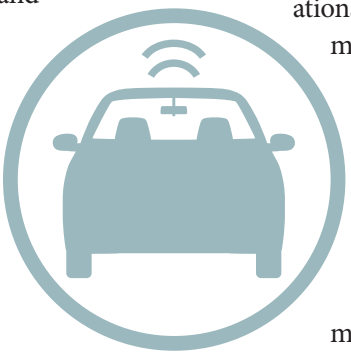
U.S. Department of Transportation

VEHICLE-TO-VEHICLE COMMUNICATION TECHNOLOGY

NHTSA ISSUES ADVANCE NOTICE OF PROPOSED RULEMAKING AND RESEARCH REPORT ON GROUND-BREAKING CRASH AVOIDANCE TECHNOLOGY: "VEHICLE-TO-VEHICLE COMMUNICATIONS: READINESS OF V2V TECHNOLOGY FOR APPLICATION"

NHTSA, as the Federal agency with authority over motor vehicle safety, has been researching vehicle-to-vehicle (V2V) communication technology for more than a decade, in partnership with others in the United States Department of Transportation (DOT), the automotive industry, and academic institutions. Today NHTSA is issuing an advance notice of proposed rulemaking (ANPRM) and a research report, "Vehicle-to-Vehicle Communications: Readiness of V2V Technology for Application," which explores technical, legal, and policy issues associated with V2V technology. These documents represent the next step following NHTSA's announcement on February 3, 2014, when NHTSA explained that the agency will begin working on a regulatory proposal to require V2V devices in new vehicles in a future year.



What is V2V?

V2V is a crash avoidance technology, which relies on communication of information between nearby vehicles to potentially warn drivers about dangerous situations that could lead to a crash. For example, V2V could help warn a driver that a vehicle up ahead is braking and they need to slow down, or let a driver know that it's not safe to proceed through an intersection because another car (yet unseen by the driver) is quickly approaching.

How does V2V work?

V2V communications systems are composed of devices, installed in vehicles, that use dedicated short-range radio communication (DSRC) to exchange messages containing vehicle information (e.g., vehicle's speed, heading, braking status). V2V devices use this information from other vehicles and determine if a warning to the vehicle's driver is needed, which could prevent a vehicle crash.

What are the advantages of V2V?

V2V messages have a range of approximately 300 meters, which exceeds the capabilities of systems with ultrasonic sensors, cameras, and radar – in some cases, by nearly twice the distance, allowing more time to warn drivers. In addition, these radio messages can "see" around corners or "through" other vehicles addressing, for example, scenarios such as those where an oncoming vehicle emerges from behind a truck, or perhaps from a blind alley. In those situations, V2V communications can detect the threat much earlier than radar or camera sensors.

Additionally, V2V technology can also be combined existing radar and cameras to provide even greater benefits than either approach alone. This combined approach could also augment system accuracy, becoming a foundation for realizing automated vehicles on the Nation's roadways.

For more detailed information on how NHTSA believes the various levels of vehicle automation will help reduce crashes and how on-board systems may someday work cooperatively with V2V technology, see NHTSA's Preliminary Statement of Policy on Vehicle Automation (May 2013).

What is V2V's potential to address vehicle crashes?

DSRC can enable a number of safety "applications" that help drivers with different aspects of driving, like warning about stopped vehicles in the road ahead, vehicles speeding unexpectedly through intersections, vehicles in blind spots, etc.

The agency's analysis of two potential applications, "intersection movement assist" (IMA) and "left turn assist"

(LTA), indicated there could be a 50-percent reduction, on average, in crashes, injuries, and fatalities for just these two applications.

Applied to the full national vehicle fleet, this could potentially prevent 400,000 to 600,000 crashes, 190,000 to 270,000 injuries, and save 780 to 1,080 lives each year. Of course, the addition of other V2V and vehicle-to-infrastructure (V2I) safety applications would save even more lives.

V2V Basics

What are dedicated short-range communications?

Dedicated short-range communications (DSRC) are two-way, wireless communications permitting secure and fast messaging needed for safety applications, where "short range" is approximately 300 meters depending on the surrounding environment. These communications occur in a 75 MHz band of the 5.9 GHz spectrum, which has been allocated by the FCC for use by Intelligent Transportations Systems (ITS) vehicle safety and mobility applications. This band affords a relatively clean operating environment with very few preexisting users, allowing for a relatively unimpeded and interference-free communication zone.

What types of DSRC-based devices are used?

DSRC-based devices can be installed directly in vehicles when originally manufactured, after initial manufacture via an "aftermarket" installation, or could potentially be carried into vehicles by drivers in the form of a handheld device (and perhaps eventually, even as a function on a smartphone).

What messages are exchanged?

A basic safety message (BSM) is exchanged between vehicles and contains vehicle dynamics information such as heading, speed, and location. The BSM is updated and broadcast up to 10 times per second to surrounding vehicles. The information is received by the other vehicles equipped with V2V devices and processed to determine collision threats. Based on that information, if required, a warning could be issued to drivers to take appropriate action to avoid an imminent crash.

