Intelligent Transportation Systems: Connected Vehicles

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Purpose

This paper communicates background and status information on the progress of various Connected Vehicle (CV) applications that fall under the greater topic of Intelligent Transportation Systems (ITSs). In addition to reviewing the current standing of CV projects that have been explored in the industry, this paper highlights Battelle's role in the continued development of this transportation industry sector.

Background

In the past 5 years, application prototyping and assessment has been a focus of Federal CV research and development activity. As a result of these efforts, more than three dozen CV applications concepts have been developed, many through prototyping and demonstration. The component application development programs also conducted assessments to measure safety, mobility, and environmental impacts as a part of this process. Field demonstrations were supplemented by an estimation of impacts that are difficult to observe and of potential future impacts from broader deployment using a range of analytical methods. The U.S. Department of Transportation (DOT) has published documentation from the more advanced application development efforts, including concepts of operations, system requirements, design documents, algorithms, and source code associated with these prototypes. Pilot deployments build upon the DOT-sponsored research. A pilot deployment concept combines multiple DOT application development efforts identified in the CV research activities.

CV technology has the potential to revolutionize the means of travel by creating a network that links together all forms of transportation. By implementing this technology, people will be able to navigate a transportation grid safer, faster, more easily, and in a more environmentally friendly way. Various applications will be developed to interpret the communication between travel modes and allow commuters to actively interface with their transportation network.

Dedicated Short-Range Communication (DSRC) technologies will be the central method that CV applications will use to send and receive data. DSRC will enable fast and reliable communication between vehicles and infrastructure that can be utilized to develop systems that improve safety, mobility, and environmental conditions in a transportation system.

One of the main focuses in CV technology is the improvement of travel safety. Various applications have been created for this purpose. Among them are Vehicle to Vehicle Communication (V2V) and Vehicle to Infrastructure (V2I) Communication capabilities.

Another area of importance in CV applications is the more efficient facilitation of mobility throughout a transportation network. In order to enhance traveler's commutes, CV has used real-time capture data and dynamic mobility applications, including Integrated Dynamic Transit Operations capabilities that work for connection protection, dynamic scheduling, and dynamic ridesharing. Battelle successfully developed Intermodal Transit Connect, T-DISP, Dynamic Ride Sharing, and Travel Time Reliability applications for another Federal Highway Administration pilot project in Columbus, Ohio.

Additionally, through the use of Applications for the Environment Real-Time Information Synthesis (AERIS), CV technology is able to capture environmentally relevant data. This data can then be applied in applications that consider a transportation system's impact on the environment. Examples of some AERIS concepts include eco-transit signal priority, integrated intermodal traveler information supporting eco-traveling, and incentivized choice transit traveling low emissions zones.

Analysis

Through research, development of prototype applications, and deployment in testbeds, much has been learned about the technology's functionality and overall potential. For example, the T-Connect program initiated in Columbus, Ohio, saved substantial amounts of net travel time for users. Positional accuracy of mobile devices, while not entirely reliable, can be improved by incorporating infrastructure data on behalf of pedestrians to be sent to vehicles. Deployment and testing of the following CV applications in Ann Arbor, Michigan, as part of the U.S. DOT Safety Pilot Model Deployment project shed light on the efficacy of applications that will enhance vehicular safety and the driving experience:

- Forward Collision Warning alerts the driver in order to help avoid or mitigate the severity of crashes into the rear end of other vehicles on the road.
- Emergency Electronic Brake Lights alerts the driver tohard braking in the traffic stream ahead. This provides the driver with additional time to look for and assess developing situations.
- Speed Warning alerts are provided to the driver who is approaching a curve at a speed that may be too high for safe travel through that curve.

Currently, DOT is funding CV Pilot Deployment Projects in Tampa, New York City, and southern Wyoming for the purpose of proving CV technology in a real-world environment. Deployment will occur in 2017 and 2018. National deployment is the goal.

An additional major CV project is being deployed by the Federal Transit Administration in Cleveland, Ohio. Buses will be equipped with the following CV applications:

- Pedestrian in Signalized Crosswalk will warn transit bus operators when pedestrians, within the crosswalk of a signalized intersection, are in the intended path of the bus.
- Vehicle Turning Right in Front of Bus Warning will alert transit bus operators of the presence of vehicles attempting to go around the bus to make a right turn as the bus departs from a bus stop.
- Transit Stop Pedestrian Warning will detect the presence of pedestrians at risk of being struck at a transit stop. Both the bus driver and pedestrian will be alerted.

When coupled with an anticipated ruling in 2016 by the National Highway Traffic Safety Administration (NHTSA) that will define what NHTSA will accept to fulfill the CV-requirements within vehicles, CV technology deployment will accelerate. This key decision will move the automobile industry forward and could result in future vehicles being CV-compatible within 5 years.

Summary

The DOT's vison of advancing CV technology to facilitate safer movement of traffic is increasingly close to fruition. Battelle has played a leading role to advance the industry to this stage and will continue to do so in this key advancement in the transportation field.

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