

# Arizona Work Zone Notification System Pilot Project

## Commercial Vehicle Safety Summit

November 19, 2019

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# Arizona Pilot Deployment of Work Zone and Incident Notification System

- Project funded by the **High Priority Grant Program - Innovative Technology Deployment (ITD) – Formerly called CVISN**
- Program is managed by the Federal Motor Carrier Safety Administration (FMCSA)
- The focus of the HP program is CMV:
  1. Safety and information sharing
  2. Electronic credentialing
  3. Electronic screening



# Arizona Project Goals and Objectives

## ➤ Goals

1. Improve safety in work zones on freeway and freight corridors
2. Improve traffic flow and reduce congestion on freeways and freight corridors due to work zones

## ➤ Objectives

1. Develop and demonstrate a Work Zone warning and alert system using connected vehicle technologies (including 5.9 GZ DSRC communications) to provide in-vehicle information for commercial vehicle operators.
2. Develop and demonstrate the use of connected vehicle systems, including variable speed limits, queue warning, lane closure warning, and vehicle-to-vehicle messages to augment the operation of core ITD capabilities (e.g. electronic screening and bypass).

# Work Zones Crash Data

- 100,000 work zone related crashes each year nationally with 710 fatalities with fatalities increasing 3% per year
- Nationally, over 30% of work zone fatalities involve heavy vehicles
- In rural areas, 50% of fatalities involve heavy vehicles
- Over 1/3 of Work Zone related crashes involve hitting a traffic control device
- Work zones account for nearly 24% of non-recurring congestion
- Or 482 million vehicle hours of delay



\*Data taken from 2017 National Workzone Safety Clearinghouse and FHWA



# Current Method of Notifying CMV of Work Zones

- Work Zone restrictions and closures entered into AZ 511
- Arterial data provide through Regional Archive Data System into AZ 511
- ADOT ePRO OS/OW Permitting System
  - Routing and Permitting system polls HCRS every hour to update restrictions used in evaluating new permit requests and truck permit routing
  - Informational Restrictions warnings for work zones will appear on the permits
  - Nightly analysis of new restrictions will check active permits and sends emails to carriers if a new restriction has been added to their routes.
- Smarter Work Zones
  - Messages displayed on Variable Message Signs
  - In road sensors
  - Speed feedback

