

# CAT Coalition

## Strategic Initiatives Technical Working Group

### July 23, 2020 Webinar

### Notes and Summary of Discussions

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#### Welcome

Blaine Leonard welcomed everyone to the webinar. Approximately 65 members and guests joined the webinar. A list of those in attendance is provided at the end of these notes.

#### Ongoing Commitment to Outreach and Knowledge Transfer

Blaine noted the commitment to outreach and knowledge transfer, asking anyone that is aware of additional resources share that information. He also encouraged the group to complete the USDOT Work Zone Data Working Group (WZDWG) Worker Presence Subgroup survey on state of the practice for tracking and publishing real-time status about the presence of workers in work zones <https://www.surveymonkey.com/r/TVLT8GK>

#### AASHTO Update

Venkat Nallamothu provided an update from AASHTO, noting that AASHTO has been working on activities related to the impacts of Covid-19 on state DOTs. Venkat went on to remind members that an AASHTO led activity (in partnership with ITE and ITS America) developed a set of Infrastructure Owner Operator (IOO) Guiding Principles for Connected Infrastructure Supporting CAT. Venkat noted that the guiding principles and technical memorandum supporting the technical concepts are now available on the AASHTO CTSO website at the following link: <https://systemoperations.transportation.org/ioo-guiding-principles-for-cat/>

#### PLR Working Group Update

Jennifer Toth provided an update from the Policy, Legislative and Regulatory (PLR) Working Group. The group had a presentation from University of California, Davis on research conducted to complete a roadmap for state automated vehicle (AV) legislation. The PLR Working Group will meet again on August 3, 2020. Agenda topics include discussion on the working group focus, an update from FHWA on the Roadway Automation ConOps, and a discussion about summarizing research the group has conducted on automated driving systems (ADS) legislative nomenclature.

#### Topic #1 – Enabling Connected Intersections Initiative

Blaine provided background on a recently created initiative called Enabling Connected Intersections. He started by describing the Infrastructure Owner Operator / Original Equipment Manufacturer (IOO/OEM) Forum that has existed since 2016. The IOO/OEM Forum has identified a series of products they are working to complete. Blaine showed a table mapping the products of the IOO/OEM Forum to each CAT

Coalition working group and noted the ones that overlap the Strategic Initiatives WG. A copy of all of Blaine’s slides are attached to this summary.

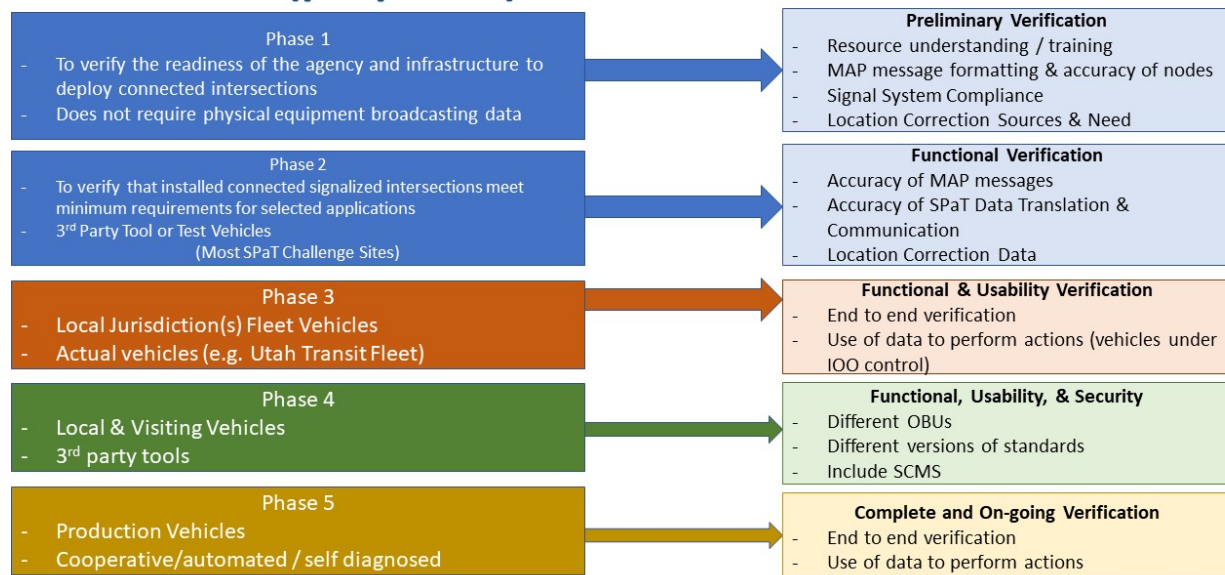
Blaine went on to describe background into the Enabling Connected Intersections initiative, noting that at least one original equipment manufacturer (OEM) has announced that production vehicles will have on-board, V2I safety applications starting in 2022. Blaine noted that there are a series of activities that IOOs need to perform to prepare for this that are unrelated to the uncertainties that exist industry-wide related to the communications medium. Enabling Connected Intersection has a total of seven activities, summarized as follows:

- Action #1: Create and reach consensus on minimum requirements for intersection broadcasts of SPaT & MAP.
- Action #2: Summarize Industry Approach(es) to SCMS and develop IOO Guidelines
- Action #3: Test Approach
- Action #4. Reference Implementation and Functional Safety Assessment
- Action #5: Develop and Execute the Enabling Connected Intersections Outreach and Expansion Strategy
- Activity #6: Deployment Tracking
- Activity #7: O&M Approach

Blaine described that there are also several parallel activities led by groups outside the CAT Coalition that will accomplish portions of the activities and the CAT Coalition is not responsible for all the activities. The CAT Coalition will collaborate with these other activities to avoid duplication.

Blaine then provided more details on Activity #3: Test Approach. The concept of this activity is to develop an overall approach to IOOs testing and verifying the connected intersection broadcasts of SPaT/MAP/RTCM. Blaine showed the following image to introduce a proposed five phases of testing.

## Connected Intersection Testing Approach (Action #3) (proposed) – Phased Verification



Blaine concluded by noting that during the October webinar, members of the Enabling Connected Intersection initiative would present a draft resource for the Preliminary Verification phase and seek input from this working group. Blaine will also arrange for an update from the ITE Connected Intersections Project on their development of connected intersections test procedures.

## **Topic #2 – Role of SCMS in Deployment Initiatives**

Raj Ponnaluri, Florida DOT, discussed the role of a security credential management system (SCMS) in two vehicle to infrastructure (V2I) deployments in Florida (the deployments Raj described are in Tallahassee and Gainesville). Raj explained that security credentialing uses SCMS certificates to validate that messages transferred between roadside units (RSUs) and On-board units (OBUs) are from trusted sources and that they are unaltered. Raj's slides are attached to this presentation and include considerable detail about the proof of concept conducted by USDOT as well as the SCMS "software as a service" that FDOT procured. Raj identified an SCMS platform onboarding workflow as a series of seven steps. Raj emphasized the importance of IOOs initiating their SCMS procurement and deployment process as early as possible when deploying connected intersections. He noted that FDOT is working on some model language they will use for SCMS procurement and will share it with this group when it is available. He also offered that he is happy to answer any questions by email.

Tony English, lead software engineer on the Wyoming CV Pilot project added that he completely agrees with Raj's suggestion and emphasis of the importance of starting the SCMS process as early as possible.

## **Topic #3 – Connected Work Zones**

Collin Castle, Michigan DOT, introduced the topic of connected work zones and the need for information describing the work zone as a map message. Collin noted that one of the IOO/OEM Forum work groups that Blaine mentioned is the Reduced Speed Zone Warning (RSZW) group, that he co-chairs. This group is coordinating with SAE and USDOT to help encourage deployment of connected work zones and to capture lessons learned.

Collin noted that work zone information (e.g. details describing lane closures, reduced speeds, workers presence) is a dataset that vehicles cannot collect autonomously and therefore are looking to IOOs to provide. He added that there is a recognized intent among many IOOs to migrate beyond traveler information data towards more accurate and timelier "CAT Ready Work Zone Data". Before they can estimate when and what percentage of the work zones will be "connected work zones", IOOs need a better understanding of "CAT Ready Work Zone Data" and the process to collect and assemble the data. Collin introduced Tony English to explain the work zone data collection (WZDC) Tool.

Tony English described work to develop the WZDC Tool for FHWA. This project builds on the earlier toolset developed by CAMP (and presented to the Strategic Initiatives WG earlier). The tool allows users to enter some basic information about a work zone through a user interface and then to drive through the work zone with the software on a tablet to automatically collect data describing node points of lanes in the work zone. Tony introduced several resources that are available, including:

- Full end to end test video located [here](#)

- GitHub site where the software and supporting material can be downloaded: <https://github.com/TonyEnglish/V2X-manual-data-collection>
- Project website at [https://neeraconsulting.com/V2x\\_Home](https://neeraconsulting.com/V2x_Home)

Collin Castle followed Tony’s presentation with a request to IOOs to do the following:

**Use this tool to learn about Connected Work Zones**

- Gain an understanding of the user interface, data needs
- Gain an understanding of the WZDx & RSM generators

**Test this tool on various work zone configurations**

- Let us know which work zones are well supported
- Let us know which work zones do not work well with the tool

**Share your feedback with us**

- A two-page summary is attached to this summary and is also being circulated with the distribution of the summary. It explains specific requests.

In summary, the goal is to increase IOO understanding and sharing about the lessons learned using the WZDC Tool.

**Partner Reports: US DOT ITS America, ITE, Other**

With time running short, Blaine and Joe Averkamp closed the meeting. There will be more time dedicated to partner reports during October.

**Close**

**The next webinar is scheduled for Thursday, October 22, 2020, at 2 pm Eastern.**

**TWG 1 July 23, 2020 Webinar Participants**

Blaine Leonard (Chair)	Deborah Curtis	Jesus Ruiz
Joe Averkamp (Co-Chair)	Doug Hohulin	Jianming Ma
Abey Yoseph	Eddie Fidler	Jim Frazer
Ahmad Jawad	Frank Provenzano	John Abraham
Alan Clelland	Fuat Aktan	Jon Riehl
Animesh Balse	Gary Duncan	Justin Chan
Anjan Rayamajhi	Hideki Hada	Ken Yang
Barry Einsig	Ivica Klanac	Kun Zhou
Blaine VanDyke	James Chang	Kyle Garrett
Carole Delion	James Harkness	Marthand Nookala
Christian Kulus	Jay Parikh	Matt Smith
Collin Castle	Jayant Gude	Mauricio Guerra
Curtis Thompson	Jeff Bergsten	Melissa Clark
Dave Miller	Jennifer Toth	Michael Sheffield
Dean Deeter	Jeremy Schroeder	Mike Schagrín
Debbie English		

Mohammed Hadi  
Pete Thompson  
Peter Jager  
Pierre Rasoldier  
Raj Ponnaluri  
Rich Deering  
Rob D'Angelo

Robert Dingess  
Roxane Mukai  
Stan Caldwell  
Stephen Mensah  
Steve Lockwood  
Steve Misgen  
Suzanne Murtha

Tom Kern  
Tom Timcho  
Tony English  
Venkat Nallamothu  
Weimin Huang

# CAT Coalition Strategic Initiatives TWG – July 23, 2020

## Webinar Agenda

1. Outreach and Knowledge Transfer
2. PLR Working Group Update
3. Topic #1: Enabling Connected Intersections Initiative (Including an overview of the IOO/OEM Forum)
4. Topic #2: Role of SCMS in Deployment Initiatives
5. Topic #3: Connected Work Zones
6. Partner Reports
7. Open Discussion on Emerging Topics



# Outreach and Knowledge Transfer

- Suggestions for additional resources to be shared
- Suggestions for additional members of this working group
- ***Worker Presence Survey:***
  - USDOT Work Zone Data Working Group (WZDWG) Worker Presence Subgroup survey on state of the practice for tracking and publishing real-time status about the presence of workers in work zones <https://www.surveymonkey.com/r/TVLT8GK>

# AASHTO Update

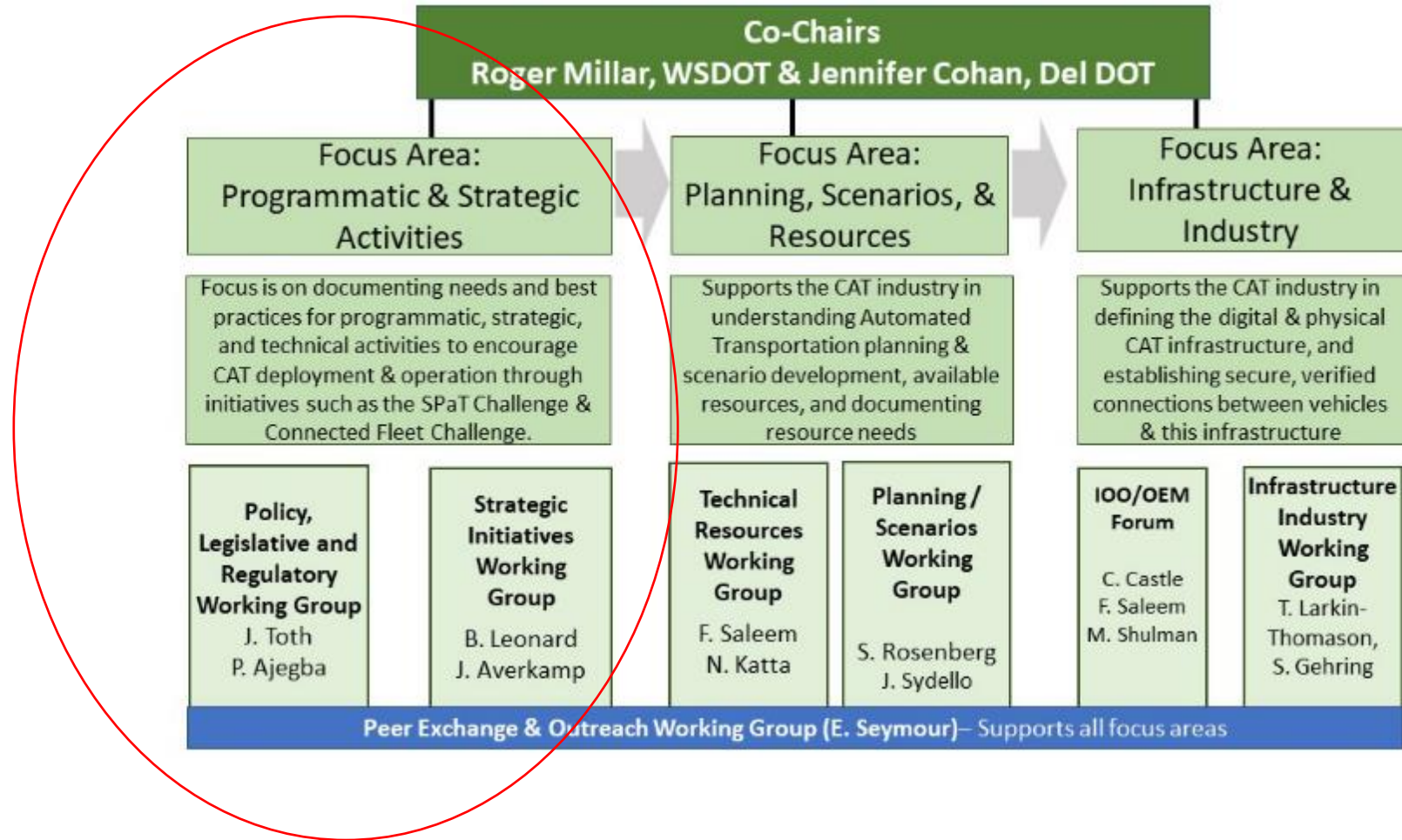
Venkat Nallamothe



# Brief Update from the Focus Area Working Group: Policy, Legislative, Regulatory (PLR) WG



# Programmatic & Strategic Activities Focus Area



# PLR Working Group – July 2020 Update

## **June 16, 2020 Webinar:**

- Presentation from UC Davis on a Roadmap for State AV Legislation
- Polling members for additional topics and focus areas of the group