Safety Applications Enabled Only by V2V

V2V can enable warnings that are not currently available to drivers and that might not otherwise be available without V2V. Potential applications of V2V technology include:

Intersection Movement Assist

IMA warns the driver when it's not safe to enter an intersection because of an increased potential for colliding with one or more vehicles.

Left Turn Assist

LTA warns the driver when there is strong probability they will collide with an oncoming vehicle when making a left turn. This is especially critical when the driver's line-of-sight is blocked by a vehicle also making a left turn from the opposite direction.

Emergency Electronic Brake Light

Emergency Electronic Brake Light (EEBL) warns the driver to be prepared to take action when a V2V-equipped vehicle traveling in the same direction but not in the driver's line-of-sight decelerates quickly. V2V would allow the driver to "see through" vehicles or poor weather conditions and know if traffic ahead may be coming to an abrupt stop.

Applications That Could Be Implemented by V2V Alone or By V2V Supplementing Other On-Board Systems

V2V can enhance the capabilities of existing advanced safety warnings such as:

Forward Collision Warning

Forward Collision Warning (FCW) warns the driver of the risk of an impending rear-end collision with a vehicle ahead in traffic in the same lane and direction of travel.

Blind Spot Warning and Lane Change Warning

Blind Spot Warning (BSW) notifies the driver that a vehicle in an adjacent lane is positioned in the driver's "blind spot" zone. If a driver attempts a lane change when another vehicle is in his or her blind spot, Lane Change Warning (LCW) warns the driver that a vehicle is present in or approaching the "blind-spot" zone.

Do-Not-Pass Warning

Do-Not-Pass Warning (DNPW) warns the driver that it is not safe to pass a slower-moving vehicle when vehicles are approaching from the opposite direction.

Preliminary Cost Estimates

Per Vehicle

NHTSA preliminarily estimates that V2V equipment and supporting communications functions (such as a security management system) would cost approximately $341 to $350 per vehicle in 2020, but then decrease to approximately $209 to $235 by 2058 as manufacturers gain experience producing the equipment.

Annual Costs

Initial estimates indicate that annual costs would range from $300 million to $2.1 billion in 2020. The costs peak to $1.1 to $6.4 billion between 2022 and 2024, and then gradually decrease to $1.1 to $4.6 billion.

Preliminary Benefit Estimates

Crashes/Injuries Prevented and Lives Saved

If the full fleet has DSRC, NHTSA estimates that two potential applications alone, IMA and LTA will prevent 400,000 to 600,000 crashes, 190,000 to 270,000 injuries and save 780 to 1,080 lives each year when implemented across the entire fleet. The addition of other V2V and V2I safety applications would save even more lives. Altogether, these applications could eventually prevent or reduce the severity of up to 80 percent of non-alcohol-related crashes.

Security

As detailed in NHTSA's V2V research report, NHTSA and industry research partners developed a security system design based on the mature and successfully applied public key infrastructure (PKI). PKI is widely used in our daily lives. Its functionality most familiar to consumers is probably banking and credit card transactions. However, the system envisioned for V2V is unique in that involves machine-to-machine PKI which improves some of the vulnerabilities associated with other PKI systems. The V2V system consists of three primary components:

1. Certificates are needed for messages to be trusted. A Security Credentials Management System (SCMS) is the entity that issues, distributes, and revokes security credentials for devices operating in the system;
2. Devices need to have valid certificates in order to communicate. V2V devices that broadcast and receive DSRC messages, communicate with the SCMS for digital security credentials that provide message authentication; and
3. Occasionally, devices will need to securely receive new certificates via a communications network, which facilitates two-way encrypted communications between an SCMS and a device (and, potentially, roadside infrastructure).

A great deal of effort was expended to develop the security approach to ensure trusted messaging, feasible operations, and privacy protection. This effort placed safety and privacy as the highest priorities while balancing preliminary costs.

NHTSA is aware of potential cybersecurity concerns as they relate to the V2V program. The current proposed design for the V2V system employs a very high level of security and is compliant with the latest standards from the National Institute of Standards and Technology, which develops guidelines, best practices, and standards for information technology systems. NHTSA is committed to supporting deployment of V2V technologies in a manner that safeguards the system from unauthorized access, and is actively engaged with security experts to ensure comprehensive security prior to system implementation.

Privacy

By design, the V2V system will not collect, broadcast, or share personal information between vehicles, nor does it permit tracking of specific drivers or their vehicles. V2V-enabled vehicles only exchange generic, anonymized, safety information. The system is designed with several layers of security and privacy protection to ensure that drivers can rely on messages sent from other vehicles, and that NHTSA and vehicle manufacturers can identify defective V2V equipment without collecting or using any personal information about specific vehicles or drivers.

Comments?

To submit comments on the ANPRM and research report, go to www.regulations.gov and enter Docket No. NHTSA-2014-0022, or go to www.safercar.gov/v2v/resources and click the yellow button to go directly to the docket. Comments will be accepted for 90 days from August 20, 2014; late comments will be considered to the extent practicable.

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