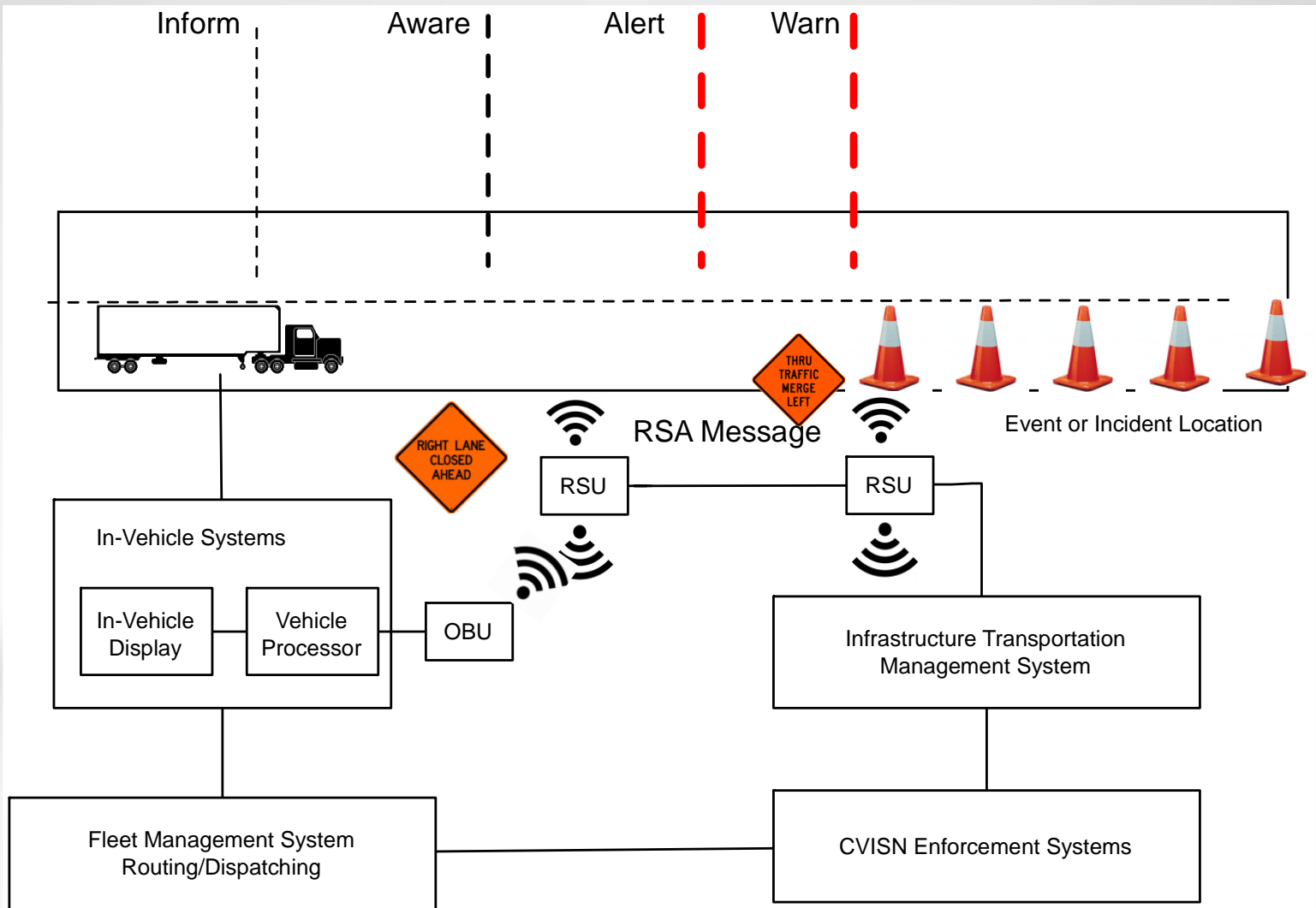


# Comparison of Workzone Control Systems

	Traveler Information	Queue Warning	Lane Merge	Incident Detection	Speed Limit	Automated Enforcement	Entering/Exiting Vehicle Notification	Performance Measurement	In-Vehicle Signage and Alerts
Traditional Work Zone	Static		Signs	Traveler and Personnel Report	Fixed			Records	
Smart Work Zone	Real-Time	Fixed Points	Signs, Dynamic Fixed Points	Fast Detection	Variable, Fixed Point, CMS	Capture Images	CMS Warnings	Sensor based	511, WAZE, Google,..
Connected Vehicle Work Zone	Real-Time	Continuous	Dynamic, In-Vehicle Info, Continuous	Vehicle Based Detection	Variable, Vehicle Based		V2V Alerts	Vehicle Based	Direct: Visual, Auditory, Haptic Messages and Alerts



# Concept Vision



# INFORM

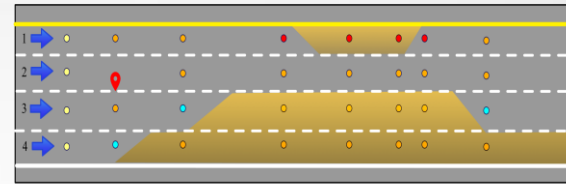
- Use data from AZ 511 and RADS
- Provide a high level notification of an upcoming work zone
- Include wait times
- Start and end information
- Alternate route information



# AWARE

- Driver is notified of a work zone in the roadway in the roadway
- Information about
  - Lane Closures
  - Workers Present
  - Speed Limit
  - Travel time
- Connected Vehicle System Components
  - MAP
  - ~~TIM~~ — Traveler Information Message
  - RSA – Roadside Alert Message
  - Roadside Safety Message (RSM)

Basic MAP



- Reference node point
- Approach lane node point
- Lane close/open node point
- Work Zone lane node point
- Workers present zone