## **Upcoming August 3, 2020 Webinar:**

- Future topics of this working group (results of member scan)
- Highway Automation ConOps (USDOT)
- Summary of earlier ADS Legislative Nomenclature research
- Products of other CAT Coalition working groups

# Enabling Connected Intersections Initiative

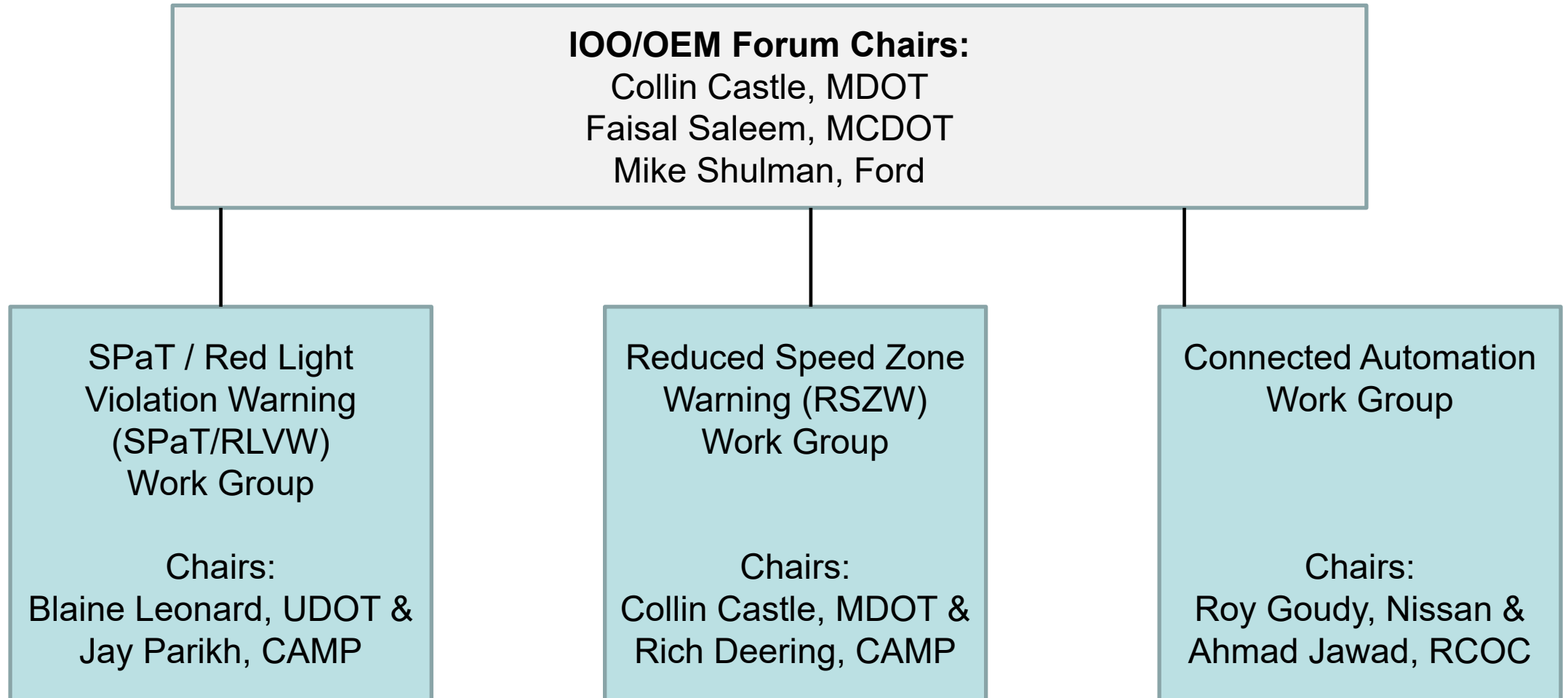
Blaine Leonard

# IOO/OEM Forum

## ***Since 2016:***

- A small group of Infrastructure Owners & Operators (IOOs) have been meeting regularly with a group of automobile Original Equipment Manufacturers (OEMs)
- This has allowed detailed discussions about the data that is needed and available from both groups to support CAT applications
- The CAT Coalition Working Groups have always been a conduit into and out of the IOO/OEM Forum – engaging the broader CAT Coalition membership in activities

# IOO/OEM Forum



# IOO/OEM Forum Work Plan – 30,000 Foot Level Summary

<b>SPaT/RLVW Group</b>	<b>Preparing for connected intersections</b> <ul style="list-style-type: none"><li>• Leveraging the success of the SPaT Challenge</li><li>• Resolving final data quality, compatibility, testing, and operational issues</li><li>• Agnostic communications medium at this time</li><li>• 7 Products Planned</li></ul>
<b>Reduced Speed Zone Warning (RSZW) Group</b>	<b>Helping IOOs understand what is needed for CAT Work Zone infrastructure</b> <ul style="list-style-type: none"><li>• Assessing tools for creating work zone MAP data</li><li>• Understanding lessons learned from early deployments</li><li>• Learning about data ambiguities that need to be clarified</li><li>• Agnostic to communications medium, just data focused</li><li>• 6 Products Planned</li></ul>
<b>Connected Automation Group</b>	<b>Helping IOOs understand Connected Automation</b> <ul style="list-style-type: none"><li>• Leveraging the TOSCo Project to understand benefits of Connected Automation</li><li>• Documenting the Infrastructure needs for Connected Automation corridors</li><li>• 4 Products Planned</li></ul>

# IOO/OEM Forum's 17 Products – Types of Products

***Products are not necessarily written documents – 4 types of products include:***

Documents	Technical Input to Other Efforts	Engagement	Support
<ul style="list-style-type: none"><li>• White papers / Technical Memorandums / Other written products</li><li>• Intended to be resources for the CAT community</li><li>• <i>7 Products</i></li></ul>	<ul style="list-style-type: none"><li>• Feedback (verbal or written) to initiatives or resources being advanced by other groups</li><li>• Will include a target audience, but expected to benefit other groups, as well</li><li>• <i>4 Products</i></li></ul>	<ul style="list-style-type: none"><li>• Facilitating and/or conducting outreach activities to benefit CAT stakeholders</li><li>• Increasing awareness or knowledge is the typical goal</li><li>• <i>5 Products</i></li></ul>	<ul style="list-style-type: none"><li>• Assisting CAT stakeholders in benefitting from resources (developed by the CAT Coalition or others)</li><li>• <i>1 Product</i></li></ul>



## IOO/OEM Forum – 17 Products and Planned Interactions with other Working Groups

IOO/OEM Forum Products	Technical Resources WG	Strategic Initiatives WG	PLR WG	Planning Scenarios WG	Infrastructure Industry WG	Peer Exchange & Outreach WG
1. Updated CCI Document	✓	✓				
2. Input to the minimum requirements for SPaT/MAP	✓					
3. Summary of Industry Approach to SCMS					✓	
4. Connected Intersections Testing Approach	✓	✓				
5. Enabling Connected Intersections Outreach		✓				✓
6. Connected Intersections Tracking Approach					✓	
7. Connected Intersections Operations Approach	✓	✓	✓		✓	
8. WZ Tool Chain Feedback to USDOT/CAMP		✓				
9. Increased use of the WZ Software Toolchain		✓				✓
10. Increased IOOs understanding of CAT WZ Needs and the Role of the WZDI						
11. CAT Work Zone lessons learned document				✓	✓	
12. Input to Accuracy Needs for Work Zone MAP Messages	✓	✓				
13. Initial draft Work Zone CCI (note: tentative)	✓					
14. IOOs Input to Connected Automation concepts and TOSCo Project						
15. Increased IOO understanding and awareness of TOSCo and related connected automation applications			✓	✓		✓
16. Increased IOO and OEM understanding of their respective processes and products						✓
17. Process for Sharing TOSCo Testing Equipment		✓				

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17. Process for Sharing TOSCo Testing Equipment		✓				

## Clarifications for Consistent Implementation (CCI)

- Identified ambiguities and options in J2735 standard
- Draft version on the CAT Coalition Website  
[https://transportationops.org/catcoalition/IOO OEM Forum](https://transportationops.org/catcoalition/IOO_OEM_Forum)
- USDOT/ITE Connected Intersection Efforts are addressing this through a detailed systems engineering process – will result in a Guidance document

# Enabling Connected Intersections

## **IOO/OEM Forum SPaT/RLVW Group – leading the initiative**

- Majority of SPaT/MAP broadcasts are received by fleet vehicles today (e.g. transit, snowplows) or after-market On-board units
- At least one OEM has formally announced that production vehicles will have on-board, V2I safety applications starting in 2022
- Outside of the communications uncertainties that exist, there are data related actions and verifications needed to “enable” this connectivity to production vehicles

# Enabling Connected Intersections

## Seven (7) Primary Actions

Action #1: Create and reach consensus on minimum requirements for intersection broadcasts of SPaT & MAP.

Action #2: Summarize Industry Approach(es) to SCMS and develop IOO Guidelines

Action #3: Test Plan for verification of messages

Action #4: Reference Implementation and Functional Safety Assessment

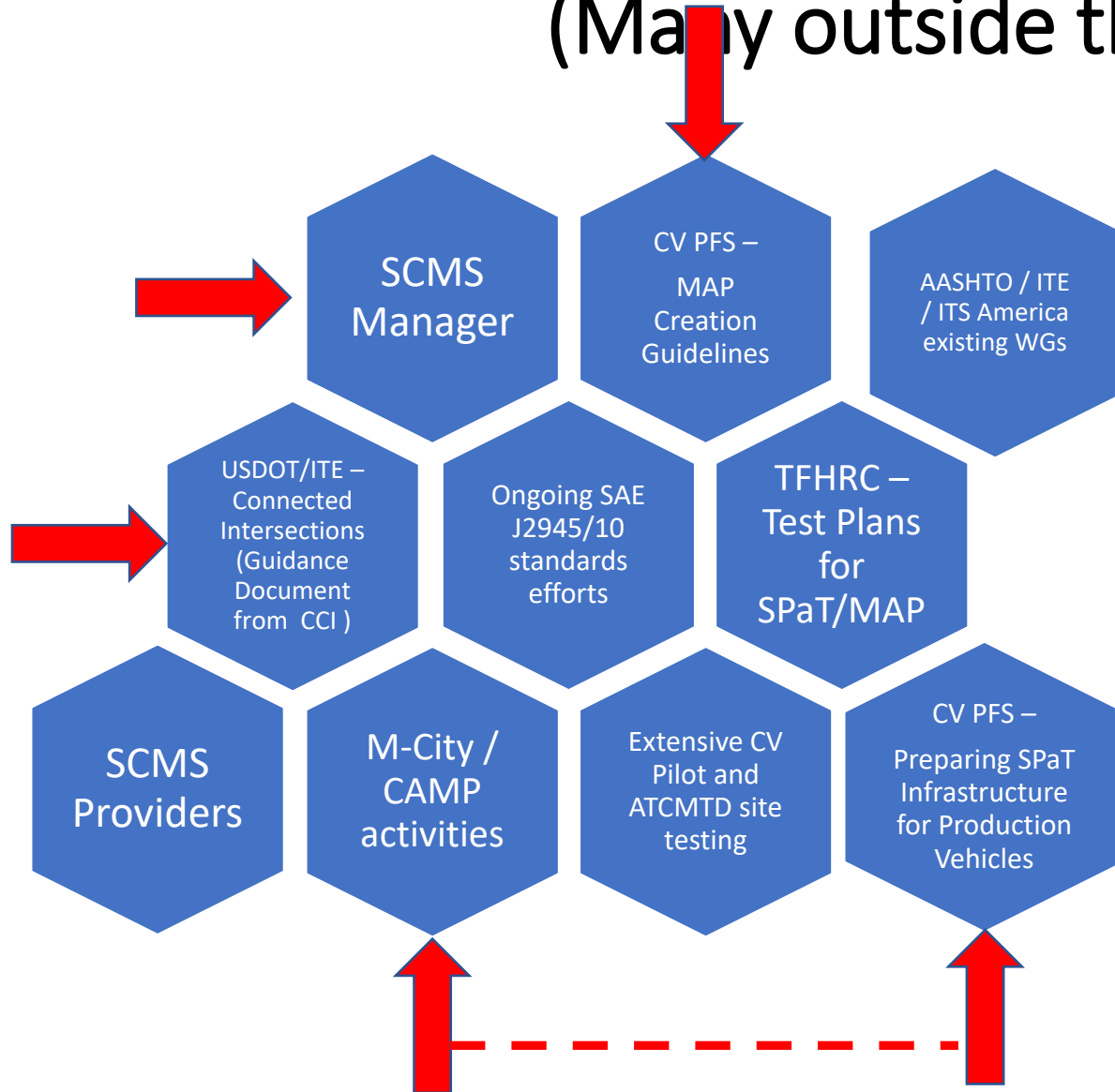
Action #5: Connected Intersection Outreach

Action #6: Deployment Tracking Approach

Action #7: O&M Approach

As an FYI: These Action numbers do not match the numbering of the IOO/OEM Forum Products

