

“Transferring knowledge about the TSMO practice around the country”

USDOT ITS JPO: Virtual Community College Workshop Series



NOCoE Founding Partners



U.S. Department of Transportation
Federal Highway Administration

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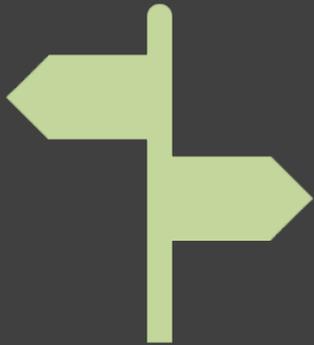


T S M O

ransportation
ystems
anagement and
perations



What is a Paraprofessional



Paraprofessional –

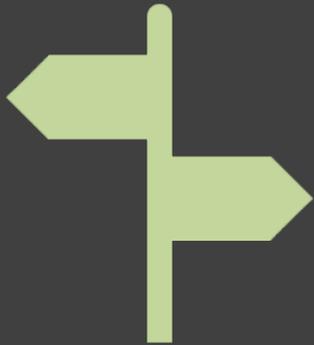
An individual supporting a professional in fields such as education, engineering, healthcare, and law.

A paraprofessional may be required to demonstrate knowledge and skills through certification, education, and/or experience.

Paraprofessionals are normally under the responsible charge of a licensed professional and may be assigned levels of responsibility commensurate with their knowledge and skills.



What is a TSMO Paraprofessional



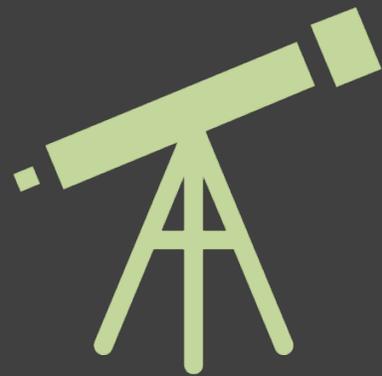
A TSMO paraprofessional is a position **supporting the management and operations** of transportation infrastructure.

A TSMO paraprofessional **may exert a high level of judgment** in the performance of their work.

TSMO paraprofessionals can **comprehend and apply knowledge** of basic engineering principles in the solution of broadly defined TSMO problems at a cursory level.

TSMO paraprofessionals provide **traffic management center operations services and a variety TSMO field services.**

So where
do I find?



Recruiting a TSMO
Workforce

Model TSMO Position
Descriptions

[NOCoE](#)
[Website](#)

Developing a
TSMO Workforce

TSMO Workforce
Retention

<https://transportationops.org/workforce>

Connected Vehicles Technology Lessons Learned from Field Deployments



Blaine D Leonard, P.E.
Transportation Technology Engineer
Utah Department of Transportation



Jonny Turner
Principal Electrical Engineer
The Narwhal Group

Ralph Koeber
Electrical Engineer
The Narwhal Group



The **Connected Vehicle** system uses wireless technologies to exchange information with:

- Other vehicles (V2V),
- Roadside infrastructure (V2I), and
- Other travelers (peds, bikes, etc) (**V2X**)

to help the driver **avoid hazards**
and drive more **efficiently**

INFORMATION BASED ON WHAT THE VEHICLE
CAN “**LEARN**” BUT CAN’T SEE

Connected Vehicle V2X Options



Roadside Unit (RSU)

On-Board Unit (OBU)



DSRC (Dedicated Short Range Communication)

Developed and evolved to meet specific needs

802.11 standards (like WiFi)

Uses 5.9GHz Spectrum

Very low latency (10-50 millisecond)

300-meter range

Tested, proven, broadly deployed, available

Future Path to IEEE NGV

Connected Vehicle V2X Options



DSRC

802.11 standards
Uses 5.9GHz spectrum
Short-range, low-latency
Broadly deployed
Future Path: IEEE NGV



RSU

OBU



C-V2X (Cellular V2X)

Cellular 4G-LTE technology (not “5G”)
Built on 3GPP Release 14 (2017) and 15 (2018)
Requesting access to 5.9GHz spectrum
Short-range, low-latency
Newer, not broadly tested yet
Commercial availability emerging
Not interoperable with DSRC

