UTC Project Information	
Project Title	Signal Awareness Applications
University	Virginia Tech Transportation Institute
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Funding Source(s) and Amounts Provided (by each agency or organization)	UTC Safe-D: $150,000 VTRC, VDOT: $150,000 VTTI Smart Road: $3,214
Total Project Cost	$303,214
Agency ID or Contract Number	Grant No: 69A3551747115 Project: VTTI-00-021
Start and End Dates	02/01/2019 – 01/31/2020
Brief Description of Research Project	Intersection collisions account for 40% of all crashes on our nation's roadways. It is estimated that 165,000 accidents, resulting in approximately 800 fatalities annually, are due to vehicles that pass-through intersections during red signal phases. Although infrastructure-based red-light violation countermeasures have been deployed, intersections remain a top location for vehicle crashes. The Virginia Department of Transportation, along with its research arm, the Virginia Transportation Research Council partnered with the Virginia Tech Transportation Institute to create the Virginia Connected Corridors (VCC), a connected vehicle test bed, located in Fairfax and Blacksburg, Virginia, that enables the development and assessment of early stage connected and automated vehicle applications. Recently, new systems have been deployed that transmit position correction messages to support lane-level accuracy, enabling signal awareness applications such as Red-Light Violation Warning to be developed. VTTI has developed and deployed a number of VCC platforms that can be used to test CV application exchanges with drivers, but such platforms are currently not capable of informing drivers of unsafe approaches to intersections. However, the new position correction capabilities will allow the development of signal awareness applications, which represent a disruptive technology that can promote safer, and more economic and ecologically-friendly driving. This project proposes to enhance the current capabilities of VCC platforms by developing new signal awareness safety and mobility features. In addition, this project will investigate the technical and

	human factors constraints associated with user interfaces for notifying and alerting drivers to pertinent intersection-related information to curb unsafe driving behaviors at signalized intersections.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	**Task 1 - Project Management** • Oversight to ensure that milestone achievements, activity progress and particular UTC Safe-D deliverables are met • Bi-weekly status updates that will be provided during the regular VCC stakeholder meeting **Task 2 - VCC System and Prototype Application Implementation Assessment** • Identification of signal awareness applications and corresponding system requirements • Identification and selection of signal awareness applications which can be developed and deployed **Task 3 - VCC Prototype Application Development** • Identification, definition and execution of activities to develop signal awareness applications • Prototype signal awareness application • Prototype signal awareness application test, verification, validation and analysis protocol **Task 4 - VCC Prototype Application Assessment** • Execution of test, verification, validation and analysis protocol • Identification of challenges and limitations of the signal awareness applications from a technical and human factors point of view that may impact overall safety effectiveness of applications • Assessment of methods to inform or alert the driver based on their interactions with signalized intersections **Task 5 - Demonstration & Final Reporting** • On-Road signal awareness application demonstration • Targeted publication worthy journal article • Final briefing and report for VDOT and UTC Safe-D **Education and Workforce Development Plan** • SPaT data from real-world intersections as a source to support course assignments to deploy, test and improve intelligent transportation system-based applications

	• Meetings with VDOT, VTRC and other stakeholders to highlight application capabilities Technology Transfer Plan • Journal articles targeting IEEE, TRB and SAE publications • Demonstrable signal awareness application
Impacts/Benefits of Implementation (actual, not anticipated)	Work will build upon one of the world's most advanced V2X test beds. Considering the VCC development and implementation to date, end-user signal applications requiring lane level accuracy are now realizable utilizing the VCC's resources. Such a capability positions the VCC to enhance existing research programs while also attracting new sponsors to take advantage of a mature V2X test bed featuring dynamic and challenging roadway environments. More importantly, VDOT and VTRC will be positioned to continue to leverage the myriad of research, development and implementation activities in this project to expand operational deployments across the commonwealth.
Web Links • Reports • Project website	https://www.vtti.vt.edu/utc/safe-d/index.php/signal-awareness-applications/