# Leveraging Other Parallel Activities (Many outside the CAT Coalition)



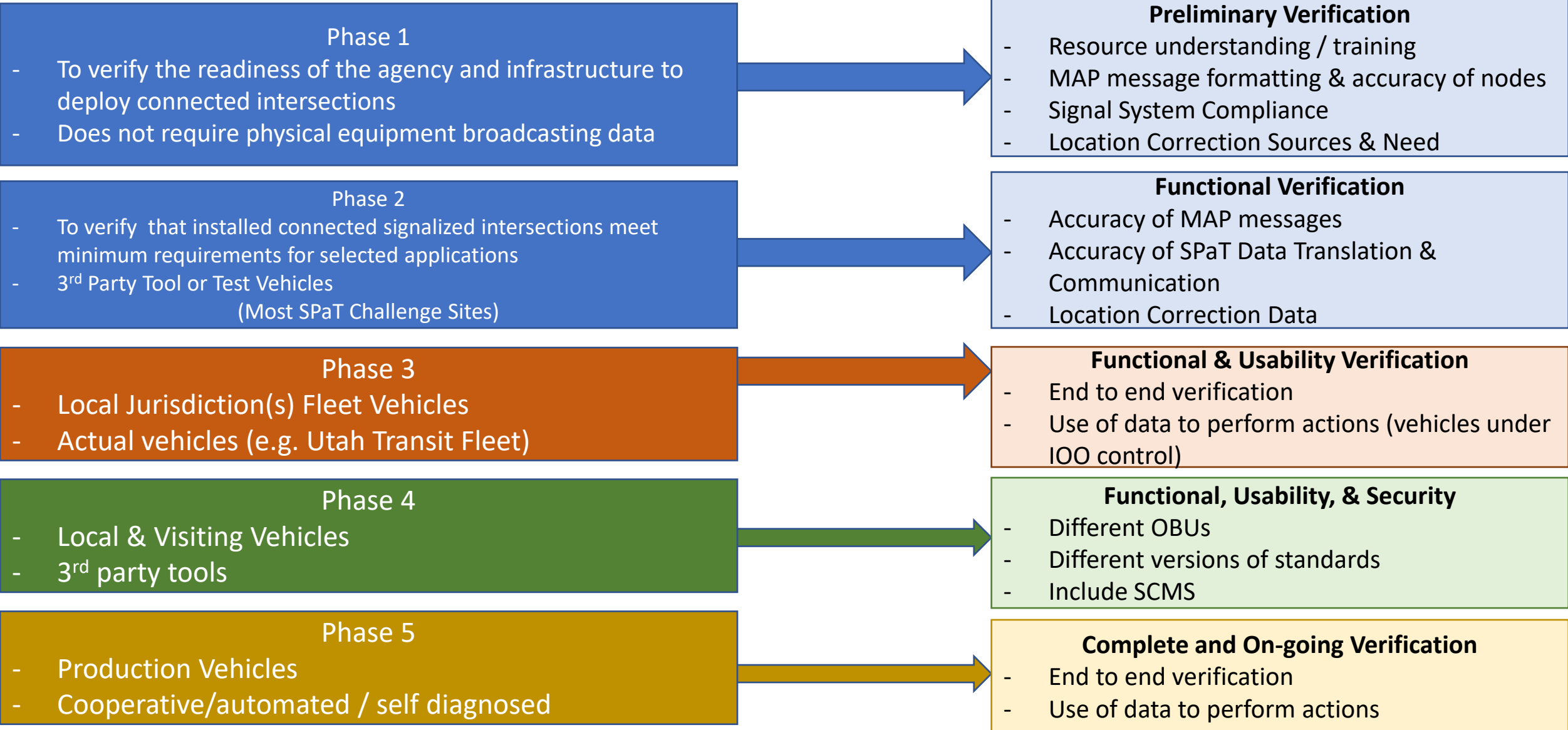
- A large part of this “Enabling” effort will be coordinating with and leveraging these outside activities
- Enabling Connected Intersections will create new content to supplement other activities

# Role of the Strategic Initiatives WG in this Effort

**We'll use the Strategic Initiatives WG webinars in 2020-2021 to request your input on several Actions, including, but not limited to the following:**

- ***Action #3: Test Plan*** – As the Test Plan is developed, Strategic Initiatives WG members will be encouraged to conduct testing on your SPaT systems and provide feedback through this group.
- ***Action #5: Outreach Strategy*** – Early draft will be shared with this group for feedback & reaction. Once finalized, this group will be asked to support outreach efforts.
- ***Action #7: O&M Approach*** – Will define a common approach to operating, maintaining, testing, and verifying connected intersections (e.g. how to handle temporary intersection outage). Early drafts will be vetted with this group, and members will be asked to provide input and perspective based on your deployments

# Connected Intersection Testing Approach (Action #3) (proposed) – Phased Verification





## IOO/OEM Forum – 17 Products and Planned Interactions with other Working Groups

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16. Increased IOO and OEM understanding of their respective processes						
17. Process for Sharing TOSCo Testing Equipment						

### Next Strategic Initiatives Webinar:

- Review of early sections of the Connected Intersections Testing Approach (Preliminary Verification)
- A request of members to initiate preliminary verification activities
- Update on related test procedure preparations (M-City and USDOT/ITE CI Project)

# Role of SCMS in Deployment Initiatives

Raj Pannaluri, FDOT





# Florida's Security Credential Management System (SCMS) for Connected and Automated Vehicles (CAV)



**Raj Ponnaluri, PhD, PE, PTOE, PMP**

Connected Vehicle, Arterial Management,  
Managed Lanes Engineer

Florida Department of Transportation

July 23, 2020

# Agenda Items

1. Introduction
  - FDOT CAV Business Plan
  - Initial SCMS: Two SPaT projects
2. Purpose and Need
  - What is SCMS
  - Statewide SCMS
  - USDOT SCMS Proof of Concept
  - FDOT procured SCMS
3. SCMS Deployment
  - Onboarding Workflow
  - PSID-SSP Profile
  - Attestation
  - Baseline Requirements for Enrollment

**1.**

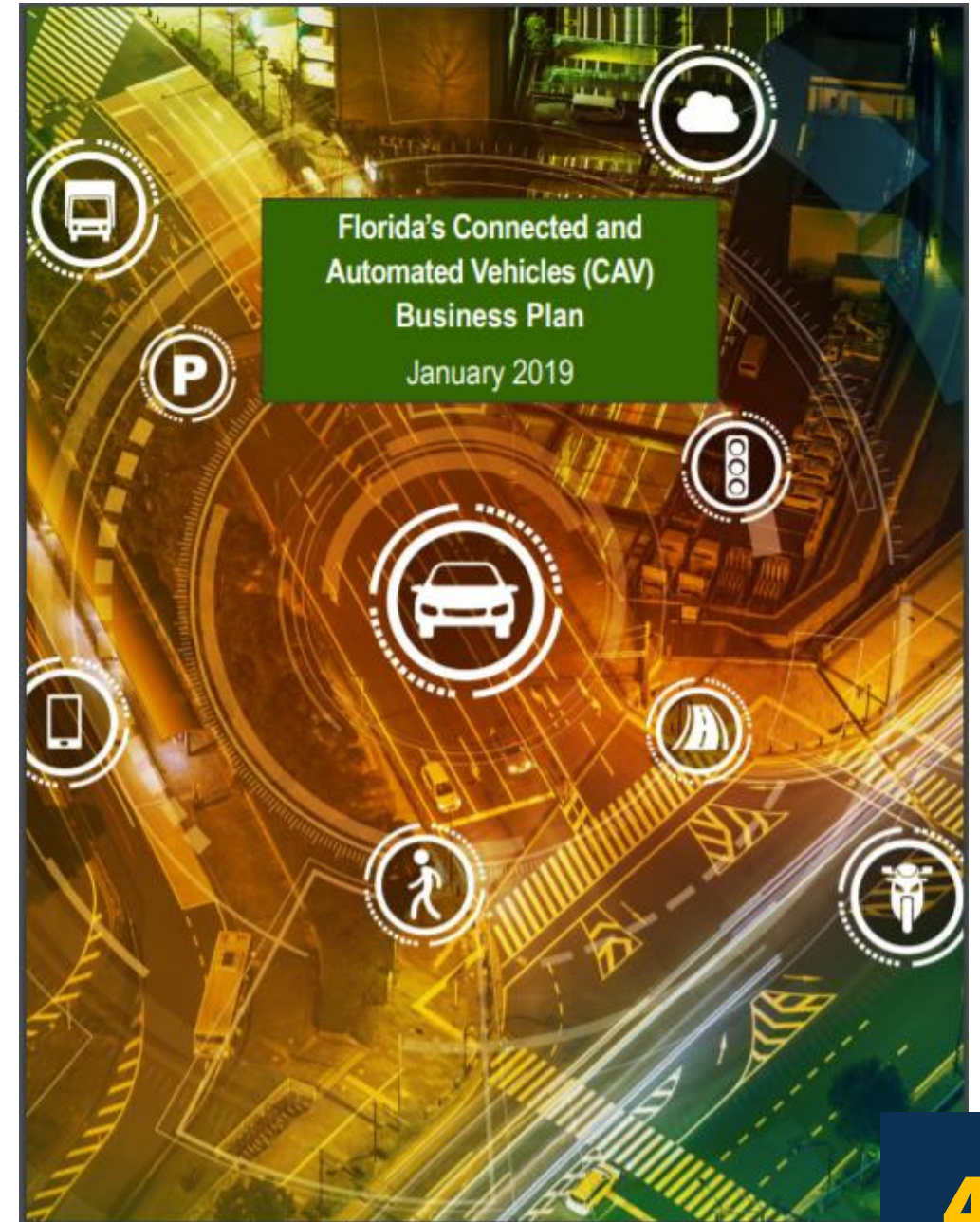
**Introduction**  
**Background**

# FDOT's CAV Business Plan

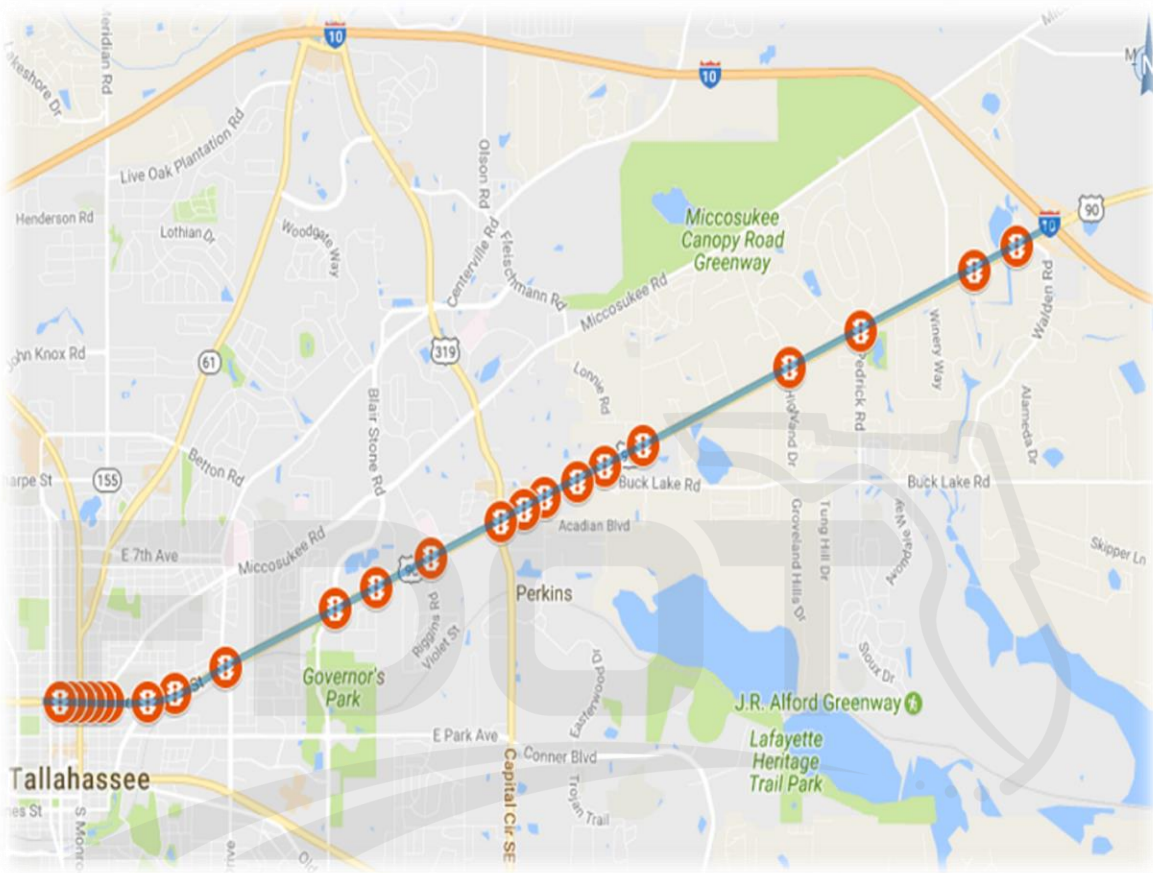
- CAV Business Plan Vision drives, towards Vision Zero with a fatality-free roadway network and a congestion-free transportation system using CAV technologies
- The objective of the CAV Program is to improve safety for all transportation modes and road users Contains seven focus areas

## FOCUS AREAS

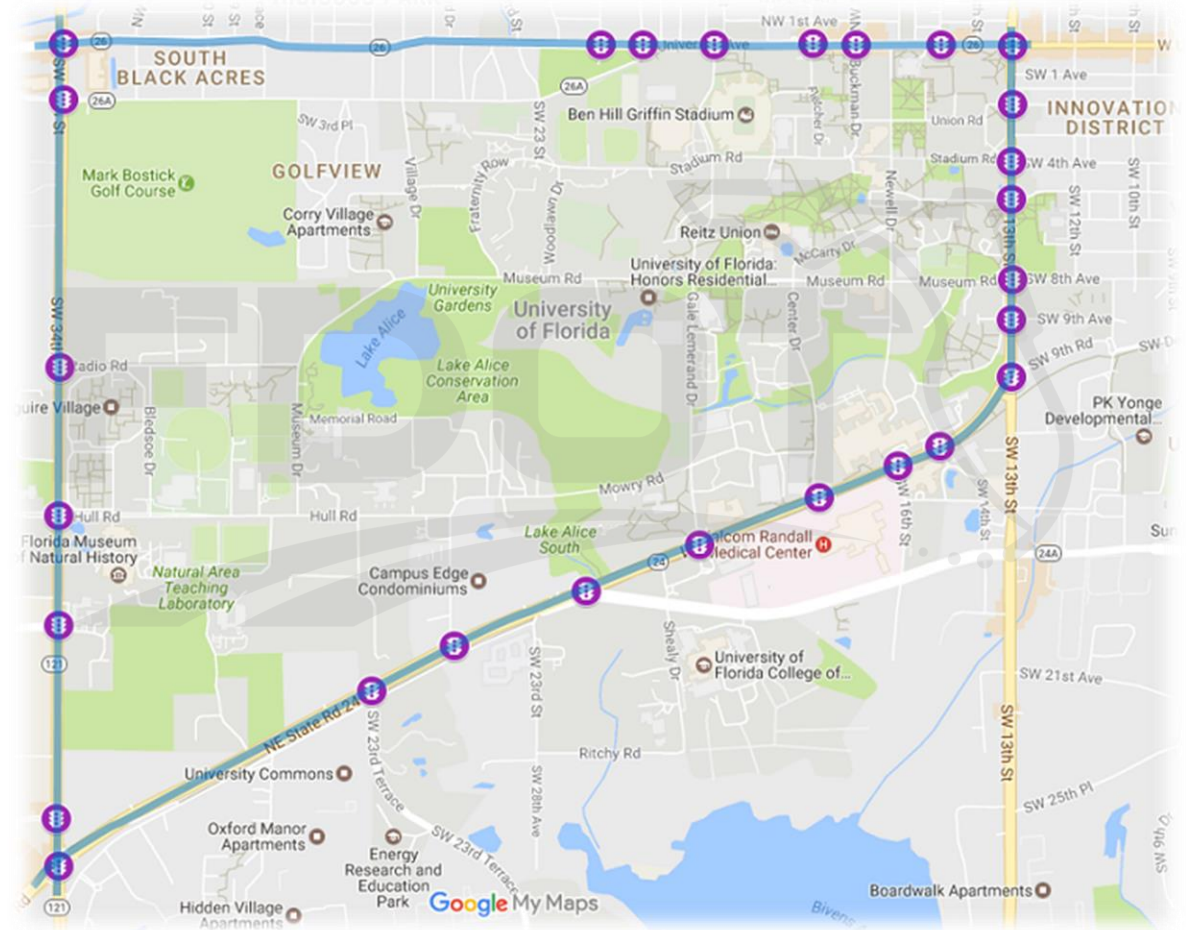
- 1/ *Policies and Governance*
- 2/ *Program Funding*
- 3/ *Education and Outreach*
- 4/ *Industry Outreach and Partnerships*
- 5/ *Technical Standards and Specifications Development*
- 6/ *Implementation Readiness*
- 7/ *Deployment and Implementation*



