The future of V2V

The U.S. government's National Highway Traffic Safety Administration (NHTSA) has announced plans to bring vehicle-to-vehicle (V2V) communication to light vehicles to mitigate crashes. But exactly when and how this will happen remains unclear. Siegfried Mortkowitz investigates.

The announcement, in early February, by the U.S. government's National Highway Traffic Safety Administration (NHTSA) that it would begin initiating a process to bring vehicle-to-vehicle (V2V) communication to light vehicles has kicked up almost as many questions as enthusiasm.

In its announcement, the agency said it was completing its analysis of data from the year-long Connected Vehicle Safety Pilot Program it ran, with some 2,800 vehicles, in partnership with the University of Michigan Transportation Research Institute in Ann Arbor, and would publish the results "in the coming weeks."

The NHTSA says that, by alerting drivers about imminent risks and hazards – especially those outside the driver's line of sight – the technology can prevent many common crash types, such as rear end, lane change and intersection collisions.

In comments made at the International Consumer Electronics Show (CES), in Las Vegas, in January, the outgoing NHTSA administrator David Strickland said that if the technology is "linked with active in-vehicle technologies, V2V has the potential to help drivers avoid or mitigate crashes in 80% of the vehicle crash scenarios involving unimpaired drivers."

How it works

One example of that, says Zachary Doerzaph, director of the Center for Advanced Automotive Research at the Virginia Tech Transportation Institute, is in the use of EEBL (Emergency Electronic Brake Lights), a V2V application that transmits a specific signal to following vehicles if the driver is forced to brake hard and suddenly.

If the scenario warrants it, any of the following vehicles equipped with V2V technology would then generate an alert to the driver. **"It is designed especially to mitigate multi-car pileups," Doerzaph says.**

These alerts could take the form of flashing LED lights in the dashboard or rearview mirrors, audible warnings, or haptic feedback in the driver's seat – or a combination of the three.

During a demonstration of the technology on a V2V-enabled Ford Taurus at this year's CES, Farid Ahmed-Zaid, a technical expert for global driver assistance at Ford's Active Safety Department, said the dedicated short-range communication (DSRC) technology picks up signals from other V2V-equipped vehicles within 900 to 1,500 feet.

The transmitted information includes vehicle speed, some vehicle-driver inputs, brake switch and turn signals. "That information is added to the GPS information," Ahmed-Zaid said, "packaged into one message and goes out 10 times a second."

"You're going to know there's something here, and it's moving that fast and in this direction, and you're going to have that information 10 times a second," he explained.

There are also trials under way using a rapid brake pulse of 500 milliseconds, according to Doerzaph. "This would provide a warning to the driver through the braking system of the car," he says. "It wouldn't stop the car, or even slow it significantly, but it would prime the brakes and elicit a braking response from the driver."

However, all of these lights, sounds and vibrations come with potential risks to the driver, warns Dave McNamara, president of McNamara Technology Solutions. "We want to improve the control of the vehicle," he says. "You don't want to add to the distraction."

An elusive timeframe

The early February NHTSA announcement also said that, once the results of the testing were made public, the agency would "begin working on a regulatory proposal that would require V2V devices in new vehicles in a future year."

That suggests strongly that the U.S. Department of Transportation (DOT) has already decided to seek some sort of mandate, similar to the Jan. 1, 1968, law that required all vehicles except buses to be fitted with seat belts.

However, it may not be weeks, but rather months, before the NHTSA makes public its findings.

Doerzaph suggests that the agency was being prudent. "There are fairly strong indications that they will pursue regulatory actions," he says. "But they're trying not to go to fast, to avoid backlash and resistance."

The regulatory proposal, when it comes, will provide more details about what parts of the V2V system they will approve, Doerzaph says, adding: "The timeline will be an important part of the announcement." He believes it will be "years before the mandate becomes real."

According to news reports, DOT officials said they planned to implement the policy before President Barack Obama leaves office, perhaps in 2017. McNamara estimates that it would take 12 years after the announcement of the mandate for the technology to reach 100% penetration among light vehicles.

