Reactive and Adaptive Protocol for Inter-Vehicle Communications (RAP-IVC)

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The Inter-Vehicle Communication (IVC) is a direct transmission of information between vehicles without the use of a fixed infrastructure (see figure1). Thus, it adapts quickly and easily to several circumstances. An IVC network is considered as an ad hoc network, which consists of a set of nodes (vehicles) that communicate through radio frequencies, without the use of a beforehand deployed infrastructure and without the use of a centralized administration.
This type of network is used to exchange various kinds of vehicular information, in order to avoid collisions between vehicles and to ensure accurate automatic driving.

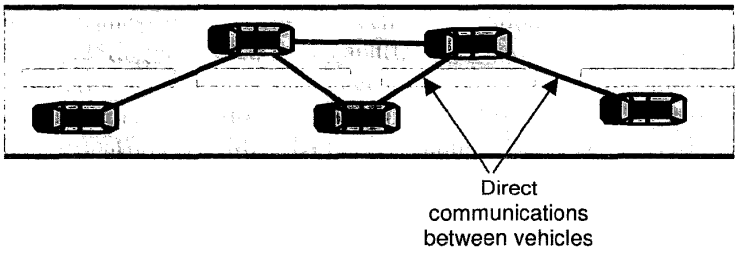

Figure 1. Inter-Vehicle Communication.

In IVC networks (like ad hoc mobile networks), the topology changes frequently and the vehicles communicate between them using radio channels. Since the bandwidth is limited and the topology of the network can generate bottlenecks, it is necessary to reduce the useless transmissions in order to decrease the traffic, and to guarantee high QoS in the network.

In what follows we will present the principal functionalities of a new protocol for IVC called: Reactive and Adaptive Protocol for Inter-Vehicle Communications (RAP-IVC).

We designate by **"scope of an IVC"** the number of hops reached by a message when transmitted by a vehicle.

To exchange vehicular information, existing IVC systems use generally a proactive approach, in a sense that vehicular information is sent continuously to inform neighbouring vehicles about the current state of the vehicle. Hence, this approach is bandwidth and computation consuming. Moreover, existing IVC systems have a fixed *scope* and hence cannot adapt to critical situations where the information must be propagated far away in order to avoid more losses in case of an accident.

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In order to save bandwidth and computation overheads, RAP-IVC sends vehicular information only when it changes its state, therefore it is a **Reactive Protocol**. Besides, RAP-IVC is **Adaptive** since it adapts the *scope* of sent messages depending on the speed of the vehicle as well as the importance of the encountered danger.

The reactive aspect of RAP-IVC:
In RAP-IVC, we distinguish two types of messages:

- The HELLO message: is sent periodically to inform the neighbouring vehicles about the presence of the vehicle. Note that this message is so small that it does not present a concern regarding bandwidth consumption.
- The DATA messages: are sent only when the vehicle changes its state, for example when the vehicle changes its speed or direction, when it receives new information, etc., or when it detects a new neighbouring vehicle (after receiving its *Hello* message).

The adaptive aspect of RAP-IVC:
By fixing the scope for an IVC, messages will be flooded on a certain number of hops unnecessarily, or in the contrary case, messages need to be flooded far away to avoid cascading accidents. In IVC networks, the vehicles can move with different speeds. Therefore RAP-IVC adjusts the scope according to the speed variation. For example, if a vehicle runs in a motorway at 120 Km/h, and if it happens an accident, this vehicle should prevent at least the 100 vehicles behind it in order to avoid a pile-up. Instead, if the vehicle runs at 40 Km/h, then, in the event of an accident, this vehicle should prevent only the 10 or 15 vehicles behind it.

In this paper, we have presented the principal functionalities of a new Reactive and Adaptive Protocol for IVC called: RAP-IVC. RAP-IVC assures reliable and real-time communication while reducing the number of exchanged messages in the network. In the contrary of most existing protocols, RAP-IVC is reactive and adaptive. The reactive aspect of the protocol allows to reduce the number of sent messages and hence to save bandwidth and computation time. The adaptive aspect of the protocol allows to take into consideration the speed of the vehicle as well as the importance of encountered dangers to adjust the scope of messages and hence to prevent happening more pile-up.

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