# US 90 and Gainesville Signal Phase and Timing (SPaT) Projects



The US 90 SPaT was FDOT's first connected vehicle project and one of the first in the nation



Gainesville SPaT includes six vehicle-to-infrastructure and four vehicle-to-vehicle applications



**2.**

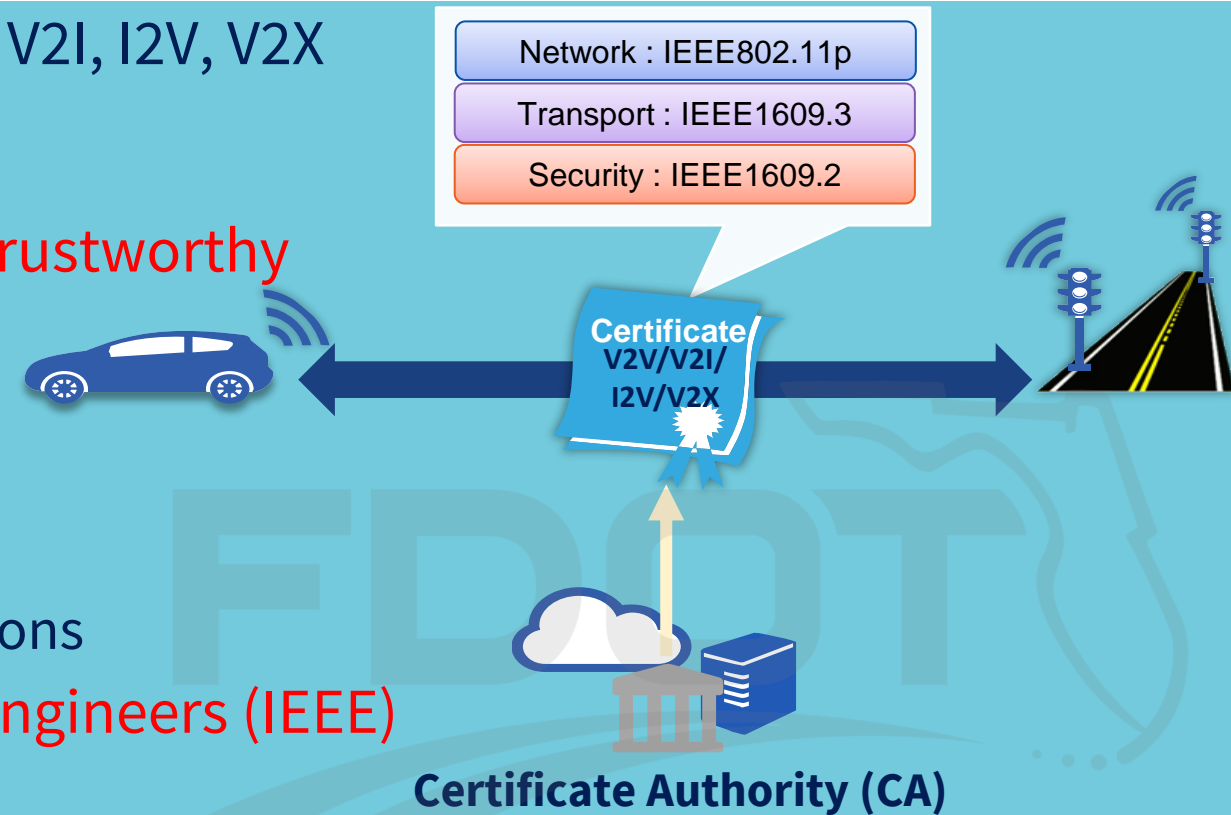
**Purpose and Need**

**SCMS**



# What is a **Security Credential Management System**?

- A **message signing security solution** for V2V, V2I, I2V, V2X communication
- Uses trust certificates
- **Makes exchanging information secure and trustworthy** between:
  - ❑ Connected Vehicles/On-Board Units (OBUs)
  - ❑ Roadway Infrastructure/Roadside Units (RSUs)
  - ❑ Traffic Management Centers (backend)
  - ❑ Wireless Mobile Devices/Smartphone Applications
- **Uses Institute of Electrical and Electronics Engineers (IEEE) Standards**



V2V – Vehicle-to-Vehicle, V2I – Vehicle-to-Infrastructure, I2V – Infrastructure-to-Vehicle, V2X – Vehicle-to-Everything

IEEE 802.11p Adds Wireless Access in Vehicular Environments (WAVE), a vehicular communication system amendment

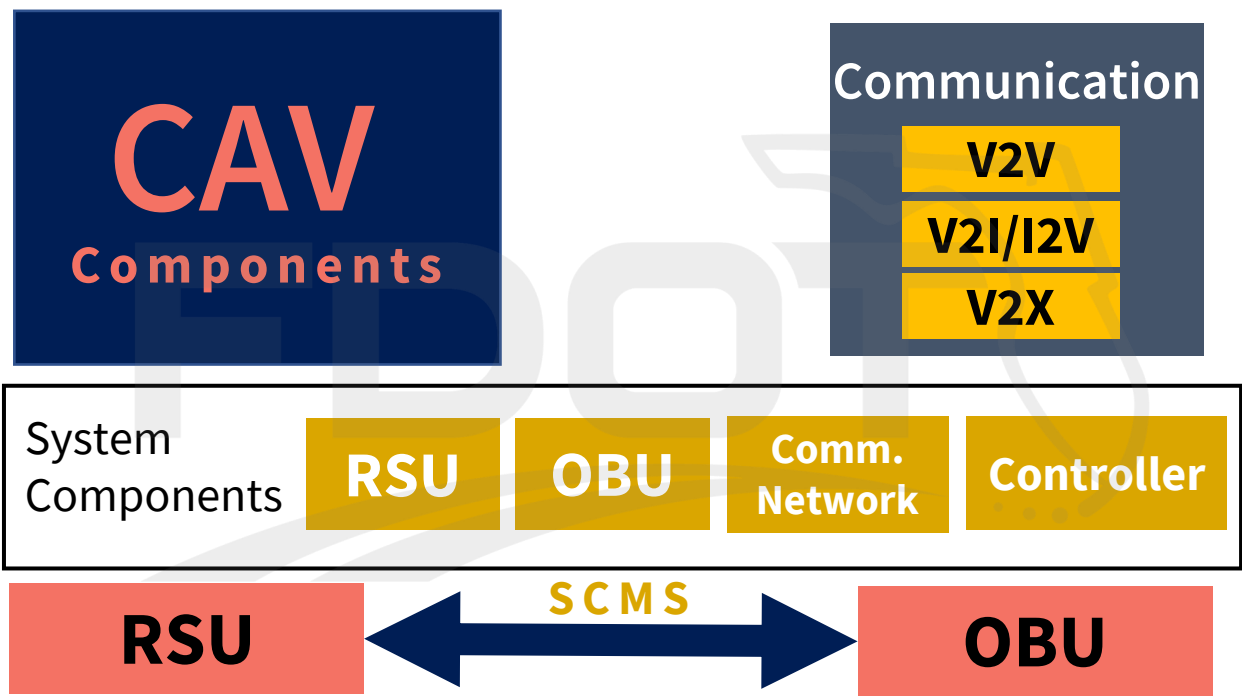
IEEE 1609.3 Specifies the open system interconnect (OSI) layer 3 (networking) and layer 4 (transport) protocols, interfaces, and services for secure, low-latency, ad-hoc connection and communication

IEEE 1609.2 Defines secure message formats and processing for use in WAVE devices

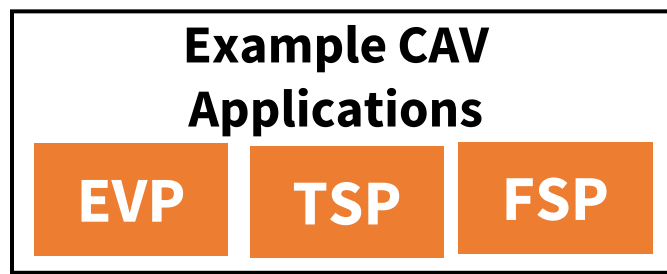


# SCMS and Messages

SCMS certificates **validate** that **messages** transferred between RSUs and OBUs are from **trusted sources** and that they are **unaltered**



MESSAGE SETS	ACRONYM
Basic Safety Message	BSM1 BSM2
Signal Phase and Timing Message	SPaT
Map Data	MAP
Traveler Information Message	TIM
Intersection Collision Avoidance	ICA
Signal Request Message	SRM
Signal Status Message	SSM
Emergency Vehicle Alert	EVA



EVP – Emergency Vehicle Preemption, TSP – Transit Signal Priority, FSP – Freight Signal Priority



# USDOT Proof of Concept

Research work (CFR 49 USC 20101) with  
Crash Avoidance Metrics Partnership (CAMP)

- Tested on the three USDOT Connected Vehicle pilot projects
- State/local maintenance and operations **not eligible** to enroll in the USDOT SCMS

USDOT encouraged to utilize security services from a commercial supplier

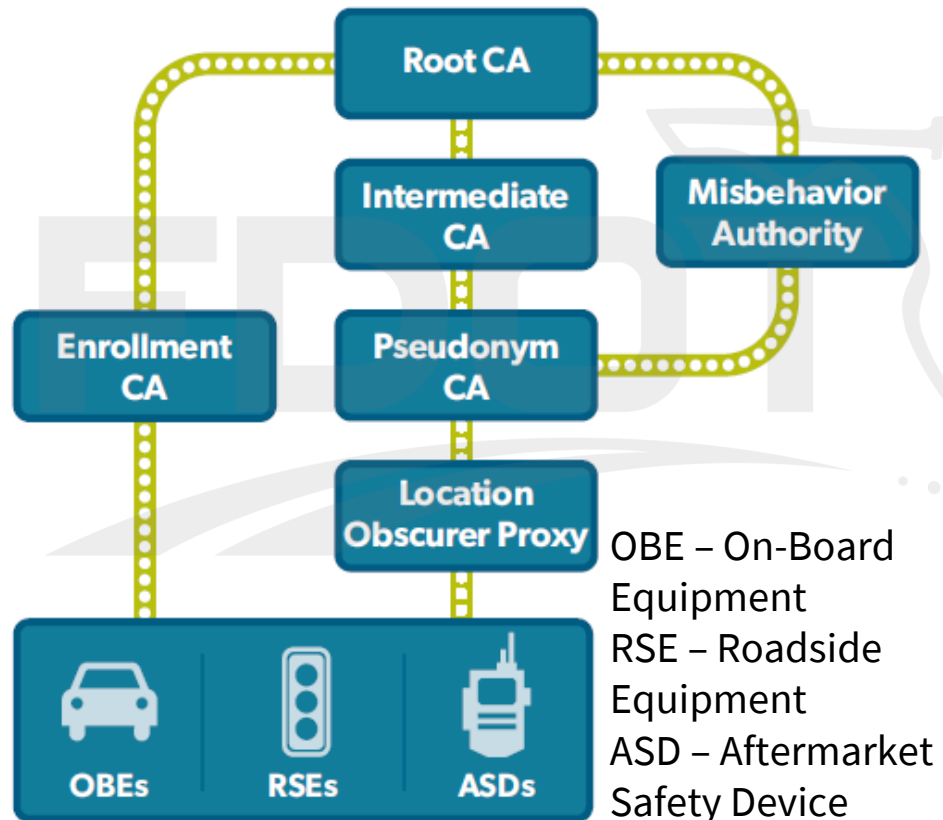
- USDOT SCMS POC lifespan is five years (**ends in 2020**)
- No future funding from USDOT



SECURITY CREDENTIAL  
MANAGEMENT SYSTEM (SCMS)  
PROOF OF CONCEPT (POC)



## SIMPLIFIED SCMS ARCHITECTURE DESIGN



# Security Credential Management System



- **FDOT procured SCMS Software as a Service**
- **Vendor providing all elements of SCMS platform**
- **SCMS establishes trust management and security for CV devices**
- **FDOT is deploying a turnkey SCMS platform to support the CAV Program implementation**





# **3.** **SCMS Deployment** **Workflow, Process, and Requirements**

# SCMS Platform Onboarding Workflow

➤ Future CAV projects will use the entire seven-step process

➤ For existing CAV projects, the process will start from Step 3

Step 1: FDOT CO & ISS Standardize the PSID and SSP for Statewide Use in Florida

Step 2: Districts Include the ISS Requirements in the Procurement Package

Step 3: District CAV team obtains the SCMS Info From the Project Vendor

Step 4: District TSM&O PM Sends E-mail to the CO Manager with Project SCMS Data

Step 5: CO Manager Notifies ISS of Pending Request and ISS Acknowledges

Step 6: CO Manager Notifies District TSM&O PM to Proceed to Send Info to ISS

Step 7: District/Vendor Initiates Data Entry

- Acronyms:
- ISS- Integrity Security Services, LLC; SCMS Service Provider to the FDOT in Partnership with the TrustPoint Systems, Inc.
  - PSID- Provider Service Identifiers
  - SSP- Service Specific Permissions
  - TSM&O- Transportation System Management and Operations
  - PM- Project Manager
  - SCMS- Security Credential Management Service
  - CO- FDOT Central Office
  - IP- Internet Protocol
  - TLS- Transport Layer Security

ISS/TrustPoint Registration/Provisioning

IPv4/IPv6 with TLS

Device Vendor Registration/Provisioning



# PSID and SSP

- Permissions are embedded in the EEs' application certificates and enable EEs receiving messages to know (i) the message is authentic and (ii) the sender was authorized to send that particular message
- Allowed message types are identified by two unique numbers
  - Provider Service Identifier (PSID) identifies the message type
  - Service Specific Permission (SSP) provides further information on the allowed use for the message type
- The Institute of Electrical and Electronic Engineers Root Authority (IEEE-RA) is globally responsible for maintaining all allowed PSID-SSP pairs and tracks each by the responsible standards organization