(To put that in perspective, Nissan CEO Carlos Ghosn has said that the Japanese carmaker would put an autonomous car on the market by 2020, which could render the mandate superfluous.)

"OEMs will need to have designs in their plans now, to get limited deployments out in 2018," McNamara says. "So this was a strong nudge to move something into their products pipelines – most likely as an addition to existing ADAS on their luxury models. By then, commercial apps and V2I [vehicle to infrastructure] using DSRC will be on the road."

DSRC or 4G LTE? Or Lidar?

For the time being, the DOT is banking on DSRC as the basis for both V2V and V2I communications. One aim of the so-called Ann Arbor test bed was to determine if DSRC was reliable and if its use in V2V led to a decline in traffic accidents when in real-world situations.

However, alternatives to DRSC are already being considered or tested, such as the 4G LTE high-speed wireless networks and Google's roof-mounted Velodyne Lidar vision sensor system.

4G LTE is “not an alternative,” McNamara says. “It’s not certifiable, not robust enough.” In addition, Doerzaph says, DSRC has a very powerful advantage over LTE. “Privacy and security are inherent in the DSRC design, but not necessarily in 4G LTE,” he says. **“It’s a little more possible that a government or other entity, could track your position. It is not put together like DSRC, that it couldn’t be tracked because nothing identifying is transmitted.”**

Or even hacked. “Any time we allow any access over wireless, it opens the possibility that it could be hacked,” Doerzaph says. “Cyber security needs to be designed right up front.” This is a critical factor when it is tied to control of the car. **Hacking is less important when the system only allows warnings, like the current DSRC-based V2V systems.**

However, the Velodyne Lidar sensor system, currently used by Google on its prototypical driverless cars, may be a more formidable alternative to DSRC, if for no other reason than it eliminates entirely the security and privacy concerns. “There are no privacy issues with the Google autonomous sensors,” McNamara says.

For his part, Doerzaph says traditional sensor-based systems are “great, but they are expensive, though they will certainly get less so over time, and they all have limitations – for example, they require line of sight.”

That would make them almost useless in crashes involving vehicles approaching each other at city intersections or around curves, any scenario where the drivers do not see each other’s vehicle.

Ford’s Ahmed-Zaid underlined the crucial importance of this feature. “That’s why OEMs have been working on this for 10 years – it’s those scenarios where you can’t see the threat,” he said. DSRC, he added, “being Wi-Fi-based, can go through buildings, with some attenuation … but enough to give a warning to the driver.”

V2V “is really just another sensor,” Doerzaph says. “But it is very inexpensive, requires little computational power, enables many applications with different goals and can be used to share information about intent, rather than traditional sensors, which can only respond to actions that have already been taken.”

Nevertheless, he adds: “In an automated world, I expect both autonomous sensors and connected vehicle capabilities to be present. Assuming automated control of a vehicle is a very complex and very risky endeavor. A robust approach using sensor fusion to ensure reliability is required to create a safe automated environment.”

Penetration is key

Once V2V becomes a reality – and no one doubts that it will – it will be vital to have it accepted as quickly and broadly as possible, since any vehicle on the road not V2V-enabled will increase the risk of accidents and decrease the effectiveness of the technology.

“We must reach a critical mass of deployment,” McNamara says. “That means getting enough sensors on the road and gaining customer acceptance. The question is: Are they willing to pay for the technology?”

Doerzaph is more pessimistic about the timeframe for full V2V deployment, putting it at 20 years after a mandate is announced. “People are going to keep driving old cars,” he observes. “They are sentimental, and it’s fun.”

What’s more, passenger cars are not the only vehicles involved in road accidents, and the NHTSA has already been taken to task for not including trucks in its regulatory process.

In a recent blog, Roger Lanctot, associate director, automotive multimedia & communications service, Strategic Analytics, criticized this omission. “What specifically did not happen [in the NHTSA announcement] was a mandate for DSRC technology to be required for FMCSA class 6, 7 and 8 commercial vehicles as well as for emergency vehicles,” he wrote.