Typical Roadside Installation

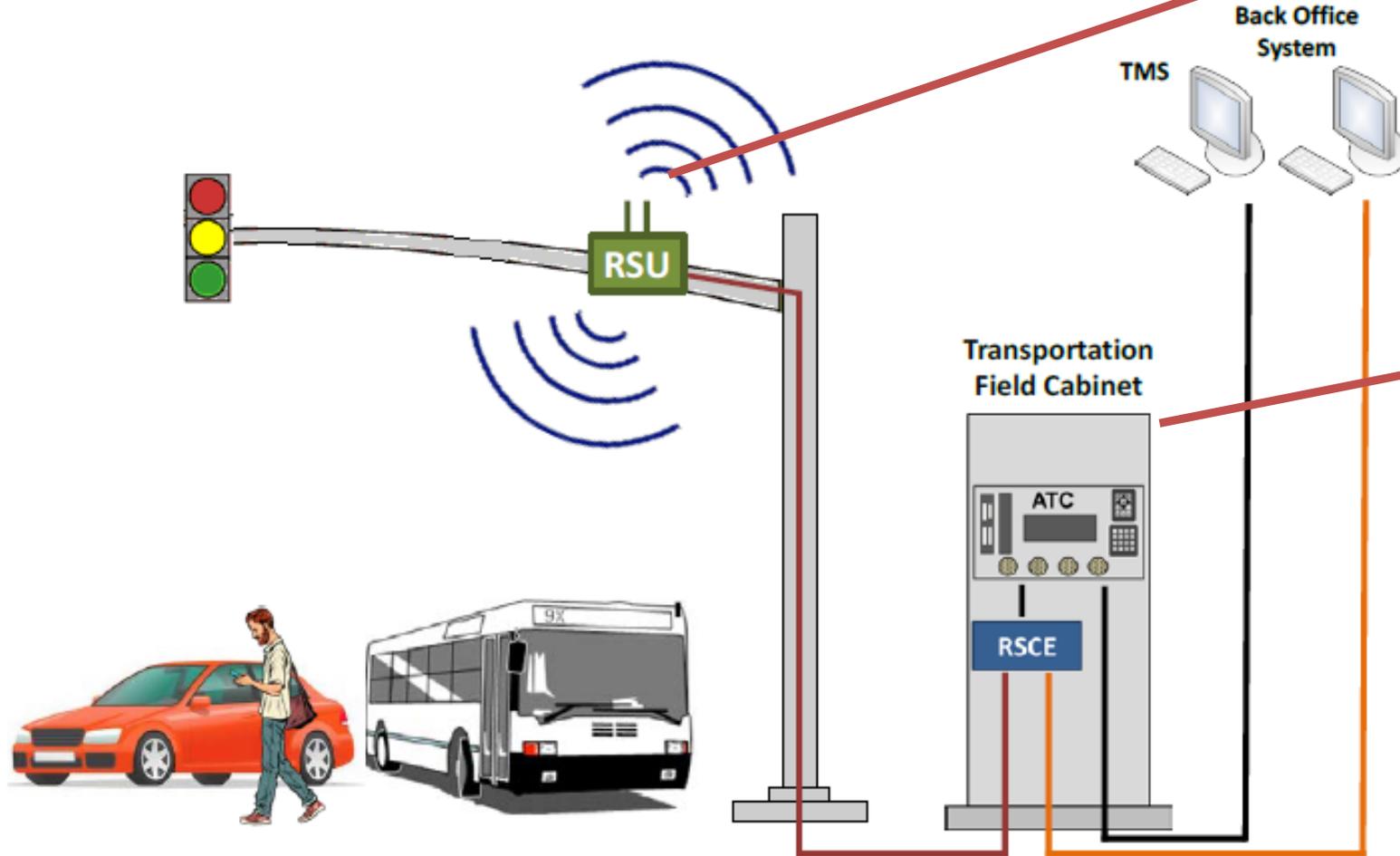
RSU – Roadside Unit

RSCE – Roadside Cabinet Electronics

TMS – Transportation Management System

ATC – Advanced Transportation Controller

- PoE Cable
- Antenna Cable
- Backhaul Network
- Other Network Connections



SPaT Challenge Deployments

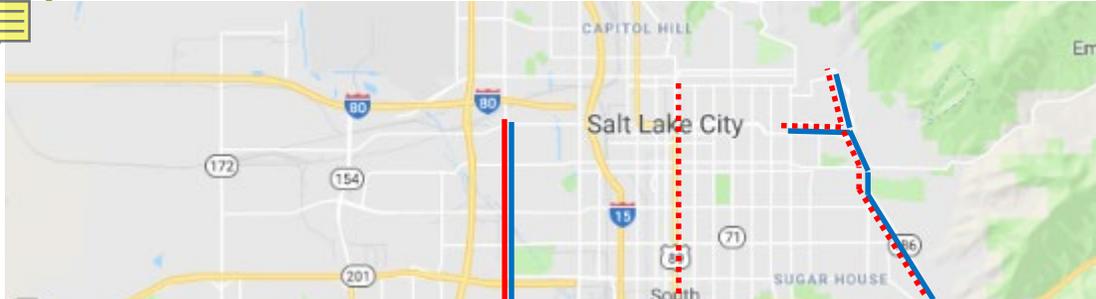
“Local Pilots of National Significance”

Challenge state and local public sector transportation Infrastructure Owners & Operators (IO&Os) to **deploy DSRC infrastructure with SPaT broadcasts** in at least one coordinated corridor or network (approximately 20 signalized intersections) in each state by January 2020.

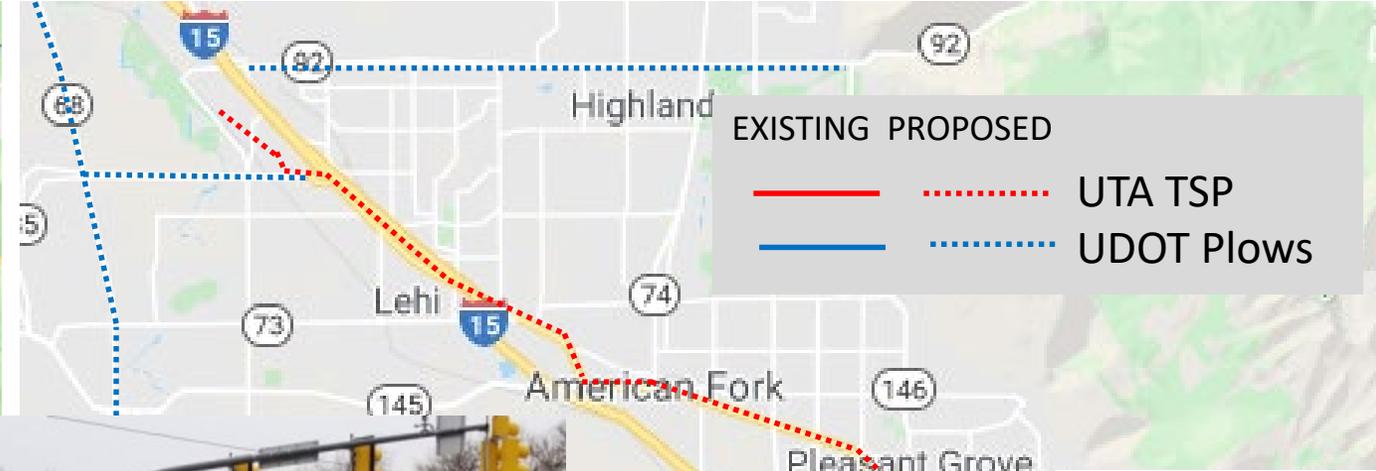
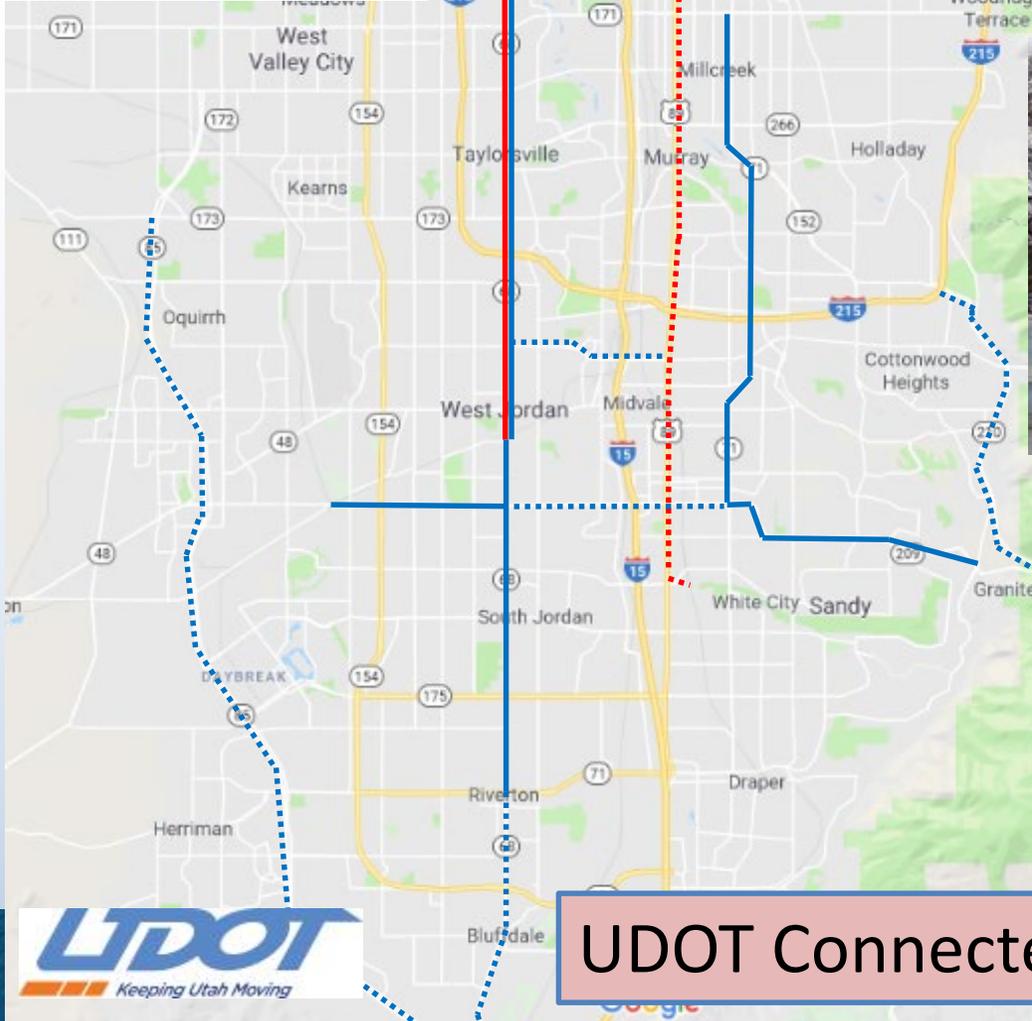