# Attestation

- The SCMS vendor releases the attestation document once the project vendor or system manager completes the website information
- This document is confidential and proprietary
- Failure to demonstrate this minimum level of security means a device cannot receive certificates from the SCMS vendor because the device represents a potential threat to the broader national V2X ecosystem



Restricted  
Authorized Users Only





# Baseline Requirements for Enrollment in the Statewide SCMS – RSU Example

<b>FDOT PSID-SSP Profile support</b>	The vendor will be notified and sent updates to this profile on a periodic basis (increments not to be less than 30 calendar days) and expected to provide software updates as required to enable compliance within 90 calendar days
<b>Pseudonym Certificates</b>	All RSUs must support PSEUDONYM certificates
<b>Technical Support Response Times</b>	Calls to technical support by the FDOT contact representative(s) must be returned within 24 business hours
<b>Hardware Security Module</b>	Hardware Security Module to protect certificate store
<b>Internet Protocol (IP) v6</b>	Goal: eventually migrate to IPv6
<b>OmniAir Certification</b>	Dedicated Short Range Communication (DSRC) certification



QUESTIONS?  
**THANK YOU!**

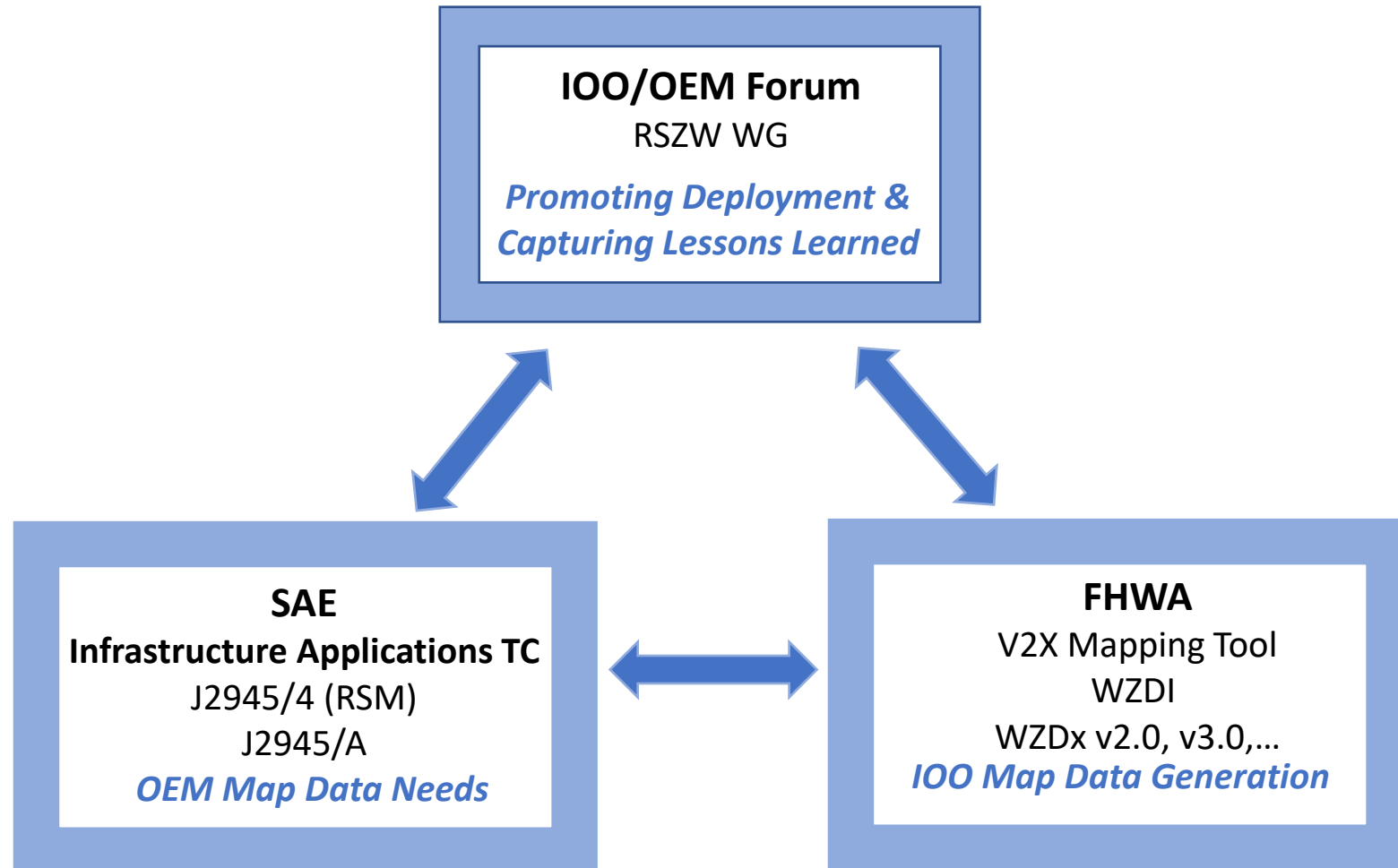
Raj Ponnaluri, PhD, PE, PTOE, PMP  
Connected Vehicles, Arterial Management, and  
Managed Lanes Engineer  
Florida Department of Transportation  
Email: [Raj.Ponnaluri@dot.state.fl.us](mailto:Raj.Ponnaluri@dot.state.fl.us)

# Connected Work Zones

Collin Castle, MDOT

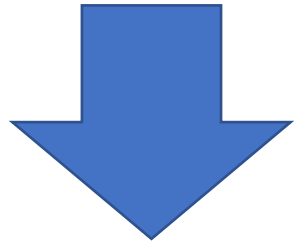
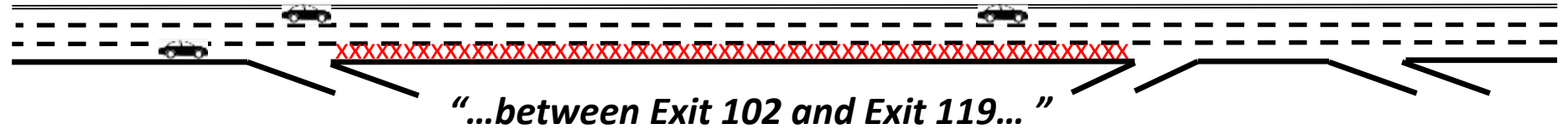
Tony English, Neaera Consulting

# Evolving a V2I Work Zone Mapping Ecosystem to support Connected Vehicles

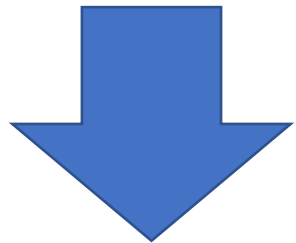
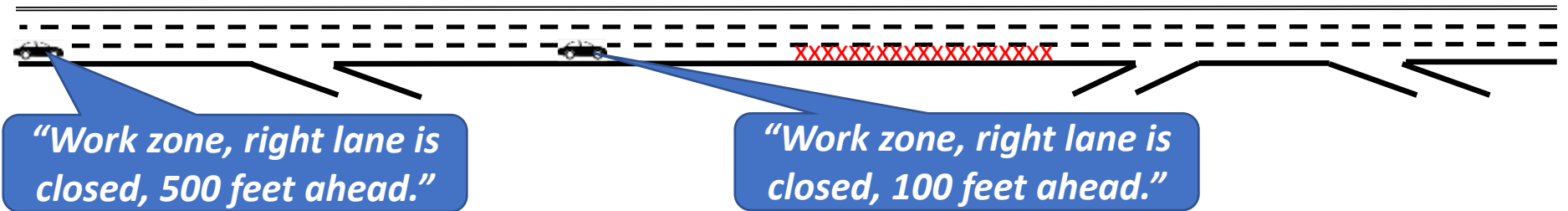


# The Migration towards CAT Ready WZ Data

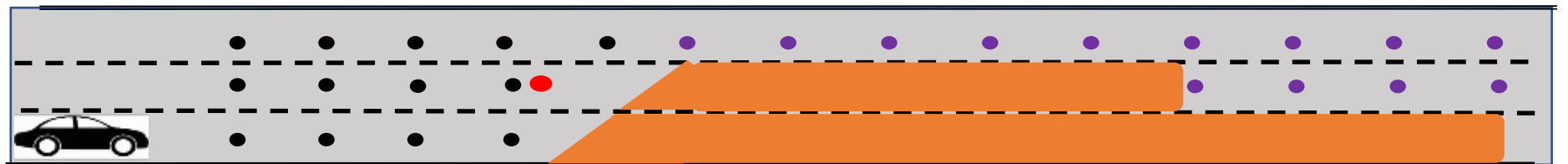
Traveler Information Level



Driver Information Level



Driver Warning Level



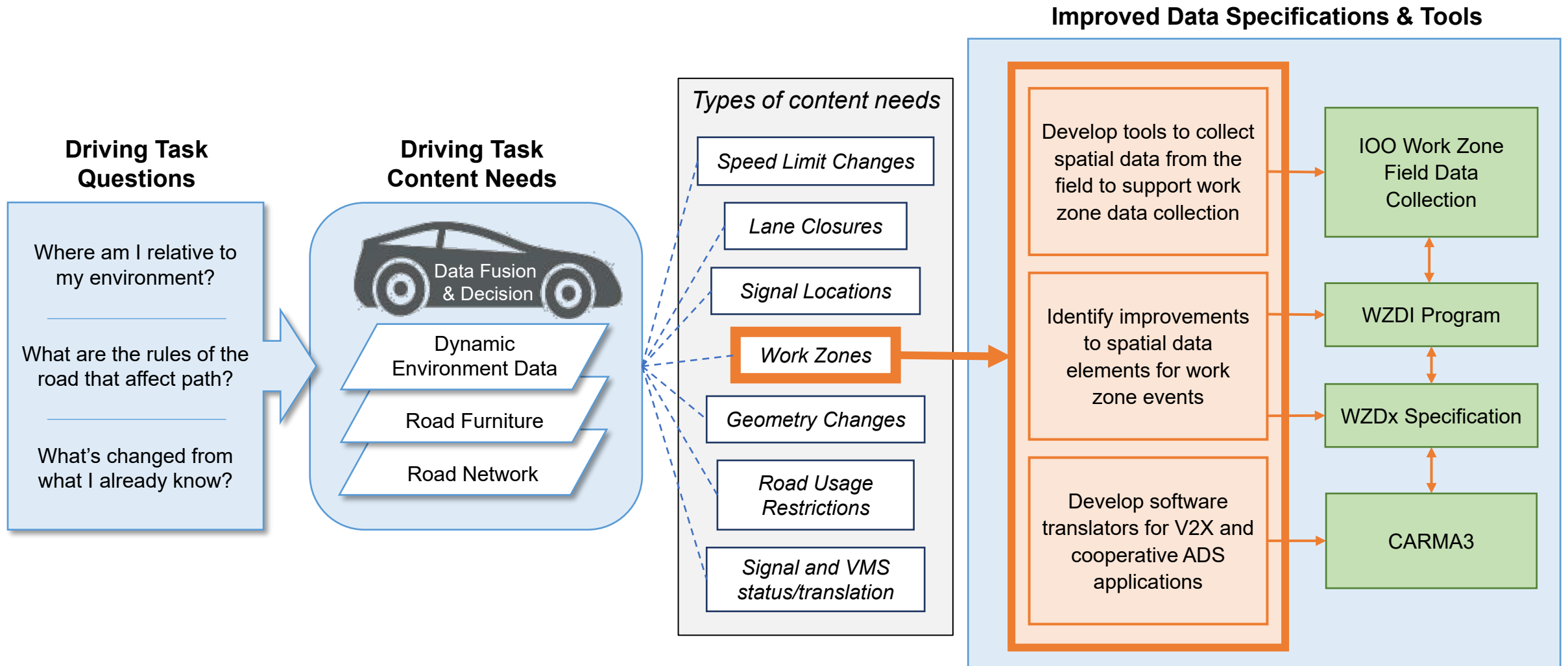
# Connected Work Zones

- Work Zone information (e.g. details describing lane closures, reduced speeds, workers presence) is one data element that vehicles cannot collect autonomously and therefore are looking to Infrastructure Owner Operators (IOOs) to provide
- There is a recognized intent among many IOOs to migrate beyond Traveler Information data towards more accurate and timelier “CAT Ready Work Zone Data”
- Before they can estimate when and what percentage of the work zones will be “connected work zones”, ***IOOs need a better understanding of “CAT Ready Work Zone Data”*** :
  - What is required?
  - How difficult is it to create and update the data?
  - What are the likely costs of creating the data?
  - What technical resources will be required to create the data?
- The Work Zone Data Collection (WZDC) Tool can enable IOOs to investigate the creation of the map data

