V2I Deployment Coalition
V2I DC

STSMO Annual Meeting

August 2, 2016
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
Organizational Structure and Technical Working Groups

V2IDC Executive Committee

TWG 1: Initiatives
TWG 2: Research
TWG 3: Partners
TWG 4: Guidance
TWG 5: Standards

USDOT
- ITS JPO
- FHWA
- FTA
- NHTSA
<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, Cal Poly</td>
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<tr>
<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>
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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 13: Infrastructure Processes as V2I Obstacles</td>
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<td>Issue 14: Federal V2I Policy Statement</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>
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Initial Focus of the V2I DC

To help accelerate V2I deployments that support passenger vehicles, freight, and transit in both urban and rural areas, with the initial focus on:

1. Intersections (signalized & unsignalized)
2. End of queue warnings
3. Work zone management
4. Curve warning systems
V2I Deployment Coalition Structure

- **Connected Vehicle Executive Leadership Team**
- **V2IDC Executive Committee**
- **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
- **USDOT - ITS JPO - FHWA - FTA - NHTSA**
## 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>
</tr>
</tbody>
</table>
TWG 1: Deployment Initiatives

Bill Legg, WSDOT
TWG 1: Issues Addressed

- Issue #1: V2X Applications
- Issue #7: Benefits / Costs of V2I Deployments
- Issue #13: Infrastructure Processes as V2I Obstacles
- Issue #14: Federal V2I Policy Statements
- Issue #15: Maintaining V2I Infrastructure
TWG 1: Key Activities

1. V2I Applications Survey (Issue #1)
2. Benefit / Cost Webinars (Issue #7)
3. Identify Infrastructure related V2I Challenges (Issue #13)
4. Identify and Support the DSRC SPaT Challenge (Issue #14)
CV Applications Included in Plans or Proposals
11 Most Selected Applications

Question 3: CV Applications Included in Agencies Plans or Proposals for Deployment
(Top 11 Applications Selected; # of Responders = 21)

- Road Weather
- Motorist Alert and...
- Incident Scene Work
- Zone Alerts for...
- Queue Warning
- Speed Harmonization
- Vehicle Data for Traffic Operations
- Emergency Vehicle Preemption
- Intelligent Traffic Signal System
- Signal Phase and Timing
- Curve Speed Warning
- Warnings about Hazards in a Work...
- Warnings about Upcoming Work Zone
Question 3: Select the 5 Applications You Feel Would be Most Beneficial to Deploy
(Top 11 Applications; # of Responders = 21)
Comparing the Most Selected “Planned/Proposed Applications” vs the “Most Beneficial”

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

Only in Planned or Proposed Applications
1. Incident Scene Work Zone Alerts for Drivers and Workers
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Only in Top 5 Responders Feel are Most Beneficial
1. Transit Signal Priority
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3. Red Light Violation Warning
4. In-vehicle Signage
5. Pedestrian in Signalized Crosswalk Warning
CV Applications of Initial Focus

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
7. Curve Warnings
The SPaT Challenge

A challenge to achieve:

• Deployment of Signal Phase and Timing (SPaT) DSRC transmissions operating on a corridor of at least 20 intersections in 50 States by 2020

• Commitment to operate for at least 10 years
The SPaT Challenge

Why would we do this?

- It will give DOTs an entry into V2I deployment and operations (valuable experience with procurement, installation, operations)
- It will help promote future (more advanced) V2I deployments
- It will show a commitment to OEMs
Possible Resources to be Developed

1. Guidelines for selecting corridors
2. Procurement guidance
3. DSRC licensing information
4. Installation guidance
5. Estimated costs (install & maintenance)
6. Identification of existing funding sources that agencies may consider
7. Briefing materials (added based on last webinar)
SPaT Challenge One Pager

Connected Vehicle Deployment Challenge
20 SPaT Intersections in 50 States by 2020

The Challenge:
Equip at least one corridor (roughly 20 signalized intersections) in each of the 50 states with Dedicated Short Range Communications (DSRC) infrastructure to broadcast SPaT information by January 2020, and maintain operations for at least 10 years.

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.

