

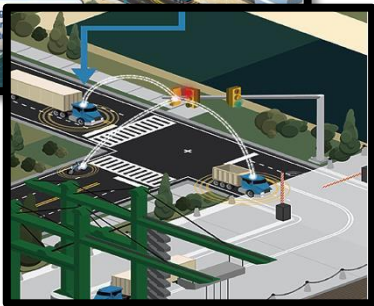
CV2: Minimum vs. Optimal Infrastructure Support for V2I - How Are Rural Infrastructure Needs Different Than Urban?

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

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Center for Urban Transportation Research (CUTR)
University of South Florida

October 4, 2016

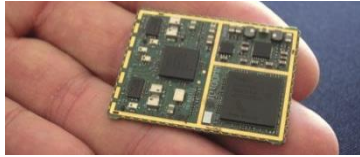


CV Infrastructure Deployment

- 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

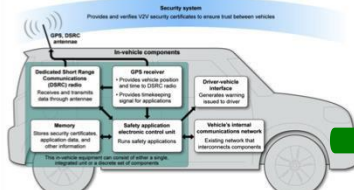
Technology



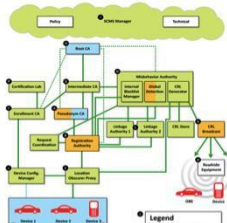
DSRC + Wireless



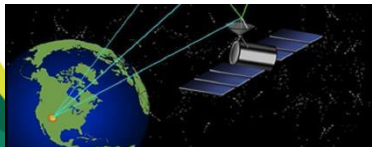
Roadside



Vehicle/OBU

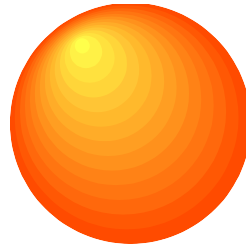


Security Layer



Location/GPS

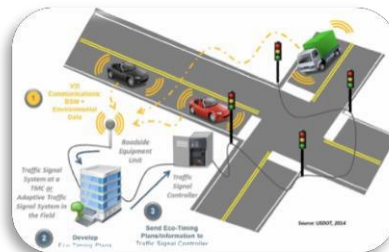
Management



Data Environment

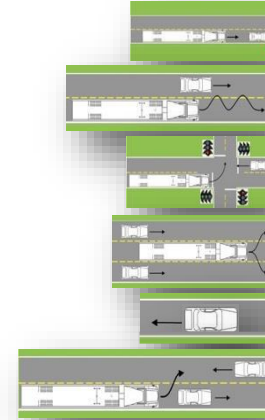


Management Strategies



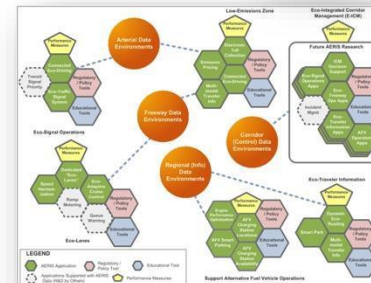
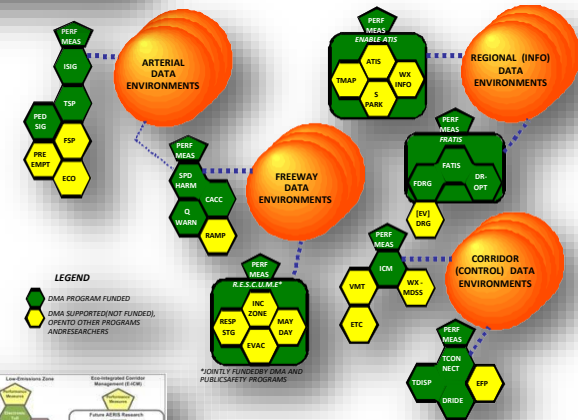
Application Engine

Applications



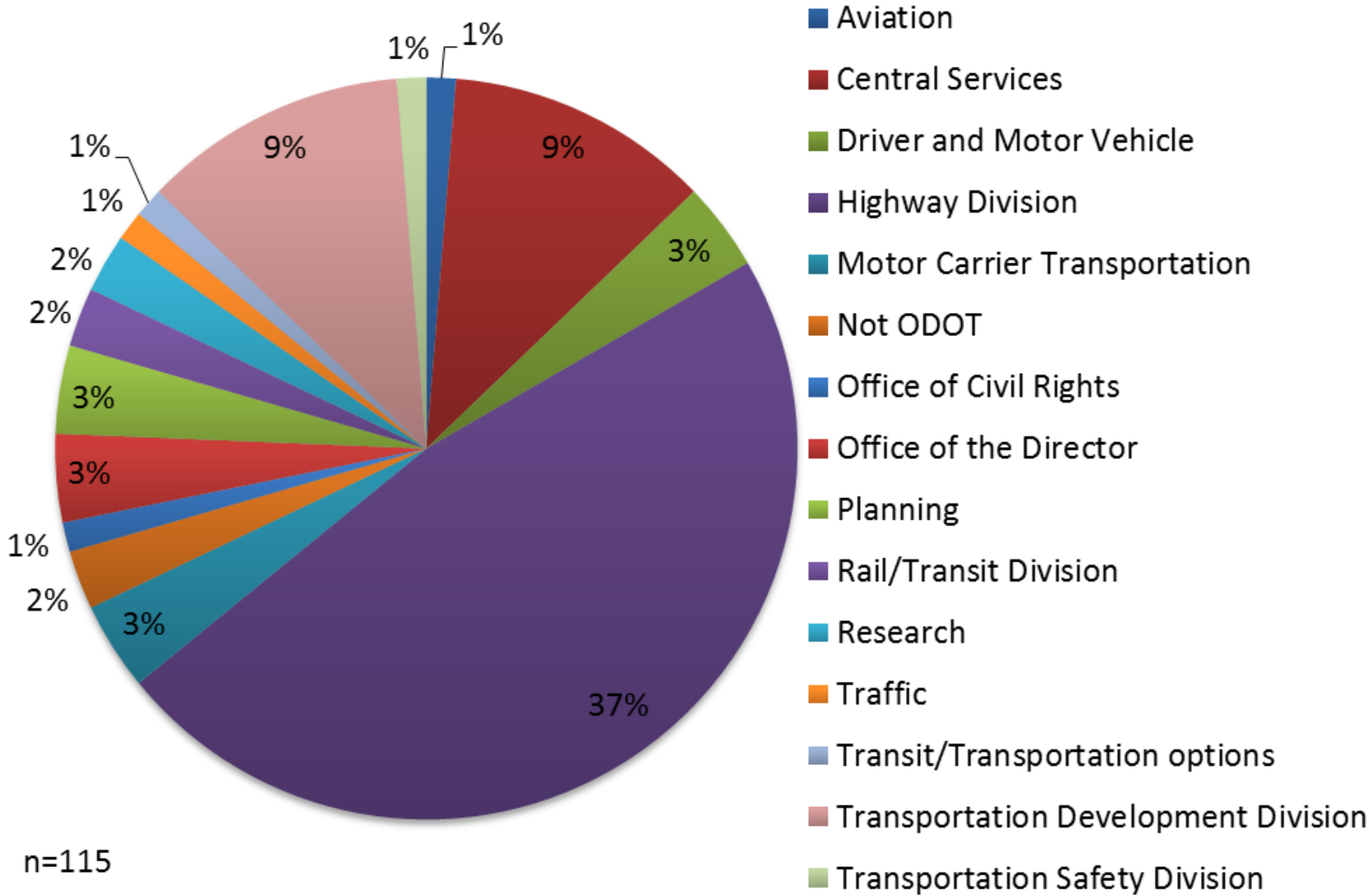
Safety

Mobility

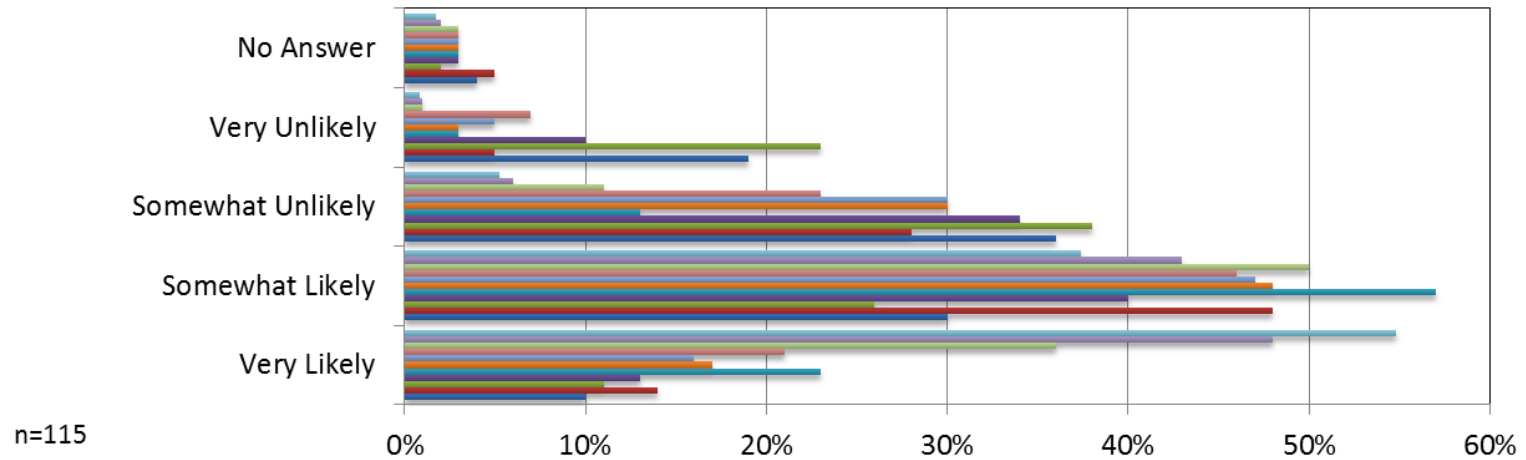


Environmental

Survey Respondents

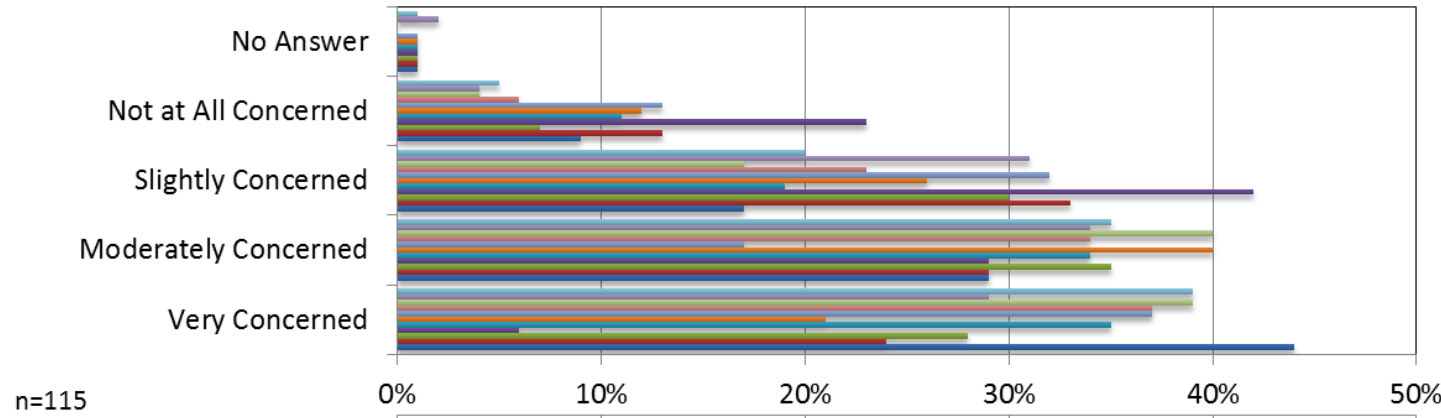


Connected Vehicle Benefits



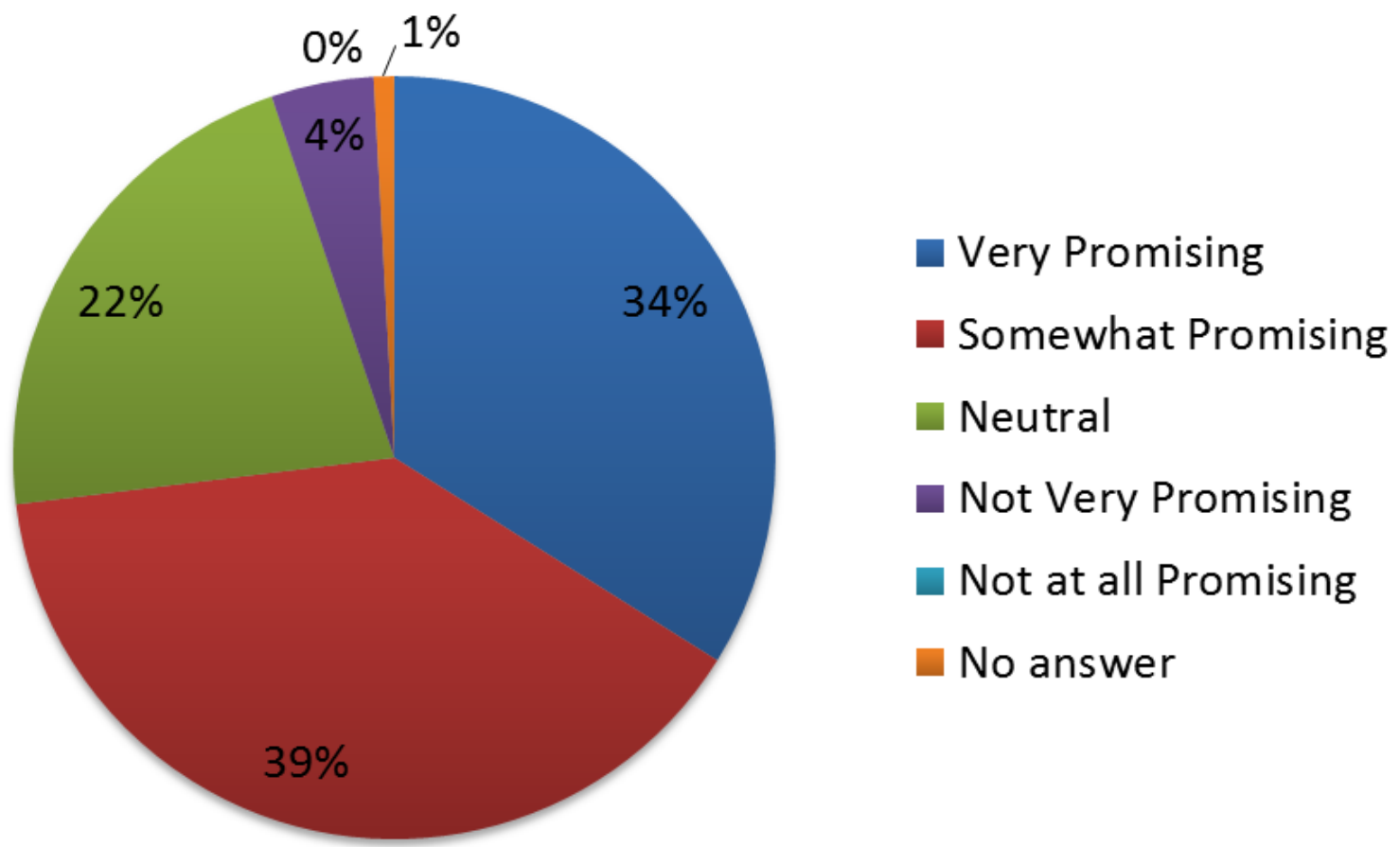
	Very Likely	Somewhat Likely	Somewhat Unlikely	Very Unlikely	No Answer
Reduced Crashes	55%	37%	5%	1%	2%
Reduced Crash Severity	48%	43%	6%	1%	2%
Improved Emergency Response	36%	50%	11%	1%	3%
Less Traffic Congestion	21%	46%	23%	7%	3%
Lower Vehicle Emissions	16%	47%	30%	5%	3%
Shorter Travel Times	17%	48%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

