CV2: Minimum vs. Optimal Infrastructure Support for V2I - How Are Rural Infrastructure Needs Different Than Urban?

Are We Ready? State and Local Agency Preparations for Connected and Automated Vehicles

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University of South Florida

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CV Infrastructure Deployment

- Roadside communications equipment (for DSRC or other wireless services), enclosures, mountings, power and network backhaul.
- Traffic signal controller interfaces for applications that require signal phase and timing (SPaT).
- Systems and processes required to support management of security credentials and ensure a trusted network.
- Mapping services that provide highly detailed roadway geometries, signage and asset locations for the various CV applications.
- Positioning services for resolving vehicle locations to high accuracy and precision.
- Data servers for collecting and processing data provided by vehicles and for distributing information, advisories and alerts to users.
Connected Vehicles: V2I

**Technology**
- DSRC + Wireless
- Roadside
- Vehicle/OBU
- Security Layer
- Location/GPS

**Management**
- Data Environment
- Management Strategies
- Application Engine

**Applications**
- Safety
- Mobility
- Environmental

Legend:
- DMA PROGRAM FUNDED
- DMA SUPPORTED (NOT FUNDED), OPEN TO OTHER PROGRAMS AND RESEARCHERS
- R.E.S.C.U.M.E* JOINTLY FUNDED BY DMA AND PUBLIC SAFETY PROGRAMS

*Environmental Management Strategies

Application Engine
Survey Respondents

- Aviation: 1%
- Central Services: 9%
- Driver and Motor Vehicle: 3%
- Highway Division: 9%
- Motor Carrier Transportation: 1%
- Not ODOT: 9%
- Office of Civil Rights: 3%
- Office of the Director: 1%
- Planning: 2%
- Rail/Transit Division: 3%
- Research: 2%
- Traffic: 1%
- Transit/Transportation options: 1%
- Transportation Development Division: 1%
- Transportation Safety Division: 1%

n=115
Connected Vehicle Benefits

<table>
<thead>
<tr>
<th>Benefit</th>
<th>Very Likely</th>
<th>Somewhat Likely</th>
<th>Somewhat Unlikely</th>
<th>Very Unlikely</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced Crashes</td>
<td>55%</td>
<td>37%</td>
<td>5%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Reduced Crash Severity</td>
<td>48%</td>
<td>43%</td>
<td>6%</td>
<td>1%</td>
<td>2%</td>
</tr>
<tr>
<td>Improved Emergency Response</td>
<td>36%</td>
<td>50%</td>
<td>11%</td>
<td>1%</td>
<td>3%</td>
</tr>
<tr>
<td>Less Traffic Congestion</td>
<td>21%</td>
<td>46%</td>
<td>23%</td>
<td>7%</td>
<td>3%</td>
</tr>
<tr>
<td>Lower Vehicle Emissions</td>
<td>16%</td>
<td>47%</td>
<td>30%</td>
<td>5%</td>
<td>3%</td>
</tr>
<tr>
<td>Shorter Travel Times</td>
<td>17%</td>
<td>48%</td>
<td>30%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Better Fuel Economy</td>
<td>23%</td>
<td>57%</td>
<td>13%</td>
<td>3%</td>
<td>3%</td>
</tr>
<tr>
<td>Lower Insurance Rates</td>
<td>13%</td>
<td>40%</td>
<td>34%</td>
<td>10%</td>
<td>3%</td>
</tr>
<tr>
<td>Fewer Driver Distractions</td>
<td>11%</td>
<td>26%</td>
<td>38%</td>
<td>23%</td>
<td>2%</td>
</tr>
<tr>
<td>Improved Agency Operations</td>
<td>14%</td>
<td>48%</td>
<td>28%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td>Reduced Agency Costs</td>
<td>10%</td>
<td>30%</td>
<td>36%</td>
<td>19%</td>
<td>4%</td>
</tr>
</tbody>
</table>
Connected Vehicle Issues

