Communication for the road

When traveling at speed in a convoy of vehicles on a busy freeway, every driver depends on the alertness and reaction speed of the drivers in front to provide warning of the need to slow down. Engineers from the **DaimlerChrysler** Research and Technology Center North America in Palo Alto, CA, have been developing a method for vehicles to communicate with each other so that the information is shared directly with all drivers in range simultaneously.

Vehicles equipped with DSRC, first demonstrated by DaimlerChrysler, can communicate directly with one another and the infrastructure around them using wireless local area network technology.

DaimlerChrysler recently presented a dynamic driving demonstration of the broadband car-to-car communication between a **Mercedes-Benz** E-Class and a **Dodge** Durango. The company claims to be the first automaker to publicly test this new wireless communications technology.

The dedicated short range communication (DSRC) technology makes real-time communication possible between a vehicle and roadside stations and from one vehicle to another. With the aid of car-to-car communications, the selective forwarding of information could help to optimize traffic flow and enhance traffic safety. For example, if a vehicle encounters a critical situation such as congestion, fog, ice, or an accident, it can pass the relevant information to all road users in the immediate vicinity of the danger spot. Traffic approaching from further away is given ample warning and can respond earlier to the situation.

Vehicles equipped with DSRC can communicate directly with one another, also making it possible to transmit braking signals back over several vehicles, giving drivers early warning that they might soon have to brake. In this information network, each vehicle can take on the role of a sender, receiver, or router, allowing a chain of information to be passed on. With the aid of this process, known as multi-hopping, information can be spread further than just a single vehicle transmit range, and can cover a substantial distance.

Data exchange between vehicles is made possible by ad-hoc networks. These short-distance connections are spontaneously created between the vehicles as the need arises and they can organize themselves without the help of any external infrastructure. DSRC uses wireless local area network (WLAN) technology to transmit data at 5.9 GHz over a distance of up to 1000 m (3280 ft). The **FCC** (Federal Communications Commission) established 75 MHz of the new spectrum exclusively for development, a step taken nowhere else in the world.

For the demonstration, a Dodge Durango was equipped to send a signal when its brakes were applied. A **Chrysler** minivan acted as a "shield" vehicle driving between the Durango and the E-Class test vehicle, with the three vehicles driving at a steady speed on the test track. When the Durango braked sharply, an audible warning was set off in the test car before the shield vehicle brake lights came on, a situation that was verified by video cameras mounted on the minivan.

A second demonstration had a minivan disabled at the roadside, which caused a warning triangle to appear on the navigation screen in the test car, indicating a possible road hazard. The third illustration was when the driver

approached a red traffic light without slowing or applying the brakes, and an audible warning was again activated.

The technology represents a further milestone towards realizing the vision of accident-free driving. According to investigations by the U.S. National Highway Traffic Safety Administration (**NHTSA**), 88% of all rear-end accidents are the result either of inattention on the part of the driver or of traveling too closely to the vehicle in front. DSRC could help prevent such accidents or reduce their severity.

As well as the major safety and traffic flow benefits of the proposed technology, DSRC could be used to transmit other data into the vehicle such as digital music, movies, or even map updates for the onboard navigation system. Convenience information such as notification of local services and attractions, parking space advisories, or drive-through toll payments can also be communicated. Researchers are aware of the potential for invasion of privacy and are building in safeguards to prevent illegal use.

DaimlerChrysler is working with the U.S. **DOT** (Department of Transportation) and the states of Michigan, California, and Florida, to prepare demonstration tests of vehicle-to-infrastructure communications. Working through the Vehicle Infrastructure Integration (VII) initiative, DOT is expected to select a set of locations for a series of progressively more integrated tests from 2005 through the end of the decade.

DOT has allocated $85 million over five years to support development of standards and protocols for deploying the communications technology. DaimlerChrysler and six other automakers—**BMW**, **Ford**, **General Motors**, **Nissan**, **Toyota**, and **Volkswagen**—are working with federal and state highway officials across the country through the vehicle safety communications consortium. Initial work with **IEEE** (Institute of Electrical and Electronics Engineers) has already begun, according to DaimlerChrysler researchers.

In Europe, six car manufacturers—**Audi**, BMW, DaimlerChrysler, **Fiat**, **Renault**, and Volkswagen—have combined forces in the nonprofit Car-2-Car Communication Consortium (C2C CC). One aim of this body is to develop a European-wide open industry standard for communications from car to car and between vehicles and the infrastructure. Beyond that, the C2C CC plans to push for the allocation of the necessary radio frequency to enable this, as well as to develop and test suitable radio communication systems. Suppliers and other researchers are encouraged to join and contribute to the effort.

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