Connected Vehicle Issues

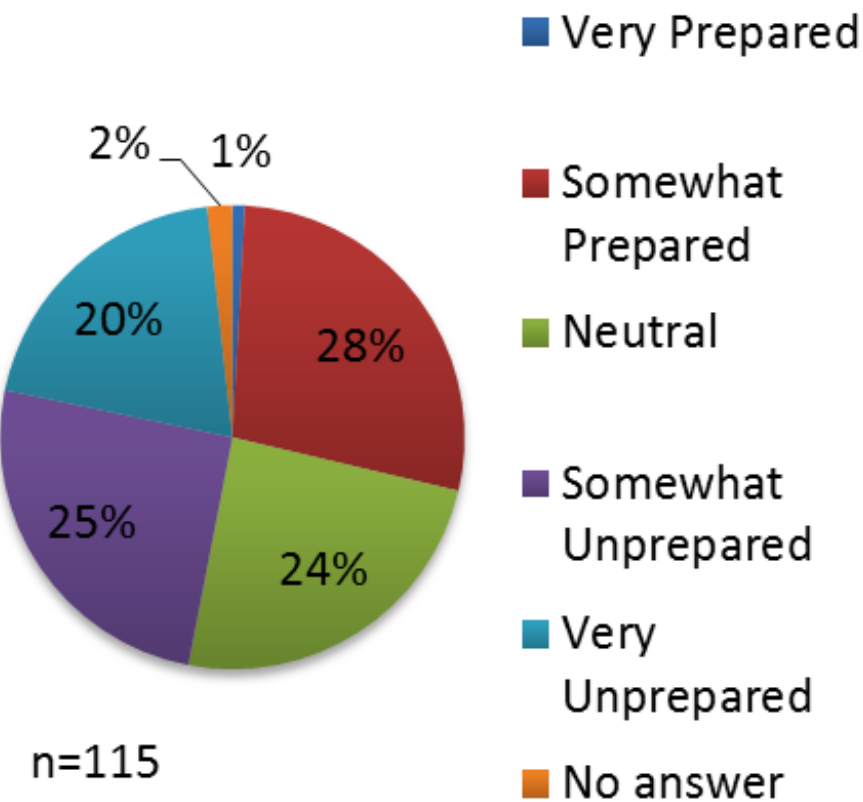


	Very Concerned	Moderately Concerned	Slightly Concerned	Not at All Concerned	No Answer
Impacts of Equipment/System Failure	39%	35%	20%	5%	1%
Legal Liability for Drivers/Owners	29%	34%	31%	4%	2%
System Cybersecurity	39%	40%	17%	4%	0%
Vehicle Cybersecurity	37%	34%	23%	6%	0%
Data Privacy	37%	17%	32%	13%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

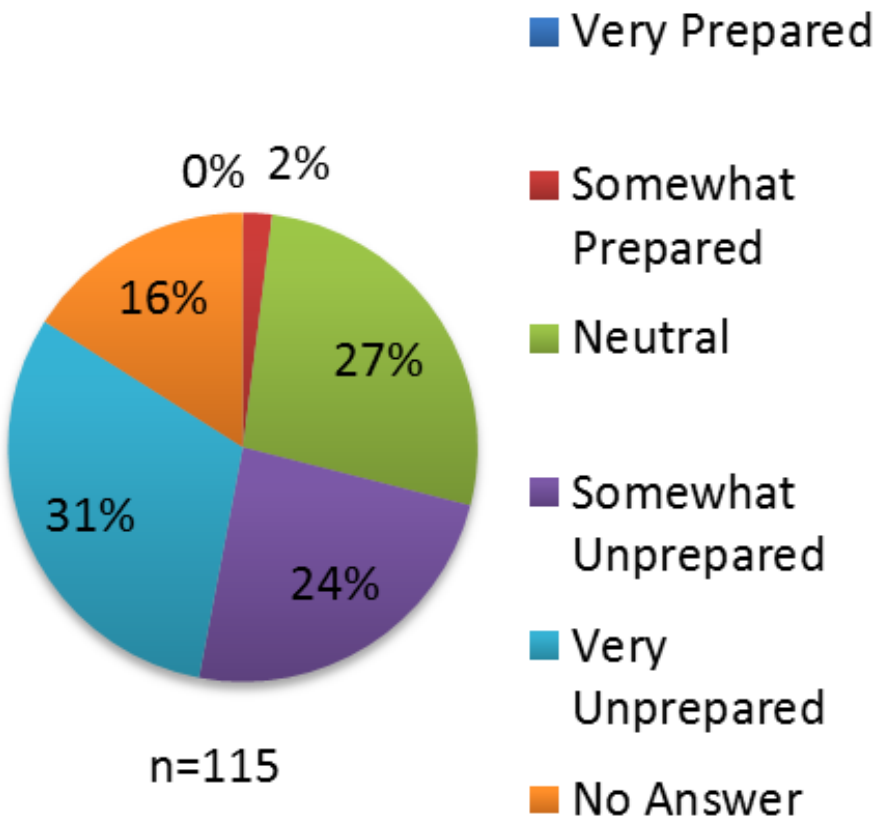
Connected Vehicle Infrastructure Development



Connected Vehicle Preparedness

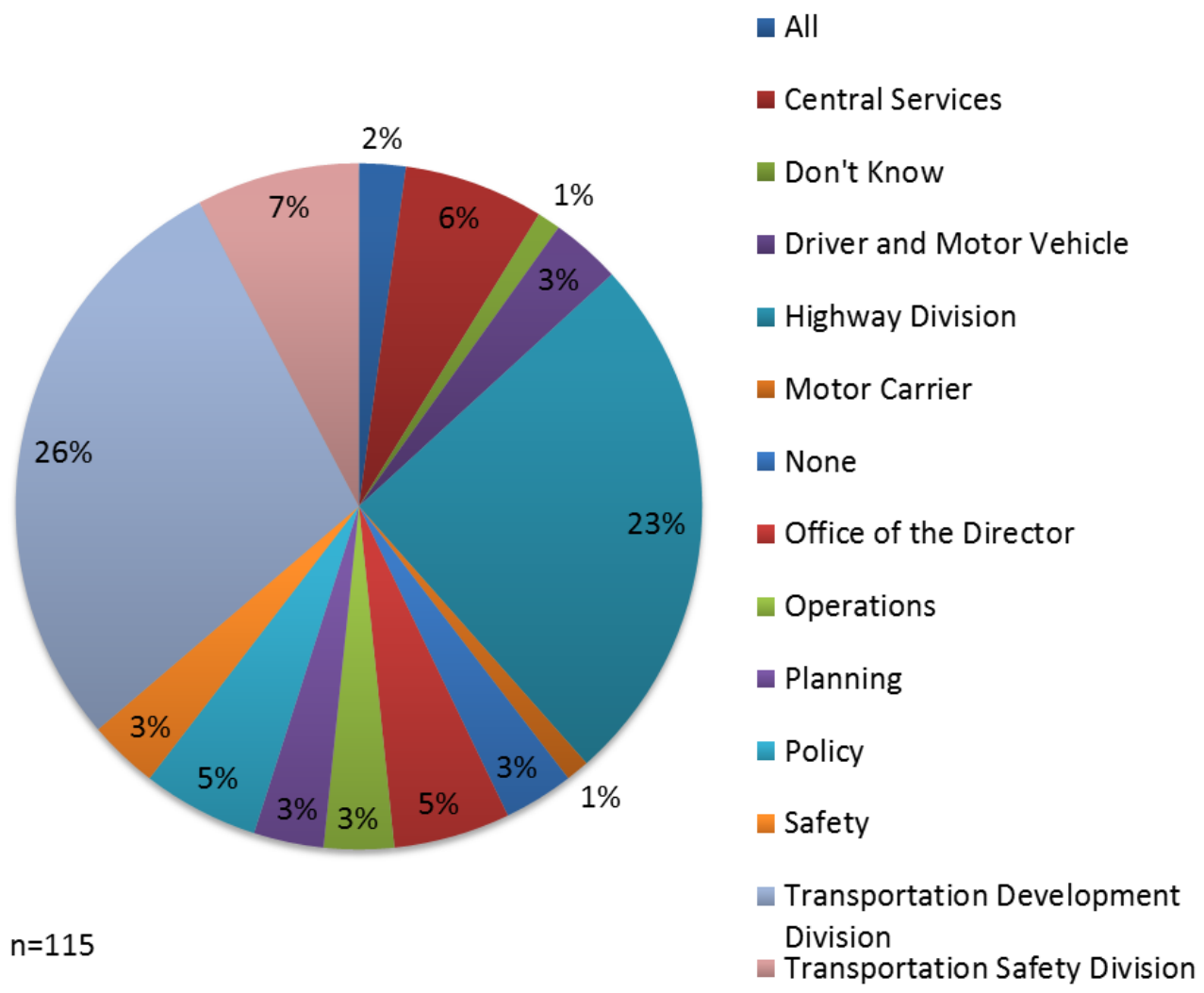


Cultural

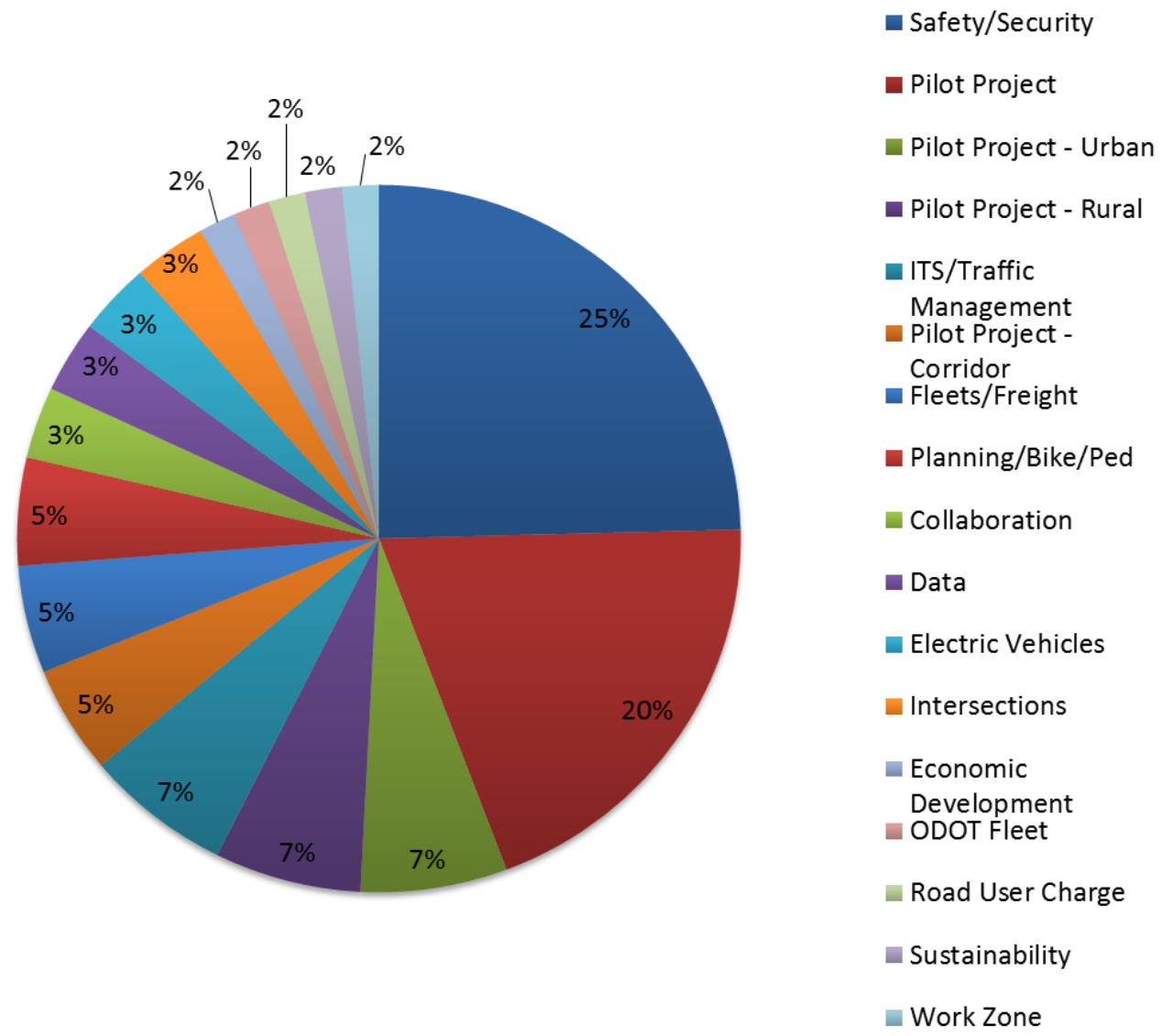


Technical

Connected Vehicle Division Priority



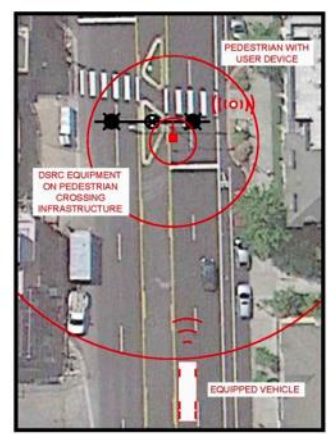
Connected Vehicle Pilot Priorities



Urban Intersection Footprint



1 INTERSECTION



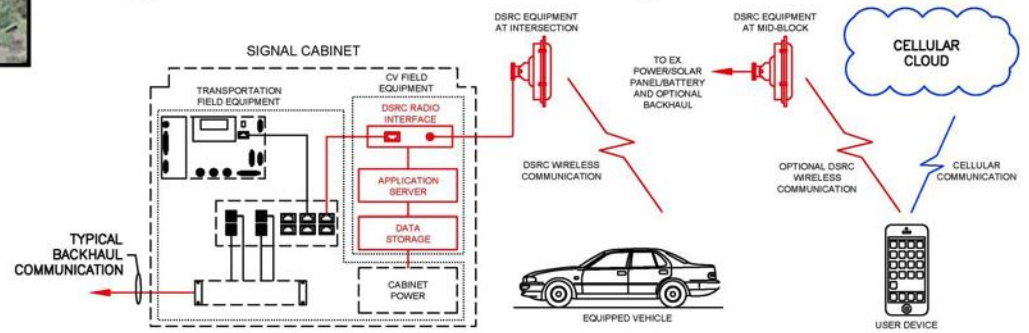
2 MID-BLOCK (OPTIONAL)