www.transportationops.org/spatchallenge

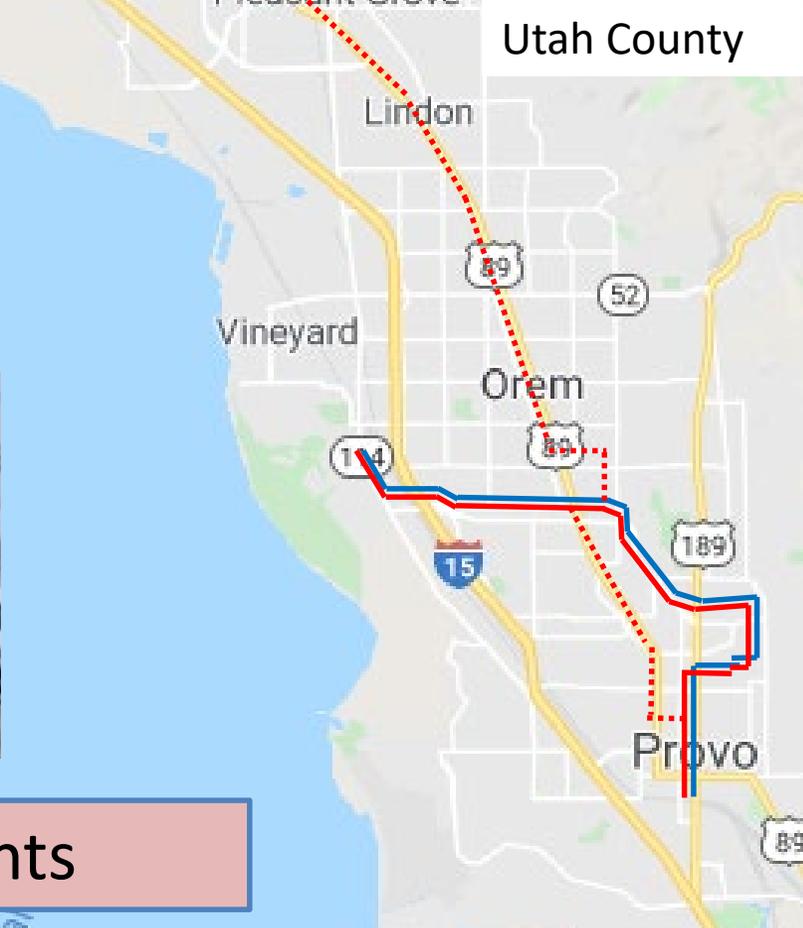
20 Intersections in 50 states by 2020!



Salt Lake County



EXISTING PROPOSED
— UTA TSP
— UDOT Plows



Utah County

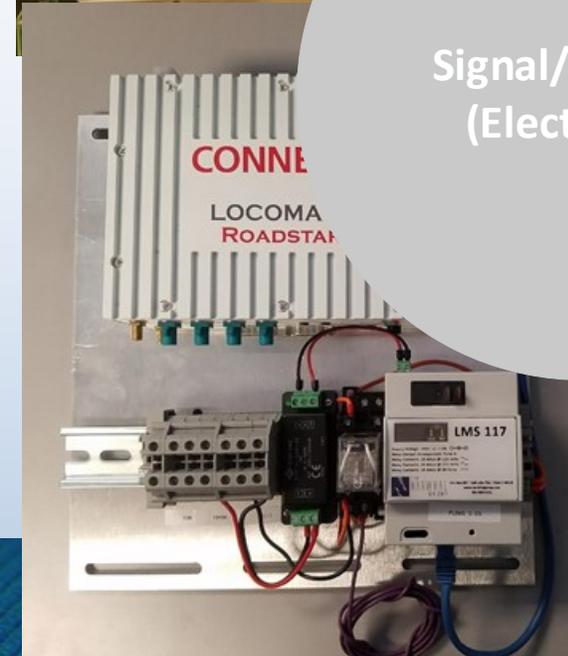
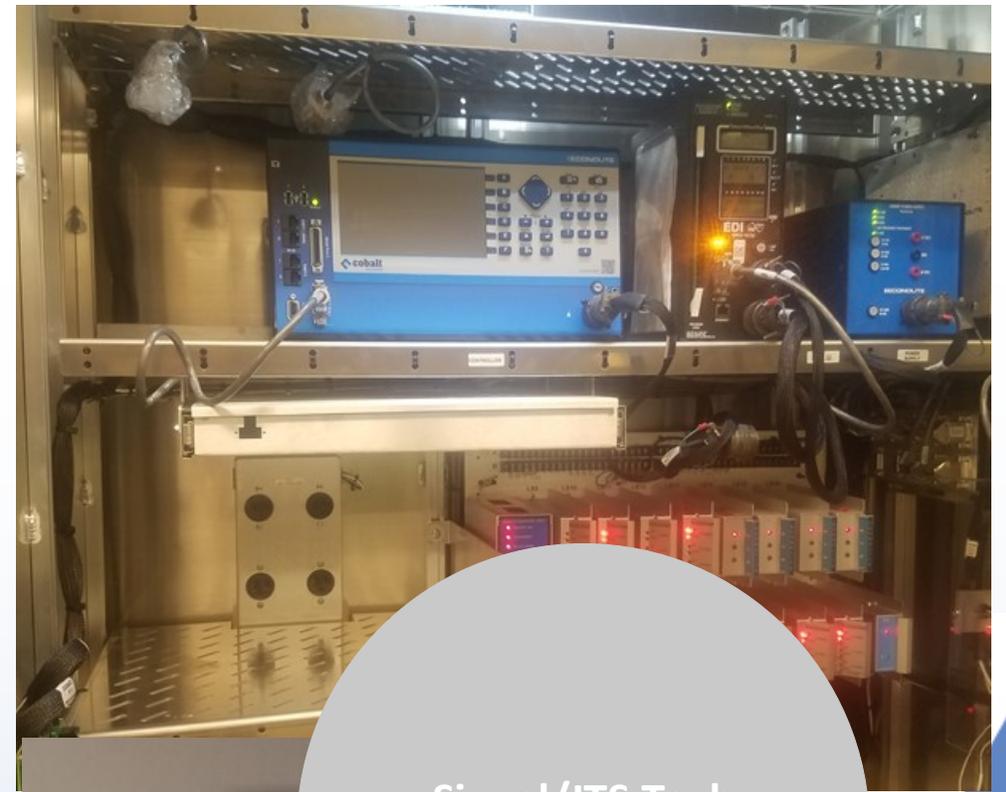


UDOT Connected Vehicle Deployments

Skills Needed

Signal/ITS Technician (Electrician)

- Safety: traffic control, utilities, signal cabinet and tools
- Equipment Operation: safety, driving, and operation
- Electrical Theory: AC vs DC, volts, amps, resistance, power and Ohm's Law
- Traffic signal operation, electronics and interfaces
- Vehicle electrical system, operation and interfaces
- Field Measurements: volts, amps and resistance
- Radio Installation (mechanical skills): alignment, drilling, cutting, banding, dressing
- Cable Installation: junction box access, cable routing and pulling, terminations, cable testing and dressing
- Surge Suppression
- Power over Ethernet



Signal/ITS Tech
(Electrician)

Skills Needed

Information Technology (IT)