<table>
<thead>
<tr>
<th>Issue</th>
<th>Very Concerned</th>
<th>Moderately Concerned</th>
<th>Slightly Concerned</th>
<th>Not at All Concerned</th>
<th>No Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impacts of Equipment/System Failure</td>
<td>39%</td>
<td>35%</td>
<td>20%</td>
<td>5%</td>
<td>1%</td>
</tr>
<tr>
<td>Legal Liability for Drivers/Owners</td>
<td>29%</td>
<td>34%</td>
<td>31%</td>
<td>4%</td>
<td>2%</td>
</tr>
<tr>
<td>System Cybersecurity</td>
<td>39%</td>
<td>40%</td>
<td>17%</td>
<td>4%</td>
<td>0%</td>
</tr>
<tr>
<td>Vehicle Cybersecurity</td>
<td>37%</td>
<td>34%</td>
<td>23%</td>
<td>6%</td>
<td>0%</td>
</tr>
<tr>
<td>Data Privacy</td>
<td>37%</td>
<td>17%</td>
<td>32%</td>
<td>13%</td>
<td>1%</td>
</tr>
<tr>
<td>Interacting with Non-connected Vehicles</td>
<td>21%</td>
<td>40%</td>
<td>26%</td>
<td>12%</td>
<td>1%</td>
</tr>
<tr>
<td>Interacting with Pedestrians/Bicyclists</td>
<td>35%</td>
<td>34%</td>
<td>19%</td>
<td>11%</td>
<td>1%</td>
</tr>
<tr>
<td>Learning to Use Connected Vehicles</td>
<td>6%</td>
<td>29%</td>
<td>42%</td>
<td>23%</td>
<td>1%</td>
</tr>
<tr>
<td>Increased Driver Distractions</td>
<td>28%</td>
<td>35%</td>
<td>30%</td>
<td>7%</td>
<td>1%</td>
</tr>
<tr>
<td>System Performance in Poor Weather</td>
<td>24%</td>
<td>29%</td>
<td>33%</td>
<td>13%</td>
<td>1%</td>
</tr>
<tr>
<td>Driver Overreliance on Technology</td>
<td>44%</td>
<td>29%</td>
<td>17%</td>
<td>9%</td>
<td>1%</td>
</tr>
</tbody>
</table>
Connected Vehicle Infrastructure Development

- Very Promising: 34%
- Somewhat Promising: 39%
- Neutral: 22%
- Not Very Promising: 4%
- Not at all Promising: 1%
- No answer: 0%
Connected Vehicle Preparedness

**Cultural**
- Very Prepared: 24%
- Somewhat Prepared: 28%
- Unprepared: 25%
- Neutral: 20%
- No Answer: 1%
- No response: 2%

**Technical**
- Very Prepared: 31%
- Somewhat Prepared: 27%
- Unprepared: 24%
- Neutral: 16%
- No Answer: 0%
Connected Vehicle Division Priority

- All: 26%
- Central Services: 2%
- Don't Know: 7%
- Driver and Motor Vehicle: 6%
- Highway Division: 3%
- Motor Carrier: 1%
- None: 23%
- Office of the Director: 1%
- Operations: 5%
- Planning: 3%
- Policy: 3%
- Safety: 3%
- Transportation Development Division: 3%
- Transportation Safety Division: 1%

n=115
Connected Vehicle Pilot Priorities

- Safety/Security: 25%
- Pilot Project: 20%
- Pilot Project - Urban: 7%
- Pilot Project - Rural: 7%
- ITS/Traffic Management: 7%
- Pilot Project - Corridor: 7%
- Fleets/Freight: 5%
- Planning/Bike/Ped: 5%
- Collaboration: 5%
- Data: 5%
- Electric Vehicles: 3%
- Intersections: 3%
- Economic Development: 3%
- ODOT Fleet: 2%
- Road User Charge: 2%
- Sustainability: 2%
- Work Zone: 2%
Urban Intersection Deployment Concept

NOT FOR CONSTRUCTION

TYPICAL SETTING FEATURES
Urban intersections are junctions of two or more roads in a city setting; they typically include curbing, designated lane markings, traffic signals, and pedestrian crossings.

CONCEPT EXAMPLE
DSRC antennas communicate with vehicles on all approaches of the intersection and at an optional mid-block location.

