Mobility and Multihoming in Vehicular Networks: Connecting simultaneously to all available networks and technologies

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Our vision of a vehicular network is the one that extends our communications from the home, office and coffee to the roads. The scenarios we envision are the following. When a vehicle moves along the road, it will be a user of the available fixed access points in the roads, and will also be able to work as a mobile router capable of spreading the Internet connection not only to its passengers, but also to the other vehicles nearby. This will allow extending the range of the Internet access connection through multi-hop over the vehicular network reducing the need of fixed infrastructures, and therefore, the costs of deploying a vehicular network. In our previous work we designed and implemented a mobility protocol capable of providing mobility to the vehicles and all their dependents to provide mobility in vehicular networks handled distributively between the vehicles and the access points.

In this work we go further than providing seamless mobility and connection to the best network: we include the concept of multihoming and enable the connection of a vehicle to multiple networks and technologies simultaneously, being able to choose the optimal path for each service and flow, through a road side unit, cellular station, or through another vehicle in multi-hop. The concept of optimal may consider the objective of load-balancing of traffic between different networks and technologies, or may consider the traffic split between different networks according to its characteristics in terms of bandwidth and delay. The integration of multihoming in a vehicular scenario will enable a more seamless and transparent handover between different networks, since the handover becomes a traffic movement between different networks. A typical scenario is, for example, a vehicle moving along a road and with two interfaces, IEEE 802.11p and WiFi. This vehicle initiates services from its users through the IEEE 802.11p interface to a road side unit, but the bandwidth requirements of the active flows in this IEEE 802.11p network are significant, and the vehicle is requested to use both interfaces simultaneously to receive the service. Then, while the vehicle moves, the multihoming approach decides to send all the traffic through the IEEE 802.11p network; after some seconds, the vehicle starts losing the connection to the first WiFi network and detects a new WiFi connection, performing a handover between these two WiFi networks (although not sending traffic to this network). Finally, the vehicle stops at a traffic light and decides to send the sensors information that it gathered before through the WiFi network, maintaining the previous services in the IEEE 802.11p network and using both simultaneously. This represents a complete paradigm shift, since the connection of a new network does not represent the need to execute handover but the possibility to use more resources; and a connection loss does not represent the loss of service, but the reconfiguration of the services through the available networks.

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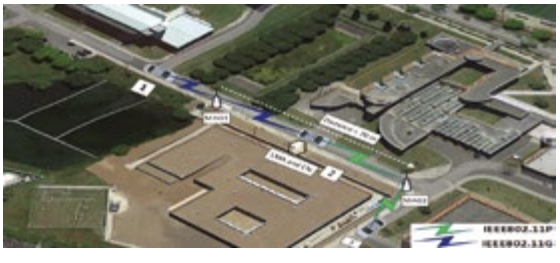
FIGURE 1
Vehicles connecting through different access networks simultaneously in multihoming.



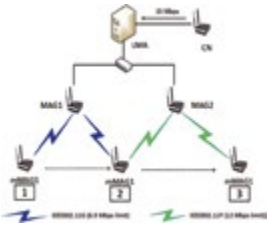


FIGURE 2
a) Real scenario;
b) schematic of the real scenario.