- Networking: wired and wireless, IP addressing, subnetting, routing, IPV4 vs IPV6, port configuration, vlan, remote access
- Windows Command Line Environment: check IP, run ping commands
- Linux Command Line Environment: check and configure IP, folder navigation, file transfer, file editing (i.e., vi, nano, etc)
- Cabling Basics: cable distribution, fiber optic vs copper networks
- Real-time data handling
- Database management
- Packet capture (Wireshark)
- Firmware updates
- Technical writing

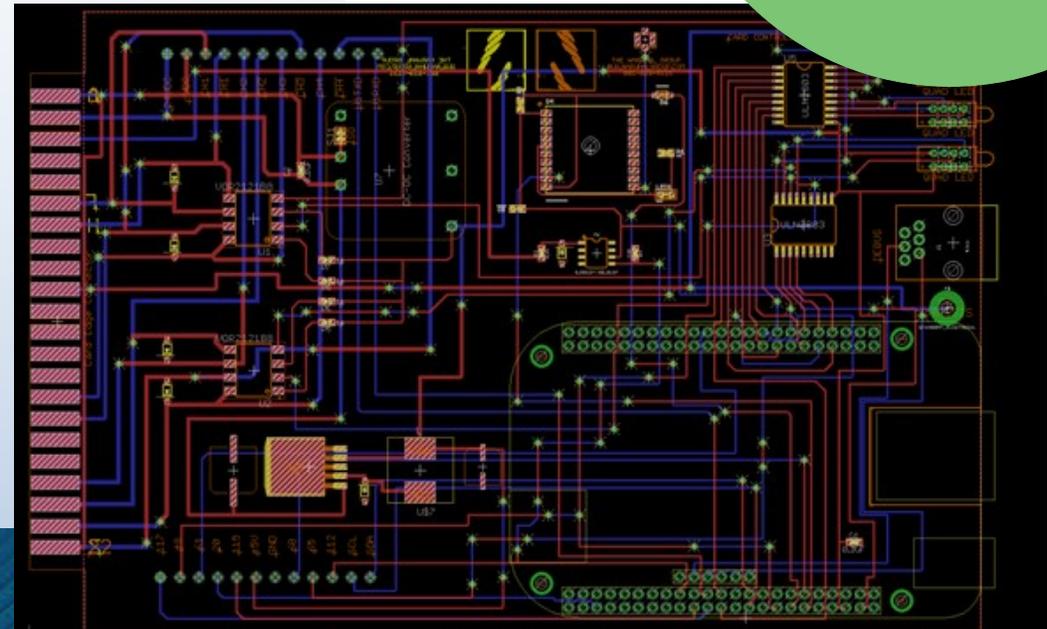
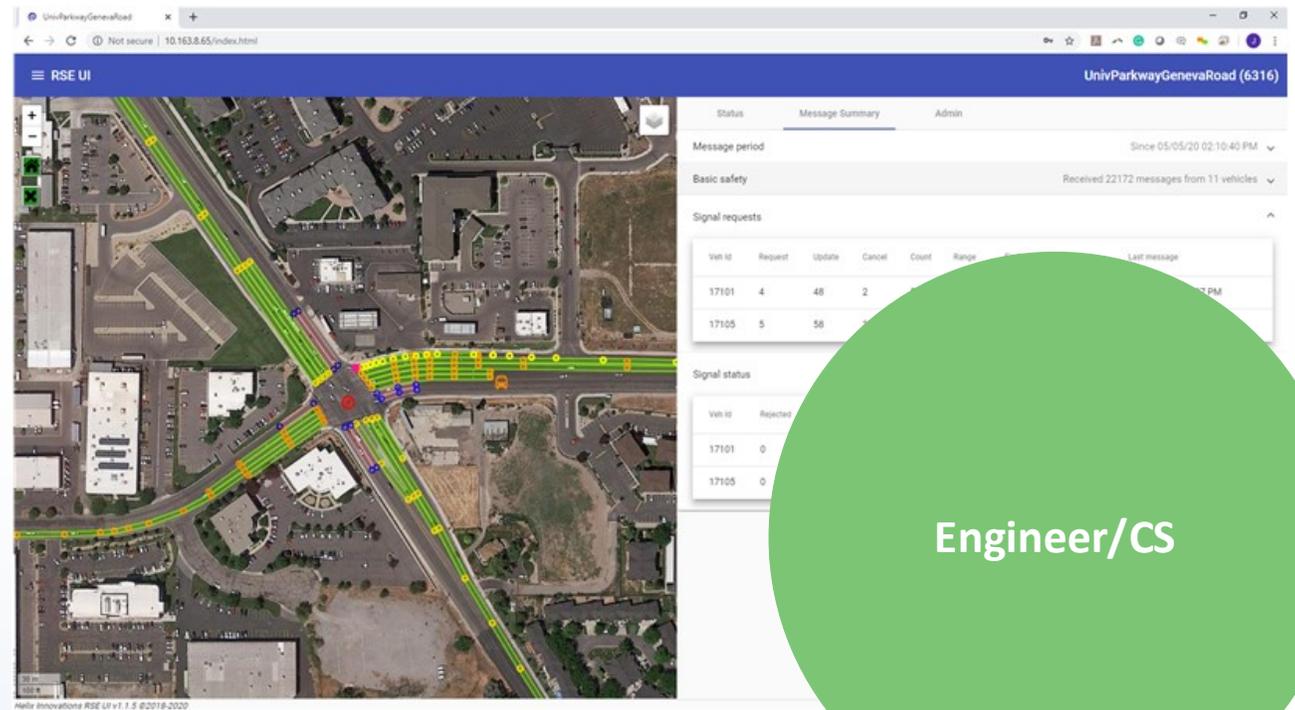
The collage features three main components:

- Wireshark Packet Capture:** A screenshot of the Wireshark interface showing a list of captured packets. The selected packet is an SAE 32.158 basicSafetyMessage. The packet details pane on the right shows the structure of the message, including fields like msgID, hlobi, vlobi, msgCnt, secMark, lat, long, and various parameters.
- Terminal Window:** A screenshot of a terminal window showing a Linux login prompt. The user 'admin' has logged in. Below the login prompt, the terminal displays the output of the 'show application details' command for 'l3m' and 'l3n', showing various configuration parameters and their values.
- Information Technology (IT) Graphic:** A large blue circular graphic with the text 'Information Technology (IT)' in white, centered over the collage.