OTHER EXAMPLE APPLICATIONS
- Red Light Violation Warning and Stop Sign Violation
- Driver Gap Assist at Signalized Intersections and Stop Signs
- Multimodal Intelligent Traffic Signal Systems
- Advanced Arterial Management and Operations
- Advanced Signal Operations

LEGEND
- Existing Mast Arm
- Existing Cabinets
- DSRC Radio
- DSRC Comm.
ITS Footprint

1955 Signals

805 ITS Equipment + 22 Weigh Stations

500 ft diameter buffers
<table>
<thead>
<tr>
<th>Category</th>
<th>Quantity</th>
<th>Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>Miles of Highway</td>
<td>8,300</td>
<td>2013</td>
</tr>
<tr>
<td>Million Vehicle Miles Traveled Daily</td>
<td>55</td>
<td>2012</td>
</tr>
<tr>
<td>Intelligent Transportation System (ITS) Assets</td>
<td></td>
<td></td>
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<tr>
<td>- Closed Circuit Television (CCTV)</td>
<td>276</td>
<td></td>
</tr>
<tr>
<td>- Collision Warning System</td>
<td>9</td>
<td></td>
</tr>
<tr>
<td>- Detector Station</td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>- Highway Advisory Radio Sign</td>
<td>22</td>
<td></td>
</tr>
<tr>
<td>- Highway Advisory Radio Beacon</td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>- Ramp Meter</td>
<td>143</td>
<td></td>
</tr>
<tr>
<td>- Ramp Gate</td>
<td>2</td>
<td>2014</td>
</tr>
<tr>
<td>- Road Weather Information System</td>
<td>96</td>
<td></td>
</tr>
<tr>
<td>- Sensor</td>
<td>6</td>
<td></td>
</tr>
<tr>
<td>- Snow Zone Sign</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>- Vehicle Alert System</td>
<td>10</td>
<td></td>
</tr>
<tr>
<td>- Variable Message Sign</td>
<td>106</td>
<td></td>
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<tr>
<td>- Variable Speed Limit Sign</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>- Flood Sensor</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>Traffic Signals</td>
<td>1,958</td>
<td>2013</td>
</tr>
<tr>
<td>Weigh in Motion (WIM) Sites</td>
<td>25</td>
<td>2013</td>
</tr>
<tr>
<td>Automatic Traffic Recorder (ATR) Stations</td>
<td>191</td>
<td>2014</td>
</tr>
<tr>
<td>Rail Crossings</td>
<td>2,371</td>
<td>2014</td>
</tr>
<tr>
<td>ODOT Maintenance Stations</td>
<td>100</td>
<td>2012</td>
</tr>
<tr>
<td><strong>TOTAL</strong></td>
<td>5,453</td>
<td></td>
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</table>
State Highway Coverage (8,300 miles)
Daily VMT Percentage (54 million veh-mi)
SPIS Sites (80-100) Within Range (n=14,940)
SPIS Sites (95-100) Within Range (n=4,530)
Spur Early CV Tech Deployment

Wirelessly Connected Vehicles

Mobile Devices

Infrastructure

Measure Deployment Benefits

Safety

Mobility

Environment

Resolve Deployment Issues

Technical

Institutional

Financial
Current Priority Coding

- **Priority 1:** Near Term Focus for ODOT

- **Priority 2:** ODOT Should Monitor, Possibly Collaborate, Leadership by Others

- **Priority 3:** Leadership by Others, ODOT Monitor
CONNECTED VEHICLE APPLICATIONS

V2I Safety
- Red Light Violation Warning
- Curve Speed Warning
- Stop Sign Gap Assist
- Spot Weather Impact Warning
- Pedestrian Warning

V2V Safety
- Emergency Electronic Brake Lights (EEBL)
- Forward Collision Warning (FCW)
- Intersection Movement Assist (IMA)
- Left Turn Assist (LTA)
- Blind Spot/Lane Change Warning (BSW/LCW)
- Do Not Pass Warning (DNPW)
- Vehicle Turning Right in Front of Bus Warning

Agency Data
- Probe-based Pavement Maintenance
- Probe-enabled Traffic Monitoring
- Vehicle Classification Traffic Studies
- CV-enabled Turning/Intersection Analysis
- CV-enabled O-D Studies
- Work Zone Traveler Information

Road Weather
- Motorist Advisories & Warnings (MAW)
- Enhanced Maintenance Decision Support
- Vehicle Data Translator
- Weather Response Traffic Info (WxTINFO)

Environment
- Eco-Approach/Departure Intersections
- Eco-Traffic Signal Timing
- Eco-Traffic Signal Priority
- Connected Eco-Driving
- Wireless Inductive/Resonance Charging
- Eco-Lanes Management
- Eco-Speed Harmonization
- Eco-Cooperative Adaptive Cruise Control
- Eco-Traveler Information
- Eco-Ramp Metering
- Low Emissions Zone Management
- AFV Charging/Fueling Information
- Eco-Smart Parking
- Dynamic Eco-Routing
- Eco-ICM Decision Support System