Why This Challenge/Goal is Needed:
- To provide State and Local DOTs with an entry into DSRC based V2I Deployment (allow them to gain valuable procurement, licensing, installation, and operation experience)
- To promote future (more advanced) V2I deployments
- To show a commitment to automobile manufacturers and applications developers

“Fortunately, there is one fairly basic connected vehicle element which is relatively simple to deploy and fundamental to a number of applications, the “signal phase and timing” (SPaT) message. SPaT defines the actions of a traffic signal. It is obtained from a traffic signal controller via a standard query protocol and is broadcast by most DSRC roadside devices as a standardized data message.”
- Blaine Leonard, Utah DOT ITS Program Manager

Deployment Tools Will Be Available
The following tools will be developed:
- Guidelines for selecting corridors
- Procurement guidance
- DSRC licensing information
- Installation guidance
- Estimated costs
- Identification of existing funding sources that agencies may consider

Success in meeting the Challenge will be Measured
The V2I Deployment Coalition will work with the National Operations Center of Excellence (NOCoE) to maintain a website to track progress using a national map to depict locations where:
- There is a commitment to deploy, and
- DSRC SPaT broadcast is operational.

How to get involved?
The Connected Vehicle SPaT Deployment Challenge is being led by the V2I Deployment Coalition TWG 1 and the AASHTO CAV WG. Information is available at: http://www.transportationops.org. Infrastructure Owners & Operators wishing to join the challenge, or others wishing to participate in the effort, may contact: Dean Deeter (AASHTO support liaison to both groups) at deeter@acconsultants.org
Multi-page Folios

The National Connected Vehicle Deployment Challenge
20 SPaT Intersections in 50 States by 2020

The Challenge:

Equip at least one corridor (roughly 20 signalized intersections) in each of the 50 states with Dedicated Short Range Communications (DSRC) infrastructure to broadcast SPaT information by January 2020, and maintain operations for at least 10 years.

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.

Why is This Challenge Necessary?

- To provide State and Local DOTs with an entry into DSRC based V2I Deployment (allow them to gain valuable procurement, licensing, installation, and operation experience)
- To promote future (more advanced) V2I deployments
- To show a commitment to automobile manufacturers and applications developers

Do you have a candidate corridor for the challenge? Ideally the corridor will have:

- 20 signals but 10 will also work
- Modern controllers with in-cabinet equipment to support the DSRC radio (the RSU)
- Backhaul communications with sufficient bandwidth either from each master
- MAP/GID* data

Available Challenge Resources

The following resources are available to help to get started with the Challenge:

- Guidelines for selecting corridors
- Procurement guidance

The goal of this document is to make DSRC licensing requirements transparent and best practices accessible to any organization seeking to deploy Connected Vehicle Dedicated Short Range Communications (DSRC) Roadside Units (RSU) that support vehicle-to-infrastructure (V2I) communications.

- Installation guidance
- Estimated costs
- Identification of existing funding
TWG 1 – Remaining Phase 1 Activity

Issue #15: Maintaining V2I Infrastructure
Discussion about Sources of Insight into Maintenance Costs

- Members suggested UMTRI may have experiences and information to share

- Also NYC DOT may be able to share projections for maintenance costs of their CV Pilot Deployment infrastructure
Maintaining V2I Infrastructure Webinar – Tentative Plan

• **90 Minute Webinar**
  - UMTRI Insight into V2I Maintenance
  - NYC Insight into V2I Maintenance
  - We will invite a USDOT presenter to give an update on the V2I Deployment Guidance or related topics

• **Tentative Date/Time: September 13 2:00 Eastern**
TWG 2: Deployment Research

Greg Larson, Caltrans
TWG 2: Issues Addressed

- Issue #1: V2X Applications
- Issue #3: V2I Data
- Issue #6: V2I Outreach
- Issue #7: Benefits/Costs of V2I Deployments
Issue 1: V2X Applications

Volunteers:
- Jian-Ming Ma, Texas DOT, Leader for this activity
- Skip Yeakel, Volvo Group North America
- Bill Mahoney, National Center for Atmospheric Research
- Danjue Chen, Traffic Operations and Safety (TOPS) Lab at UW-Madison

Timeline: Give problem statements to TRB in June for consideration in NCHRP CAV Roadmap Project.

Two Research Definitions Developed:
- Connected Vehicles and Traffic Incident Management
- Infrastructure-to-Vehicle Communications for Automated Vehicle Navigation
Issue 1: V2X Applications (cont.)

