Vehicle-to-vehicle communications research moves forward in the United States

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A motorcycle passes a car during a demonstration of vehicle-to-vehicle communication technology by the Virginia Tech Transportation Institute.

Following a U.S. Department of Transportation call to require vehicle-to-vehicle communication technology for all cars and light trucks on the nation's highways, the Virginia Tech Transportation Institute has been tapped to design the delivery integration framework that will allow vehicles to "talk" with their drivers and with other automobiles on the roadway.

The National Highway Traffic Safety Administration has awarded a $1 million follow-on to a $3 million project managed by the transportation institute.

The project's focus: Design, test, and disseminate the initial recommended framework that controls how motorists receive communications—traffic warnings, the too-close approach of another vehicle, weather warnings, or text messages—while driving. Focus will be placed on the communication's format, visual or audible, and the order and timing of such messages.

The Virginia Tech Transportation Institute has been building connected-vehicle technology since 2001, when the idea of drivers interacting with their vehicles in a manner similar to high-tech computers, and cars and trucks communicating with each other as well as infrastructure, was the product of fantasy television, movies, or books.

On Feb. 3, the National Highway Traffic Safety Administration announced its intention to pursue a mandate of this technology in light vehicles in an effort to improve highway safety, prevent crashes, and help alleviate congestion, among other potential benefits.

"We see this as a hugely progressive move. Vehicle communication technology has the great ability to improve safety, if it is implemented in a wise and safe way," said Zac Doerzaph, director of the institute's Center for Advanced Automotive Research and lead investigator on the project. "We're trying to get ahead of the game to ensure design before connectivity proliferates the entire driving experience."

The integration framework project builds on the institute's already $30 million-and-growing funded projects related to connected-vehicle communication technology, including long-term research into crash-avoidance systems, automated driving, and naturalistic driver experiences behind the wheel.

The institute, in coordination with the Virginia Department of Transportation, has a $14 million connected-vehicle test bed along

Interstates 66 and 495 near Fairfax, Va., that contains 43 wireless infrastructure devices installed along roadways, all communicating with dozens of cars, trucks, and motorcycles equipped with wireless communication systems. The test bed will soon expand to include 80 roadside devices.

Doerzaph and his team for several years have been testing various methods for drivers to receive key information in a wise, safe, and timely manner, without causing distraction or overwhelming the motorist with myriad details, such as non-emergency weather reports during high-congestion traffic.

Tests already have been done on driver interfaces such as augmented reality pop-ups on windshields or audible devices, both in simulated labs and on open highways, with motorists communicating with the car by voice or by gesture, such as "sweeping" away information on a screen with the wave of a hand.

"We want to coordinate the surge of information," said Doerzaph, adding that the coming changes to how motorists interact with connected vehicles can be likened to the way the Internet changed how users interact with desktop computers. The key is to contain vital information fast, accurately, and as required.

Doerzaph says the framework being designed and subsequently documented as a set of design principles will serve as a reference guide by designers of apps and driver systems for connected automobile and related wireless devices, with driver safety and ease of use as a focus.

Challenges in implementing vehicle communication systems are myriad: From creating uniform warnings and data formats across varying handheld devices and vehicles, to sorting vital information from traffic officials that may be only for truck drivers and not passenger-car

motorists, and stacking warnings and communications in order of importance. Also vital: Securing communication networks from hacking.

Motorists, too, should have the option of being entirely in control of not just the car – this study does not touch on fully self-driving or autonomous vehicles, still decades off – but the information they receive. If a motorist wishes to not be informed of, say, coupon deals from nearby restaurants, they should do so, said Doerzaph.

In its Feb. 3 announcement seen as a mandate for connected-vehicle use, U.S. Transportation Secretary Anthony Foxx said, "Vehicle-to-vehicle technology represents the next generation of auto safety improvements, building on the life-saving achievements we've already seen with safety belts and air bags. By helping drivers avoid crashes, this technology will play a key role in improving the way people get where they need to go while ensuring that the U.S. remains the leader in the global automotive industry."

Several federally funded connected-vehicle research test beds are operating throughout the United States. Funding for the institute's Fairfax test-bed project came from the U.S. Department of Transportation, the Virginia Department of Transportation, and Virginia Tech, among other resources. The 43 roadside wireless communication antennas installed around Interstates 66 and 495 corridors and receive information –basic safety-related messages—from test cars equipped with their own wireless technology.

Virginia Tech also has smaller set-ups that facilitate testing of various traffic scenarios, including the Virginia Smart Road, at the transportation institute's Blacksburg base, and at the Virginia International Raceway, near Danville, Va.

The institute also has been heavily involved with automated driving

systems, teaming with automotive companies such as General Motors to study how drivers interact with varying stages of automated car technology, including parking systems and features that can halt or slow a car to avoid crash- or near-crash events. In 2013, Google brought its famed autonomous car to the Smart Road for testing.

Transportation experts consider connected-vehicle technology a stepping stone to achieving automation. Once cars are equipped with the ability to share information and modify driver behavior for the prevention of accidents, that same technology can also inform the vehicle to perform a safety maneuver.

"Our institute has the facilities and experience necessary to stay at the forefront of connected-automation research," said Tom Dingus, director of the institute and an endowed professor with Virginia Tech's Charles E. Via Jr. Department of Civil and Environmental Engineering. "This award is indicative of a successfully led program that is equipped with the tools to continue producing results that save lives, with more than $30 million in connected-vehicle research awarded since the start of the millennium."

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