Mobility
- Advanced Traveler Information System (EnableATIS)
- Multimodal Intelligent Traffic Signal (MMITSS)
- Intelligent Traffic Signal System (I-SIG)
- Signal Priority (Transit & Freight)
- Mobile Accessible Pedestrian Signal (PED-SIG)
- Emergency Vehicle Preemption (PREEMPT)
- Intelligent Network Flow Optimization (INFLO)
- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Cooperative Adaptive Cruise Control (CACC)
- Incident Guidance Emergency Response (RESP-STG)
- Incident Scene Work Zone Alerts (INC-ZONE)
- Emergency Communications/Evacuation (EVAC)
- Integrated Dynamic Transit Operations (IDTO)
- Connection Protection (T-CONNECT)
- Dynamic Transit Operations (T-DISP)
- Dynamic Ridesharing (D-RIDE)
- Freight Advanced Traveler Information (FRATIS)
- Freight Dynamic Travel Planning & Performance
- Drayage Optimization

Smart Roadside
- Wireless Inspection
- Smart Truck Parking
# Connected Vehicle Applications

## V2I Safety
- Signal Phase & Timing (SPAT)
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- Signal Phase & Timing (SPAT)
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- Pedestrian Warning
- Railroad Crossing Warning
- Disabled/Oversized Vehicle Warning

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## Fee Payment
- Tolling
- High Occupancy Toll Lanes
- Congestion Pricing

## Smart Roadside
- Wireless Inspection
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### Connected Vehicle Applications

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- Eco-Approach/Departure Intersections
- Eco-Traffic Signal Timing
- Eco-Traffic Signal Priority
- Connected Eco-Driving
- Wireless Inductive/Resonance Charging
- Eco-Lanes Management
- Eco-Speed Harmonization
- Eco-Cooperative Adaptive Cruise Control
- Eco-Traveler Information
- Eco-Ramp Metering
- Low Emissions Zone Management
- AFV Charging/Fueling Information
- Eco-Smart Parking
- Dynamic Eco-Routing
- Eco-ICM Decision Support System
- Dynamic Emissions Pricing

### Road Weather
- Motorist Advisories & Warnings (MAW)
- Enhanced Maintenance Decision Support
- Vehicle Data Translator
- Weather Response Traffic Info (WxTINFO)

### Agency Data
- Probe-based Pavement Maintenance
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- CV-enabled O-D Studies
- Work Zone Traveler Information

### Fee Payment
- Tolling
- High Occupancy Toll Lanes
- Congestion Pricing

### Mobility
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- Dynamic Ridesharing (D-RIDE)
- Freight Advanced Traveler Information (FRATIS)
- Freight Dynamic Travel Planning & Performance
- Drayage Optimization

### Smart Roadside
- Wireless Inspection
- Smart Truck Parking
## Connected Vehicle Applications

### V2I Safety
- Signal Phase & Timing (SPAT)
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**CONNECTED VEHICLE APPLICATIONS FOR OREGON**

**Enterprise Data Driven Improvement**
- Probe-based Pavement Maintenance
- Probe-enabled Traffic Monitoring
- CV-enabled Performance Measures
- Work Zone Traveler Information

**Enabled Corridors and Segments**
- Advanced Traveler Information System (EnableATIS)
- ICM Decision Support System
- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Next Generation Ramp Metering (RAMP)
- Freight Dynamic Travel Planning & Performance

**Fee Payment**
- Road User Charging
- Tolling/HOT Lanes/Congestion Pricing

**Equipped Roadside Nodes**
- Signal Phase & Timing (SPAT)
- Curve Speed Warning
- Spot Weather Impact Warning
- Railroad Crossing Warning
- Disabled/Oversized Vehicle Warning
- AFV Charging/Fueling Information
- Wireless Inspection
- Smart Truck Parking

**Enhanced Operations and Responsiveness**
- Motorist Advisories & Warnings (MAW)
- Enhanced Maintenance Decision Support
- Incident Guidance Emergency Response (RESP-STG)
- Incident Scene Work Zone Alerts (INC-ZONE)
- Emergency Communications/Evacuation (EVAC)
Close Look: Safety Applications

**V2I Safety**
- Signal Phase & Timing (SPAT)
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- Vehicle Turning Right in Front of Bus Warning
Close Look: Mobility Applications