Skills Needed

Engineering / Computer Science

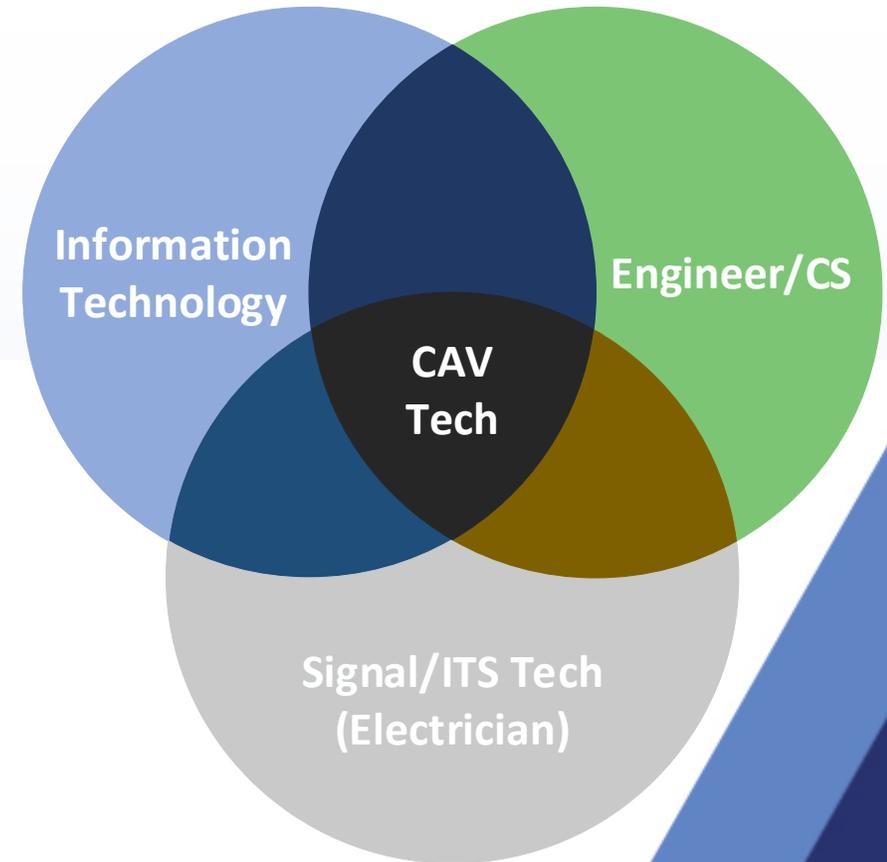
- File Editing: configuration files
- Security Certificate Management System (SCMS)
- RF Theory: transmit, receive, dBm, interference, dual radio impacts (not like COTS radio links)
- Hardware design
- Programming
- Device testing
- Configuration files
- Understanding of applications
- SNMP
- MIBs
- Encoding/Decoding
- Next-level support from manufacturers
- Data Analysis
- Technical writing



Skills Needed

On the Job Training (OJT) – To round things out

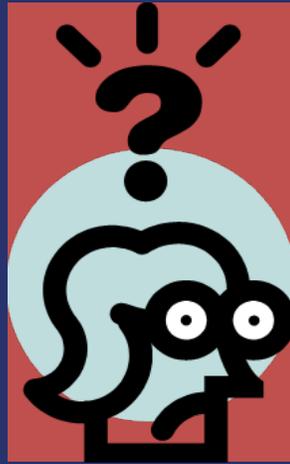
- Alphabet Soup: DSRC, CV2X, OBU, RSU, Dual Unit, BSM, MAP, SPaT, TIM, FCC, Spectrum, Frequency, Channels, PSID, IEEE 1609, SAE J2735, J2945, 3GPP, NTCIP
- GIS: MAP Generation
- System monitoring analysis
- Custom Applications: ISD Message Creator, TIM Message Creator, Message Validator
- Proficiency with: VPN, SSH, Telnet, RDP, SCP



Lessons Learned

- We have found that the implementation of this technology requires professionals from all of these areas
- This rapidly changing technology and their deployments have proven to give consistent challenges and growth to those that have chosen to do this work
- Ideal candidates have IT or Engineering background that are willing to work on the side of a busy road, 20' in the air, in extreme environments (which electricians, signal and ITS techs do regularly)
- This work provides a great sense of accomplishment and satisfaction





