Connected Vehicles and Maintenance Operations

Presentation to AASHTO SCOM

Dean Deeter
Athey Creek Consultants
Topics

• Connected Vehicle Priorities Survey Results

• Connected Vehicle Applications Related to Maintenance Operations

• Upcoming Activities of the V2I DC of Interest to Maintenance and Operations
Welcome to the Connected Vehicle Reference Implementation Architecture (CVRIA) Website! This site is your tool for reviewing, providing feedback, and using the architecture content for standards and project development. CVRIA is being developed as the basis for identifying the key interfaces across the connected vehicle environment which will support further analysis to identify and prioritize standards development activities. CVRIA will also support policy considerations for certification, standards, core system implementation, and other elements of the connected vehicle environment.

As shown in the figure, CVRIA is developed in 4 Views:

- Enterprise - Describes the relationships between organizations and the roles those organizations play within the connected vehicle environment
- Functional - Describes abstract functional elements (processes) and their logical interactions (data flows) that satisfy the system requirements
- Physical - Describes physical objects (systems and devices) and their application objects as well as the high-level interfaces between those physical objects
- Communications - Describes the layered sets of communications protocols that are required to support communications among the physical objects that participate in the connected vehicle environment

Another way to view the architecture is from the perspective of the connected...
Maintenance Operations Related
Connected Vehicle Applications

• Vehicle Data for Traffic Operations
• Enhanced Maintenance Decision Support System
• Road Weather Information for Maintenance and Fleet Management Systems
• Road Weather Motorist Alert and Warning
• Variable Speed Limits for Weather-Responsive Traffic Management
• Warnings about Hazards in a Work Zone
• Warnings about Upcoming Work Zone
Survey of Infrastructure Owners & Operators

Attempted to learn 3 things:

- Which CV applications responding agencies had **included in their proposal or plan** for CV deployment

- Which CV applications responding agencies felt **were most beneficial**; and

- Which CV applications responding agencies had already deployed
Q3: V2I Applications

72 V2I Applications from CVRIA Website
(presented in 8 categories)

<table>
<thead>
<tr>
<th>Category</th>
<th>Number of V2I Applications</th>
</tr>
</thead>
<tbody>
<tr>
<td>AERIS/Sustainable Travel</td>
<td>16</td>
</tr>
<tr>
<td>Border, Commercial Vehicle, Freight</td>
<td>8</td>
</tr>
<tr>
<td>Traffic Network/Traffic Signals</td>
<td>9</td>
</tr>
<tr>
<td>Traveler Information</td>
<td>3</td>
</tr>
<tr>
<td>Road Weather</td>
<td>6</td>
</tr>
<tr>
<td>Public Safety</td>
<td>5</td>
</tr>
<tr>
<td>Transit</td>
<td>12</td>
</tr>
<tr>
<td>V2I Safety</td>
<td>13</td>
</tr>
</tbody>
</table>
Q3: CV Applications Included in Agencies Plans or Proposals for Deployment
(# of Responders = 21)
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)
4 Focus Areas of the V2I Deployment Coalition

- At the September, 2015 V2I DC Executive Committee meeting, four focus areas were defined for the V2I DC

Focus Areas Defined by V2I DC

1. Intersections
2. Queue Warnings
3. Work Zone Management
4. Curve Warnings
How do the most selected Applications map to the focus areas?

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

All Four Focus Areas Represented!

1. Intersections
2. Queue Warnings
3. Work Zone Management
4. Curve Warnings
CV Applications Responders Feel Would Be Most Beneficial to Deploy

Q3: Select the 5 Applications You Feel Would Be Most Beneficial to Deploy
(# of Responders=21)
CV Applications Most Beneficial to Deploy

11 Most Selected Applications

Question 3: Select the 5 Applications You Feel Would be Most Beneficial to Deploy
(Top 11 Applications; # of Responders = 21)
How do the Applications selected as most beneficial map to the focus areas?

Question 3: Select the 5 Applications You Feel Would be Most Beneficial to Deploy
(Top 11 Applications; # of Responders = 21)

3 of 4 Focus Areas Represented
1. Intersections
2. Queue Warnings
3. Work Zone Management
4. Curve Warnings
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
Comparing the Most Selected “Planned/Proposed Applications” vs the “Most Beneficial”

- Incident Scene Work Zone Alerts for Drivers and Workers
- Speed Harmonization
- Emergency Vehicle Preemption
- Curve Speed Warning
- Warnings about Hazards in a Work Zone

- Transit Signal Priority
- Advanced Traveler Information Systems
- Red Light Violation Warning
- In-vehicle Signage
- Pedestrian in Signalized Crosswalk Warning

