Improving Road Safety and Efficiency Using Connected Vehicle Technology

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What is DSRC?

Mission: Connected Vehicle Technology
Objectives: Safety, Mobility and Efficiency
Outline

• Introduction
  – DSRC Technology Overview
  – Applications
  – Work Zone Environment

• V2I Traffic Information System
• V2V Assisted V2I System
• VMS Integration
• V2V System – Ongoing Work
• Summary / Questions
DSRC Technology Overview

Dedicated Short Range Communication (DSRC) is also known as Connected Vehicle Technology. It incorporates both Vehicle to Infrastructure (V2I) and Vehicle to Vehicle (V2V) communication.

Technical Specifications:
- Range up to 1000 meters
- Data rate 6 to 27 mbps
- Vehicle speed up to 100MPH

Connected Vehicles Research Lab
Obstacles to Adoption of DSRC Technology

- The Chicken and Egg Dilemma
- Market Penetration
- Infrastructure Support
DSRC Potential Applications

- Traffic Information Systems
- Emergency Vehicle Signal Preemption
- Approaching emergency vehicle warning
- Weather and road conditions warning
- Curve speed warning
- Do not pass warnings
- Cooperative Adaptive Cruise Control
- Cooperative Forward Collision Warning
- Left Turn Assist
- Merge Assist
Work Zone Environment
# Total Work Zone Related Fatalities

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<th>Year</th>
<th>Work Zone Related Fatalities</th>
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<tr>
<td>2011</td>
<td>587</td>
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<tr>
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*Source: Fatality Analysis Reporting System (FARS) - Final, NHTSA*
Current Approach to Reduce Fatalities

Estimate travel time and communicate to the drivers
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Student In Action
• RSU is placed such that RSU monitoring range aligns with the end of the congestion.
• At periodic intervals, an OBU participation is requested by the RSU to monitor a vehicle’s speed and position through a congestion area.
• RSU sends traffic alert message to all OBUs indicating travel time through monitoring area.
The field demonstration site was chosen at Rice Lake Rd, Duluth MN with the focus on providing a clear line of sight between RSU and the OBU.

The RSU is placed near the congestion end due to reduced range on one side due to signal blocking by back of the vehicle.
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V2V-Assisted V2I System

Starting Location of Congestion (Varying)

Ending Location of Congestion

Broadcast Coverage

Work Zone

DSRC RSU

Congestion length
V2V Message Relaying

- Increased message broadcast range using V2V-assisted DSRC communication.
- Much longer congestion coverage beyond the access range of one portable roadside DSRC unit.
V2V Message Relaying

- Selective Relay
- Directive Relay
• Only one of the vehicles should relay the message forward.
• Selection should be such that the number of hops can be minimized.
Message should be relayed towards the direction of the road from which the vehicles are approaching towards the congestion.
Field Demonstration Setup - V2V

- The field demonstration site was chosen at Rice Lake Rd, Duluth MN with the focus on providing a clear line of sight between RSU and the OBU.

- The RSU is placed nearer to the congestion end due to reduced range on one side from the signal being blocked.
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DSRC Market Penetration

Not all vehicles will be DSRC equipped in the initial deployment phase.

What Market Penetration is needed for this system to acquire Travel Parameters?
Acquisition vs. Dissemination
Need for VMS Integration

How to communicate travel parameters to the vehicles lacking DSRC capability?

DSRC Equipped VMS is the answer but requires a DSRC-VMS interface
DSRC-VMS Interface Demonstration

Starting Location of Congestion (Varying)

DSRC Equipped VMS

QUEUE AHEAD 1.6 MI

CAUTION WORK ZONE

DSRC Equipped VMS

V2V

DSRC RSU

Work Zone

Ending Location of Congestion

Department of Electrical Engineering
Umair In Action
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Current Work

V2I System

Work zone length ~ ½ Mile

V2V Assisted V2I System

Work zone length ~ 3-5 Miles

V2V System

Work zone length ~ 3-5 Miles
Summary

• Introduction
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• V2I Traffic Information System
  – System Architecture and Design
  – Field Demonstration

• V2V Assisted System
  – System Architecture and Design
  – V2V Protocol
  – Field Demonstration

• VMS Integration
  – Need
  – Demonstration

• V2V System – Ongoing Work

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