UTC Project Information	
Project Title	Reducing School Bus/Light-Vehicle Conflicts Through Connected-Vehicle Communications
University	Virginia Tech Transportation Institute
Principal Investigator	Darrell Bowman
PI Contact Information	DBowman@vtti.vt.edu
Funding Agencies	CVI-UTC (Tier 1 UTC)
Agency ID or Contract Number	TBD
Project Cost	$150,000.00
Start and End Dates	February 1, 2013 – January 31, 2014
Project Duration	1 year
Brief Description of Research Project	In 2010, 249 buses were involved in fatal crashes, and approximately 12,000 buses were involved in crashes that resulted in injuries. The total number of buses involved in crashes with other motor vehicles, pedestrians, or objects was approximately 54,000 in the United States1. Of the 249 fatal crashes reported above, 114 involved school buses, 37 involved cross-country/intercity buses, 83 involved transit buses, and 15 involved other or unknown bus types. Buses are particularly susceptible to rear-end conflicts due to their frequent decelerating and stopping behaviors in traffic. Statistics indicate that the rear of the bus is the most frequent initial point of impact during a crash (approximately 28 percent of the 54,000 crashes1). The rear-end collisions that occurred during 2010 resulted in 35 fatalities, 2,000 injuries, and 13,000 incidents of property damage. Fatalities resulting from collisions with passenger buses are often the light-vehicle motorists1,2. When analyzing Buses Involved in Fatal Accidents (BIFA) data, Blower et al.3 found that driver error leading to the crash was more likely to have occurred in the striking vehicle than the vehicle being struck. Therefore, rear-end collisions with buses are a concern for the entire motoring public. Blower et al.3 stated that the high proportion of rear-end crashes during which the bus was struck suggested that improved conspicuity and increased awareness of the stopped bus could enhance the safety of the situation. While today's vehicles are equipped with safety technologies (e.g., collision warning systems, forward collision warnings [FCW], adaptive cruise control), it is recognized4,5 that these current safety technologies have limitations around curves and over hills. For instance, when an FCW-equipped vehicle is traversing a sharp curve, the stopped vehicle may not be within the system's sensor range due to its limited azimuthal coverage. The same can be said for situations during which an FCW-equipped

	vehicle crests a hill, at which point the FCW sensor coverage is aimed above the descending roadway on the other side. Connected-vehicle communications, particularly dedicated short-range communications (DSRC), could be used to provide following traffic with in-vehicle notifications of a stopped bus, especially when the bus is stopped over a hill or around a blind curve. DSRC provides an "extended information horizon" and lets the drivers "see over hills and around curves."6 This project will provide a novel opportunity to apply this enhanced capability designed to facilitate increased awareness of stopped buses during moments when they are obscured from the flow of traffic. Although connected-vehicle communications (e.g., DSRC, cellular, WiFi) could be applied to all passenger bus types (e.g., transit, school, motorcoach), this work will focus on school buses engaged in pupil transportation. School bus drivers face unique safety concerns as professional drivers. They carry what is perhaps the nation's most precious cargo: our children. Every school day, more than 25 million school-aged children are transported to and from school on nearly 480,000 school buses. This annually equates to approximately 20 billion boardings and de-boardings of school buses throughout the United States2. Many of these boardings and de-boardings result in school buses stopped in the roadway. This scenario is considered one of the most dangerous situations for a school bus and its student riders. Connected-vehicle technology could be the solution for improving bus conspicuity and increasing awareness among other roadway users of a stopped school bus.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	The objectives of this 12-month study are threefold. First, the research team will develop a Concept of Operations (ConOps) for the connected school bus. Second, the research team will develop a prototype, in-vehicle message display for following vehicles to alert them of a stopped school bus. Finally, the team will conduct preliminary testing of the prototype driver-vehicle interface (DVI) on the Virginia International Raceway (VIR) in southern Virginia.
Impacts/Benefits of Implementation (actual, not anticipated)	This study is still in progress, actual impacts and benefits of implementation will be determined in Winter 2014 when the study is completed. This page will be resubmitted in the next round of reporting to state these actual impacts and benefits.
Web Links • Reports • Project Website	http://www.connectedvehicleinfrastructure-utc.org/?q=node/21 https://rip.trb.org/browse/dproject.asp?n=33463