In his view, this could have a very negative impact on the technology. “By the time DSRC makes it to market, it is highly likely that competing technologies will already have been adopted via market mechanisms, rendering DSRC irrelevant,” he wrote. “The one thing [the] NHTSA could do to change this depressing prospect is to require the implementation of the technology in those vehicle segments (commercial) where it has the relevant authority.”

McNamara agrees that not including commercial vehicles was a mistake. “They should have spoken about commercial vehicles first,” he says. “[Commercial fleets] can afford it, and the federal government can make rules across fleets because it’s interstate commerce.”

McNamara believes that the reason commercial vehicles were omitted was because the NHTSA partnered with the Crash Avoidance Metrics Partnership – Vehicle Safety Communications (CAMP VSC3) in the V2V testing. The CAMP VSC3 consortium consists of R&D segments from eight passenger OEMs, including Ford, GM, Mercedes and Nissan.

But McNamara does not see the omission of trucks as a major problem. “You can do commercial vehicles immediately,” he says. “They would just add the equipment.”

Doerzaph cites another class of vehicle that would also benefit from the technology: motorcycles. “With motorcycles, you have a look-but-didn’t-see situation,” he says. “The alert would catch the driver’s attention when he could not actually see the cyclist,” he says. “It makes perfect sense for motorcyclists to send their positions. We are now researching that.”

Consumer Acceptance

Consumer acceptance of the new technology is a vital element of its deployment, and deploying a critical mass of V2V-enabled vehicles is vital to its functioning as intended.

But as many OEMs have already discovered, consumers are not eager to spend money on safety features; they assume safety technology should be part of standard equipment. In addition, the issue of privacy, as it has been perceived by the public and a number of libertarian commentators, is a factor in consumer acceptance that cannot be taken lightly.

Still, at the CES, Ford’s Ahmed-Zaid described the V2V communication from one vehicle to another as far from threatening. “If you’re within 900 to 1,500 feet, you’re going to hear that vehicle,” he said. “You’re not going to know if it’s a Taurus or its license plate [number]. Everything’s anonymous.”

However, “the question is, who’s using the data,” McNamara says. “The answer? Another car is using your data.”

It certainly raises the possibility of a driver or the police combining a visual sighting of an automobile with its V2V communication and tracking the vehicle that way, for whatever reason.

More pressing, however, is to convince consumers that the technology actually works and is worth the cost. “We’re trying to find the best way to have security and still have a system that’s deployable,” Ahmed-Zaid said. “We need to find a reliable security system and make sure the vehicles can download the credentials. This could be complex and costly.”

Security is essential to how well V2V works in preventing crashes, especially as it concerns the accuracy of the information communicated from one vehicle to the next. Or, as Ahmed-Zaid said, “How do I trust that you’re sending me accurate information?”

This is currently of great concern to OEMs and will require some time to work out. “There’s a whole certification process that needs to happen so you can warn the driver properly,” he explained.

The future

These questions will no doubt be raised, and answered, as interested parties wait for the NHTSA to drop the other shoe and move the regulatory process forward. In the meantime, OEMs will continue to develop the technology.

Because each brand of car must be able to speak to every other brand of car, the technology requires a large degree of interoperability. Car-makers will, therefore, be working hard to refine their proprietary V2V HMIs.

“Each car manufacturer will be focused on differentiating on HMI – how each OEM deals with the impact of the alerts on the driver,” says Chris Ruff, CEO of UIEvolution, a provider of cross-platform connected device solutions. “This will become an important differentiator as the car becomes more autonomous.”

At the same time, some U.S. states are already working on implementing DSRC technology in basic V2I functions for the purpose of improving traffic flow and reducing gas consumption and vehicle emissions.

According to McNamara, Florida, Texas, New York and other states “will start to deploy wireless communication at intersections, to coordinate traffic light signaling and harmonize [traffic] speed – the so-called green wave.” “This will provide a lot of immediate benefits,” he says.

It certainly seems inevitable that, with or without a government mandate, cars will soon be speaking to other cars or, at least, the surrounding traffic infrastructure.

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