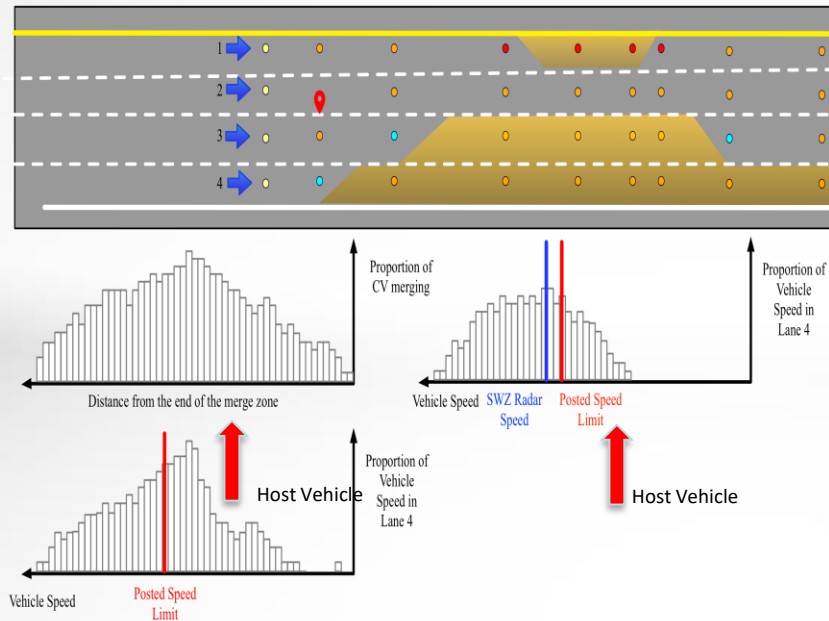
HMI Concept



Drivewyze Concept

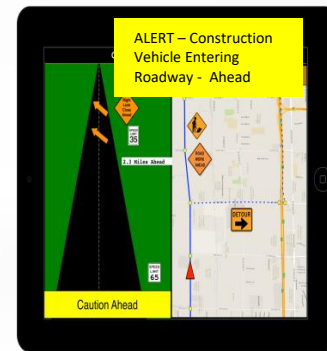
# ALERT

- Driver can be alerted to hazardous conditions and provide merging data based on the queue
- Based on Traffic Data and Vehicle Decisions



## ➤ Alert Conditions

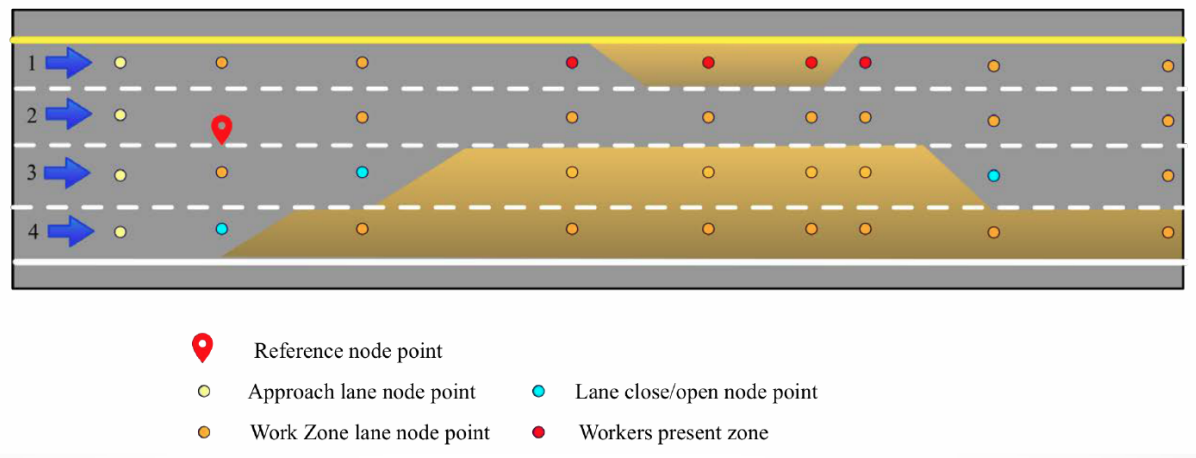
- Lane Closure
- Workers Present
- Speed Warning (exceeding speed)
- Continue to provide travel time





# Data Definition

Data	Description
Work Zone Map	Each work zone requires a Map that defines the lanes and boundaries of the work zone from a vehicle point of view. The roadside unit (RSU) is responsible for broadcasting the message that contains the Map.
TIM and RSA Messages	The Traveler Information Message (TIM) and the Roadside Alert message are used to send speed limit and Speed and Merge Thresholds to all connected vehicles (with OBU) in the system.