1 INTERSECTION INSTALLATION



2 OPTIONAL MID-BLOCK PEDESTRIAN CROSSING



3 COMMUNICATION AND POWER SCHEMATIC

LEGEND

- Existing Mast Arm
- Existing Cabinets
- DSRC Radio
- DSRC Comm.

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

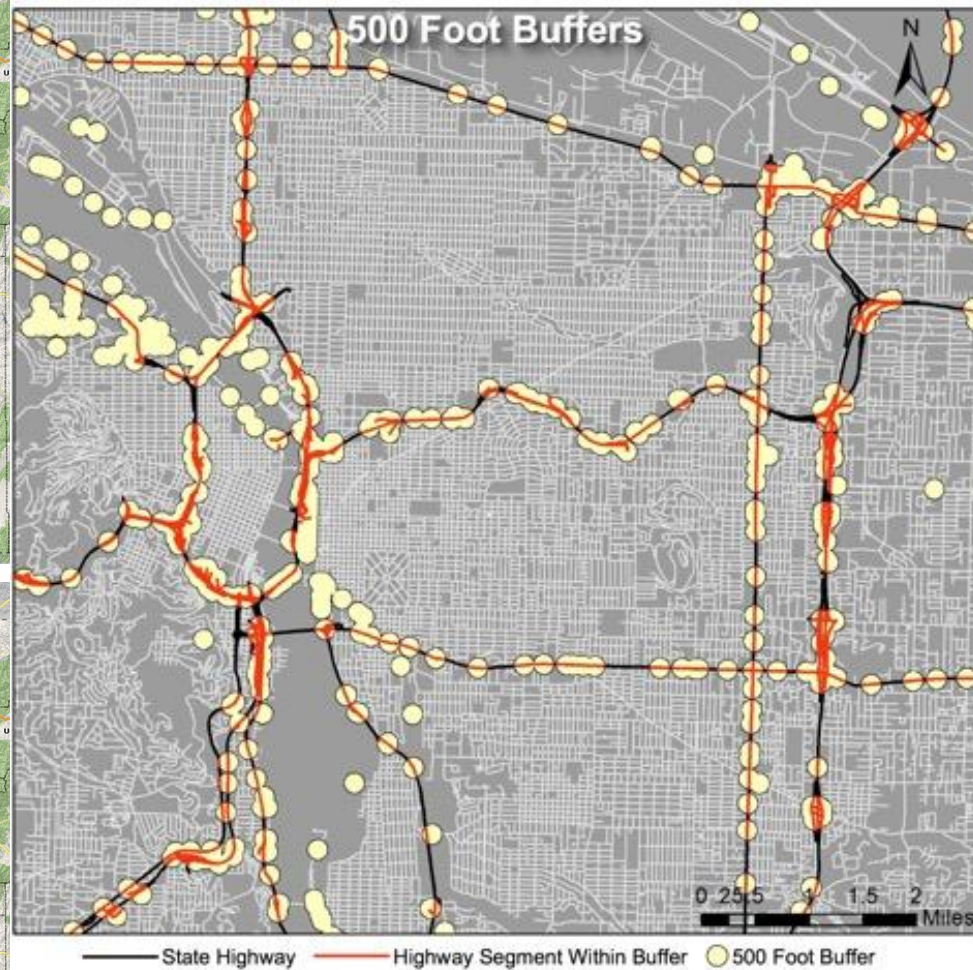
Urban Intersection Deployment Concept

NOT FOR CONSTRUCTION

AASHTO
THE VOICE OF TRANSPORTATION

ITS Footprint

1955 Signals

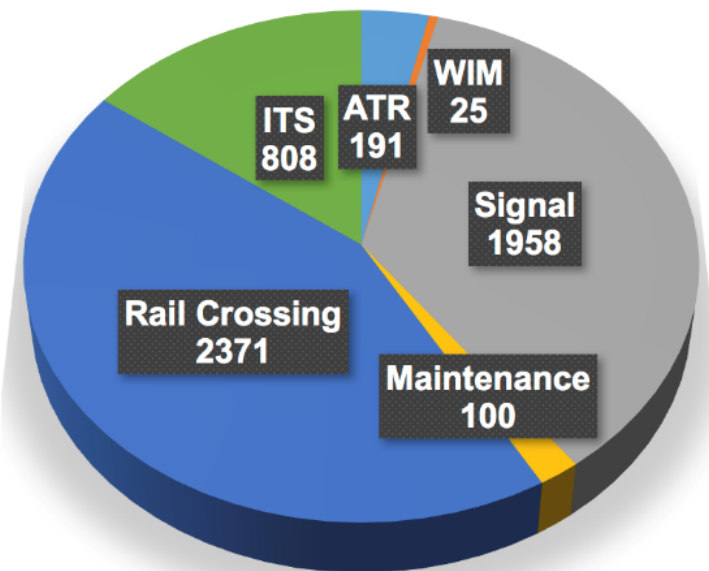


500 ft diameter buffers

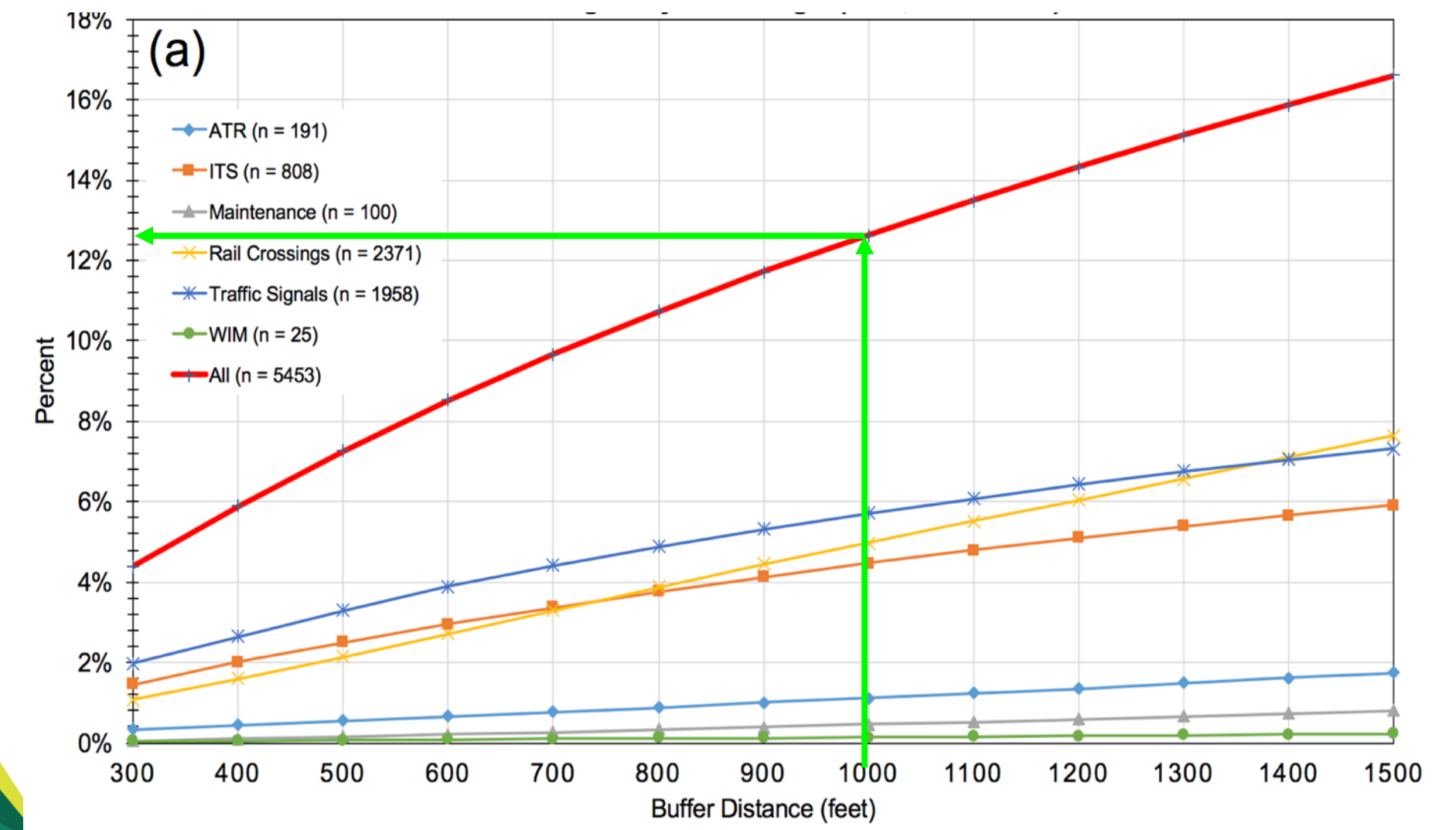
805 ITS Equipment + 22 Weigh Stations

Category	Quantity	Date
Miles of Highway	8,300	2013
Million Vehicle Miles Traveled Daily	55	2012
Intelligent Transportation System (ITS) Assets	808	2014
• Closed Circuit Television (CCTV)	• 276	
• Collision Warning System	• 9	
• Detector Station	• 51	
• Highway Advisory Radio Sign	• 22	
• Highway Advisory Radio Beacon	• 53	
• Ramp Meter	• 143	
• Ramp Gate	• 2	
• Road Weather Information System	• 96	
• Sensor	• 6	
• Snow Zone Sign	• 17	
• Vehicle Alert System	• 10	
• Variable Message Sign	• 106	
• Variable Speed Limit Sign	• 5	
• Flood Sensor	• 12	
Traffic Signals	1,958	2013
Weigh in Motion (WIM) Sites	25	2013
Automatic Traffic Recorder (ATR) Stations	191	2014
Rail Crossings	2,371	2014
ODOT Maintenance Stations	100	2012
TOTAL	5,453	

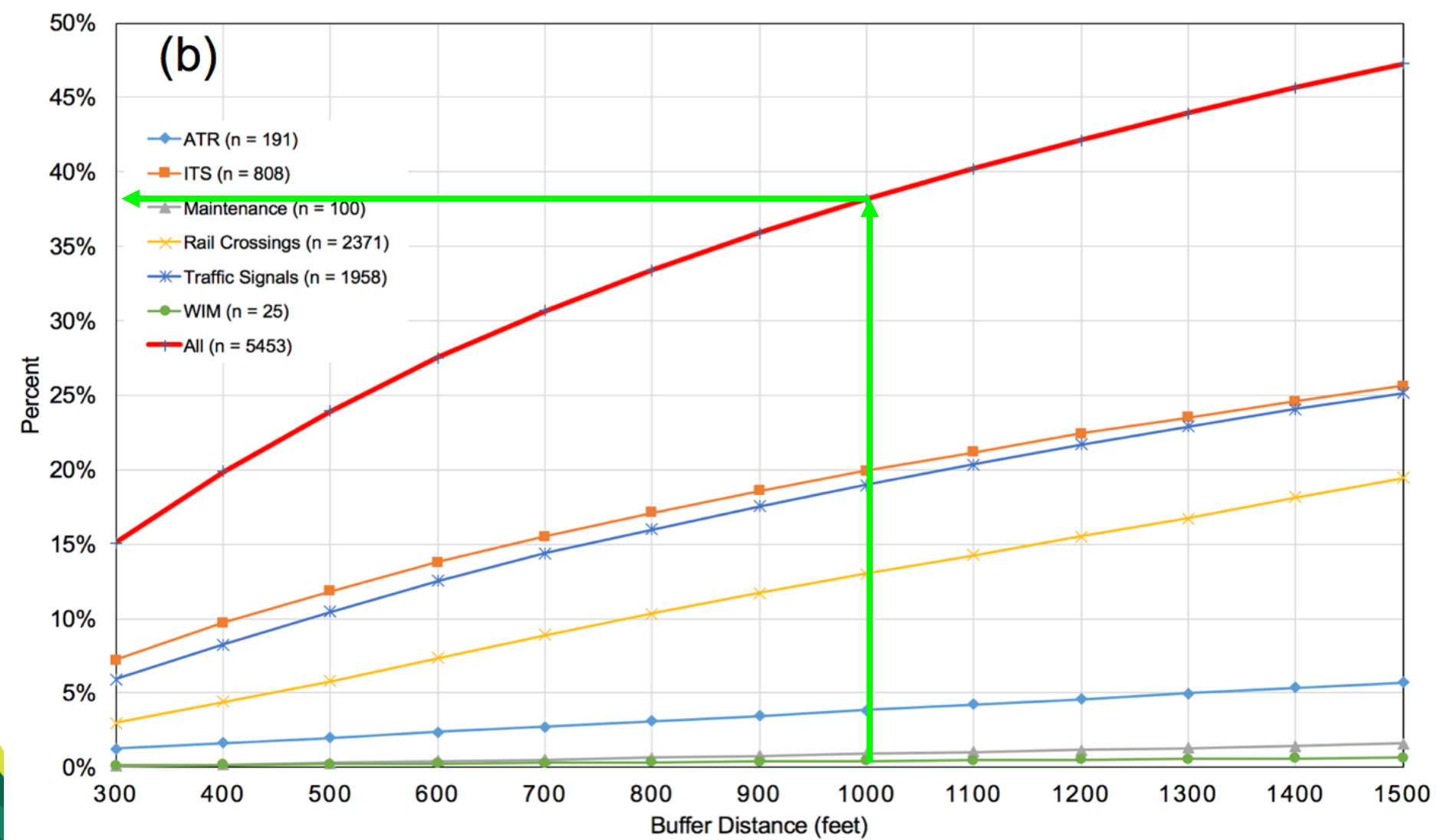
Potential Sites for V2I Devices
(n=5453)



