A Joint Routing and Location Service for VANETs

Marwane Ayaida*, Mohtadi Barhoumi*, Hacène Fouchal*, Yacine Ghamri-Doudane** and Lissan Afilal*
*Centre de recherche CReSTIC,
Université de Reims Champagne-Ardenne:
51687 REIMS Cedex 2, France
**{marwane.ayaida, mohtadi.barhoumi, hacene.fouchal, lissan.afilal}@univ-reims.fr

Abstract—In this paper, we propose a combination between a routing protocol and Hierarchical Location Service (HLS) that we denote Hybrid Routing and Hierarchical Location Service (HRHLS). HLS and a routing protocol used to be combined in the original work with a direct method, i.e. the routing protocol takes care of routing packets and HLS is called to get the destination position when the target node position is not known or is not fresh enough. When a destination is quite far away from the sender, the exact position of the target is calculated, and an extra overhead is generated from sender to receiver. Our main purpose is to reduce this overhead in HRHLS. We suggest to proceed as follows: when a packet has to be sent to the destination, it will be sent directly to the former position of the target instead of requesting for the exact position. When the packet is approaching the former position, the exact position request is then sent.

Index Terms—VANETs; Location-based Services; Geographic Routing Protocols.

I. INTRODUCTION

VANETs (Vehicular Ad-hoc NETworks) are a special case of MANETs (Mobile Ad-hoc NETworks). Their major features is the high mobility of nodes. The immediate consequences are: topology changes and link disconnections.

Usual topology-based routing protocols have limited performances in such networks. Geographic routing protocols were designed to provide better performances for such networks. The main principle adopted by these protocols is that each node has to care about its actual geographic position (often achieved by a GPS) and the position of the targeted node to reach. With these protocols, the paradigm position-to-position is used. The Location-based Services is required to catch the destination position. The combination of this service with routing is quite natural in order to guarantee interesting performances. This combination called Hybrid Routing and Hierarchical Location Service (HRHLS) was made between the routing protocol Greedy Perimeter Stateless Routing (GPSR) as a geographic routing protocol and Hierarchical Location Service (HLS) as a location-based service. Several experimentations were carried out over NS-2 network simulator. These experimentations demonstrate that the efficient combination between the geographic routing protocols and the location-based services enhanced the network performances while reducing the location overhead.

II. RELATED WORKS

A. Location Service

The location-based services can be classified into two classes: Flooding-based and Rendez-vous-based. The first class is composed of reactive and proactive services. In the proactive flooding-based location-based service, every node floods its geographic information through all the network periodically. Thus, all the nodes are able to update their location tables. Since this approach uses flooding and may surcharge the network by location update messages, several techniques to reduce the congestion were used. One of them is to tune the update frequency with the node mobility (the more nodes are moving fast, the higher update location frequency is used). In the second class (rendez-vous-based location service), all the nodes agree on a unique mapping of a node to other specific nodes. The geographic information are disseminated through the elected nodes called the "location servers". The two major hierarchical services are: the Grid Location Service (GLS)[1] and the Hierarchical Location Service (HLS)[2].

B. Geographic Routing Protocols

Routing protocols algorithms must choose some criteria to make routing decisions, for instance the number of hops, latency, transmission power, bandwidth, etc. The topology-based routing protocols suffer from heavy discovery and maintenance phases, lack of scalability and high mobility effects (short links). However, geographic routing are suitable for large scale dynamic networks. One of the first real geographic routing protocol is the Greedy Perimeter Stateless Routing (GPSR) [3]. It is a reactive protocol which forwards the packet to the destination’s nearest neighbor (Greedy Forwarding approach) until reaching the destination. Therefore, it scales better than the topology-based protocols, but it does still not consider the urban streets topology and the existence of obstacles to radio transmissions. We have used the Greedy Perimeter Stateless Routing (GPSR) as the geographic routing protocol for the combination. However, the work still available with other geographic routing protocols.
III. HRHLS: AN EFFICIENT ROUTING & HLS COMBINATION

A. Description

In order to reduce the overhead of HLS and GPRS, we combine them in HRHLS algorithm. This combination is composed of three parts: Poslookup, GPRS Emit and forward-Packet. The first function Poslookup handles the querying of destination’s position, it looks into the local cache memory of the current node and updates the packet information with the destination’s position. Then, the second function manages the creation and emission of new packets, it verifies at first, whether the sender has fresh or non-fresh information about the destination’s position and then starts the routing of packets. If not, the function starts a new position query and places the packet into a buffer while the query is taking place. The function forwardPacket handles the forwarding of packets, it is called whenever a packet reaches a intermediary node, it verifies whether this node has a fresher position of the target and eventually updates the packet’s information with it. Otherwise, if the reached node is in the same region of the destination, we must launch a new query to retrieve the new position of the target.

B. Simulations

The simulations were performed using the NS-2 simulator 2.33. The main result in our simulations is the number of sent location requests shown in Figure 1. Clearly, the number of location requests is reduced in HHLS. For example, there are 93% less location requests in HHLS compared to HLS with 20 nodes. This difference decreases when the number of nodes increases(25% with 100 nodes and 22% for 120 nodes). This is due to the traffic overload when the number of nodes increases.

Another performance criterion is the average number of packet hops. The results of the average hops were not included because they was almost the same in both approaches HLS and HHLS.

Considering the results of these experimentations, we conclude that HRHLS scheme has not only a lower cost (number of requests and consumed bandwidths) than HLS, but it enhances the network performances (PDRs and latencies). This confirms that mixing the geographical routing protocols and the location-based services reduces the overhead and also improves the performances instead of dealing with each issue alone.

IV. CONCLUSION & FUTURE WORKS

We have proposed a hybrid approach HRHLS to handle the location service and to make the routing decisions in VANETs. In fact the approach provides one unique process which includes on one hand routing and on another hand location service. We implemented it in the NS-2 framework by means of an appropriate patch. We have conducted many experimentations with this patch in order to observe network performances. We have shown in this paper that a smart combination of HLS with GPRS could provide better results in terms of network performances in particular for the packet delivery rate.

REFERENCES