Example of a CV Work Zone Map

# Work Zone Status Display Panel

### Speed and Position Status

Speed Limit



Current Speed


**36.6**

Vehicle Position

Latitude: 33.437128  
Longitude: -112.233252  
Elevation: 311.2  
Heading: 270.18  
Lane: 1


### Work Zone Alerts and Warnings

Left Lane Alert



Left Lane Ends  
65 ft

Right Lane Alert



Right Lane Ends  
213 ft

Workers Present

### Work Zone Messages

Active

MC-85 Westbound

Received

MC-85 Westbound  
MC-85 Eastbound  
I-10 Westbound  
I-10 Eastbound



# Revised Project Tasks

## Task 1: Data Integration with Drivewyze

- Sends Arizona Connected Vehicle (AZCV) Work Zone data to Drivewyze for notification on ELD-equipped vehicles

## Task 2: Truck Recruitment

- Request assistance and insight from carrier regarding value of in-cab notifications.
- Provide trucks with Drivewyze enabled ELDs. Possibly equipping them with a Connected Vehicle OBU radio and antenna

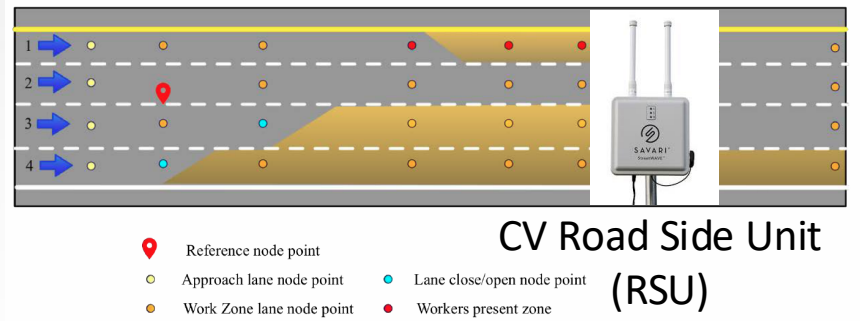


# Planned Integration Architecture

## Data Integration with Drivewyze



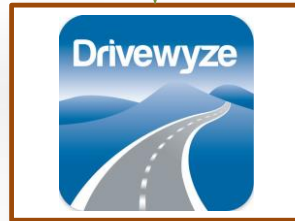
Drivewyze ELD-equipped Truck



Notification to Individual trucks

Work Zone MAP CV Messages

CVWZ data is processed to generate notifications using geo-fencing



Drivewyze Server

Work Zone Map CV Messages



Regional Archived Data System



# Data Integration with Drivewyze

## Original Plan

- Create a secured web session between RADS and Drivewyze server
- Data is pushed by RADS when a change in data is detected
- Data include:
  - Work Zone Map
  - Roadside Alert (RSA) message

Ultimately had to demonstrate the capabilities of the software without the RSU and use a push from laptop.