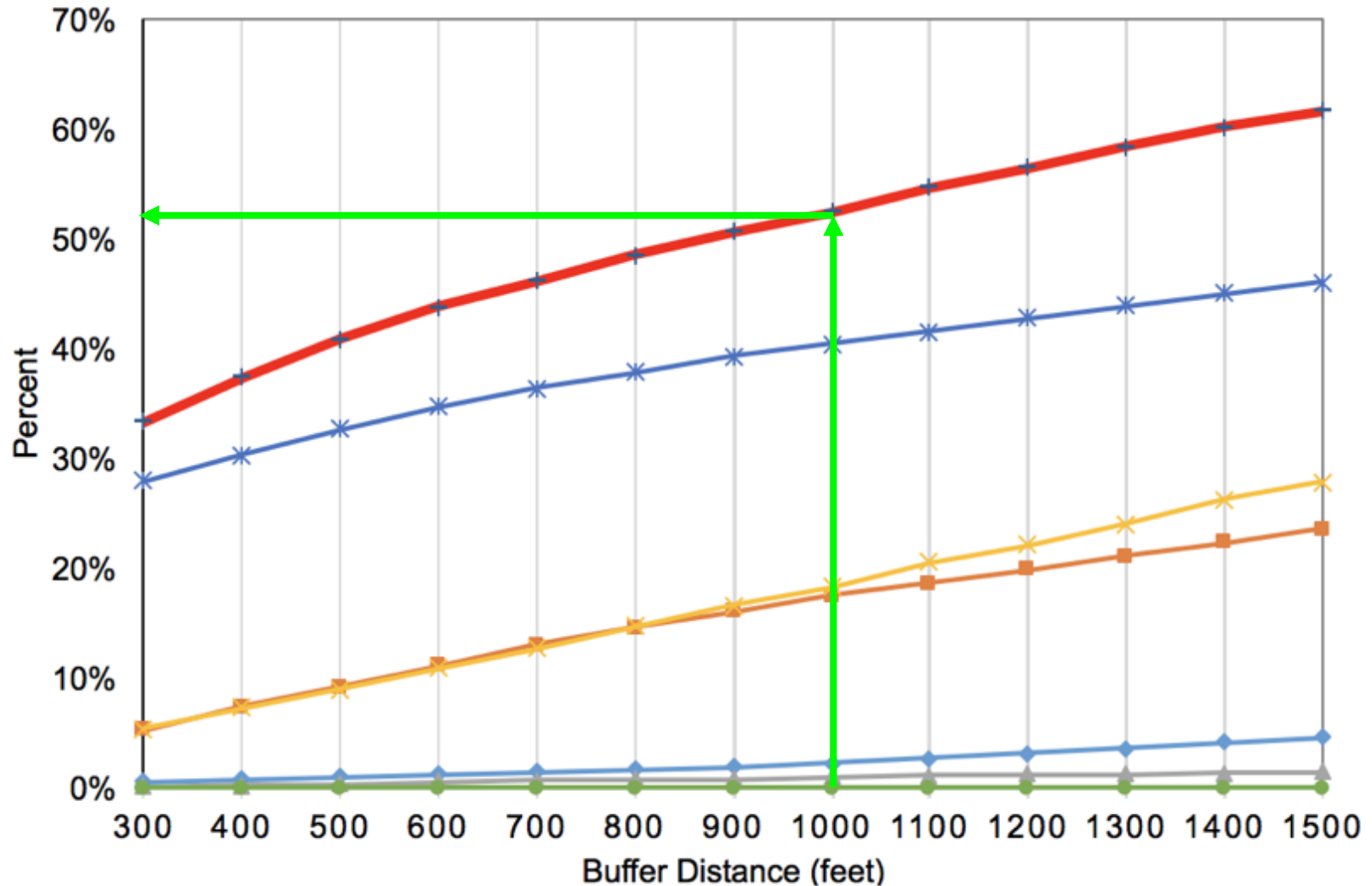
State Highway Coverage (8,300 miles)



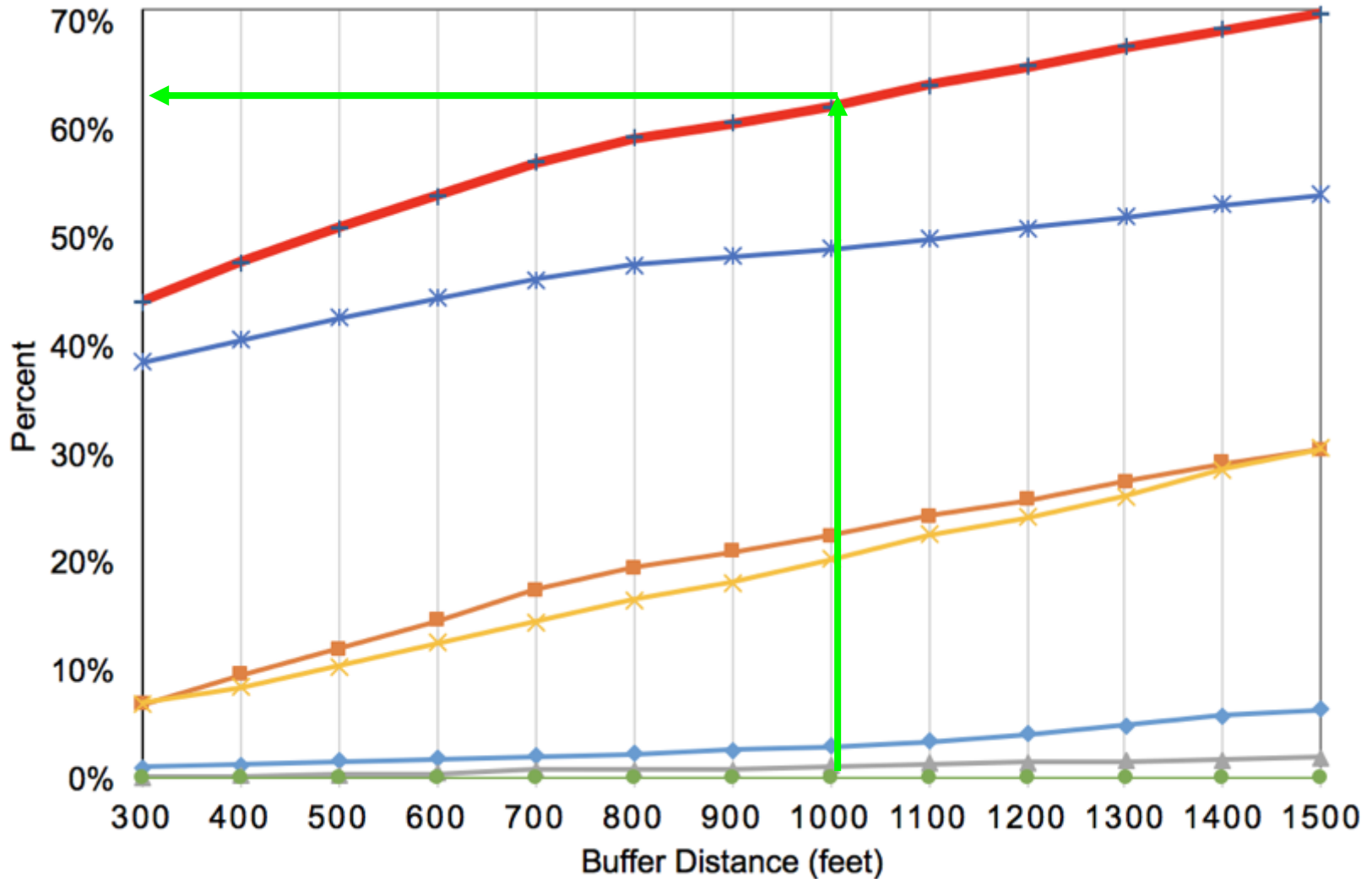
Daily VMT Percentage (54 million veh-mi)



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

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)
Response, Incident, Emergency (RESCUME)
Incident Guidance Emergency Response (RESP-STG)
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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

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)

Smart Roadside

Wireless Inspection
Smart Truck Parking

CONNECTED VEHICLE APPLICATIONS

V2I Safety

Signal Phase & Timing (SPAT)

Red Light Violation Warning

Curve Speed Warning

Stop Sign Gap Assist

Spot Weather Impact Warning

Pedestrian Warning

V2V Safety

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Smart Roadside

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Smart Truck Parking

CONNECTED VEHICLE APPLICATIONS

V2I Safety

Environment

Mobility

Signal Phase & Timing (SPAT)
 Red Light Violation/**Driver Gap** Warning
 Curve Speed Warning
 Stop Sign **Violation**/Gap Assist
 Spot Weather Impact Warning
 Pedestrian Warning
Railroad Crossing Warning
Disabled/Oversized Vehicle Warning

Eco-Approach/Departure Intersections
 Eco-Traffic Signal Timing
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V2V Safety

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Motorist Advisories & Warnings (MAW)
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 Vehicle Data Translator
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Tolling
High Occupancy Toll Lanes
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 Smart Truck Parking

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V2I Safety

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Safety Pilot

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 Disabled/Oversized Vehicle 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 Performance Measures
 CV-enabled Turning/Intersection Analysis
 CV-enabled O-D Studies
 Work Zone Traveler Information

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
 Dynamic Emissions Pricing

Road Weather

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

Fee Payment

Tolling
 High Occupancy Toll Lanes
 Congestion Pricing

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)
 Next Generation Ramp Metering (RAMP)
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 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)
 Red Light Violation/Driver Gap Warning
 Curve Speed Warning

Spot Weather Impact Warning
 Pedestrian Warning
 Railroad Crossing Warning
 Disabled/Oversized Vehicle Warning

V2V Safety

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 Eco-Traffic Signal Priority

Eco-Lanes Management
 Eco-Speed Harmonization

Eco-Traveler Information
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V2V Safety

Environment

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Eco-Traffic Signal Timing
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Vehicle Classification Traffic Studies
CV-enabled Performance Measures
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CV-enabled O-D Studies
Work Zone Traveler Information

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Vehicle Data Translator
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CONNECTED VEHICLE APPLICATIONS

V2I Safety

Signal Phase & Timing (SPAT)

Curve Speed Warning

Spot Weather Impact Warning

Railroad Crossing Warning

Disabled/Oversized Vehicle Warning

V2V Safety

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Eco-ICM Decision Support System

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Wireless Inspection

Smart Truck Parking

CONNECTED VEHICLE APPLICATIONS

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Curve Speed Warning
Spot Weather Impact Warning
Railroad Crossing Warning
Disabled/Oversized Vehicle Warning

Environment

AFV Charging/Fueling Information
Eco-ICM Decision Support System

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V2V Safety

Agency Data

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Road Weather

Motorist Advisories & Warnings (MAW)
Enhanced Maintenance Decision Support

Fee Payment

Tolling
High Occupancy Toll Lanes
Congestion Pricing

Smart Roadside

Wireless Inspection
Smart Truck Parking

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

Fee Payment

- Road User Charging
- Tolling/HOT Lanes/Congestion Pricing

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)

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

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

Close Look: Safety Applications

V2I Safety

Signal Phase & Timing (SPAT)

Red Light Violation/Driver Gap Warning

Curve Speed Warning

Stop Sign Violation/Gap Assist

Spot Weather Impact Warning

Pedestrian Warning

Railroad Crossing Warning

Disabled/Oversized Vehicle 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

Close Look: Mobility Applications

Mobility

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Intelligent Traffic Signal System (I-SIG)

Signal Priority (Transit & Freight)

Mobile Accessible Pedestrian Signal (PED-SIG)

Emergency Vehicle Preemption (PREEMPT)

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Dynamic Ridesharing (D-RIDE)

Freight Advanced Traveler Information (FRATIS)