Developing tools to  
support WZDx use  
as part of  
V2X Mapping  
Project

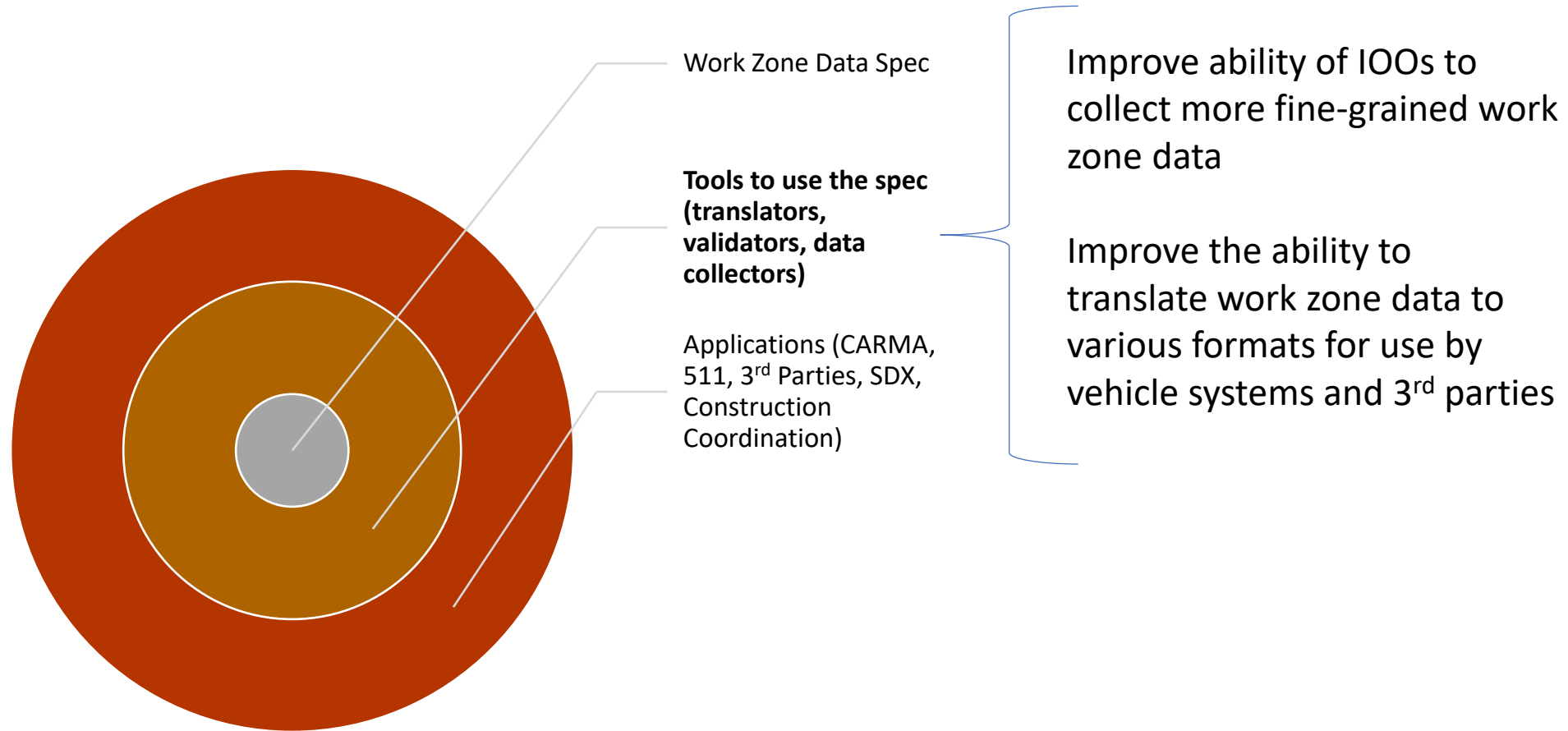


# Utilizing Common Work Zone Event Data

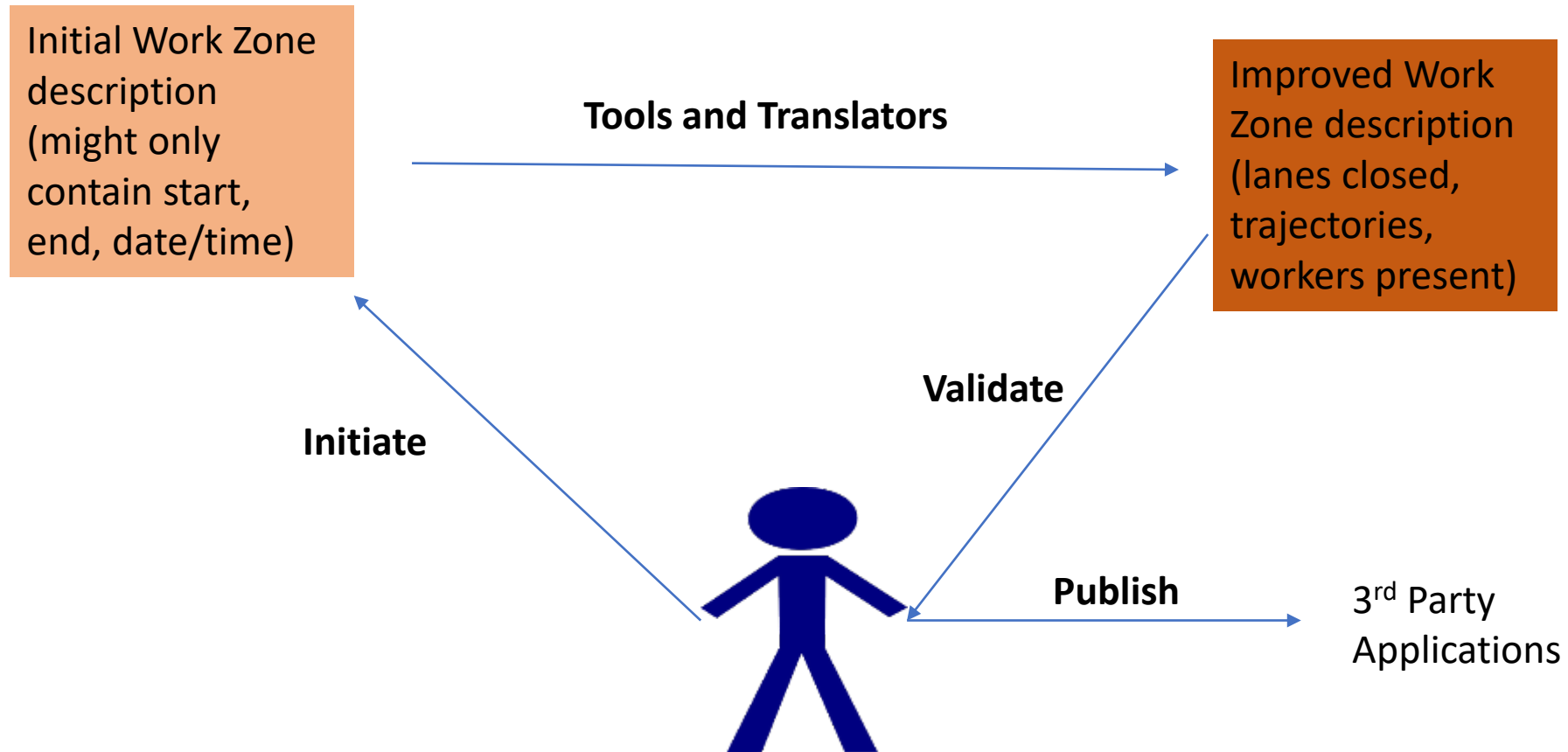




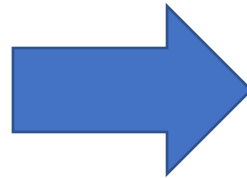
# Expanding how WZDx Spec is used



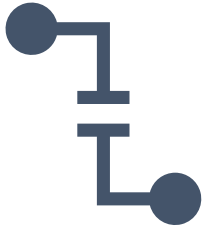
# Focus of this toolset



# Enabling IOOs to collect WZDx in greater precision and detail



# Toolset Capabilities (open source)

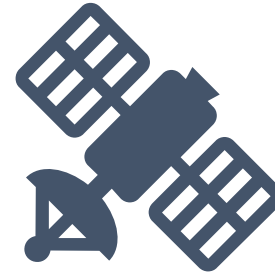


## Back-office tools for TMC/IOO

Work Zone Configurator

WZDx/RSM Map Based Validator

Publish Validated WZDx and RSM to 3<sup>rd</sup> Parties



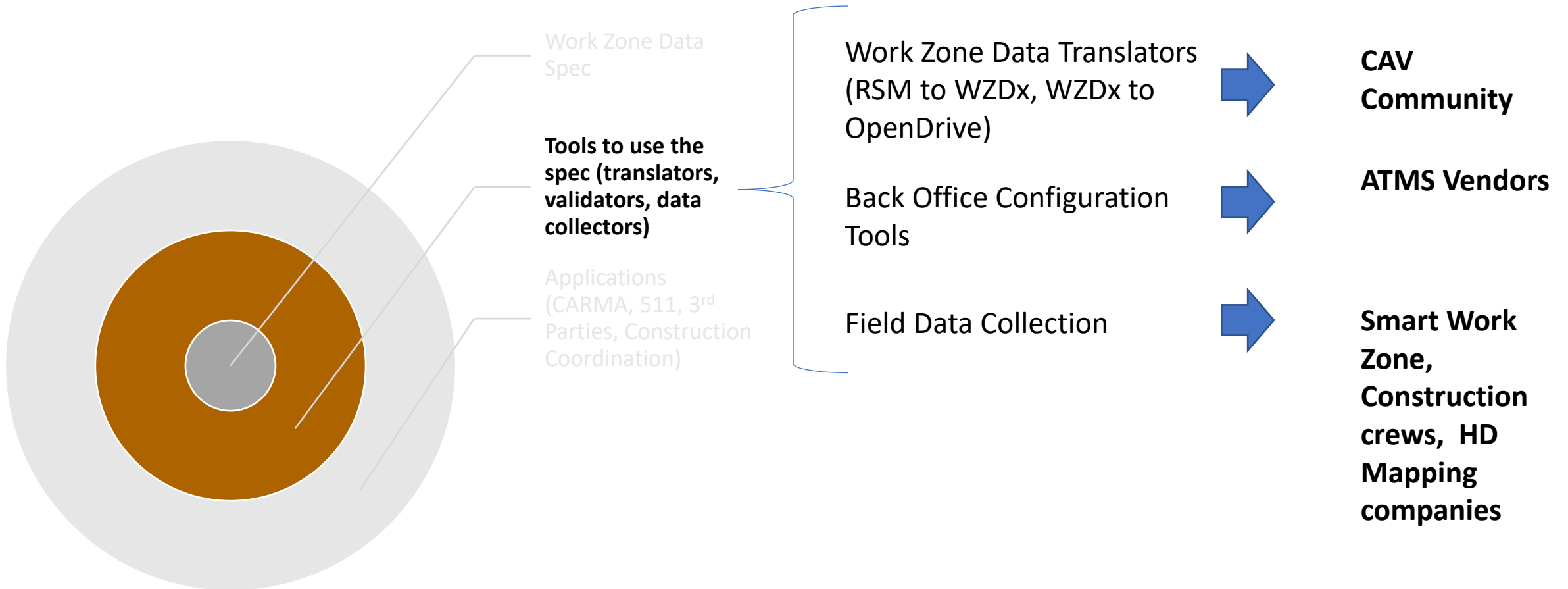
## Field Data Gathering

Generate WZDx and RSM Messages

GPS Location Collection

Receive/Send files to cloud

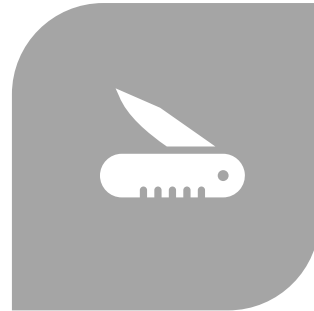