- Road Weather Motorist Alert & Warning
- Queue Warning
- Vehicle Data for Traffic Operations
- Intelligent Traffic Signal System
- Signal Phase & Timing
- Warnings About Upcoming Work Zones

Only in Planned or Proposed Applications

Overlap in Both

Only in Top 5 Responders Feel are Most Beneficial

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
Maintenance Operations Related Connected Vehicle Applications

- Vehicle Data for Traffic Operations
- Enhanced Maintenance Decision Support System
- Road Weather Information for Maintenance and Fleet Management Systems
- Road Weather Motorist Alert and Warning
- Variable Speed Limits for Weather-Responsive Traffic Management
- Warnings about Hazards in a Work Zone
- Warnings about Upcoming Work Zone
High Level Connected Vehicle Diagram

Central Systems

Roadside Units

DOT Operated Fleets

Private Vehicles
Maintenance Operations
Data/Information Flows

- Central Systems
  - Roadside Units
    - DOT Operated Fleets
    - Private Vehicles
Warnings About Upcoming Work Zones

- DOT Operated Fleets
- Private Vehicles
- Roadside Units
- Central Systems
- Lane Closures Details
Road Weather Motorist Alert and Warning

Central Systems

Weather & Road Conditions

DOT Operated Fleets

Private Vehicles

Roadside Units
Maintenance Operations
Data/Information Flows

Central Systems

DOT Operated Fleets
Controlled by The DOTs

Roadside Units

Private Vehicles
Involve OEMs Or Private Fleets
## 16 Issues Considered by the V2I DC

<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>
</tr>
</thead>
<tbody>
<tr>
<td>Issue 1: V2X Applications</td>
<td>P</td>
<td>S</td>
<td>S</td>
<td>S</td>
<td>S</td>
</tr>
<tr>
<td>Issue 2: Complementary Communications to DSRC</td>
<td>N</td>
<td>P</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Issue 3: V2I Data</td>
<td>N</td>
<td>S</td>
<td>P</td>
<td>N</td>
<td>S</td>
</tr>
<tr>
<td>Issue 4: Patents-Intellectual Property</td>
<td>N</td>
<td>P</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Issue 5: Security</td>
<td></td>
<td></td>
<td></td>
<td>No action planned at this time</td>
<td></td>
</tr>
<tr>
<td>Issue 6: V2I Outreach</td>
<td>N</td>
<td>S</td>
<td>N</td>
<td>P</td>
<td>S</td>
</tr>
<tr>
<td>Issue 7: Understanding the Benefits and Costs of V2I Deployment and Operation</td>
<td>S</td>
<td>S</td>
<td>P</td>
<td>S</td>
<td>N</td>
</tr>
<tr>
<td>Issue 8: V2I Standards</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>P</td>
</tr>
<tr>
<td>Issue 9: Understanding V2I Liability Assignment</td>
<td>N</td>
<td>P</td>
<td>N</td>
<td>S</td>
<td>N</td>
</tr>
<tr>
<td>Issue 10: V2I Synergies with Other Emerging Technologies</td>
<td></td>
<td></td>
<td></td>
<td>No action planned at this time</td>
<td></td>
</tr>
<tr>
<td>Issue 11: V2I Consumer Messaging</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>P</td>
<td>N</td>
</tr>
<tr>
<td>Issue 12: V2I Multimodal Applications</td>
<td></td>
<td></td>
<td></td>
<td>No action planned at this time</td>
<td></td>
</tr>
<tr>
<td>Issue 13: Infrastructure Processes as V2I Obstacles</td>
<td>P</td>
<td>N</td>
<td>N</td>
<td>S</td>
<td>N</td>
</tr>
<tr>
<td>Issue 14: Federal V2I Policy Statement</td>
<td>P</td>
<td>N</td>
<td>N</td>
<td>S</td>
<td>N</td>
</tr>
<tr>
<td>Issue 15: Maintaining V2I Infrastructure</td>
<td>P</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
</tr>
<tr>
<td>Issue 16: Operator and OEM Goals for V2I</td>
<td>N</td>
<td>N</td>
<td>P</td>
<td>N</td>
<td>N</td>
</tr>
</tbody>
</table>
Upcoming V2I DC Activities Related to Maintenance Operations

- **OEM Workshop**
  - Opportunity to present vehicle & Infrastructure data needs and discuss availability

- **Maintenance Costs of Roadside Equipment**
  - September (tentative) Webinar

- **SPaT Challenge**
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 each state in the coming 3 years

• 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
The SPaT Challenge

What is needed to achieve this?

Anticipated Resources:

- Guidelines for selecting corridors
- Procurement guidance
- DSRC licensing information
- Installation guidance
- Estimated costs
- Identification of existing funding sources that agencies may consider
Questions?