Freight Dynamic Travel Planning & Performance

Drayage Optimization

Close Look: Agency/BizOps Applications

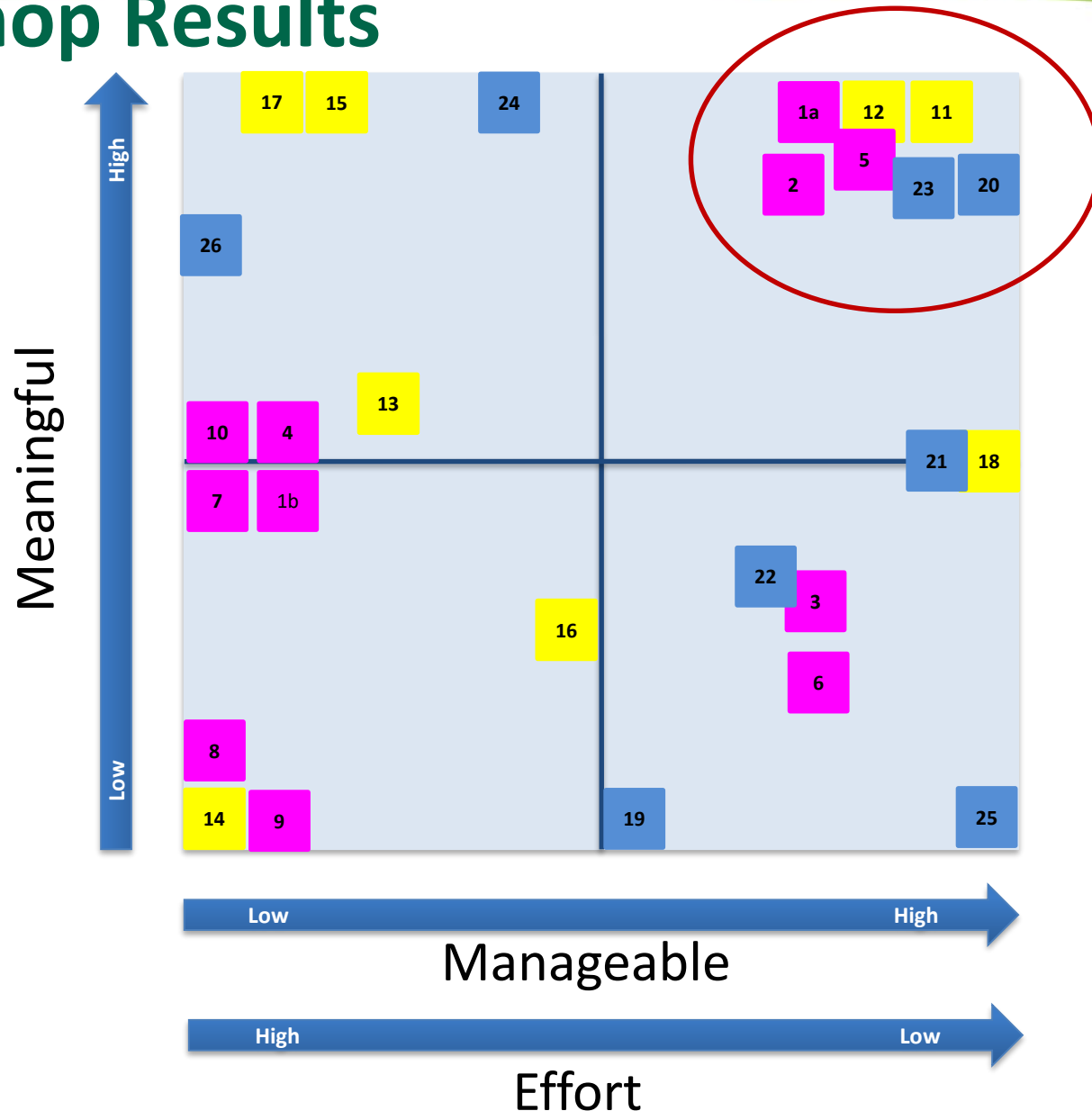
Agency Data

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

Smart Roadside

- Wireless Inspection
- Smart Truck Parking

Workshop Results



Near Term Focus for ODOT

Number	Connected Vehicle Application	Impact/ Benefit	Effort
1a	Advanced Traveler Information System (Enable/ATIS) Deliver	5	5
2	Dynamic Speed Harmonization (SPO-HARM)	4	4
5	Freight Dynamic Travel Planning & Response	5	5
11	Signal Phase and Timing (SPAT)	5	5
12	Curve Speed Warning	5	5
20	Probe-enabled Traffic Monitoring	5	5
23	Motorist Advisories & Warnings (MAW)	5	4

ODOT Should Monitor, Possibly Collaborate, Leadership by Others

Number	Connected Vehicle Application	Impact/ Benefit	Effort
1b	Advanced Traveler Information System (Enable/ATIS) gather access?	3	1
4	Next Generation Ramp Metering (RAMP)	3	1
7	Eco-ICM Decision Support System	3	1
10	Congestion Pricing (with road user charge)	3	1
13	SPOT Weather Impact Warning	4	2
15	Disable/Oversized Vehicle Warning	5	2
17	Incident Scene Work Zone Alerts (INC-ZONE)	5	2
18	Emergency Communications/Evacuation	3	5
19	Probe-based Pavement Maintenance	1	3
22	Work Zone Traveler Information	2	4
24	Enhanced Maintenance Decision Support	5	2
26	Smart Truck Parking	4	2

Leadership by Others, ODOT Monitor

Number	Connected Vehicle Application	Impact/ Benefit	Effort
3	Queue Warning (Q-WARN)	2	4
6	AFV Charging/Fueling Information	2	4
8	Tolling	1	1
9	HOT Lanes	1	1
14	Railroad Crossing Warning	1	1
16	Incident Guidance Emergency Response	2	3
21	CV-enabled Performance Measures	3	5
25	Wireless Inspection	1	5

CV Roadmap

94 Actions

12 Categories

Priority	Lower	Medium	Higher
	○	◐	●
Timing	Shorter-term	Medium-term	Longer-term
	■▶	■▶▶	■▶▶▶
Cost	Lower	Medium	Higher
	\$	\$\$	\$\$\$

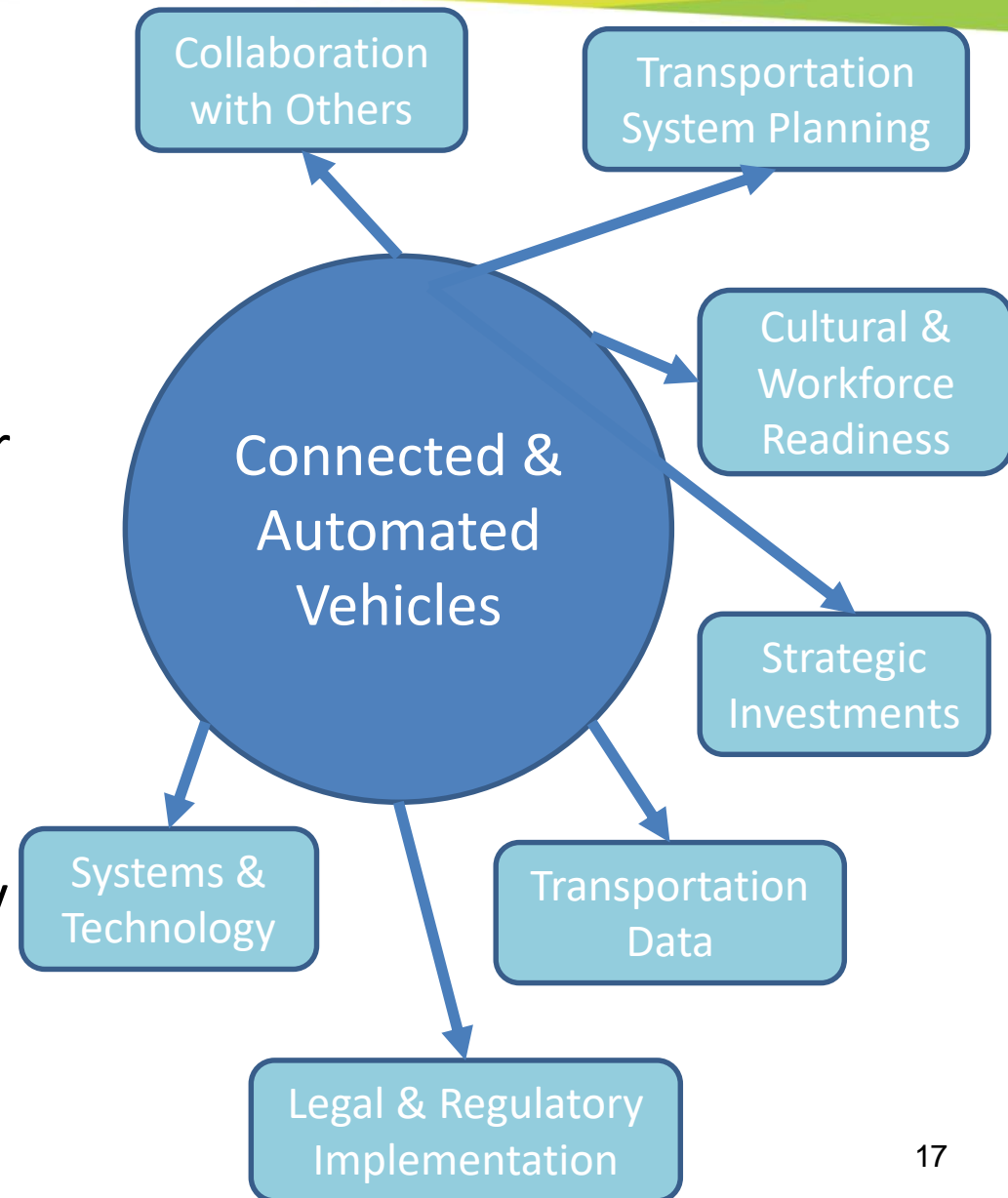
- DSRC and Backhaul Communications
- Education and Outreach
- Policy and Communications/Collaboration
- Benefits/Business Case
- Data Management and Strategies
- Applications
- Try Things
- Research Questions/Challenges
- Planning and Equity
- Multimodal
- Design and Construction
- Operations and Maintenance

Planning and Equity				Priority	Timing	Cost
patterns choices						
▪ Medium term: vehicle ownership and usual mode choices and household level choices						
▪ Longer term: lifestyle, residential and work locations, and						
Operations and Maintenance				Priority	Timing	Cost
▪ Operational Analysis: determine and plan for how highways will perform with an increasing level of CV proportion of the fleet. Determine whether capacity will increase.				●	■▶▶	\$
DSRC and Backhaul Communications				Priority	Timing	Cost
▪ Communications Plan: Identify CV communication needs for V2I priorities that will ensure robust communications, in the context of existing statewide communications network (including				●	■▶	\$
Policy and Communications/Collaboration				Priority	Timing	Cost
▪ Internal Coordination: Establish internal ODOT working group to focus on CV policy and deployment issues.				●	■▶	\$\$
▪ Success: ODOT Formed CAV Steering Committee in 2015.						\$\$
▪ Staffing: Designate a specific individual within ODOT to be responsible for CV.						\$\$
Success: ODOT hired Connected, Automated, and Electric Vehicle (CAEV) Program Manager (Operations and Policy Analyst 3) in 2016 to serve as the agency's subject matter expert on connected and autonomous vehicle (CAV) policy and legislation. Among other things, this position will coordinate the flow of information within ODOT, including leading the CAV agency steering committee, make recommendations on CAV policy and legislation for Oregon, and manage implementation of the agency's strategic framework implementation for connected and autonomous vehicles, including tracking and reporting on progress.				●	■▶	\$\$
▪ Staffing: Add technical CV staff in addition to program manager/policy analyst.				●	■▶▶	\$\$