Supplemental Activity: Develop a problem statement for harmonization of V2X apps for CAV research roadmap

• Analyze the two lists (USDOT and TRB), see what applications are the same, define what those mean, and assess their readiness.

Volunteers: Rob Bertini, Cal Poly, and Tom Timcho, WSP
Issue 3: V2I Data

Volunteers:
- Tom West, California PATH/UC Berkeley, Leader for this activity
- Jian-Ming Ma, Texas DOT
- James Li, Oakridge National Laboratory
- Danjue Chen, Traffic Operations and Safety (TOPS) Lab at UW-Madison
- Yang Cheng, Traffic Operations and Safety (TOPS) Lab at UW-Madison,

Timeline: Give problem statements to TRB in June for consideration in NCHRP CAV Roadmap Project.

Two Research Definitions Developed:
- Cooperative Vehicle-Infrastructure Situational Awareness
- Readiness Assessment of OSADP Connected Vehicle Applications for Deployment

Additional Needs: Develop the following research problem statements
- Mechanisms for higher frequency dynamic map updates
- Determining corrections for lane-level GPS positioning
- Determining roadway friction indicators (e.g., skidding/braking)
- Identifying the data that owner/operators want from OEMs
Issue 6: V2I Outreach (One-Stop Shop for Research)

Volunteers:
• Greg Larson, Caltrans
• Rob Bertini, Cal Poly
  Ray Derr, Transportation Research Board
• Skip Yeakel, Volvo Group North America

Role in Coordination: TWG 2 will develop a description of the concept and intent for a “one-stop-shop” for Connected Vehicle research sharing. This concept will be available to enable entities that may be able to serve the purpose of the “one-stop shop” (e.g. NoCOE or other entities) to understand what resources would be required to develop and support the effort. The intent is for the “one-stop shop” (as defined by TWG 2) to be developed in subsequent years by one or more entities to be determined based on the concept.

Status: TWG 2 has engaged the NOCoE to help develop the one-stop shop, and the Center will use its resources to help develop and maintain the one-stop shop. We are now in Task 2 of the list of recommended next steps.
One-Stop Shop for Research (cont.)

Targeted Outcome: Prepare a “one-stop shop” concept described to the point where entities could estimate the costs and resources required to create and operate it.

Draft Work Plan:

• **Task 1:** Email the CV/AV stakeholder group responsible for CV/AV research/operations in TRB, AASHTO, V2IDC, etc., to frame the early discussions on this initiative and the proposed approach.

• **Task 2:** Reach out to the Transportation Research International Documentation (TRID) Database ([http://trid.trb.org/](http://trid.trb.org/)) at the Transportation Research Board and the National Transportation Library ([http://ntl.bts.gov/](http://ntl.bts.gov/)) in the Office of the Assistant Secretary for Research and Technology at the US Department of Transportation and capture their CV/AV knowledge resources for compilation in the NOCoE Knowledge Center.

• **Task 3:** Review and identify a desirable taxonomy to ensure effective key search word tagging of CV/AV content.

• **Task 4:** Engage the CV/AV community proactively to obtain new content.

• **Task 5:** Identify strategies for promotion and outreach of these knowledge resources: NOCoE newsletter stories, webinars, listserv/discussion forums, etc.
Issue 7: Understanding the Benefits and Costs of V2I Deployment and Operation

Volunteers:
- Doug Gettman, Kimley-Horn, Leader for this activity.
- Bill Gouse, SAE International
- Dick Mudge, Compass Transportation and Technology
- Alan Korn, Meritor WABCO

Role in Coordination: TWG 2 members participated in the webinars conducted by TWG 1 and the case studies performed by TWG 3, and identified the gaps in what has been delivered (or is planned) from the current studies. TWG 2 will prepare a Research Definition for additional research activities needed to further define anticipated costs and benefits of V2I.

Timeline: Give problem statements to TRB in June for consideration in NCHRP CAV Roadmap Project.

