and Cognitive Radio

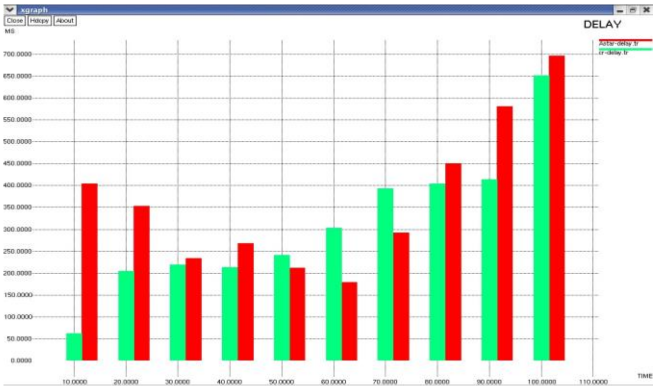

Fig 5 Delay for A-STAR and Cognitive Radio

Throughput is the successful data packets received at destination and usually measured in bits per second (bit/s or bps), and which the information can be or not the data packets correctly delivered to the destinations. The performance evaluation is made to find the throughput for the communication happening between vehicles and in x-axis contains time and in y-axis contains kilo-bits per seconds(KBPS).

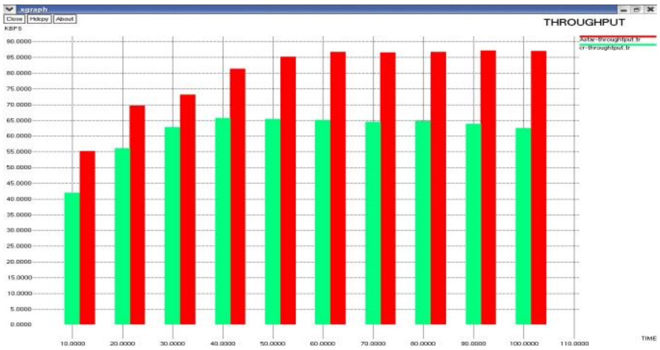

Fig 6 Through-Put for A-STAR and Cognitive Radio

In the beginning, the packet delivery ratio is less due to less number of vehicles and the packet delivery ratio is compared with number of nodes as shown in Fig. 7. Packet delivery ratio is calculated by number of packets received through the number of packets originated by the by the destination and CBR source. The number of packets dropped does not take into retransmissions and make the number of transmitted packets equal to the sum of the number of received packets and number of dropped packets.

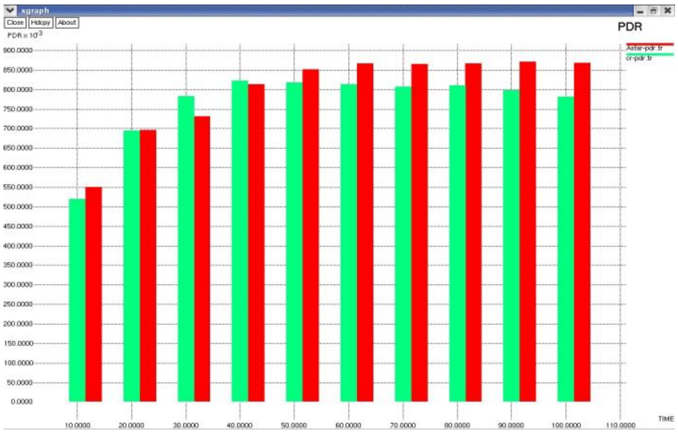

Fig 7 Packet Delivery Ratio for A-STAR and Cognitive Radio

5. CONCLUSION

This method has high social relevance and usefulness to provide a safety message to all the vehicles in the environment that avoid unwanted event in the network. The communication has been made between Vehicle to vehicle using A-star protocol as well as vehicle to infrastructure using cognitive radio which allocates multiple channels in the network region. Thus the vehicular-infrastructure communication reduces the delay using a cognitive radio protocol and position- based protocol.

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