LTDOT
Keeping Utah Moving



Connected Intersection MAP Messages

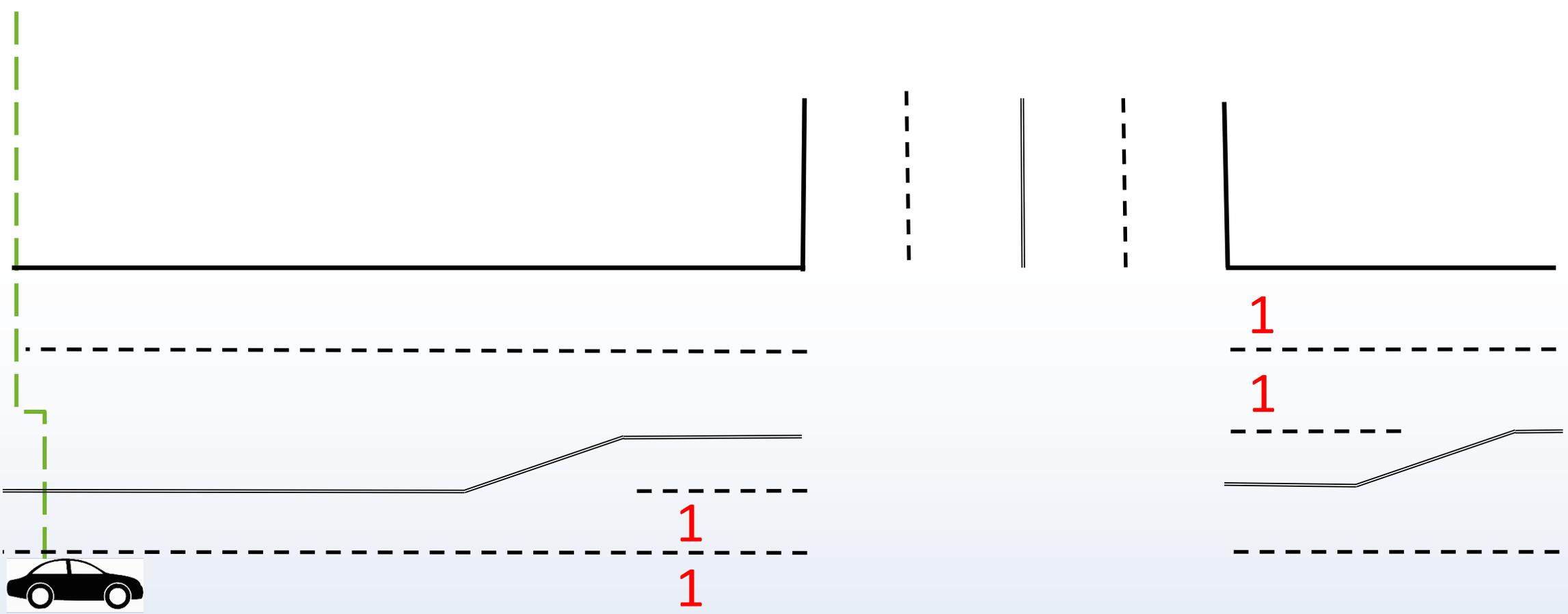
Dean Deeter,

President, Athey Creek Consultants

deeter@acconsultants.org



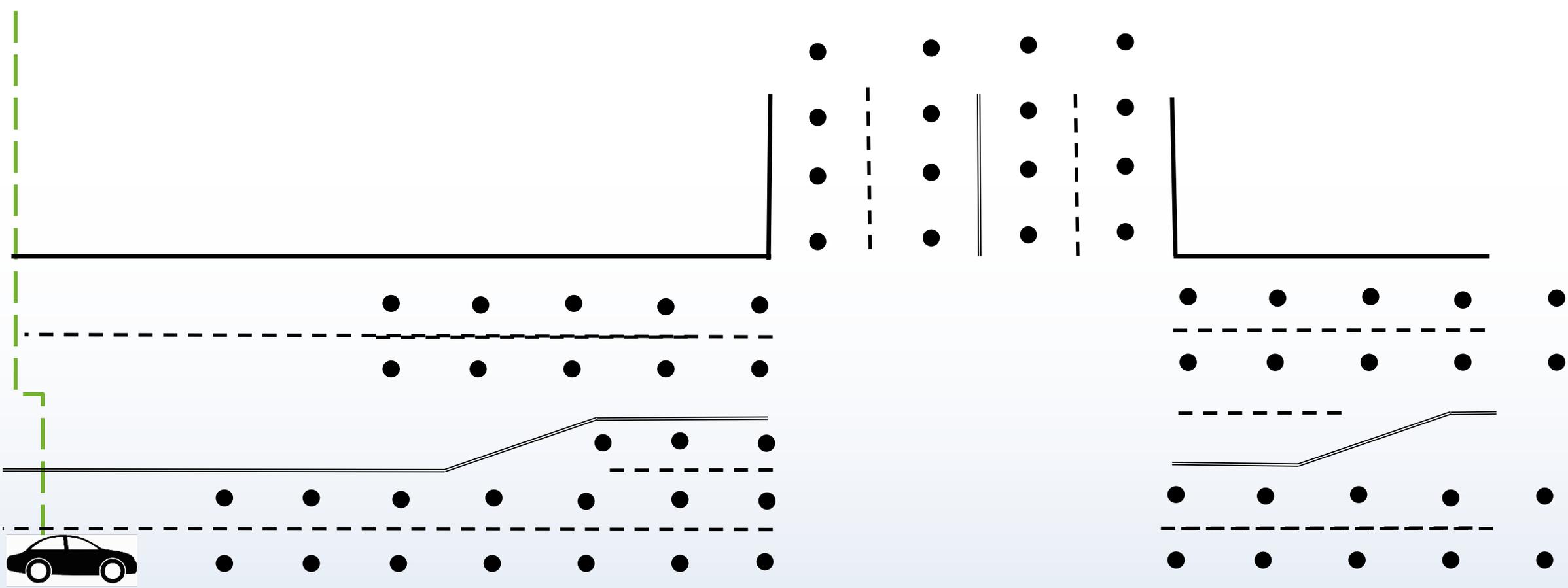
National Operations Center of Excellence



SPaT Message:

- From the Signal Controller
- Current Signal Status for each approach (signal group)
- Expected time of next signal phase change
- Whether pedestrian cross walks are activated
- Others





MAP Message:

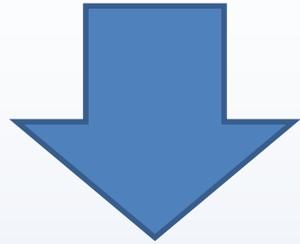
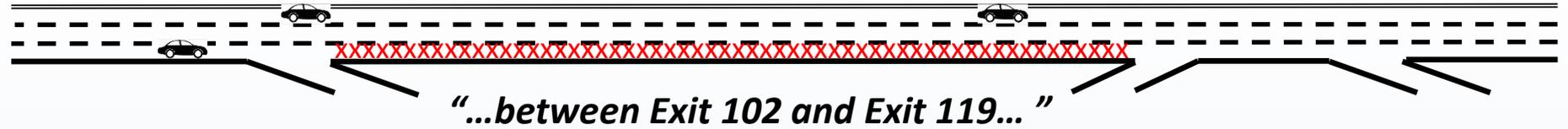
- Geographic map of an intersection (node points)
- Associated signal group for each lane

Key Skills / Resource Familiarity

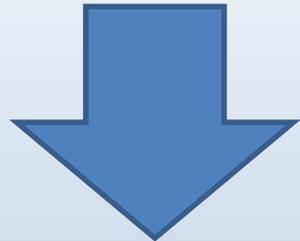
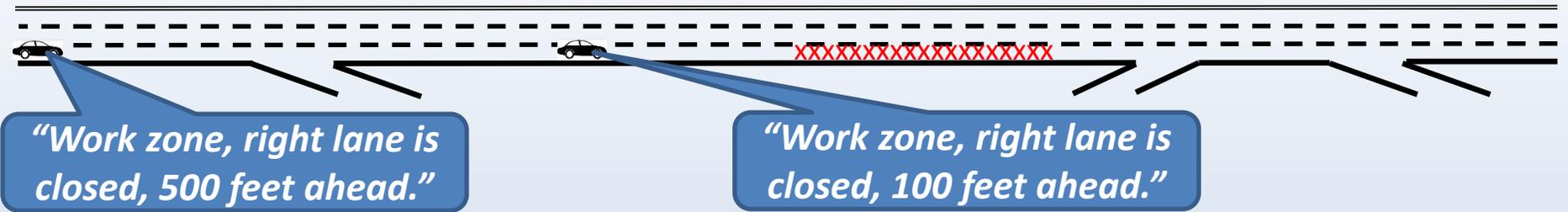
- FHWA Mapping Tool: Available on-line
- GIS Tools and Software
- Online Mapping Resources: Google Maps, Bing Maps
- Data Collection Tools: LIDAR, UAVs, Traditional surveying equipment, handheld GPS
- Data Formats / Languages: XML, KML, JSON
- Location Correction: Approaches and Data Sources

The Migration towards CV or AV Ready Work Zone Data (map message)

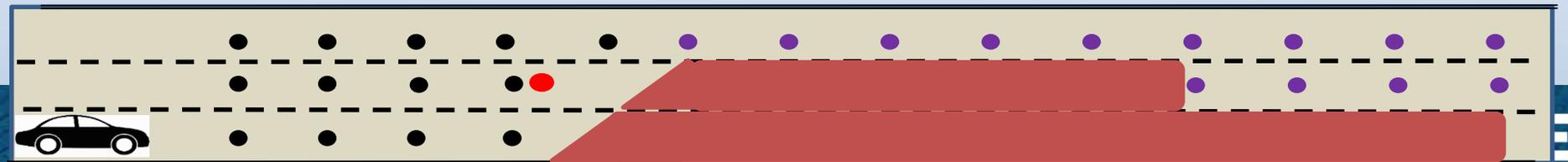
Traveler Information Level

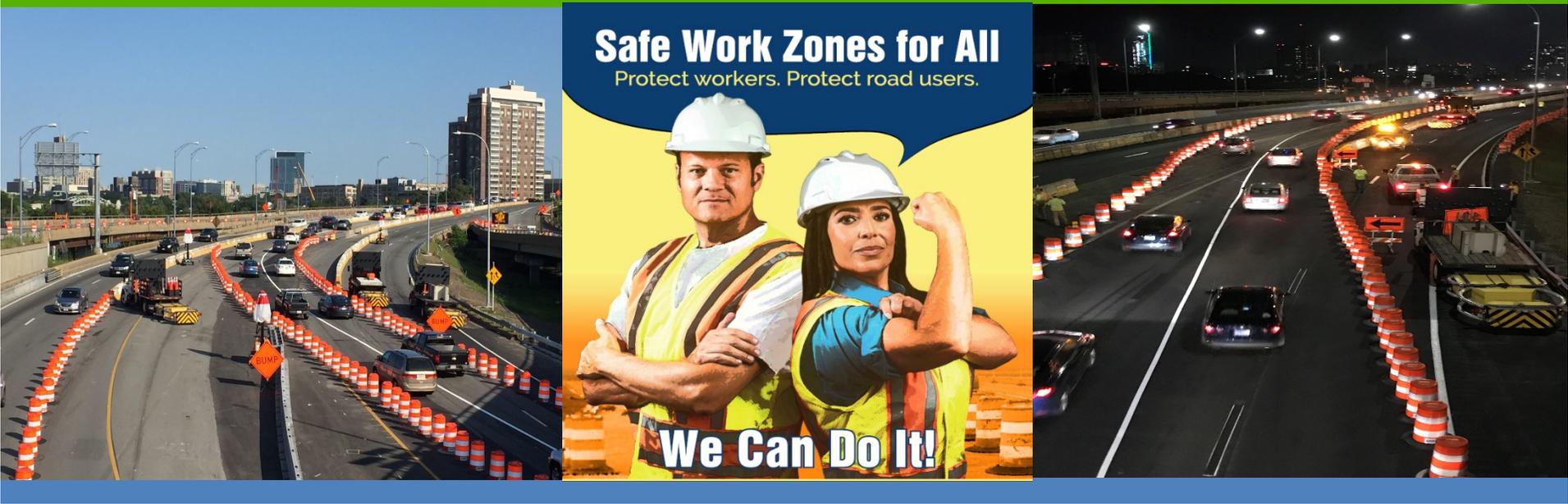


Driver Information Level



Driver Warning Level





Work Zone Technology Innovations

Neil Boudreau
Assistant Administrator for Traffic & Safety
MassDOT – Highway Division



Why make Work Zones “Smart”?

