Routing in vehicular ad hoc networks

Yacine Khaled
Heudiasyc lab. UMR UTC-CNRS 6599
Université de Technologie de Compiègne
France
Institut National de Recherche en Informatique et en Automatique
INRIA
France

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The routing in vehicular Ad hoc NETworks (VANET) has attracted many attention during the last few years. Such particular case of mobile ad hoc network is characterized by a strong mobility of the nodes, a high dynamic and specific topology, a significant loss rate and a very short duration of communication. Among applications of the VANET, we may quote automatic driving, enhancing safety by propagating emergency alerts and novel driver and passengers services.

Many routing solutions have been proposed, for the mobile ad hoc network (MANET), to deal with the node's mobility: creating routing tables, discovering routes, using geographical information, detecting stable structures (clusters), using the node's movements for messages transportation, using the broadcasting approach for messages forwarding, etc (see Figure 1).

Figure 1: VANET applications

However, the specific properties of the VANET, such as the high dynamic topology, affect the performances of these routing solutions usually applicable to traditional MANET. Thus, routing messages in a such network is a great challenge.

In this study we overview the VANET applications and services, thus, we presente and analyze the VANET routing protocols on an application and road traffic point of view. We then sketch a new taxonomy based on applications requirements and road environment. Having the application and environnement requirements in mind is important to design new routing algorithms or to use some existing solutions. Our contribution should help in both the design and cohabitation of the VANET routing solutions as well as in the choice of the tests scenarios for their evaluations. We study also the cohabitation of different routing solutions according to the application requirements and road conditions.

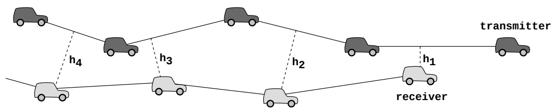

Figure 2: trajectory correlation

In order to deal with the dynamic, we proposed a novel approach relying on conditional transmissions. Instead of transporting addresses or positions, a message is sent with some conditions used for retransmission or reception. Thanks to the dynamic receiver-oriented evaluation of the conditions, our solution can efficiently support the high dynamic of the networks. The conditions can rely on the time or the message duration, the position or the distance, the speed or the trajectory (see figure 2) and any combination of such conditions.

A stand-alone implementation has been developed on our embedded distributed framework (see Figure 3) to perform tests on the road with several vehicles. Moreover an implementation in network simulator allowed scaling up the study of performances to a large number of vehicles and different traffic scenarios.

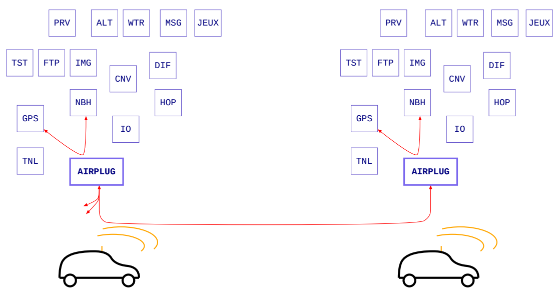

Figure 3: Embedded platform architecture

The simulation results show that the conditional transmissions offer better performances than (i) the proactive algorithms OLSR and Fast OLSR, (ii) the reactive algorithm AODV and (iii) the geocast algorithms LBM and GAMER.

While the performance of HOP depends on the conditions used, we observed that the end-to-end delay of the first packet is very short with HOP and is not affected by the road traffic scenario. Moreover the end-to-end ratio of received data to sent data is also not affected by the dynamic. It logically decreases when the inter-packets gap of the source decreases as with other protocols, but it remains very interesting.