UTC Project Information	
Project Title	MPC 435- Realization of a Coarse Position Verification System for an Automated Highway System
University	Utah State University
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Funding Agencies	USDOT, Research and Innovative Technology Administration
Agency ID or Contract Number	DTRT12-G-UTC08, Modification No. 1
Project Cost	$100,000
Start and End Dates	January 1, 2013- December 31, 2013
Project Duration	1 Year
Brief Description of Research Project	To increase the throughput, efficiency, and safety of our transportation systems researchers have proposed that the system be automated and that groups of vehicles act as one unit by closely following one another at fixed speeds to form what is known as a platoon [Rajamani and Shladover, 2001]. Managing the platoon requires accurate, real-time knowledge of each vehicle's position, velocity, and acceleration (PVA). A malicious vehicle that provides false information about its position would be able to slow down or stop the platoon, open up space for greater maneuverability, or even introduce instabilities that lead to crashes. It is therefore imperative that each vehicle's PVA in an automated system be substantiated. Existing methods to verify the position of an agent, of which [Capkun and Hubaux, 2006; Capkun et al., 2008; and Fiore et al., 2011] are representative, are insufficient for deployment in automated transportation as they are costly or vulnerable to attack by multiple, colluding adversaries and insiders. **Research Objectives:** The object for this research is to produce a technical demonstration of a technique for PVA verification that is secure regardless of the number of colluding attackers (internal or external) and can be integrated into an automated transportation system (ATS) in a cost-effective manner.

	The PVA verification method that will be demonstrated operates by having vehicles respond to messages that can only be received at a given locality. Special transmitters, henceforth *waypoints*, will be designed to ensure that communication with the vehicles can only occur within a certain radius of the transmitter. The waypoints would be integrated into an ATS by placing them alongside or within the roadway, which would then allow for periodic verification of vehicle positions. Establishing the veracity of a vehicle's position claim using these waypoints requires a four-step process: 1) the vehicle under consideration is queried for its current location, *xa*, and velocity, *va*; 2) the distance between the alleged position and nearest upcoming waypoint, *xw*, is calculated according to $d = xw - xa$; 3) a message, consisting of a random string of binary digits known to the system, would then be transmitted at the waypoint in d/va seconds for the vehicle to receive; and 4) finally the vehicle would re-send the message send to the system after traveling over the waypoint to prove that it was where it said it would be. The granularity of position measurements would depend on the number and spacing of the waypoints. The security of this approach depends upon ensuring that the verification messages could only have been received at a given locality (otherwise colluding attackers situated away from the waypoints could use antennas and amplifiers to acquire the encrypted verification message). This research will focus on the design and experimental validation of a waypoint that employs one set of antennas to transmit the verification message, with a second set placed outside the first and transmitting noise in an outward direction so as to obscure the verification message. Because of the noise a verification message is obscured and unrecoverable by an attacker situated outside the second set of antennas. A graduate student under the PI's supervision is currently working to extend the above verification procedure to include vehicle acceleration and establish the necessary communication protocols to facilitate verification. As the methodological component of the verification scheme is nearly complete, the purpose of research funded through this program will be to create and validate a waypoint.
Describe Implementation of Research Outcomes (or why not implemented) Place Any Photos Here	

Impacts/Benefits of Implementation (actual, not anticipated)	
Web Links • Reports • Project Website	