

# Vehicle Network Security and Resiliency: Analysis of the Controller Area Network Protocol

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Automobiles are equipped with Electronic Control Units (ECUs) that communicate via in-vehicle network protocols such as the Controller Area Network (CAN). These protocols were designed under the assumption that separating in-vehicle communications from external networks is sufficient for protection against cyber-attacks. This assumption, however, has been shown to be invalid by recent attacks in which adversaries were able to infiltrate the in-vehicle network. Motivated by these attacks, intrusion detection systems (IDSs) have been proposed for in-vehicle networks that attempt to detect attacks by exploiting physical properties such as clock skew of an ECU. In this talk, I will describe new attacks on the CAN, one based on timing and one based on voltage, along with the corresponding methods we used to detect and mitigate the attacks. We implement the attacks on two hardware testbeds, a laboratory Arduino-based prototype and the UW EcoCAR.

**Linda Bushnell** is a Research Professor in the Department of Electrical and Computer Engineering at the University of Washington - Seattle. She received her Ph.D. in Electrical Engineering and Computer Sciences from University of California - Berkeley in 1994, her M.A. in Mathematics from University of California - Berkeley in 1989, her M.S. in Electrical Engineering from University of Connecticut - Storrs in 1987, and her B.S. in Electrical Engineering from University of Connecticut - Storrs in 1985. She also received her MBA from the University of Washington Foster School of Business in 2010. Her research interests include networked control systems and cyber-physical systems. She is a Fellow of the IEEE for contributions to networked control systems. She is a Fellow of IFAC for contributions to the analysis and design of networked control systems. She is a recipient of the US Army Superior Civilian Service Award, NSF ADVANCE Fellowship, and IEEE Control Systems Society Distinguished Member Award. She has been a member of the IEEE since 1985, and a member of the IEEE CSS since 1990. She is currently the Treasurer of the American Automatic Control Council, Member of the Technical Board for the International Federation on Automatic Control, Associate Editor for *Automatica*, and Associate Editor for the *IEEE Transactions on Control of Network Systems*.