**Mobility**

- Advanced Traveler Information System (EnableATIS)
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Close Look: Agency/BizOps Applications

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Workshop Results

Meaningful

Manageable

Low Effort

High Effort

Group 1

Group 2

Group 3
## Near Term Focus for ODOT

<table>
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<tr>
<td>1a</td>
<td>Advanced Traveler Information System (Enable/ATIS) Deliver</td>
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<td>2</td>
<td>Dynamic Speed Harmonization (SPO-HARM)</td>
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<td>Freight Dynamic Travel Planning &amp; Response</td>
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<td>Signal Phase and Timing (SPAT)</td>
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<td>12</td>
<td>Curve Speed Warning</td>
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<td>Probe-enabled Traffic Monitoring</td>
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<td>23</td>
<td>Motorist Advisories &amp; Warnings (MAW)</td>
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### ODOT Should Monitor, Possibly Collaborate, Leadership by Others

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<td>Advanced Traveler Information System (Enable/ATIS) gather access?</td>
<td>3</td>
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<td>4</td>
<td>Next Generation Ramp Metering (RAMP)</td>
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<td>7</td>
<td>Eco-ICM Decision Support System</td>
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<td>10</td>
<td>Congestion Pricing (with road user charge)</td>
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<tr>
<td>13</td>
<td>SPOT Weather Impact Warning</td>
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<td>15</td>
<td>Disable/Oversized Vehicle Warning</td>
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<td>17</td>
<td>Incident Scene Work Zone Alerts (INC-ZONE)</td>
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<td>Emergency Communications/Evacuation</td>
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<td>Probe-based Pavement Maintenance</td>
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<td>Enhanced Maintenance Decision Support</td>
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## Leadership by Others, ODOT Monitor

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<td>8</td>
<td>Tolling</td>
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<td>9</td>
<td>HOT Lanes</td>
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<td>14</td>
<td>Railroad Crossing Warning</td>
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<td>16</td>
<td>Incident Guidance Emergency Response</td>
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<td>25</td>
<td>Wireless Inspection</td>
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CV Roadmap

94 Actions
12 Categories

- DSRC and Backhaul Communications
- Education and Outreach
- Policy and Communications/Collaboration
- Benefits/Business Case
- Data Management and Strategies
- Applications
- Try Things
- Research Questions/Challenges
- Planning and Equity
- Multimodal
- Design and Construction
- Operations and Maintenance
Outcomes

ODOT Intermodal Leadership Team approved three recommendations:

• New position: Policy Adviser for Connected, Automated and Electric Vehicles
• CAV Steering Team is forming
• CAV “Business Map” provides an initial taxonomy for actions by the Policy Adviser and the Steering Team
Tampa CV Pilot
New York City CV Pilot
Acknowledgments

Project Funded by Oregon Department of Transportation

Haizhong Wang, Oregon State University
Tony Knudson, Oregon Department of Transportation
Kevin Carstens, California Polytechnic State University
Thank You!

“These self-honking cars make it so much easier to focus on driving.”


rbertini@usf.edu
V2I Deployment Coalition
V2I DC

Overview and Early Findings
Topics

• Introduce the V2I Deployment Coalition (V2I DC)

• Introduce the Connected and Automated Vehicle Executive Leadership Team (CAV-ELT)

• Describe the Initial 18 Month Focus of the V2I DC

• Share Early Findings
What is the V2I Deployment Coalition?

• V2I DC Concept
  ▪ A single point of reference for stakeholders to meet and discuss V2I deployment related issues

• V2I DC Approach
  ▪ USDOT asked AASHTO, ITS America and ITE to collaborate on organizing and managing the coalition
V2I Deployment Coalition Structure

V2I Deployment Coalition

- TWG 1: Deployment Initiatives
- TWG 2: Deployment Research
- TWG 3: Infrastructure Operator, OEM, and Supplier Partnerships
- TWG 4: Deployment Guidance
- TWG 5: Deployment Standards