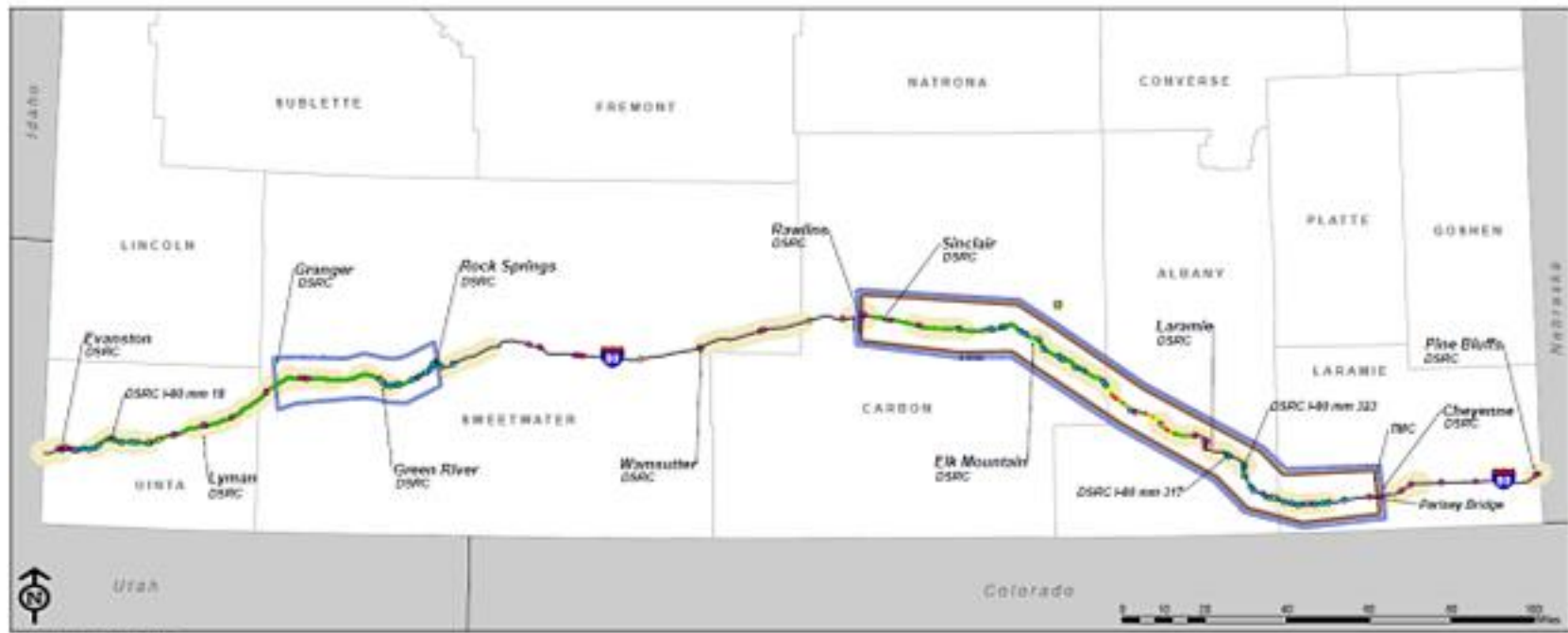
Outcomes

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



Wyoming CV Pilot



CHS/MS/MSM DMR 2/2015



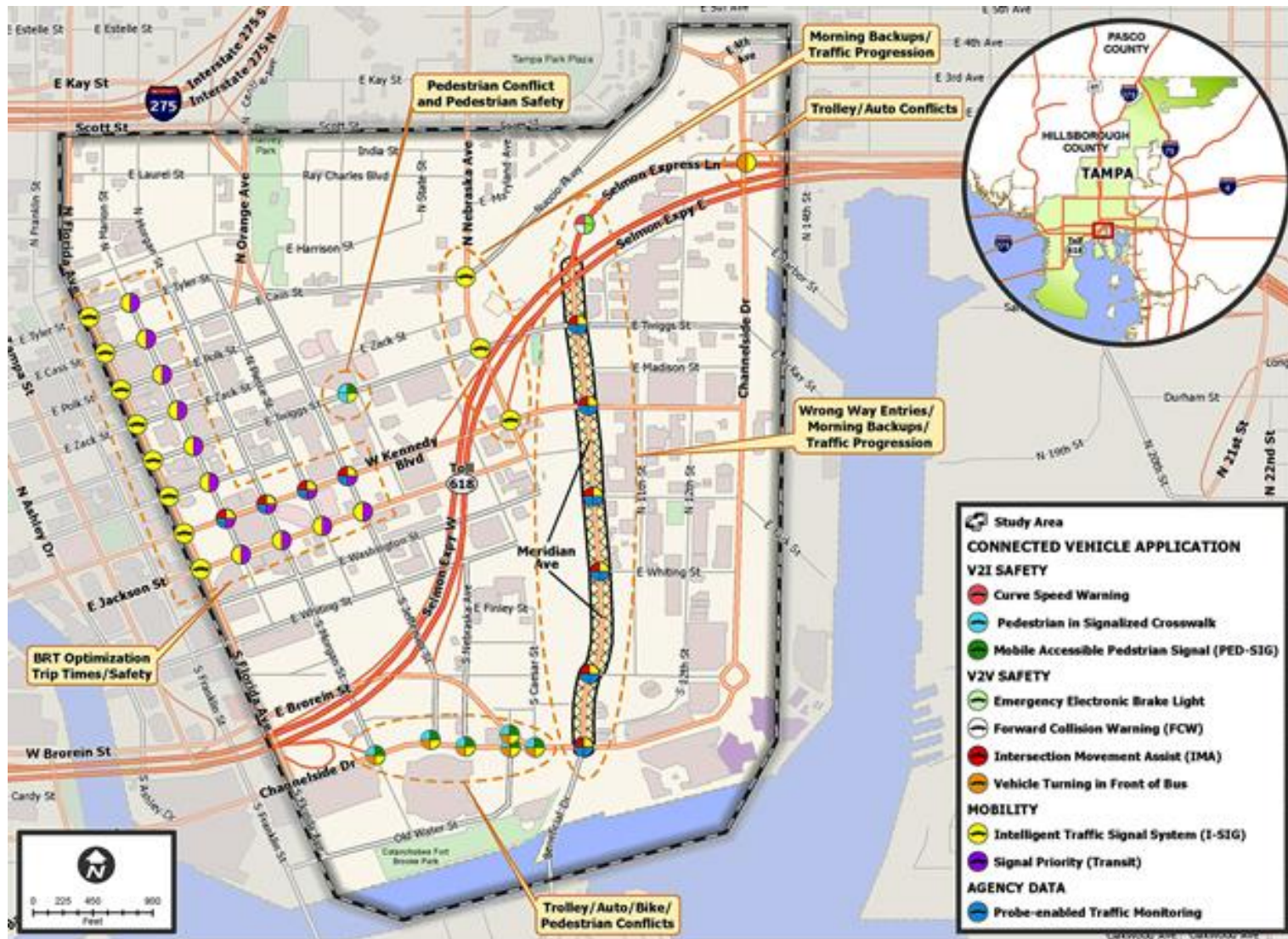
The State of Wyoming and its agencies make no warranty or representation as to the map and the data it displays. Users of this information should verify or consult the primary data and information sources to ensure the accuracy and validity of the information. The State of Wyoming and its agencies assume no liability associated with the use or misuse of this information and specifically retain sovereign immunity and all services available to traveling law.

Legend

- High Profile Wind Warning Area
- AVL/Teletest Snow Flows
- STIP Areas 2015-2018
- WyoLink - Signal Strength
 - Good
 - Spotty
 - Unreliable
- I-80, Wyoming
- Possible Locations Roadside OSRC (Going into/out of each town off I-80 for supporting VSL Application. These include locations with mile labels)
- WiFi Locations (9 within 500 ft of I-80)
- VSL Devices (122 on I-80)
- Truck Parking (55 on I-80)



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."

http://www.oregon.gov/ODOT/TD/TP_RES/pages/ResearchReports.aspx
rbertini@usf.edu

V2I Deployment Coalition

V2I DC

Overview and Early Findings

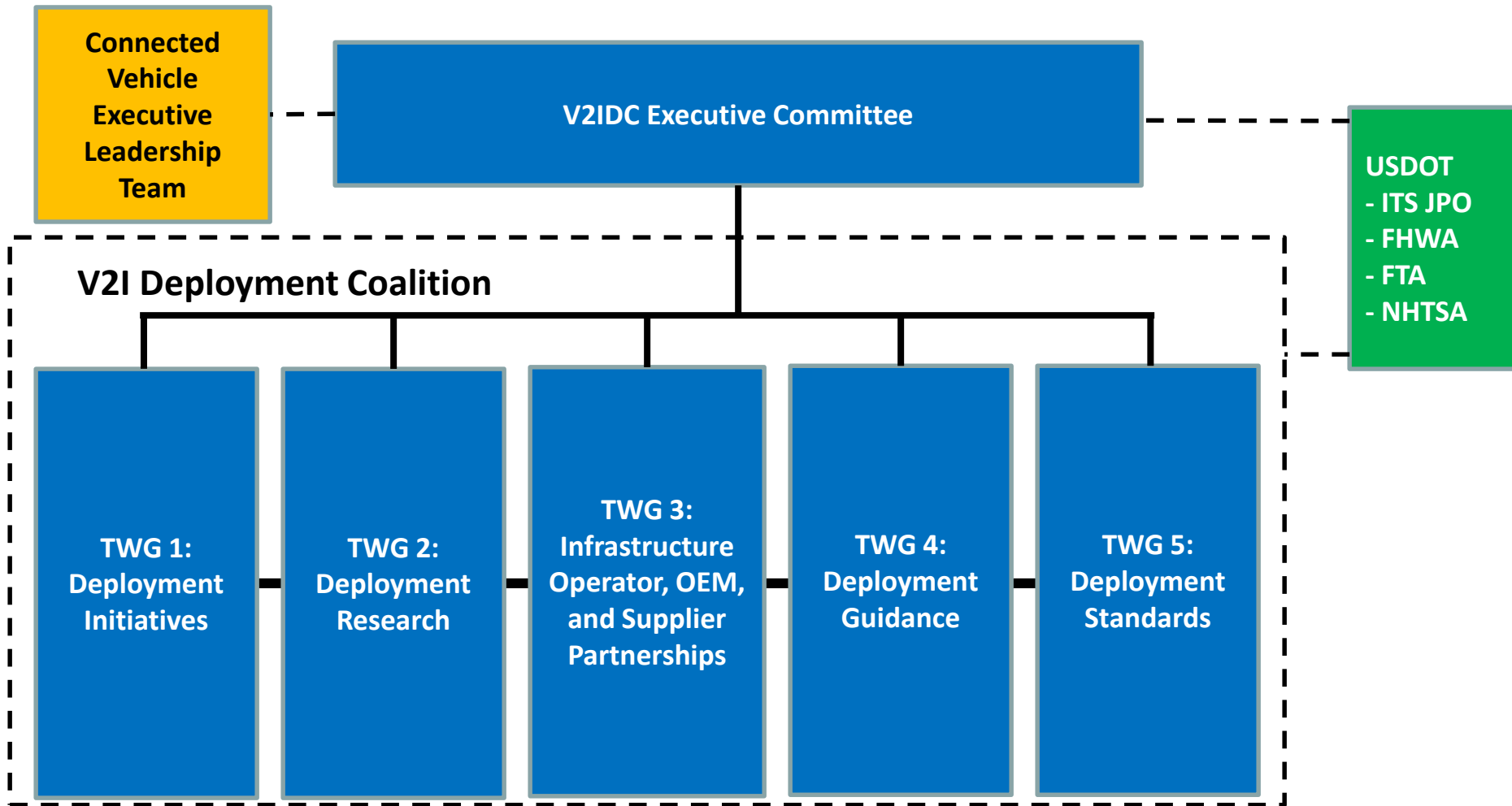
Topics

- 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



TWG Chairs & Co-Chairs

TWG	Chair	Co-Chair
TWG 1: Initiatives	Bill Legg, WSDOT	Joe Averkamp, Xerox
TWG 2: Research	Greg Larson, Caltrans	Rob Bertini, CUTR
TWG 3: Partners	Matt Smith, MDOT	Roger Berg, Denso
TWG 4: Guidance	Faisal Saleem, MCDOT	Navin Katta, Savari
TWG 5: Standards	Ed Seymour, Texas A&M	Gary Duncan, Econolite

16 Deployment Issues Identified

Issue	TWG 1 Initiatives	TWG 2 Research	TWG 3 Partners	TWG 4 Guidance	TWG 5 Standards
Issue 1: V2X Applications	P	S	S	S	S
Issue 2: Complementary Communications to DSRC	N	P	N	N	N
Issue 3: V2I Data	N	S	P	N	S
Issue 4: Patents-Intellectual Property	N	P	N	N	N
Issue 5: Security	No action planned at this time				
Issue 6: V2I Outreach	N	S	N	P	S
Issue 7: Understanding the Benefits and Costs of V2I Deployment and Operation	S	S	P	S	N
Issue 8: V2I Standards	N	N	N	N	P
Issue 9: Understanding V2I Liability Assignment	N	P	N	S	N
Issue 10: V2I Synergies with Other Emerging Technologies	No action planned at this time				
Issue 11: V2I Consumer Messaging	N	N	N	P	N
Issue 12: V2I Multimodal Applications	No action planned at this time				
Issue 13: Infrastructure Processes as V2I Obstacles	P	N	N	S	N
Issue 14: Federal V2I Policy Statement	P	N	N	S	N
Issue 15: Maintaining V2I Infrastructure	P	N	N	N	N
Issue 16: Operator and OEM Goals for V2I	N	N	P	N	N

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

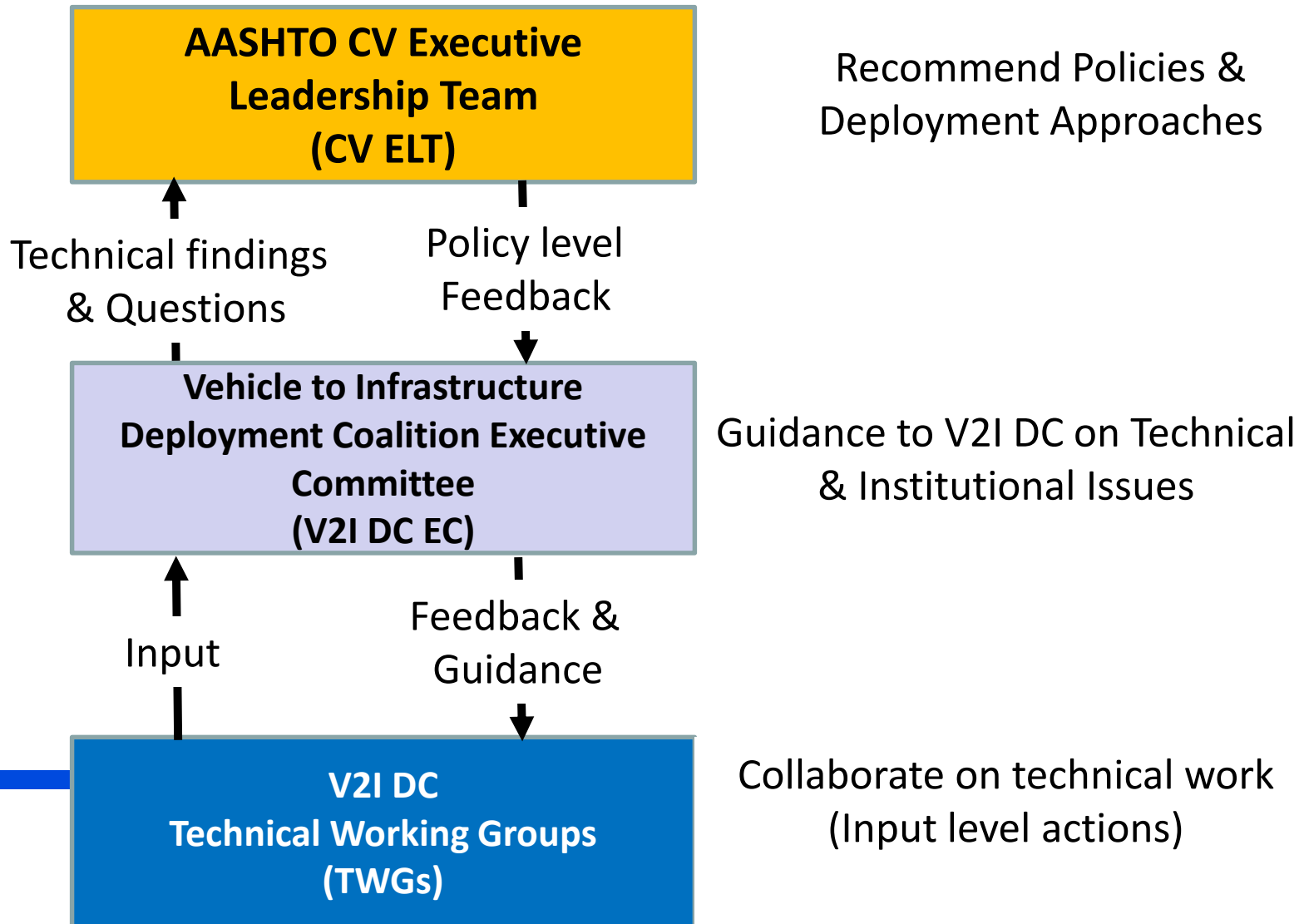
CAV ELT Roster

Entity	# of Members
USDOT	7 Liaisons
State DOTs	15 members
Local Governments	5 members
AASHTO	3 members
ITE / ITS America	1 member each
Automotive Industry	20+ members
TRB	1 member
NACO / NACTO / IBTTA / VII / AAMVA/ Others	9 members

