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Transit Connected Vehicle Research Program

INTRODUCTION

Connected vehicles have the potential to transform the way Americans travel through the creation of a safe, interoperable wireless communications network that links cars, buses, trucks, trains, transportation infrastructure, and personal mobile devices. Connected vehicle applications provide connectivity between and among vehicles, infrastructure, and wireless devices to:

- enable crash warnings;
- enable safety, mobility, and environmental benefits; and
- provide continuous real-time connectivity to all system users

Connected vehicle technology will change the transportation system paradigm by giving people the tools to avoid crashes, and make travel faster, easier, more accessible, and environmentally friendlier. The vision for Transit Connected Vehicle research is to collaborate and leverage the evolving Connected Vehicle communications capability to achieve desirable transit safety, mobility, and environment outcomes.

WHY CONNECTED VEHICLE TECHNOLOGIES ARE NEEDED

Connected vehicle technologies aim to tackle some of the biggest challenges in the surface transportation industry—in the areas of safety, mobility, and environment.

- **Safety:** According to the Federal Transit Administration, there were more than 4,000 transit crashes reported in 2009, resulting in over 200 fatalities and more than 2,500 injuries. While transit is already one of the safest modes for travel, connected vehicle technologies will further empower transit drivers with the tools they need to anticipate potential crashes and significantly reduce the number of lives lost each year.
- **Mobility:** According to the Texas Transportation Institute, U.S. highway users waste 4.8 billion hours in 2010 stuck in traffic—nearly one full work week (or vacation week) for every traveler. Connected vehicle mobility applications will enable system operators and travelers to make informed decisions that reduce travel delay.
- **Environment:** According to the American Public Transportation Association, each year transit systems collectively reduce carbon dioxide emissions by 16.2 million metric tons by reducing private vehicle miles. Connected vehicle environmental applications will give all travelers the real time information they need to make “green” transportation choices.

HOW CONNECTED VEHICLES WORK

A system of connected vehicles is still in development, and plenty of research still needs to be done. Safety-related systems for connected vehicle technology will likely be based on Dedicated Short Range Communications (DSRC), a technology similar to WiFi. DSRC is fast, secure, reliable, and is not vulnerable to interference. Nonsafety applications may be based on different types of wireless technology. Cars, trucks, buses, and other vehicles will be able to “talk” to each other with in-vehicle or after market devices that continuously share important safety and mobility information with each other. Connected vehicles can also use wireless communications to “talk” to the transportation infrastructure, such as traffic signals, toll equipment, and work and school zone warning systems. The vehicle information communicated is encrypted so that drivers cannot be tracked and the system is secure against tampering.

CONNECTED VEHICLE RESEARCH PROMOTES TRANSIT SAFETY

The transit industry has always shown a great interest in the adoption of transformational safety technologies to improve the safety of its passengers and drivers, as well as all road users and pedestrians.

Due to its unique characteristics and behaviors, such as vehicle size and frequent stops/starts, transit often deals with safety challenges and priorities that are different from those for light and commercial vehicles. In collaboration with transit industry stakeholders, the U.S. Department of Transportation (U.S. DOT) has identified several priority Transit Connected Vehicle safety applications. Among these safety applications, two are selected for near-term development and testing:

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- **Pedestrian Warning Application for Transit Vehicles (V2I)**—A bus driver receives an alert of the presence of a pedestrian near or in a crosswalk as the driver makes a right or left turn at a signalized intersection. Signal Phasing and Timing (SPaT) information, including pedestrian detection data, is transmitted to the bus from Roadside Equipment (RSE) via V2I communications.

The second application addresses collisions involving vehicles making illegal right turns in front of transit buses at intersections with near side bus stops.

- **Vehicle Turning Right in Front of a Transit Vehicle (V2V)**—A bus driver receives an alert of a vehicle making a right turn in front of the bus as the bus driver pulls away from a bus stop. SAE J2735 DSRC messages are transmitted to the bus via V2V communications and are used to predict collisions between buses and other vehicles in this scenario.

TRANSIT CONNECTED VEHICLE RESEARCH ENHANCES MOBILITY CHOICES

The overarching goal of the Transit Connected Vehicle for Mobility program is to improve public transportation by increasing transit productivity, efficiency, and accessibility; mitigating congestion in an integrated transportation environment; and providing travelers better transportation information and transit services. Transit-oriented Connected Vehicle for Mobility applications support dynamic system operations and management, enable a convenient and quality travel experience and provide an information-rich environment to meet the needs of travelers and system operators across all modes.

The following three mobility applications have been selected as high-priority applications and are collectively identified as the Integrated Dynamic Transit Operations, or IDTO "bundle."

- **Connection Protection (T-CONNECT)**—enables public transportation providers and travelers to communicate to improve the probability of successful transit transfers.
- **Dynamic Transit Operations (T-DISP)**—advances the concept of demand-responsive transportation services utilizing the global positioning system (GPS) and mapping capabilities of personal mobile devices to enable a traveler to input a desired destination and time of departure tagged with their current location when requesting transit service.
- **Dynamic Ridesharing (D-RIDE)**—makes use of in-vehicle and hand-held devices to allow dynamic ride-matching, thereby reducing congestion, pollution, and travel costs to the individual with a low initial investment.

A description of all the high-priority Connected Vehicle for Mobility applications and the process through which they were selected and grouped can be found at: http://www.its.dot.gov/press/2011/mobility_app.htm.

TRANSIT A KEY ELEMENT IN CONNECTED VEHICLE RESEARCH TO IMPROVE THE ENVIRONMENT

Mitigating greenhouse gas (GHG) contribution is everyone's responsibility. The transportation sector contributes roughly 28 percent of the country's GHG emissions, according to the Environmental Protection Agency's *Inventory of U.S. Greenhouse Gas Emissions and Sinks*. Connected vehicle technologies will generate real-time data that drivers and transportation system managers can use to make green transportation choices.

Transit vehicles operate primarily on urban streets in heavily congested areas and thus offer a unique opportunity to study and assess the positive environmental impacts that could result from improved operations. By the very nature of their purpose Transit vehicles represent a unique vehicular operational profile, resulting in higher idle times and frequent mild acceleration/deceleration into and out of traffic that impact the environment differently than other types of vehicles. Thus, transit vehicles and operators have different needs in relation to the development of environmental mitigation strategies from those for light duty and heavy duty vehicles. In the context of this research, transit vehicles are considered as both a source of pollutants as well as sources of data to measure and mitigate environmental impacts.

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The U.S. Government's Role

The U.S. DOT's Research and Innovative Technology Administration's (RITA) Intelligent Transportation Systems (ITS) Joint Program Office fosters the development and future deployment of these connected vehicle technologies. But Connected Vehicle research involves all agencies within U.S. DOT including NHTSA, the Federal Highway Administration (FHWA), the Federal Motor Carrier Safety Administration (FMCSA), Federal Transit Administration and the Federal Railroad Administration.

U.S. DOT and its public and private partners are working to address the technical, safety and policy challenges and are helping to create the standards and the wireless architecture that will be the backbone of the system.

Connected vehicle research will leverage the potentially transformative capabilities of wireless technology to make surface transportation safer, smarter and greener. If successful, connected vehicles will ultimately enhance the mobility and quality of life of all Americans, while helping to reduce the environmental impact of surface transportation.

For more information about this initiative, please contact

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