Introduction of ITS (Intelligent Transportation Systems) into the work zone provides:

- Improved communication for motorists
- Reduce driver distraction
- Increase mobility
- Worker Safety Measures



The future of Work Zone Innovations

- Solution-Based Work Zone Technology
- Digitally Connecting Work Zones



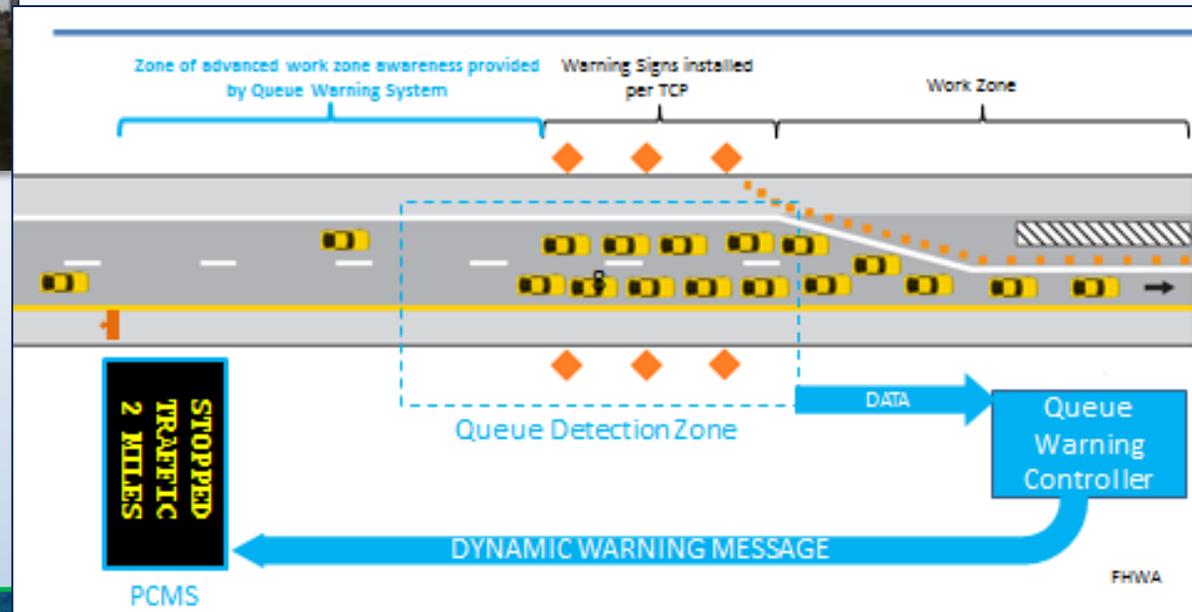
Examples of Innovations in Work Zone Safety

Vehicle Queue Warning Systems

- Used to alert motorists of slow or stopped traffic before they reach the back of queue
- Helps to prevent rear-end crashes before they happen

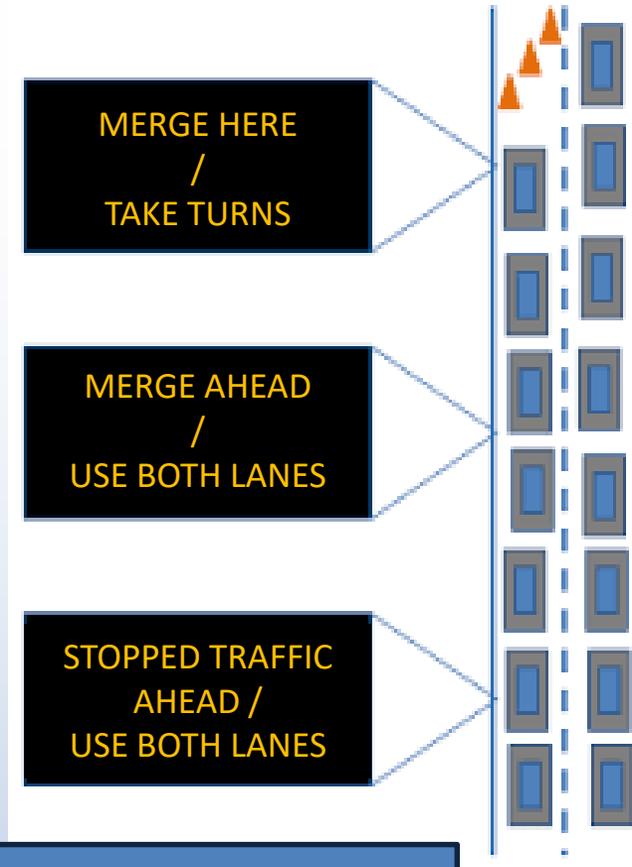


Good for remote/off-peak construction



Dynamic Merge Systems

- **Early Merge:** Light traffic; encourage aggressive drivers to merge into the open lane sooner than they would
- **Late Merge:** Effective for higher volumes of traffic where the congestion and backups are expected



Helps to dynamically manage traffic

Portable Traffic Signals

Many states use portable traffic signals to support work zone safety and mobility - but the market is getting smarter!



Use Video Detection
Remote connection to message signs
Countdown timer to help motorists