# Likely Users of Toolset



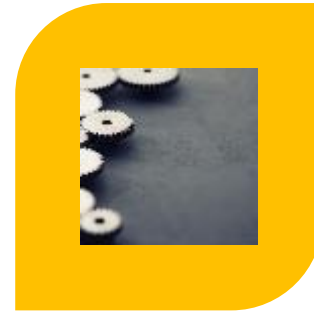
# Leverages Precursor Toolsets



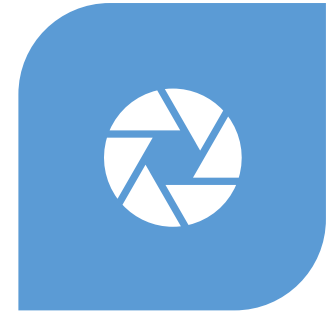
UPCOMING RSM  
STANDARD  
SAE J2945/4



CAMP TOOL



RSM TO WZDx  
TRANSLATOR



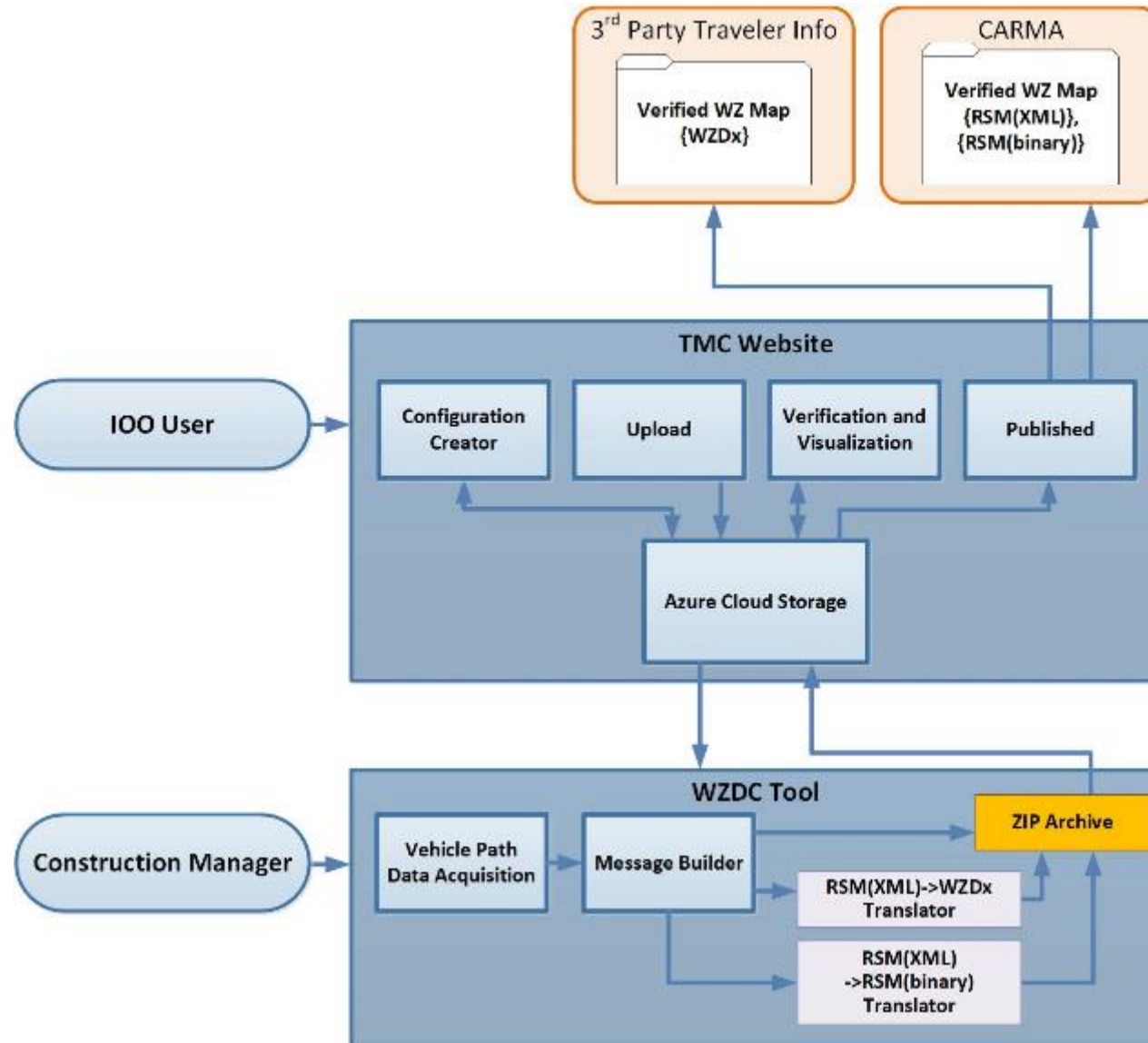
WZDx SPEC

---

# Demonstration

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# High Level Tools Workflow





# Back-Office Toolset

## V2X Enabled Work Zone Data Collection

Work Zone Data Exchange

### V2X Enabled Work Zone Data Collection

Configuration  
Creator

Create your config file

Upload Data  
Files

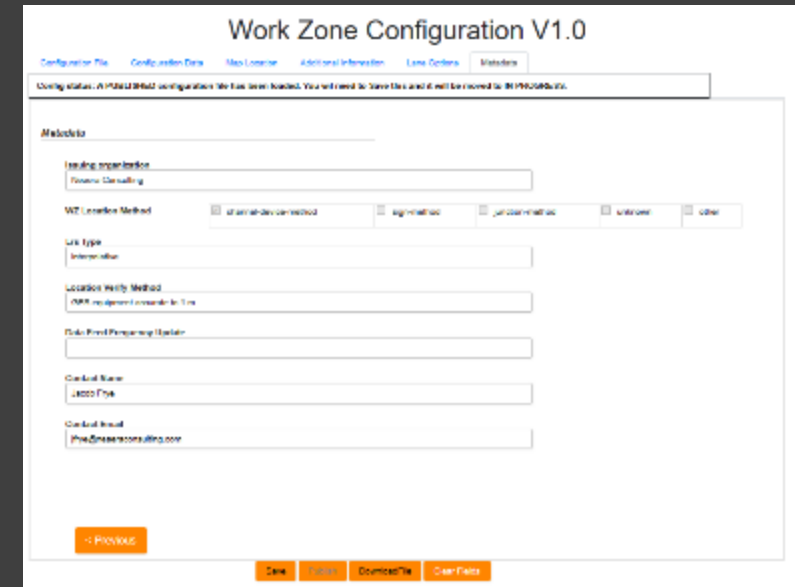
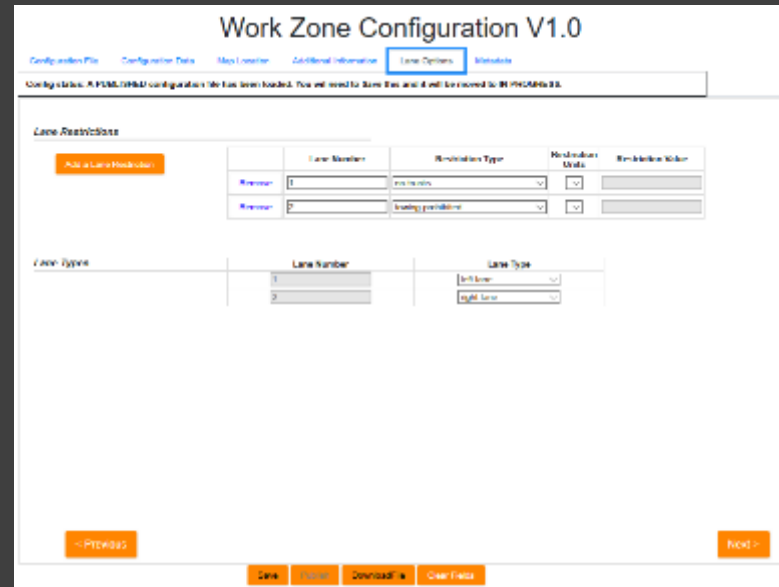
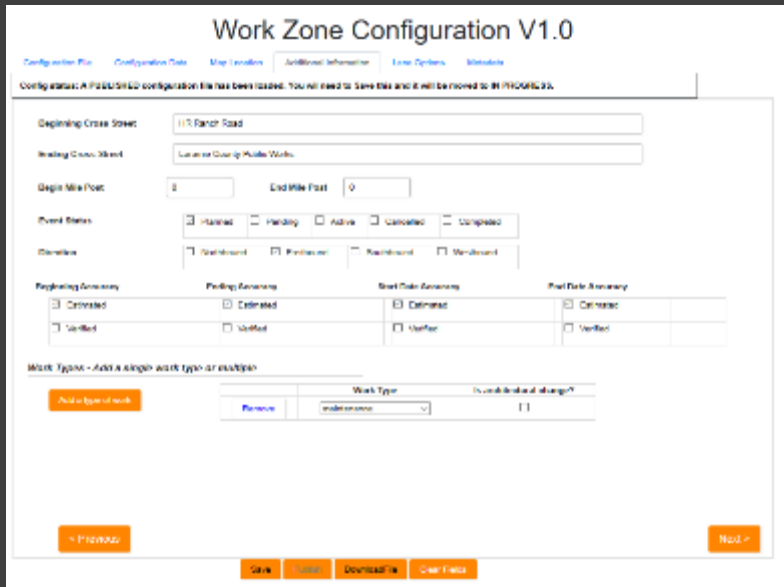
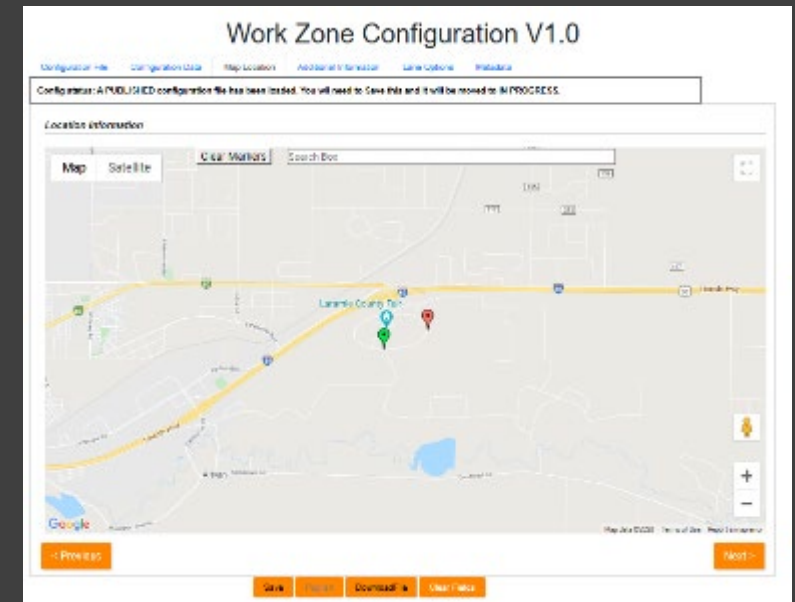
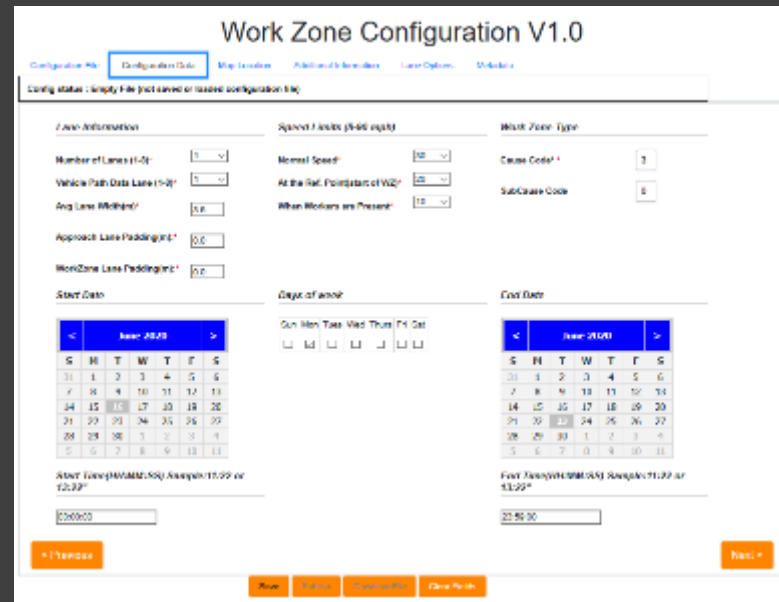
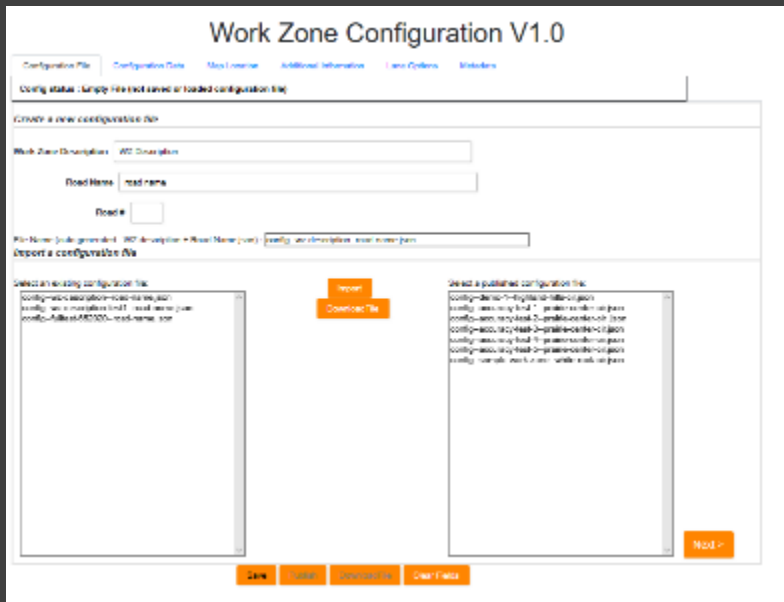
Upload Work Zone Data  
Collection Files

