Background
What is Wrong-Way Driving (WWD)?

An event where a driver, inadvertently or deliberately, drives in the opposite direction.
Texas WWD Crashes on Freeways*

237 crashes/year
< 1% of all crashes

12% result in a fatality

47% result in injuries

* CRIS data from 2010 to 2014
Texas WWD Crashes by Time of Day*

* 1409 crashes on Texas freeways from 2007 to 2011

Average BAC level 0.18 g/dL
More Wrong-Way Events than Crashes

Avg. 33 Crashes/year*

Avg. 447 Events/year**

* CRIS data from 2010 to 2014
** SAPD data from 2011 to 2015
What Can We Do?

• There is not ONE answer!
• It takes engineering, education, and enforcement
• Variety of countermeasures needed
• Need capability to detect, monitor, and warn
• Connected vehicles (CVs) provide a new approach
TxDOT Project 0-6769
September 2012 – August 2014
Alcohol-Impaired Driver Study

- Conducted at night on a closed-course
- Phase 1 study
  - Determined where alcohol-impaired drivers look
  - Determined impact of alcohol on
    • Sign color recognition
    • Sign legibility distance
- Phase 2 study
  • Assessed conspicuity of select WWD countermeasures
Where Do Alcohol-Impaired Drivers Look?

• Look more at pavement in front of vehicle
• Concentrate glances in a smaller area

BAC = 0.00  BAC = 0.12
At Higher BAC Levels...

- Must be closer to sign to
  - Identify background color
  - Read legend
- Drivers misidentified red background color as orange
- Took longer to find signs and arrow pavement markings
WRONG WAY Sign with Flashing Lights

• San Antonio 15-mile pilot corridor
• Increase conspicuity of signs at night
  • Lights continually flashed under low ambient lighting
  • Catch attention on frontage road prior to entering freeway

<table>
<thead>
<tr>
<th>After Analysis Period</th>
<th>Reduction in WWD Events</th>
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<tbody>
<tr>
<td>22 months</td>
<td>38%</td>
</tr>
<tr>
<td>46 months</td>
<td>32%</td>
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</table>
Warning Message for DMS

- WARNING
  - Conveys urgency
  - Distinguishes from traffic safety messages

- WRONG WAY DRIVER
  - Do not split phrase onto two lines
  - Location implied
  - Non-specific driving action implied

- REPORTED
  - Validation that ongoing event
TxDOT Project 0-6867
Phase 1: February 2015 – December 2015
Phase 2: April 2016 – October 2017
Key CV WWD System Features

• Reduce the time from detection to alerting right way drivers and law enforcement
• Ability to provide warning message in-vehicle in addition to broadcasting to DMS
CV WWD Project Overview

• Phase 1
  • Reviewed state of the practice
  • Identified user needs
  • Developed concept of operations, functional requirements, and high-level design

• Phase 2
  • Built and tested a proof-of-concept system
  • Conducted human factors studies
TxDOT CV System Architecture
Types of In-Vehicle Messages

Wrong-Way Warning Message

Alert Message to Right-Way Vehicle

Alert Message to Law Enforcement
Overview

• High-speed divided highway safety analysis
  • Examine characteristics of wrong-way crashes
  • Determine impact of median width and select traffic control devices
• Active technology evaluations at freeway exit ramps
  • LED border illuminated signs
  • Red rectangular flashing beacons
• Recommended changes to MUTCD
Final Remarks
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• Reports
  • TxDOT
    • http://tti.tamu.edu/documents/0-6769-1.pdf
    • http://tti.tamu.edu/documents/0-6867-1.pdf
    • http://tti.tamu.edu/documents/0-6867-01-1.pdf
  • NCHRP final report should be published in third quarter of 2018 (July-September)