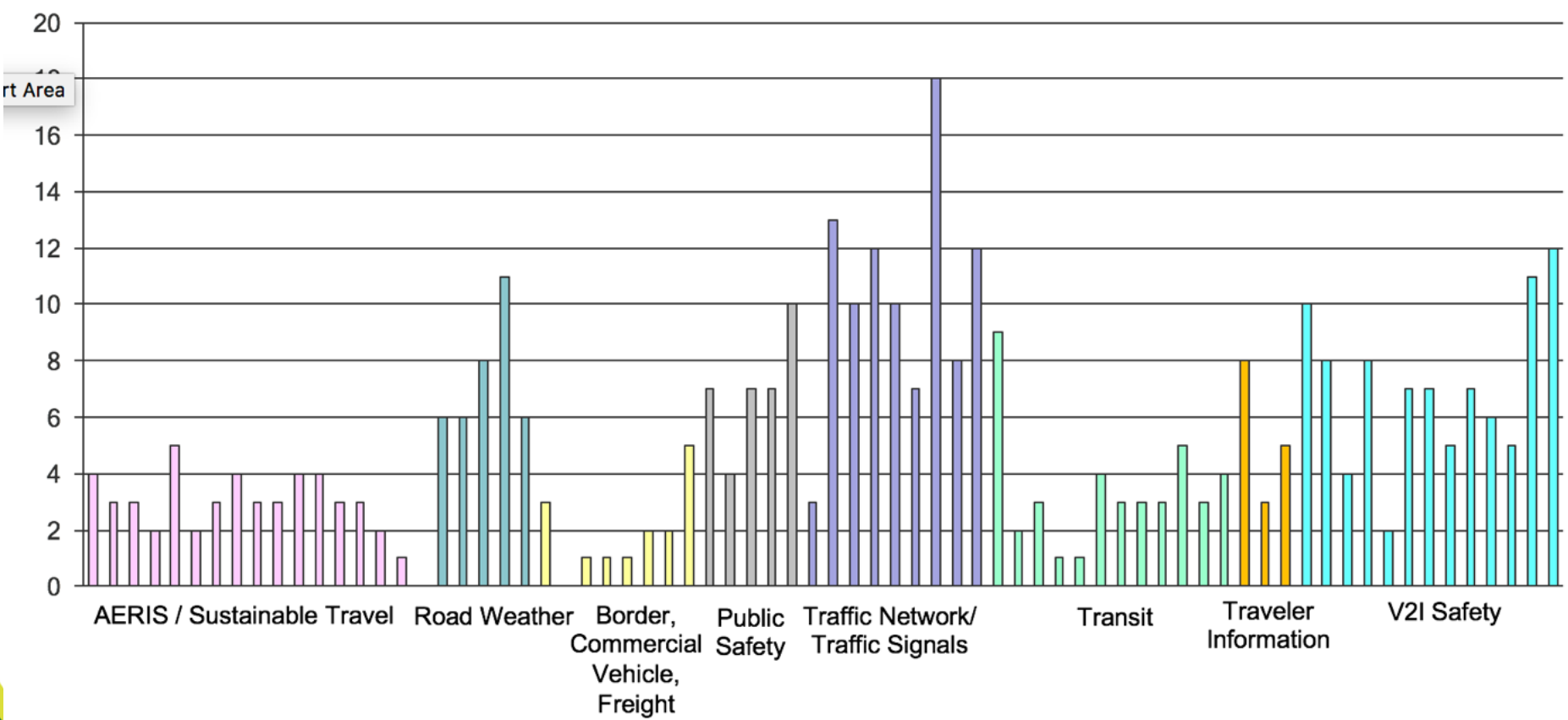
CV Institutional Framework

CV Entity

Role

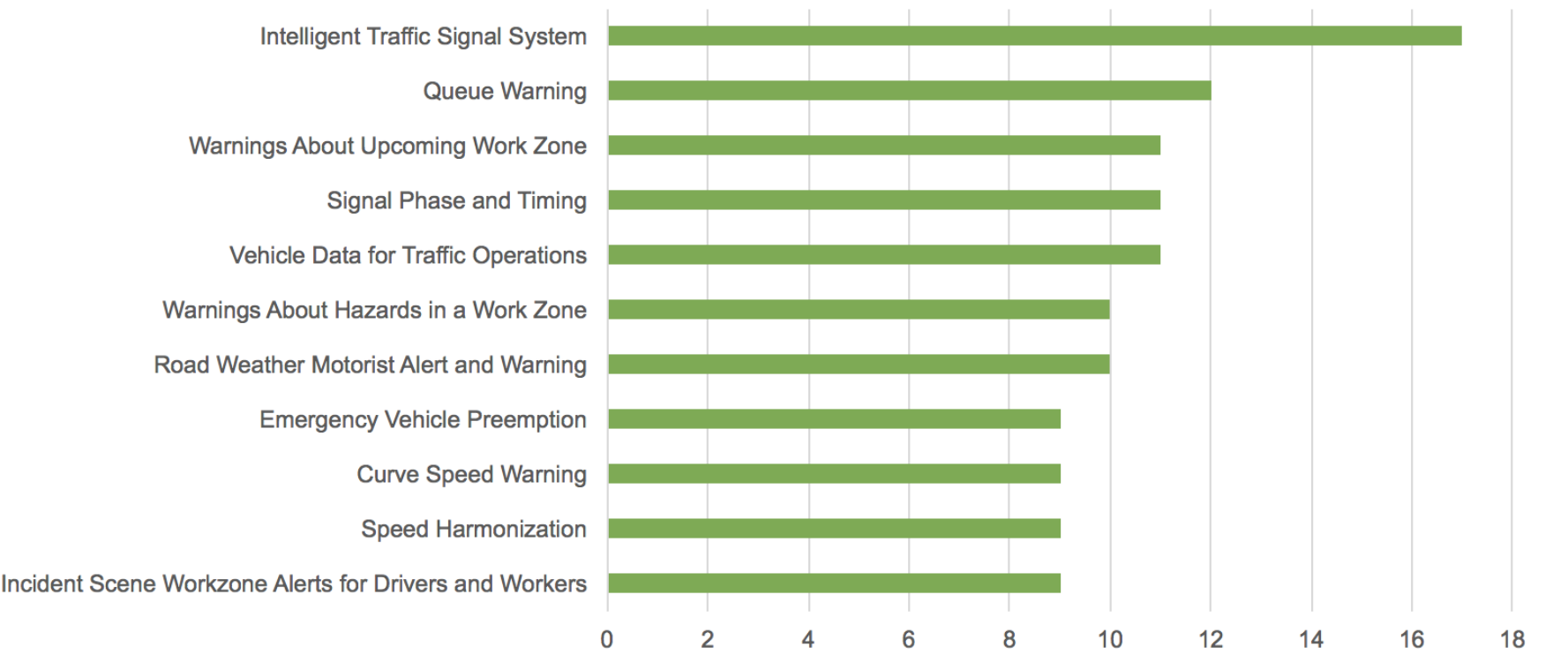


CV Applications Included in Agency Plans or Proposals

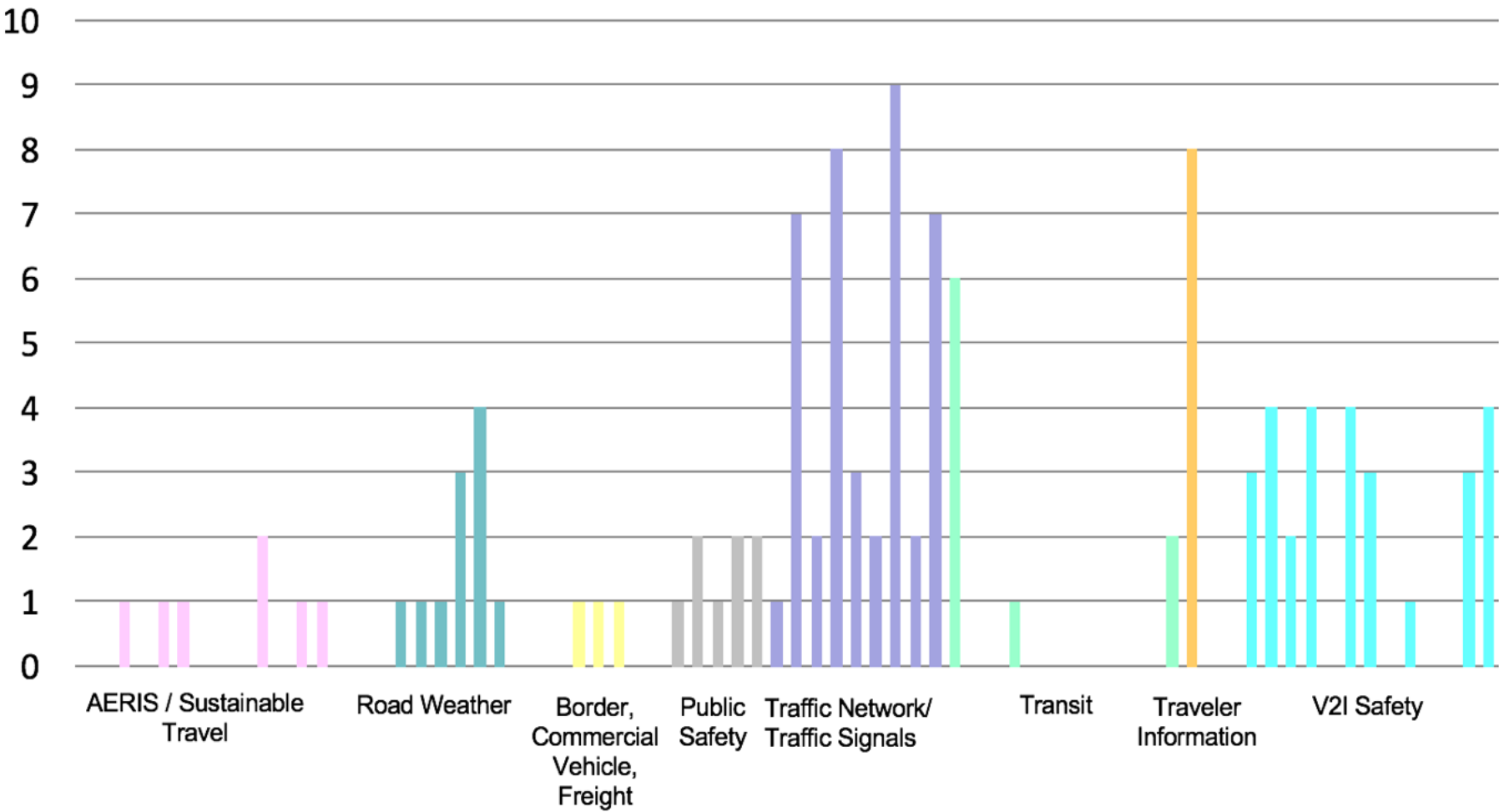


Most Selected CV Applications Included in Agency Plans or Proposals

Most Selected Applications

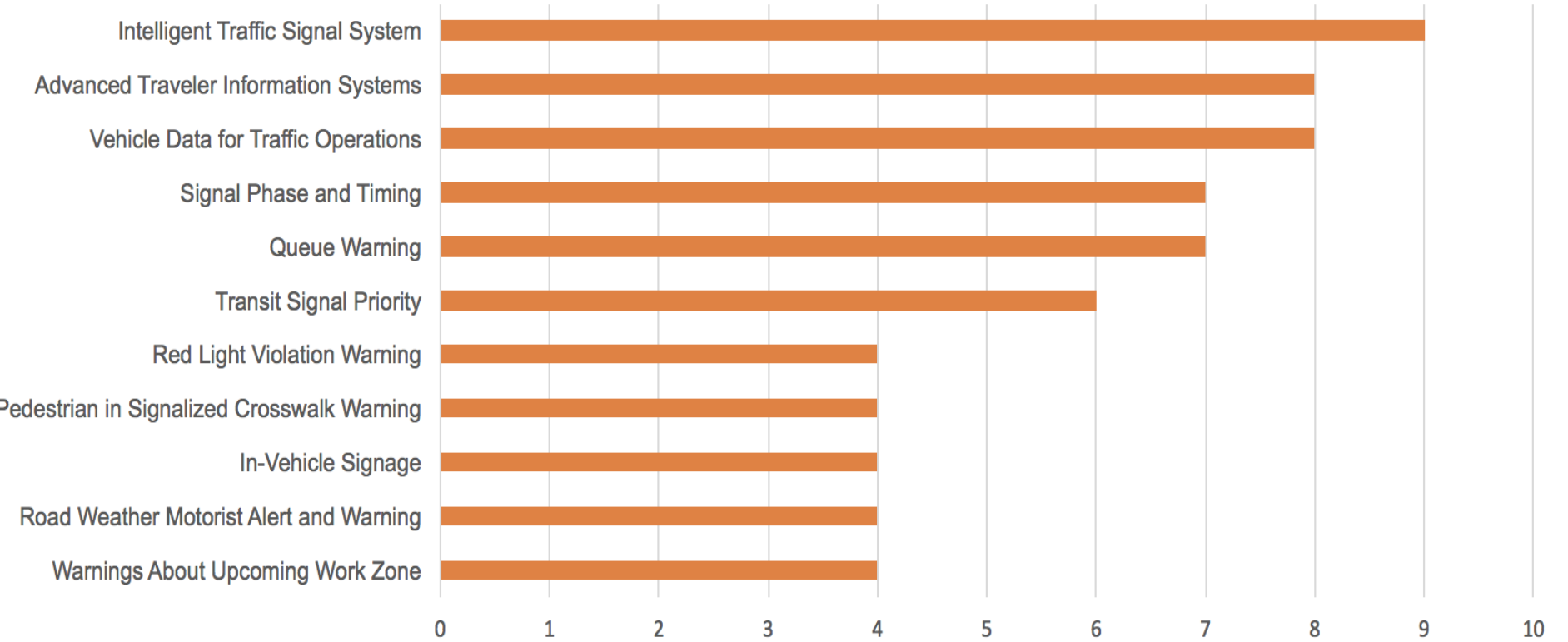


Most Beneficial CV Applications to Deploy

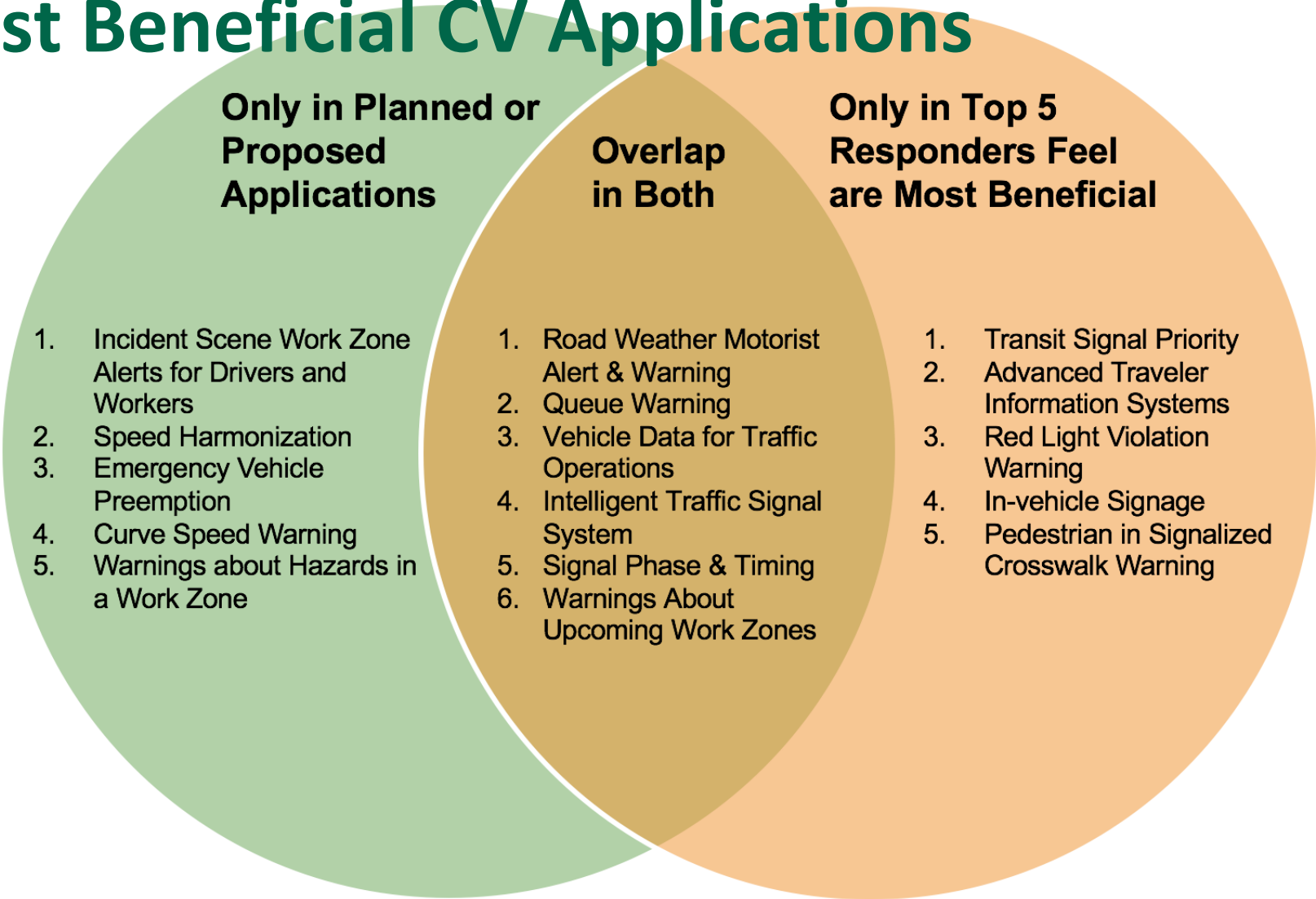


Most Selected Most Beneficial CV Applications

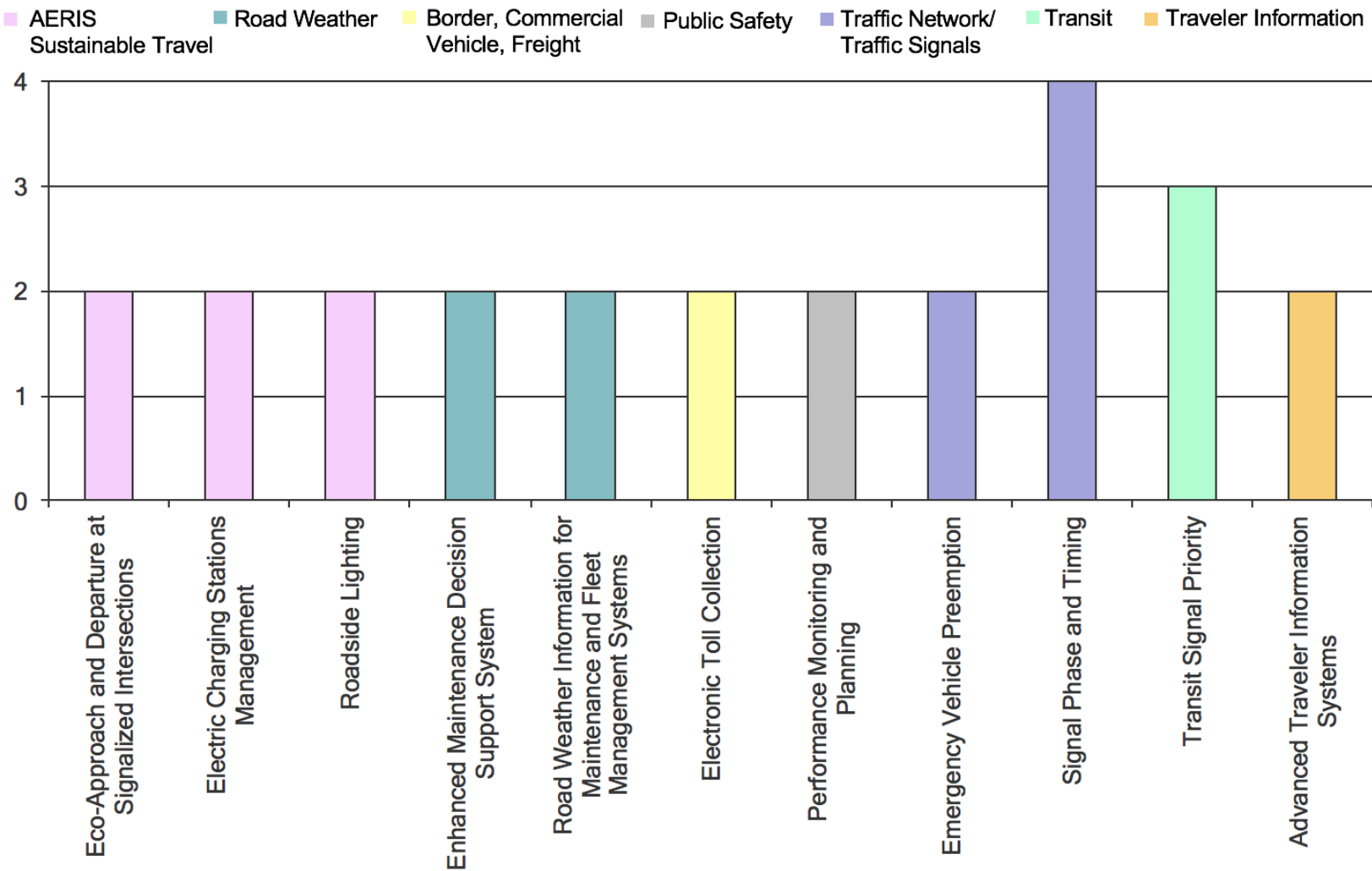
Top Most Beneficial CV Applications



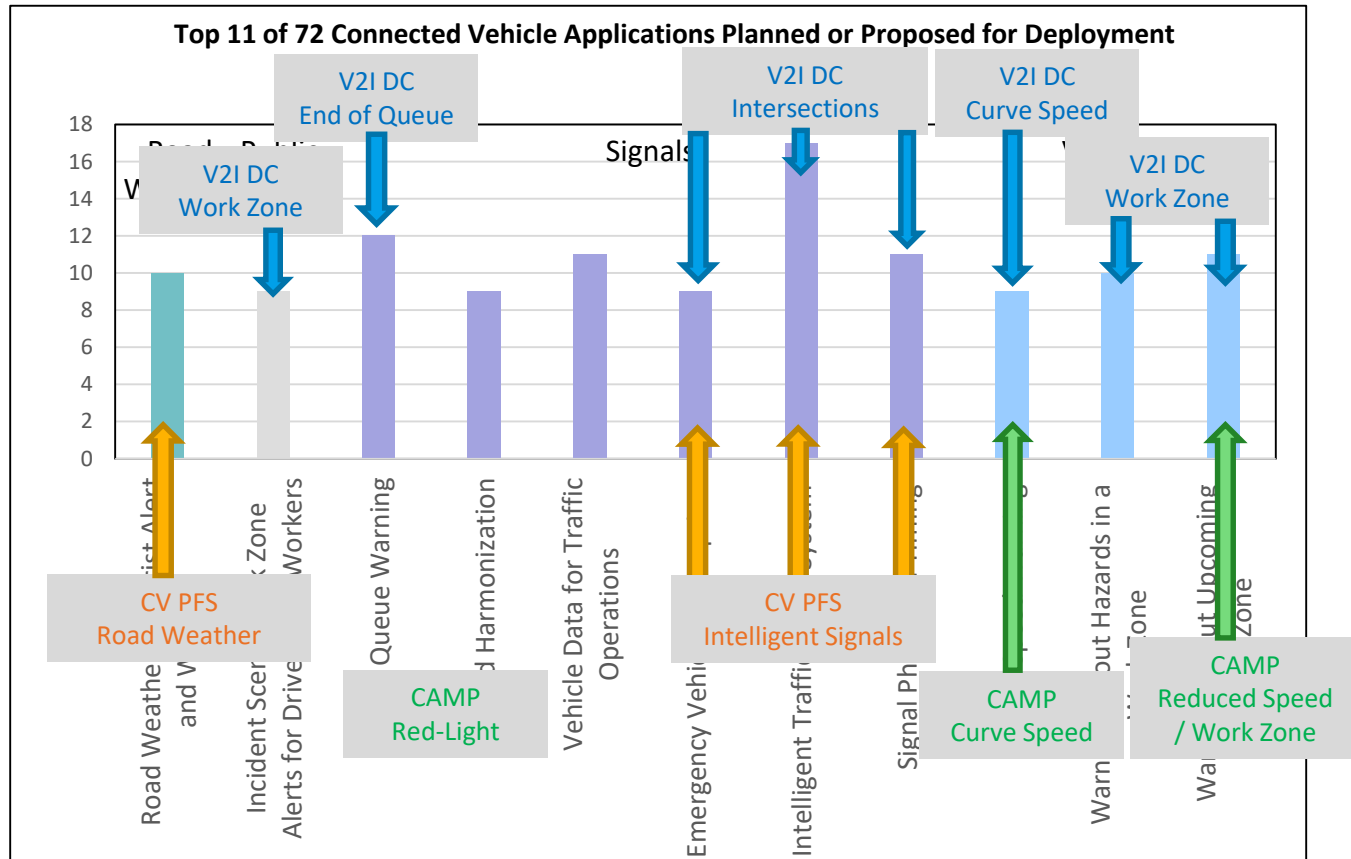