Connected Vehicle Executive Leadership Team

V2IDC Executive Committee

USDOT - ITS JPO - FHWA - FTA - NHTSA
## TWG Chairs & Co-Chairs

<table>
<thead>
<tr>
<th>TWG</th>
<th>Chair</th>
<th>Co-Chair</th>
</tr>
</thead>
<tbody>
<tr>
<td>TWG 1: Initiatives</td>
<td>Bill Legg, WSDOT</td>
<td>Joe Averkamp, Xerox</td>
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<tr>
<td>TWG 2: Research</td>
<td>Greg Larson, Caltrans</td>
<td>Rob Bertini, CUTR</td>
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<td>TWG 3: Partners</td>
<td>Matt Smith, MDOT</td>
<td>Roger Berg, Denso</td>
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<tr>
<td>TWG 4: Guidance</td>
<td>Faisal Saleem, MCDOT</td>
<td>Navin Katta, Savari</td>
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<tr>
<td>TWG 5: Standards</td>
<td>Ed Seymour, Texas A&amp;M</td>
<td>Gary Duncan, Econolite</td>
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# 16 Deployment Issues Identified

<table>
<thead>
<tr>
<th>Issue</th>
<th>TWG 1 Initiatives</th>
<th>TWG 2 Research</th>
<th>TWG 3 Partners</th>
<th>TWG 4 Guidance</th>
<th>TWG 5 Standards</th>
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<tbody>
<tr>
<td>Issue 1: V2X Applications</td>
<td>P</td>
<td>S</td>
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<td>Issue 2: Complementary Communications to DSRC</td>
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<td>Issue 3: V2I Data</td>
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<td>Issue 4: Patents-Intellectual Property</td>
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<td>Issue 5: Security</td>
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<td>Issue 6: V2I Outreach</td>
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<td>Issue 7: Understanding the Benefits and Costs of V2I Deployment and Operation</td>
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<td>Issue 8: V2I Standards</td>
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<td>Issue 9: Understanding V2I Liability Assignment</td>
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<td>Issue 10: V2I Synergies with Other Emerging Technologies</td>
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<td>Issue 11: V2I Consumer Messaging</td>
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<td>Issue 12: V2I Multimodal Applications</td>
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<td>Issue 13: Infrastructure Processes as V2I Obstacles</td>
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<td>N</td>
<td>N</td>
<td>S</td>
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<td>Issue 14: Federal V2I Policy Statement</td>
<td>P</td>
<td>N</td>
<td>N</td>
<td>S</td>
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<td>Issue 15: Maintaining V2I Infrastructure</td>
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<td>Issue 16: Operator and OEM Goals for V2I</td>
<td>N</td>
<td>N</td>
<td>P</td>
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V2I DC Overview

Initial Goals of the V2I DC:

To help accelerate V2I deployments related to:

1. Intersections (signalized & non-signalized)
2. End of queue warnings
3. Work zone management
4. Curve warning systems
V2I DC Efforts

TWGs approach to the 4 Focus Areas:

• Addressing the key issues impacting V2I deployment
• Each TWG has a Work Plan of activities
• ‘Fishbone Diagrams’ helped coordinate activities of TWGs
• Monthly TWG webinars
• Coalition wide meetings/calls

Four Focus Areas
1. Intersections
2. Queue Warnings
3. Work Zone Management
4. Curve Warnings
CAV Executive Leadership Team (CAV-ELT)

Meeting since 2005, Originally as the CV ELT:
• Provide strategic guidance,
• Recommend policies and national deployment approaches,
• Provide critical program reviews,
• Assess the risks associated with deployment,
• Commit the resources of their organizations,
• Educate their organizations and supporting institutions

Reconvened in 2015 – Expanded Scope to Include Automated Vehicles, added additional Automotive Industry Members
### CAV ELT Roster

<table>
<thead>
<tr>
<th>Entity</th>
<th># of Members</th>
</tr>
</thead>
<tbody>
<tr>
<td>USDOT</td>
<td>7 Liaisons</td>
</tr>
<tr>
<td>State DOTs</td>
<td>15 members</td>
</tr>
<tr>
<td>Local Governments</td>
<td>5 members</td>
</tr>
<tr>
<td>AASHTO</td>
<td>3 members</td>
</tr>
<tr>
<td>ITE / ITS America</td>
<td>1 member each</td>
</tr>
<tr>
<td>Automotive Industry</td>
<td>20+ members</td>
</tr>
<tr>
<td>TRB</td>
<td>1 member</td>
</tr>
<tr>
<td>NACO / NACTO / IBTTA / VII / AAMVA/ Others</td>
<td>9 members</td>
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</tbody>
</table>
CV Institutional Framework

**CV Entity**

- AASHTO CV Executive Leadership Team (CV ELT)
  - Technical findings & Questions
  - Policy level Feedback