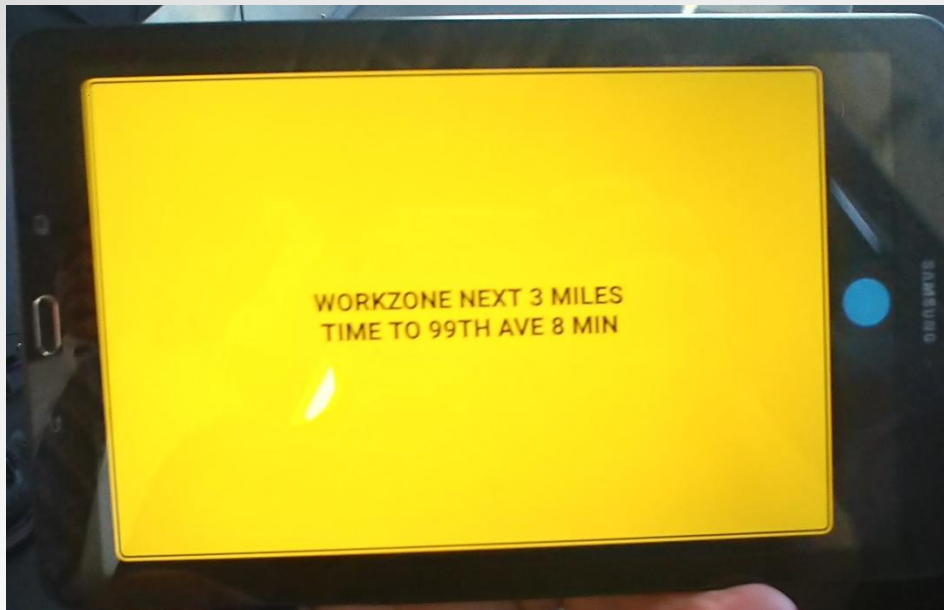


# Drivewyze Processing

- Drivewyze processes the CV Work Zone data and generates notifications for an approaching truck using geo-fencing.
- A review of CV Work Zone messages determined that many warning messages were not suitable for dissemination on Drivewyze ELD
- Project focused on non-mapping message



# In-Truck Demonstration



# USDOT WZDx v1.1

- Used USDOT framework as standard message format
- Work Zone Data Exchange (WZDx)
- Common Core Data Specification Reference Document

<https://www.transportation.gov/av/data>

- Sent to Drivewyze using the WZDx JSON API

<https://api.mcdot-its.com/WZDx/Activity/Get>



# Sample WZDx Data Frame

Tag	Value	Notes/Comments
identifier	Maricopa.gov.2019012001	
subidentifier	TT0345;TCP_12;eastbound	Use Project # and TCP #. A single TCP could generate two restrictions, one in each direction.
StartDateTime	startDateTime-ver: 2019-01-20T06:35:00-07:00	By convention, we will include timezone value (-07:00) since AZ does not recognize DST; could also use UTC (Z). Suggest this be a convention for all.
EndDateTime	endTime-est: 2019-08-20T23:59:59-07:00	How would day-time construction (8 AM to 5 PM, M-F) be represented? Make five entries?
BeginLocation	roadName: MC-85 (Buckeye Rd) roadDirection: eastbound latitude-est: 33.435795 longitude-est: -112.259716 crossStreet: 91st Ave	
EndLocation	latitude-est: 33.437151 longitude-est: -112.224501 crossStreet: 79th Ave	
wz_status	active	Could this field include a separate Date/Time field if Work Zone will only be set up during off-peak hours during an extend time period?
totalLanes	2	



# Experience and Lessons Learned

- Work Zones are VERY COMPLEX geometries
  - Discussions with CAMP about modeling – with consideration for Freight Vehicles
    - Lane Add and Drop, Narrow Lanes, Lane Change Restrictions
- Geometries change (that's the point)
  - Creating and updating accurate maps must be a responsibility of the construction contractor
- AZ511 and other systems note the locations – not the geometries
- Connected Vehicle technologies need to mature
  - BSM sent from vehicle can be used to make alerts and warnings
- New technologies are challenging but improving
- Standards are very new and not embraced by all manufacturers
- **DON'T DISTRACT THE DRIVER**

# Data Interfaces

## Info Generators

Construction



TMC

Data entry

TCP Plans

Smart Work Zone

- Dynamic Message Signs
- Travel Times
- Speed Warning
- Camera Feed (TMC only)

RADS

TMDD

WZDx

WZDx

## Info Consumers

511 & ISPs

- TMDD format



CMVs

- WZDx format
- In-vehicle displays



Automated Vehicles

- WZDx format
- In-vehicle displays



# Questions/Discussion



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