Overlap Between Proposed Applications and Most Beneficial CV Applications



Most Selected Most Beneficial CV Applications



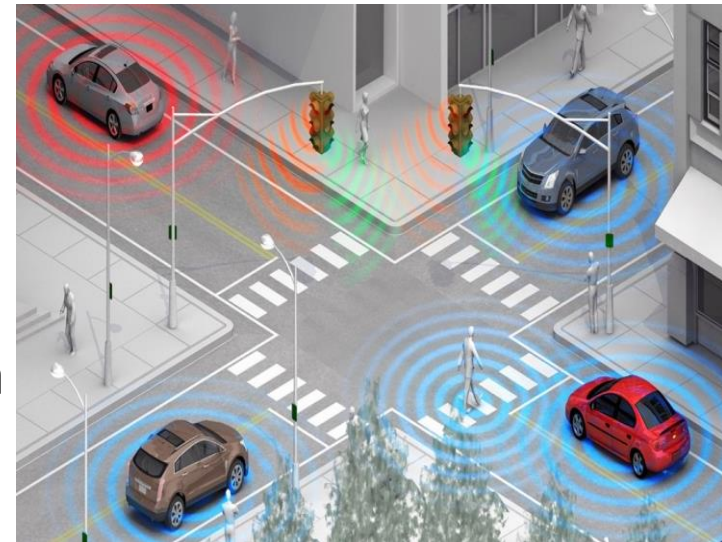
Priority Connected Vehicle Applications



SPaT as an Early Entry into V2I Deployment

So, what is SPaT?

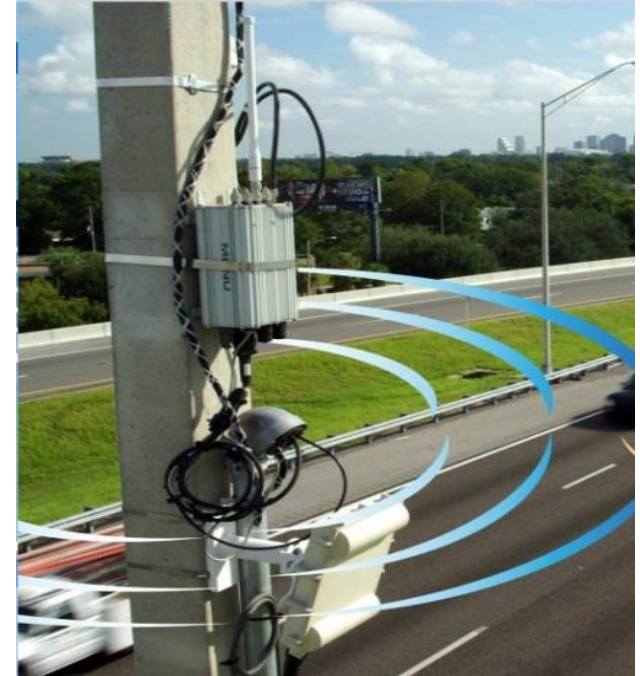
- A Signal Phase and Timing (SPaT) message defines the current intersection signal light phases. The current state of all lanes at the intersection are provided, as well as any active pre-emption or priority.
- The SPaT message can be obtained from a traffic signal controller via a standard query protocol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