

Tutorial T-4: Dedicated Short Range Vehicular Communications: Overview, Technical Challenges, and Applications

Presenters: John B. Kenney (Toyota InfoTechnology Center, USA), Gaurav Bansal (Toyota InfoTechnology Center, USA)

Tutorial Overview

In this tutorial we cover the most important aspects of Dedicated Short Range Communications (DSRC), also known as Cooperative ITS. This technology is in the early stages of deployment in North America, Europe, and other regions. The US DOT plans to require DSRC in new vehicles in the coming years. DSRC is used to communicate vehicle-to-vehicle (V2V) and vehicle-to/from-infrastructure (V2I), enabling a set of compelling safety, mobility, automated driving, and environmental applications. This tutorial focuses on the safety and automated driving use cases. We explain the DSRC protocol stack, collision avoidance applications, and technical challenges for deployment. We discuss large-scale field tests and early deployment projects in the US, Europe, and Japan, e.g. the US Safety Pilot and the Rotterdam-Vienna Corridor Project. After presenting DSRC basics, we focus on a specific research problem that is currently of great interest: DSRC Channel Congestion. We discuss the merits of various approaches to address congestion, including avoidance and active control, as well as control modalities (message rate, transmit power, etc.). As a case study we present our specific research on adaptive message rate control, which is under consideration for standardization in the US and Europe. We end the tutorial with a discussion of the role DSRC can play in support of automated vehicles, including a framework for communicating dynamic road conditions to nearby vehicles. The primary goal of the tutorial is to empower the attendee to participate in this important emerging technology, whether as a researcher, a developer, or a planner.

The objectives of the tutorial are:

- a. Master the fundamentals of a critical emerging vehicular communication technology, DSRC
- b. Design collision avoidance applications based on V2V communication
- c. Evaluate the impact of strategic investment on DSRC deployment
- d. Join the DSRC research community, contributing to solutions for congestion control and other technical challenges
- e. Incorporate DSRC in automated vehicle development

The syllabus of the tutorial:

- a. DSRC Technology
- b. Vehicular Safety Communications
- c. Overview of DSRC Protocols
- d. Technical and Policy challenges for deployment
- e. Field tests and early deployments
- f. DSRC channel congestion control
- g. DSRC in support of automated vehicles

Presenter Biographies

Dr. John B. Kenney: John holds electrical engineering degrees from Stanford and Notre Dame, where he also served as Adjunct Professor. Currently a Principal Researcher at the Toyota InfoTechnology Center in Mountain

View, CA, he has researched vehicular communications since 2007. John represents Toyota in the automakers' Vehicle Safety Communication consortium, including as past lead of the VSC-A Communications Task. He and Dr. Bansal actively contribute to VSC research in congestion control and security. He also represents the industry in the investigation of potential sharing of spectrum between DSRC and unlicensed devices, including recent testimony before a US Congressional committee. He is active in IEEE and European standards, and serves as an elected officer of the SAE DSRC Technical Committee. He co-chaired the 2011 and 2012 ACM VANET Workshops, and the IEEE SmartVehicles 2014 and 2015 Workshops. He also authored an invited Proceedings of the IEEE paper on DSRC Standards in the US (2011).

Dr. Gaurav Bansal: Gaurav received a B.Tech. degree from Indian Institute of Technology (IIT) Kanpur, India and a Ph.D. degree from the University of British Columbia (UBC), Canada. From August 2007 to July 2008, he worked as a Research Intern with Mercedes Benz Research and Development North America Inc., Palo Alto, CA. He joined Toyota InfoTechnology Center, USA, in July 2010 where he currently works as a Senior Researcher in the Network Group. He is a recipient of Natural Science Engineering and Research Council of Canada's Alexander Graham Bell Scholarship. He is Demonstrations Chair for the 2014 WiVEC Symposium, and has served as a TPC member for several international conferences including IEEE VTC Fall 2014, CSCITA-2014, COMSNETS 2014, and SmartVehicles '14. He also serves on the Editorial board of IEEE Communication Surveys and Tutorials.