Center for Advanced Multimodal Mobility Solutions and Education

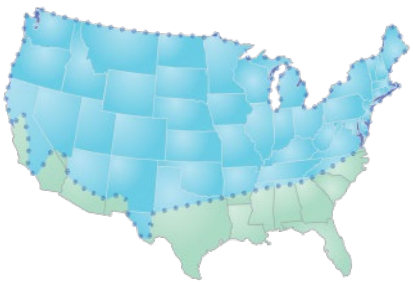
UTC Project Information – CAMMSE @ UNC Charlotte	
Project Title	The Use of Connected Vehicle Technology to Facilitate Multimodal Winter Travel (Phase I)
University	Washington State University
Principal Investigator	Xianming Shi
PI Contact Information	(509)-335-7088 / xianming.shi@wsu.edu
Funding Sources and Amount Provided (by each agency or organization)	The University of North Carolina at Charlotte: $106,733 Washington State University: $77,000
Total Project Cost	$183,733
Agency ID or Contract Number	
Start and End Dates	01/15/2017 – 09/30/2018
Brief Description of Research Project	The Federal Highway Administration (FHWA) has estimated that "over 70 percent of the nation's roads are located in snowy regions…and nearly 70 percent of the U.S. population lives in these regions" (Fig. 1). As such, it is desirable to use the best technologies to enhance the transportation system user experience during the winter season. 

	Fig. 1. U.S. areas affected by snow and ice (FHWA) Smart snowplows have been increasingly used as mobile data collection platform for enhanced winter operations, featuring automatic vehicle location (AVL) and other sensors. For winter travel, there are also existing technologies such as road weather information systems (RWIS), dynamic message signs (DMS), and traveler information systems. Connected vehicle (CV) data could be utilized to enhance these strategies by supplementing or complimenting current roadway sensing components to improve the effectiveness of the system operations to react to changing road weather conditions. The 360° awareness by snowplow operators and increased system reliability are envisioned to reduce the risk of vehicle crashes and enhance the efficiency of system operations. Road weather data collection will be improved by utilizing weather sensors in CVs and by transferring collected data through vehicle-to-vehicle (V2V) and vehicle-to-infrastructure (V2I) communication, which has been demonstrated in the European WiSafeCar project (Sukuvaara and Nurmi, 2012). Connected Vehicle Reference Implementation Architecture (CVRIA) developed by FHWA (2014) has defined how CVs will contribute to the road weather management data collection and information dissemination. The enhanced road weather condition information can be communicated to the general public so that they can slow down, choose a different route, or stay home in light of inclement

	weather. In this context, there is an urgent need to identify and demonstrate the operational scenarios in which CV technologies can be employed to improve winter road surface condition monitoring and traveler information, with a focus on multimodal travel. This project aims to investigate how CV data could be utilized to improve decision-making for roadway operations subject to inclement winter weather events (e.g., snowstorm, icy roads) and enhance situation awareness of drivers, thus improving the multimodal traveler experience. The focus will placed on the transition from airports to roadways and the intersection of roadways and bicycle lanes. To develop real-time localized roadway advisories and forecasts, development of alert algorithms is critical and requires multidisciplinary research to ensure effectiveness of algorithms and advisory messages. In Phase I, the multidisciplinary research team will: (1) Conduct a comprehensive literature review and a national practitioner survey to identify the appropriate solutions, data needs, data gaps, and potential challenges in implementation of CV for such niche application; (2) Document the best practices of technologies to be integrated into CV for winter road surface condition monitoring; and (3) Develop the Concept of Operations (ConOps) for the use of CV technology to facilitate multimodal winter travel, using an airport in the State of Seattle as

	the case study and engaging at least one stakeholder agency such as WSDOT or City of Pullman. Note that this project aims to lay the foundation to address the innovative use of CV technologies for improving winter travel experience. Future phases of this project may expand the scope into data collection from stakeholder groups, comparative and statistical analyses to explore the costs and benefits of using the CV solution, demonstration of the identified CV solutions, and more road weather-related mobility applications of CV technologies. Moreover, collected real-time raw data can be shared with commercial application developers to build value-added services (Chapman and Drobot, 2012).
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*	https://cammse.uncc.edu/sites/cammse.uncc.edu/files/media/CAMMSE-UNCC-2017-UTC-Project-Information-09-Shi.pdf https://cammse.uncc.edu/sites/cammse.uncc.edu/files/media/CAMMSE-UNCC-2017-UTC-Project-Report-09-Shi-Final.pdf