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Intelligent transport systems — Cooperative adaptive cruise control systems (CACC) — Performance requirements and test procedures

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This document was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

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Introduction

Cooperative Adaptive Cruise Control (CACC) system is an enhancement to the Adaptive Cruise Control (ACC) system by the addition of wireless communication with preceding vehicles and/or the infrastructure to augment the ACC active sensing capability. It uses active sensing data such as ranging to forward vehicle, subject vehicle data, over the air data from other surrounding vehicles and from infrastructure, and driver input to longitudinally control the vehicle via throttle and brake controls, and to convey the appropriate CACC status information to the driver (see Figure 1).

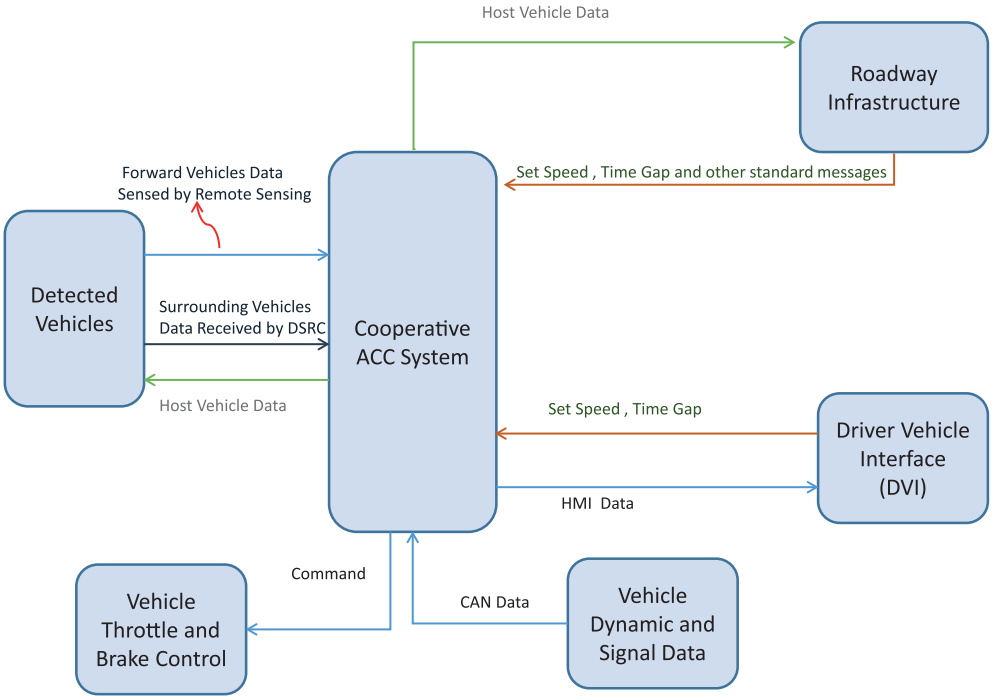

Figure 1 — Functional CACC elements

ACC systems can be made cooperative by adding vehicle-vehicle (V2V) and/or infrastructure-vehicle (I2V) communication capabilities and adjusting the performance of the system to make use of the information received via the communication system, e.g. Dedicated Short Range Communication System (DSRC) (see Figure 2).

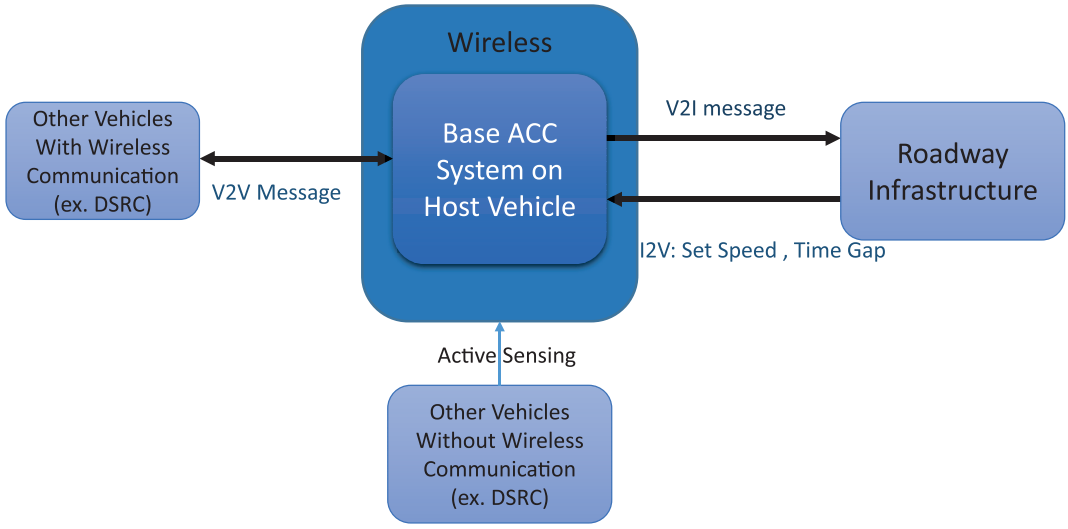

Figure 2 — CACC additions to ACC

The V2V communications can provide the ACC system with frequent updates about the speed, acceleration and commands (throttle and brake) of multiple vehicles driving in the surrounding area of the CACC-equipped vehicle. This enables the following performance improvements over ACC:

— higher-accuracy control of vehicle following gap, while maintaining smooth ride quality;

— significantly faster responses to speed changes by multiple forward vehicles, not only the vehicle immediately ahead of the subject vehicle;

— shorter vehicle-following gap settings, without compromising safety or driver confidence and comfort with the system.

These performance improvements produce the following benefits:

— increased driver confidence in the responsiveness of the system, leading to willingness to select shorter gap settings and use ACC under a wider range of traffic conditions;

— fewer cut-ins at the shorter gaps may make ACC acceptable to a wider range of drivers;

— significant damping of traffic flow disturbances, improving traffic flow dynamics and thereby reducing energy use and emissions;

— significant increase in the effective capacity (throughput) per lane of highway traffic.

The I2V communications can provide the ACC system with inputs from the local traffic management system, which determines the recommended values for set speed and vehicle-following gap. These can be used to enhance the effectiveness of traffic management strategies on limited access highways, where it is possible to determine the speed and gap settings that are likely to maximize the effective capacity of a bottleneck section. When the I2V CACC vehicles follow these recommended values, the overall traffic flow capacity can be optimized with a minimum of active intervention by the vehicle drivers (other than opting in to decide to follow the infrastructure-based guidance). This means that the driver of the subject vehicle gains a smoother trip, with less acceleration and braking and lower energy consumption, and the highway as a whole gains a higher effective capacity, reduced energy consumption and pollution, and reduced traffic delays.