- Vehicle to Infrastructure Deployment Coalition Executive Committee (V2I DC EC)
  - Input
  - Feedback & Guidance

- V2I DC Technical Working Groups (TWGs)

**Role**

- Recommend Policies & Deployment Approaches
- Guidance to V2I DC on Technical & Institutional Issues
- Collaborate on technical work (Input level actions)
CV Applications Included in Agency Plans or Proposals
Most Selected CV Applications Included in Agency Plans or Proposals

Most Selected Applications

- Intelligent Traffic Signal System
- Queue Warning
- Warnings About Upcoming Work Zone
- Signal Phase and Timing
- Vehicle Data for Traffic Operations
- Warnings About Hazards in a Work Zone
- Road Weather Motorist Alert and Warning
- Emergency Vehicle Preemption
- Curve Speed Warning
- Speed Harmonization
- Incident Scene Workzone Alerts for Drivers and Workers
Most Beneficial CV Applications to Deploy
Most Selected Most Beneficial CV Applications

Top Most Beneficial CV Applications

- Intelligent Traffic Signal System
- Advanced Traveler Information Systems
- Vehicle Data for Traffic Operations
- Signal Phase and Timing
- Queue Warning
- Transit Signal Priority
- Red Light Violation Warning
- Pedestrian in Signalized Crosswalk Warning
- In-Vehicle Signage
- Road Weather Motorist Alert and Warning
- Warnings About Upcoming Work Zone
Overlap Between Proposed Applications and Most Beneficial CV Applications

Only in Planned or Proposed Applications:
1. Incident Scene Work Zone Alerts for Drivers and Workers
2. Speed Harmonization
3. Emergency Vehicle Preemption
4. Curve Speed Warning
5. Warnings about Hazards in a Work Zone

Overlap in Both:
1. Road Weather Motorist Alert & Warning
2. Queue Warning
3. Vehicle Data for Traffic Operations
4. Intelligent Traffic Signal System
5. Signal Phase & Timing
6. Warnings About Upcoming Work Zones

Only in Top 5 Responders Feel are Most Beneficial:
1. Transit Signal Priority
2. Advanced Traveler Information Systems
3. Red Light Violation Warning
4. In-vehicle Signage
5. Pedestrian in Signalized Crosswalk Warning
Most Selected Most Beneficial CV Applications

- Eco-Approach and Departure at Signalized Intersections
- Electric Charging Stations Management
- Roadside Lighting
- Enhanced Maintenance Decision Support System
- Road Weather Information for Maintenance and Fleet Management Systems
- Electronic Toll Collection
- Performance Monitoring and Planning
- Emergency Vehicle Preemption
- Signal Phase and Timing
- Transit Signal Priority
- Advanced Traveler Information Systems
Priority Connected Vehicle Applications

Top 11 of 72 Connected Vehicle Applications Planned or Proposed for Deployment

- Road Weather
- Public Safety
- Signals
- V2I Safety
- V2I DC Intersections
- V2I DC Curve Speed
- V2I DC Work Zone
- CV PFS Road Weather
- CAMP Red-Light
- CV PFS Intelligent Signals
- CAMP Curve Speed
- CAMP Reduced Speed / Work Zone
SPaT as an Early Entry into V2I Deployment

So, what is SPaT?

- A Signal Phase and Timing (SPaT) message defines the current intersection signal light phases. The current state of all lanes at the intersection are provided, as well as any active pre-emption or priority.
- The SPaT message can be obtained from a traffic signal controller via a standard query protocol and is broadcast by most DSRC roadside devices as a standardized data message.
The SPaT Challenge

The Challenge

- To challenge state and local public sector transportation Infrastructure Owners & Operators (IO&Os) to cooperate together to achieve deployment of DSRC infrastructure with SPaT broadcasts in at least one corridor or network (approximately 20 signalized intersections) in each state by January 2020.

- Additional V2I Applications that build on SPaT are also encouraged!

20 Intersections in 50 states by 2020!
Early Findings / Results

- V2I Standards Context Drawing
- V2I Deployment Guidance Feedback / Input
- Definition of Research Activities for 4 Issues
- Increased Interaction with Automobile Manufacturers re: Data Exchanges – Planned Upcoming Meetings
- Survey of Planned & Most Beneficial V2I Deployments
To Become Involved

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Dean Deeter, Athey Creek — deeter@acconsultants.org