Two Research Definitions Developed:
- Cost-Benefit Analysis of V2I Applications
- Planning Analysis Methods
TWG 3: Deployment Partners
Matt Smith, MDOT
TWG 3: Issues Addressed

- Issue #3: V2I Data
- Issue #7: Benefits / Costs of V2I Deployments
- Issue #16: Operator and OEM Goals for V2I
TWG 3: Key Activities

• V2I Data:
  ▪ OEM Data Needs
  ▪ Infrastructure Data Needs
  ▪ Follow up Needs

• Benefits / Costs of V2I
  ▪ Case Studies

• Operator / OEM Goals for V2I
  ▪ Addressed common goals
  ▪ Summary
TWG 3 Follow-Up Activities

- OEM and Infrastructure Owner/Operator Workshop
  - Data Discussion (*prelim discussion tomorrow*)
  - Common Goals
  - Future Activity Planning
TWG 4: Deployment Guidance
Faisal Saleem, MCDOT
V2I Deployment Guidance

• Draft version issued by USDOT September 2014
• Intended to assist Federal staff and transportation system owners/operators deploy V2I technology in terms of the Federal-aid Highway program requirements and in terms of practices that will help ensure interoperability, and efficient and effective planning, procurement, and operations throughout the full life-cycle.
V2I Deployment Guidance

• New version expected to be released in 2016
• Will include several, detailed supporting products
  – Systems Engineering Guide
  – Connected Vehicles and the Planning Process
  – Guide to Licensing
  – V2I Message Lexicon
  – Pre-Deployment Guidance for V2I Safety Applications
  – Estimating Benefits and Economic Impacts
  – Near Term Transition and Phasing
  – Connected Vehicle Training Resources
TWG 4: Issues Addressed

• Issue #6: V2I Outreach
• Issue #11: V2I Consumer Messaging
• Issue #14: Federal V2I Policy Statement
TWG 4: Key Activities

• V2I Outreach
  ▪ Reviewed current version of V2I Deployment Guidance and supporting products
  ▪ Reviewed existing outreach and USDOT future plans for outreach to provide feedback to USDOT

• Consumer Messaging
  ▪ Reviewed samples of V2I messages to identify common, supportive and questionable
  ▪ Provided feedback to USDOT

• Drafted briefing on Federal policy statement
TWG 5: Standards
Ed Seymour, Texas A&M
TWG 5: Key Activities

• Standards Context Drawing
• V2I Standards Gaps
  ▪ Context Diagram, US DOT Docs, CV Pilots, Liaison w/TWGs
• Operational alignment for new standards
SCMS Standardization

• Support standardization of the Security Credential Management System (SCMS)
  - SCMS is a technical document
  - IEEE 1609 Working Group - Project Action Request

• Consider adding devices in the “ecosystem” of security credential management – field devices, backend systems
Engage with DOT Data Efforts

- Conduct a webinar-based workshop to review the US DOT Data Capture Management (DCM) document with all V2I Deployment Coalition working groups
- Continue to monitor US DOT V2I standards efforts and leverage those investments
- Identify other gap efforts
RSE Standardization

- Move DSRC Roadside Unit (RSE) from specification to a standard
- Currently covered by a specification developed by USDOT and contractor
- Currently undergoing changes to reflect issues noted by suppliers & users and changes to the DSRC requirements
Adjust MUTCD and Other Guidance for V2I and AV

- Encourage update of Manual on Uniform Traffic Control Devices (MUTCD) and other guidance documents
- TRB Automated Vehicle Symposium has hosted breakout sessions focused on the highway infrastructure that have begun to raise this issue
- Address by collaborative group
Reliability Standards for Operations

- Explore a move from best practices to “enforceable” or “gradable” performance that helps ensure reliability
- Provide guidance to infrastructure deployers and operators with respect to the level of reliability, monitoring, mean time to repair (MTTR), and operational responsibility for the infrastructure
Explore Development of Testing Tools

- Explore development of automated testing tools for roadside units (RSUs) to ensure they meet applicable standards
- Have done this in the past
- Operating agencies use tools & test configurations
- Operating agencies lead discussion
Engage Telecom Providers

Communications

- Engage with telecom industry to ensure standards & guidelines for connectivity in the V2I ecosystem are robust and reflect current technologies & standards
- Marketplace is providing new paths, value propositions, & products to deliver V2I & backend connections
- Infrastructure budgets are constrained
USDOT Perspective
Bob Sheehan, USDOT ITS Joint Program Office