Verification  
and  
Visualization

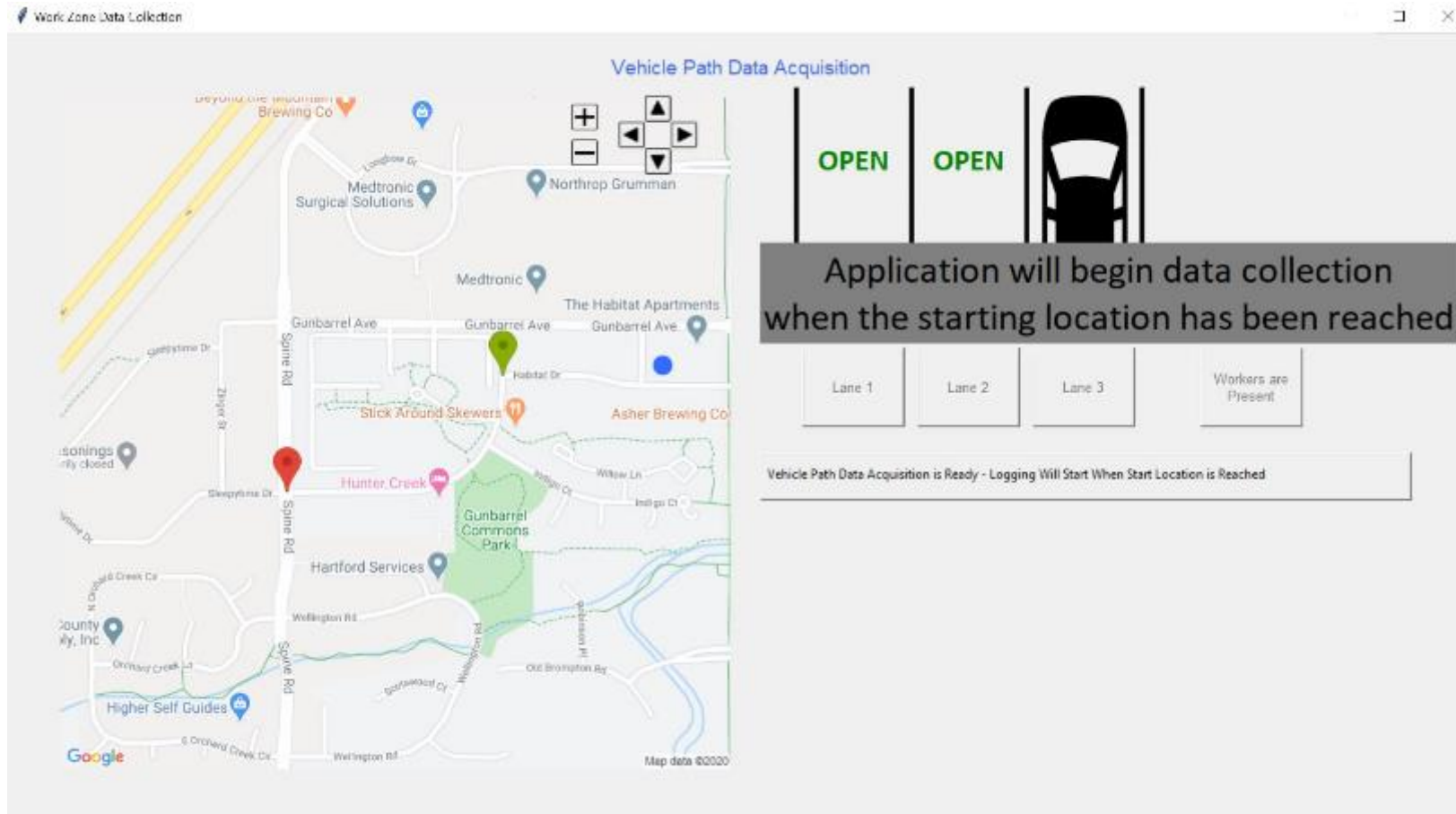
Verify and Visualize  
Work Zone Data

View Published  
Work Zones

View Published Work  
Zones and Data

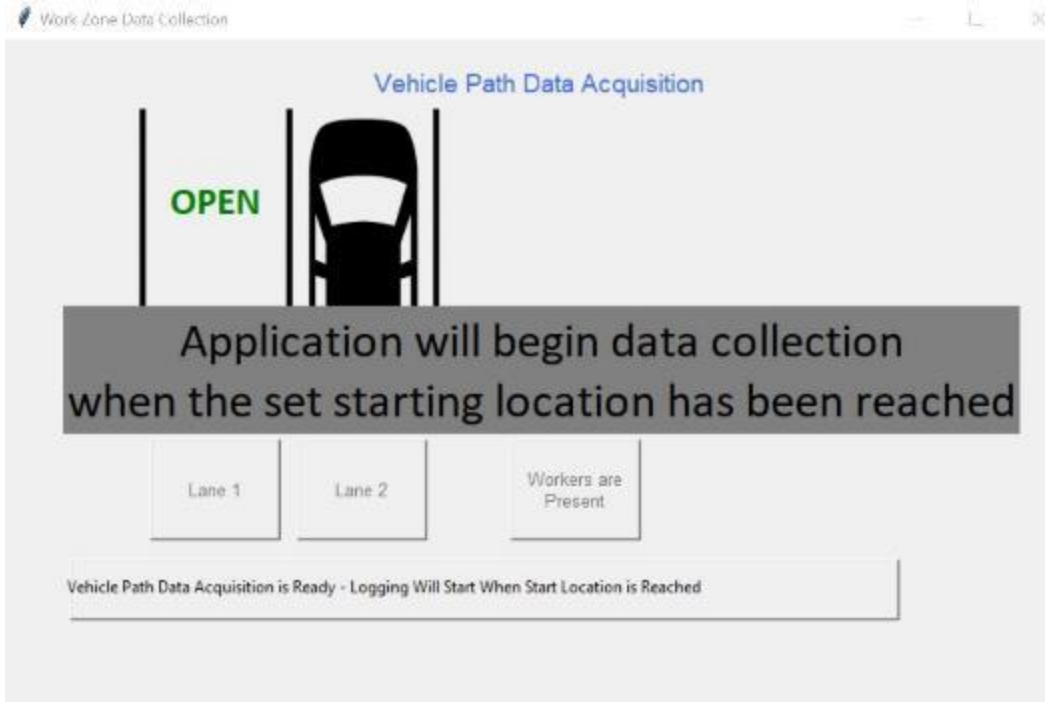


TMC Operator/IOOs enter basic information about work zone



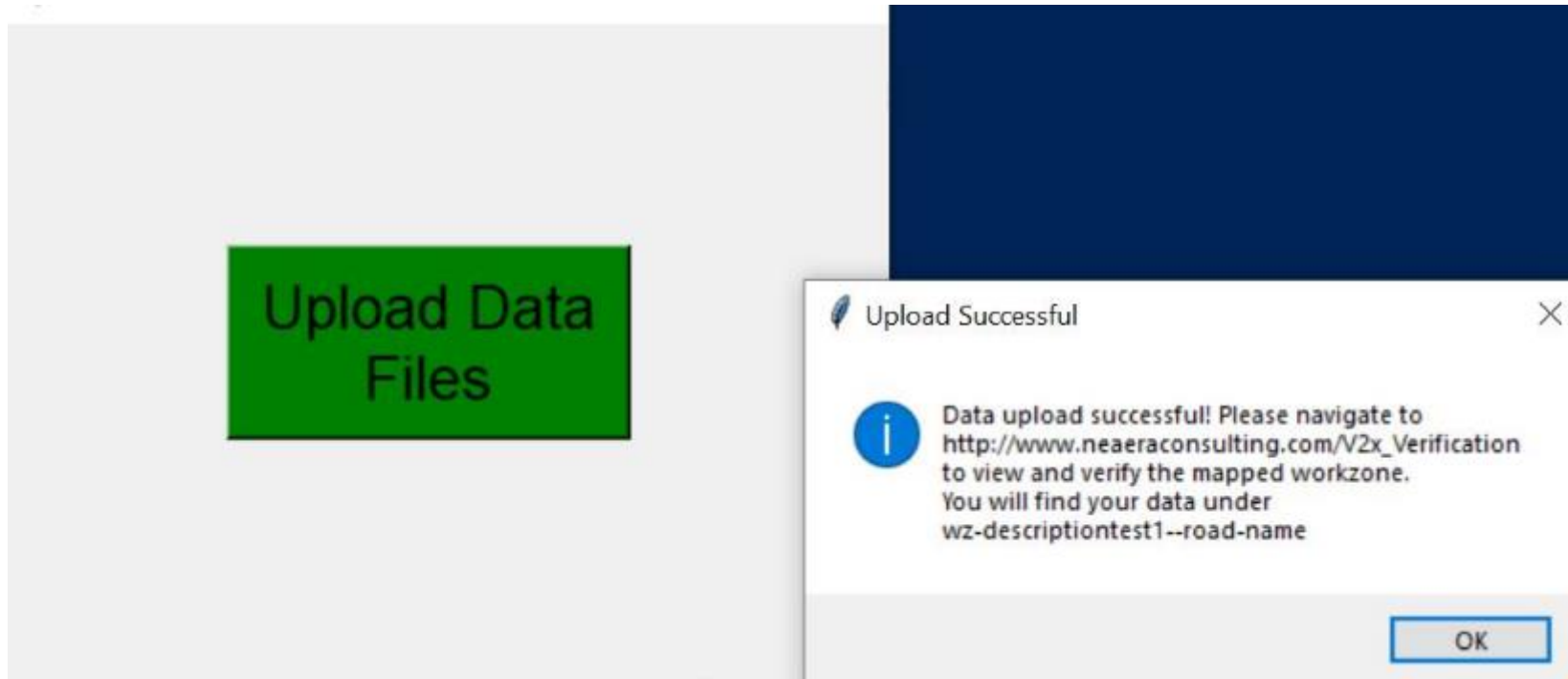
# Field Data Collection Tool (Persona: Work Zone Manager)

- Field vehicle receives information (via cloud, via RSU)
- Download published configuration files
- Automatically detect GPS device
- Dynamically generate GUI for number of lanes and which lane is the driven lane



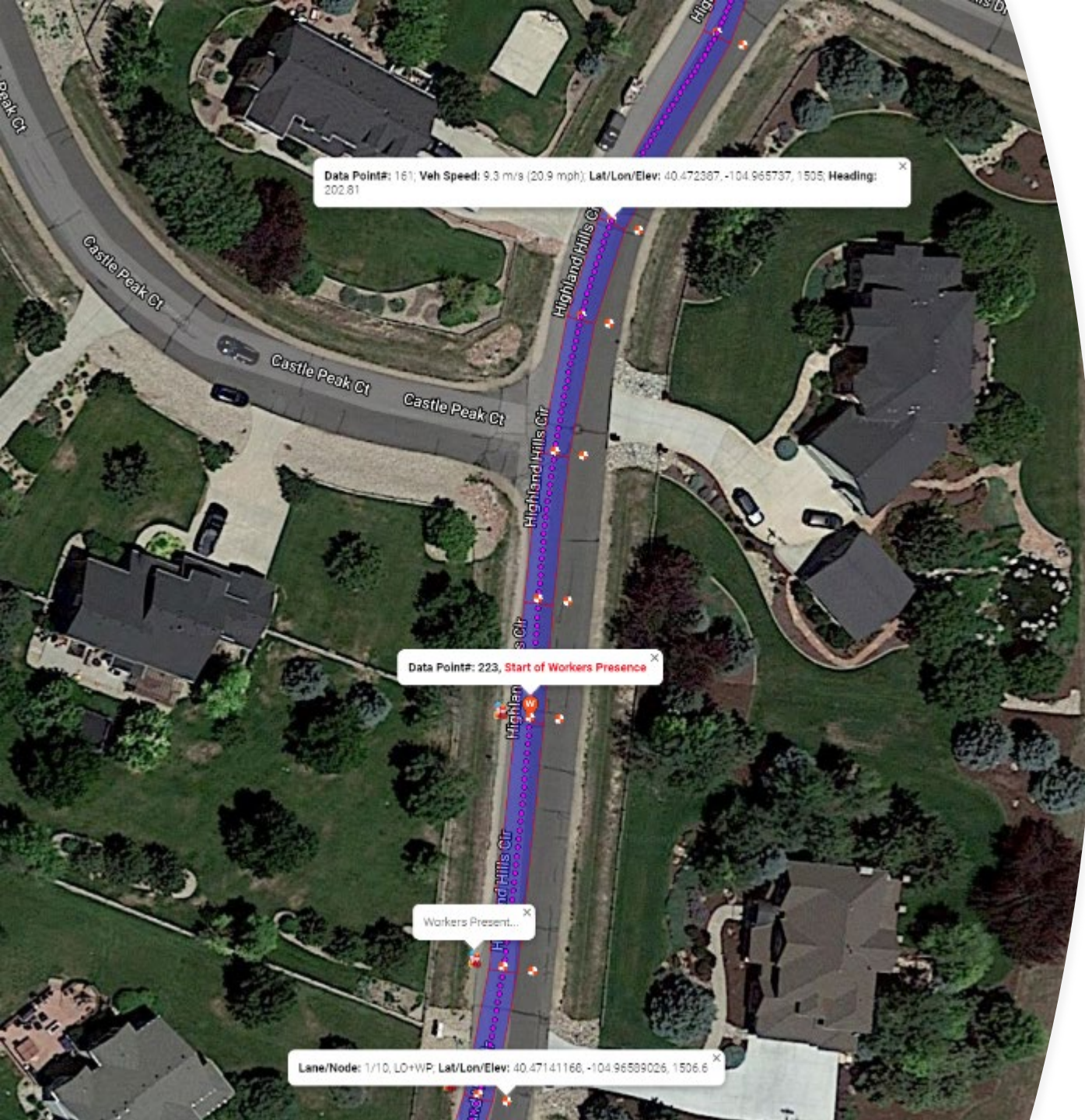
# Field Data Collection Tool

- Data collection automatically starts/ends when set starting/ending locations are reached
- User interface to select current state of road/work zone



## Field Data Collection Tool (Upload)

- When the work zone has been mapped, the path history data is compressed/reduced and messages are created (WZDx and RSM) automatically
- RSM (XML) Message is converted into binary (UPER) automatically
- Messages and path data are zipped and uploaded to the back-office



Received information is used to generate a work zone with new geospatial details in the back office (cloud) for validation

- Overlay WZ Map information
  - Work zone data points
  - Compressed data points (updated to use breadcrumb from SAE J2945/1 spec)
  - Worker presence
  - Lane closures
  - Approximate lane locations
- TMC Operator verifies accuracy of recorded work zone
- TMC Operator publish verified work zones available for
  - 3<sup>rd</sup> party (SDX, WAZE, HERE)
  - 511
  - CARMA and other cooperative automation applications

# V2X Enabled Work Zone Data Collection

Get Work Zone Data

HOME CONFIGUR

## Published Work Zone Data

Choose Work Zone to Download

Choose a work zone and specify messages to download

accuracy-test-1-prairie-center-cir  
accuracy-test-2-prairie-center-cir  
accuracy-test-3-prairie-center-cir  
accuracy-test-4-prairie-center-cir

Description: accuracy-test-1  
Road Name: Prairie Center Cir  
Start Date: 2020-06-15T12:00:00Z  
End Date: 2020-06-19T11:59:00Z

- Work Zone Data Exchange message (WZDx), type = geojson
- XML Roadside Safety Message (RSM), type = xml
- Binary Roadside Safety Message (RSM), type = uper

Download Work Zone Data



## Published Work Zones

- View published work zones
- Download published work zone data (WZDx, RSM-XML, RSM-UPER)

# Future Enhancement Possibilities

Website:

[https://neeraconsulting.com/V2x\\_Home](https://neeraconsulting.com/V2x_Home)

GitHub site:

<https://github.com/TonyEnglish/V2X-manual-data-collection>

Full end to end test video  
located [here](#)

- Mobile app (iPhone/Android)
- Message generation in the cloud
  - Move translator from vehicle to cloud
- ASN1.c open source encoder/decoder for RSM
- V2X-Hub integration with RSU/OBU for message upload/download
- Auto detect:
  - Workers (DNN/CNN)
  - Lanes open/closed (OpenCV)
  - Road signs (DNN/CNN)



# Our Request Today

- **Use this tool to learn about Connected Work Zones**
  - Gain an understanding of the user interface, data needs
  - Gain an understanding of the WZDx & RSM generators
- **Test this tool on various work zone configurations**
  - Let us know which work zones are well supported
  - Let us know which work zones do not work well with the tool
- **Share your feedback with us**
  - See request on the next slide (MS Word document will be mailed to attendees)

## Cooperative Automated Transportation (CAT) Coalition Encouraging Use of Work Zone Mapping Tools – Requests for IOOs

July, 2020

### Background

Work Zone information (e.g. details describing lane closures, reduced speeds, workers presence) is one data element that Connected Vehicles (CV) are looking to Infrastructure Owner Operators (IOOs) to provide to improve the operation of in-vehicle information, warning and control systems. There is a recognized intent among many IOOs to migrate beyond Traveler Information data towards more accurate and timelier “CV Ready Work Zone Data”.

Before IOOs can estimate when and what percentage of their work zones will be “connected work zones”, they need a better understanding of the process involved in creating “CV Ready Work Zone Data”. To understand this process, an IOO does not need to deploy the roadside units or network cellular broadcasts that will eventually communicate the data, rather they can experiment with available tools and create the Mapping information describing work zone lane closures. This will allow IOOs to increase their understanding of the level of detail needed and likely processes they will follow, while also enabling them to provide key feedback about the tools and map data requirements.

### Available Tool

FHWA has developed a proof of concept Work Zone Data Collection Tool (WZDC) that is available for download. This tool functions alongside a TMC website. These tools can be used to gather and assemble information to describe connected work zones. A video demonstration the tools is available as well as support provided by FHWA.

- [Video Demonstrating the POC Work Zone Data Collection Toolset](#)
- [POC Work Zone Data Collection Tool](#)
- [POC TMC Website](#)
- POC Toolset User Guide
- [USDOT Support](#)

The purpose of this tool was to show a proof of concept and in its current deployment it is not able to provide a full robust solution. This tool should be used just as a testing platform. Future work on this application will integrate authentication and security.

### Request of IOOs

To increase industry knowledge about connected work zones, and to gather lessons learned when creating CV ready work zone data, the [CAT Coalition](#) is requesting IOOs to download and try the POC WZDC Tool, following the steps below. In addition, the CAT Coalition is

#### Request of IOOs:

1. Initialize work zone in TMC website
2. Download and install WZDC tool
3. Try mapping an existing work zone that includes a lane closure
4. Provide feedback on your experience

requesting feedback on your experience with using the tool with questions noted in the steps below.

1. Select an existing work zone on your infrastructure that includes a lane closure and at least 1 lane that never closes throughout the work zone.
2. Capture any existing traveler information website images/text or Dynamic Message Sign (DMS) message texts that are displayed to travelers and save screenshots or images of these. This is for reference of how “traveler Information” displays of the work zone are performed.
3. Using the document titled “[Infrastructure System to Support the Reduced Speed Zone Warning – Lane Closure Application Concept of Operations \(ConOps\)](#)”, specifically the excerpt that is Section 3.4.2 (inserted on the last page of this document):
  - a. Please provide us feedback on whether this explanation of the location data required to meet the anticipated SAE J2945/4 standards is clear and understandable.
  - b. Are there any questions about the data needs that can be addressed at this time?
4. If you were to create the detailed J2945/4 data as described (e.g. node points in center of lanes for lanes through the work zone, taper lanes, etc.) does your agency have tools and/or resources to create these data for your selected work zone? If so, what are these tools?
5. Where you able to create the ~~WZDC~~ message and verify that the lane closure, workers present and end of work zone were defined correctly using the defined [here](#).
6. Please enter information about the work zone into the [TMC website configuration creator page](#), utilizing the guide located here (Toolset User Guide). Please enter as many fields as you have information for. Record the name of the configuration file that was automatically generated.
7. Please download and install the [WZDC Tool](#) and become familiar with the tool, either with DOT staff, partner universities, or contractors.
8. After initializing the WZDC tool with the configuration file that was created earlier, drive the work zone (with an assistant), marking the locations of lane closures/openings and the presence of workers. After mapping the work zone, upload the generated data. Record any observations or areas for improvement about the tool during the drive.
9. Consider the location of the work zone and the nature of work being done (e.g. whether there is merging traffic from other routes, whether there is limited sight distance before the work zone, the frequency that lane closure location changes, etc.) and consider the following questions:
  - a. In a scenario where there are a number of vehicles with on-board applications capable of receiving infrastructure messages about work zones and providing alerts/warnings to drivers when appropriate, what would be your preferred approach for broadcasting the data to the on-board applications?
    - i. Roadside units (low latency, limited distances)?
    - ii. Network cellular (higher latency, unlimited distance)?



# Agenda Item #5: Partner Reports

USDOT

ITS America

# Next Strategic Initiatives WG Webinar

- Next Webinar:
  - October 22<sup>nd</sup>, 2020 2:00 – 3:30 PM Eastern