2014 ITS Maryland Annual Conference

Connected Vehicles & Vehicle-to-Infrastructure Communications

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Today’s Transportation Challenges

**Limit 35**

**Safety**
- 33,561 highway deaths in 2012
- 5.615 million crashes in 2012
- Leading cause of death for ages 4, 11-27

**Mobility**
- 5.5 billion hours of travel delay
- $121 billion cost of urban congestion

**Environment**
- 2.9 billion gallons of wasted fuel
- 56 billion lbs of additional CO₂

Data Sources:
2011 Annual Urban Mobility Report, Texas Transportation Institute (Feb 2013)
Agenda

• Overview of the USDOT Connected Vehicle (CV) Research Program
• Overview of V2V & V2I Applications
• V2I Enabling Technologies
• Moving Toward Deployment
OVERVIEW OF USDOT CV RESEARCH PROGRAM
Fully Connected Vehicles

Vehicle Data:
Latitude, Longitude, Speed, Brake Status, Turn Signal Status, Vehicle Length, Vehicle Width, Bumper Height

Infrastructure Data:
Signal Phase and Timing, Drive 35 mph, 50 Parking Spaces Available

Image Source: Thinkstock/USDOT
CV Communications Technology

• What it is
  - 5.9 GHz DSRC (Dedicated Short Range Comm.)
  - Wi-Fi radio adapted for vehicle environment
  - Inexpensive to produce in quantity
  - Original FCC spectrum allocation in 1999
  - FCC revised allocation in 2004 and 2006

• How the technology works
  - Messages transmitted 10 times/sec (300m range – line of sight)
    - Basic Safety Message: vehicle position, speed, heading, acceleration, size, brake system status, etc.
    - Privacy is protected (vehicles are anonymous, location is NOT tracked)

• Other Communications Modes
  - Cellular 4G
  - Satellite
  - Fiber optic
Safety Pilot

- ~2,800 vehicles (cars, buses, and trucks) equipped with V2V devices
- 29 RSU devices
- Includes vehicles with integrated safety applications and others that use aftermarket devices (i.e., not built into the vehicle)
- Applications tested include:
  - Forward Collision Warning
  - Electronic Emergency Brake Lights
  - Blind Spot Warning/Lane Change Warning
  - Intersection Movement Assist
  - Do Not Pass Warning
  - Left Turn Assist
Path to Deployment

- Defined V2V Apps
- Defined Safety (V2I), Mobility (V2V & V2I), AERIS and Weather Apps
- Application Development
- Pilots/Early Deployments

- 2011
- 2012
- 2013
- 2014
- 2015
- 2016

- FHWA Deployment Guidelines
- NHTSA Decision to Move Forward with V2V Communication for Light Vehicles
- NHTSA Decision for Heavy Vehicles
- Safety Pilot in 2013

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OVERVIEW OF V2V & V2I APPLICATIONS
Connected Vehicle Applications

Safety
- V2V
- V2I

Mobility
- Dynamic Mobility Applications

Environment
- AERIS
- Road Weather Applications
## Safety Applications: V2V

<table>
<thead>
<tr>
<th>V2V Safety Applications</th>
<th>Abbreviation</th>
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<tr>
<td>Forward Collision Warning</td>
<td>FCW</td>
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<tr>
<td>Emergency Electronic Brake Light</td>
<td>EEBL</td>
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<tr>
<td>Blind Spot/Lane Change Warning</td>
<td>BSW/LCW</td>
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<tr>
<td>Do Not Pass Warning</td>
<td>DNPW</td>
</tr>
<tr>
<td>Intersection Movement Assist</td>
<td>IMA</td>
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<tr>
<td>Left Turn Assist</td>
<td>LTA</td>
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## Safety Applications: V2I

<table>
<thead>
<tr>
<th>V2I Safety Applications</th>
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<tr>
<td>Curve Speed Warning</td>
<td>CSW</td>
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<tr>
<td>Red Light Violation Warning</td>
<td>RLVW</td>
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<tr>
<td>Spot Weather Information Warning</td>
<td>SWIW</td>
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<td>Reduced Speed Zone Warning</td>
<td>RSZW</td>
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<tr>
<td>Stop Sign Gap Assist</td>
<td>SSGA</td>
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<tr>
<td>Smart Roadside</td>
<td>SRI</td>
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<tr>
<td>Transit Pedestrian Warning</td>
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AERIS EcoDrive Demonstration

Slightly Reduce Speed to Avoid Stop at Red Light
V2I ENABLING TECHNOLOGIES
V2I – Enabling Technologies

• Goal – Develop and integrate the infrastructure components necessary to provide the foundation for V2I deployment
  o Signal Phase and Timing (SPaT)
  o Mapping
  o Positioning
  o Communications
  o Roadside Unit (RSU)
  o Integrated V2I Prototype
Signal Phase and Timing (SPaT) & Related Messages

- Develop interface between signal controllers and RSU to enable 2-way data exchange between vehicles and controllers
  - SPaT data
  - Geometric intersection description (GID)
  - Signal request messages (SRM)
  - Signal status messages (SSM)
  - Position correction
  - Standards to promote interoperability
Signal Phase and Timing (SPaT)

• Past and current activities
  o Interface testing at Safety Pilot
    ➢ 12 intersections equipped with controllers from two vendors
    ➢ Transit application using SPaT data
    ➢ SPaT data logged to facilitate future application development
  o Lessons learned from Safety Pilot and other studies, and industry comment, used to refine SPaT message

• Planned near-term steps
  o Analyze SPaT Prototype in test beds to support field testing of Multi-Modal Intelligent Traffic Signal System (MMITSS)
  o Refine SPaT and MAP messages and software to conform to SAE J2735 (2014 updated version)
V2I Reference Implementation

- System of specifications and requirements that allow various components of V2I hardware, software, and firmware to work together
- Agencies will be able to select capabilities and applications desired at a given installation
- Based on Integrated V2I Prototype with physical manifestation at TFHRC in 2015 timeframe
- Incorporated into CVRIA
MOVING TOWARD DEPLOYMENT
FHWA V2I Deployment Guidance

• **Guidance** - not regulation
• What and how to implement infrastructure and supporting systems
  o Guidelines
  o Best Practices
  o Toolkit
• Supporting high-priority applications
  o V2I safety applications (crash warnings at traffic signals, etc.)
  o Dynamic mobility
  o Road-weather
  o Environmental
• Based on USDOT research and AASHTO analysis of infrastructure needs and deployment approaches
- CV Pilot Program Goals

- Proposed Program Schedule
  - Summer-Fall 2014 - Regional Pre-Deployment Workshops/Webinars
  - Early 2015 - Solicitation for Wave 1 Pilot Deployment Concepts
  - Early 2017 - Solicitation for Wave 2 Pilot Deployment Concepts
  - September 2020 - Pilot Deployments Complete

- Resources
  - ITS JPO Website: http://www.its.dot.gov/
  - CV Pilots Program Website: http://www.its.dot.gov/pilots
Thank you

Contact Information

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