Variable Speed Limit Systems

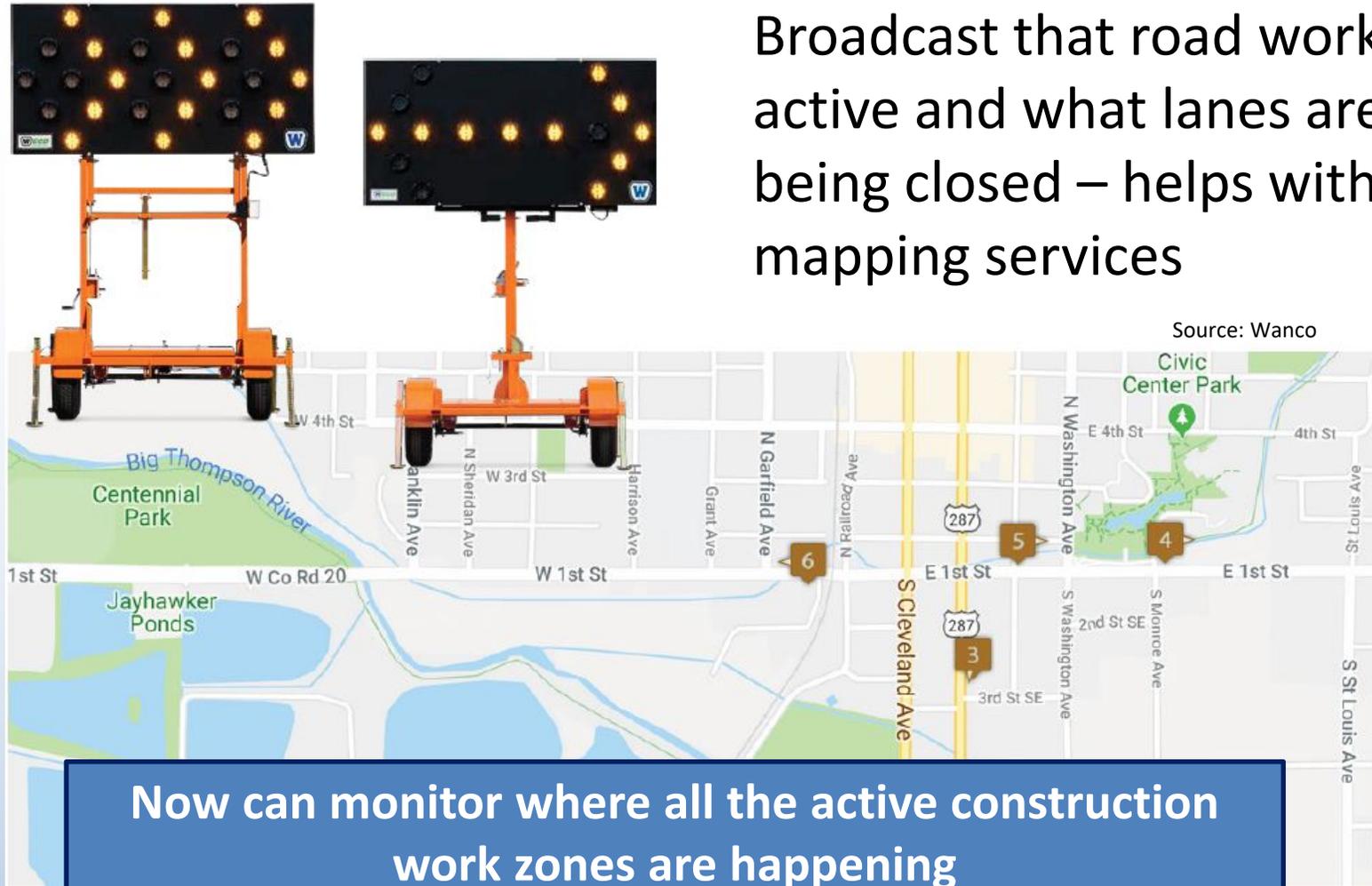
Allow DOTs to dynamically reduce speed during active construction and when workers are present



Use beacons to actively show to the motorist that work is going on

Connected Arrow Boards

Broadcast that road work is active and what lanes are being closed – helps with mapping services

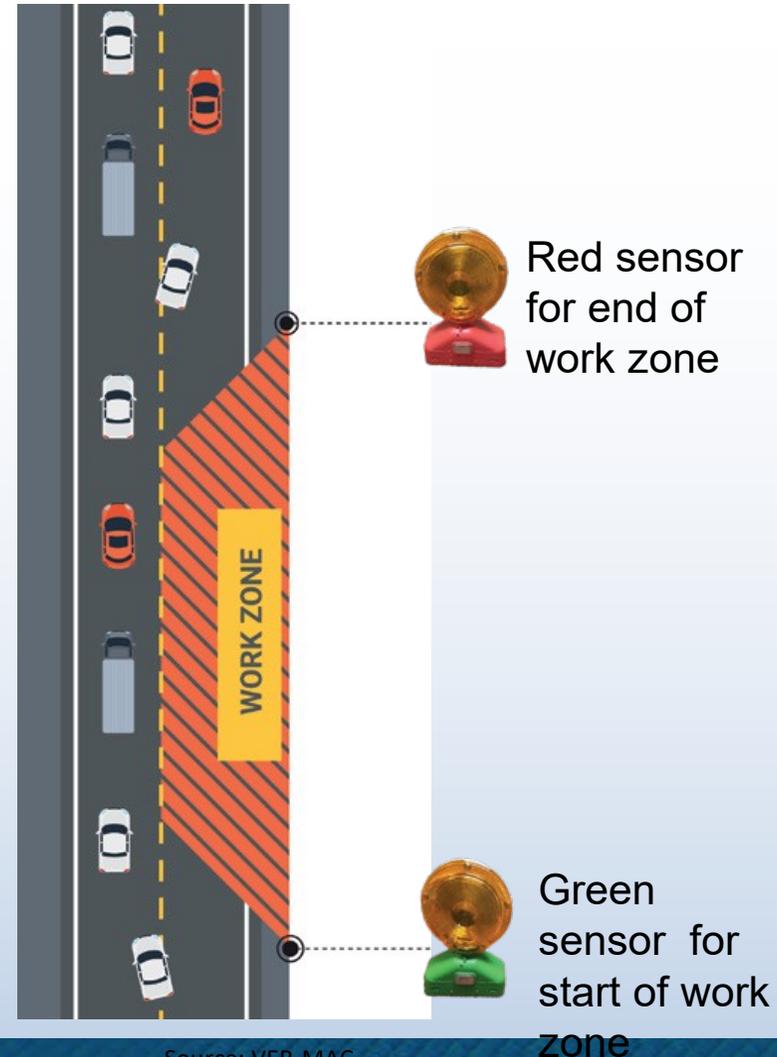


Now can monitor where all the active construction work zones are happening

Digital Mapping of Work Zones

Use Work Zone Location Sensors to digitally map the GPS location, where work zone begins and ends, and direction of travel

Data can be absorbed by traffic service providers to give improved guidance to approaching motorists



Source: VER-MAC

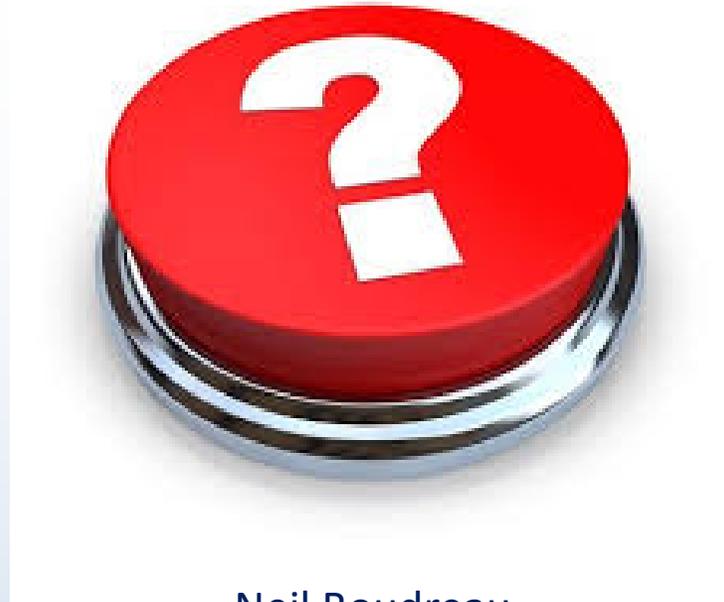
So who does this work?

Use of Smart Work Zone (ITS) technology requires a unique skill set that is not developed through most standard college programs -

- Transportation Engineering Principles
- Systems Operations and Maintenance
- Computer Science / Basic Programming
- Electrical Technician
- Knowledge of Sensors
- Understanding of Communications Protocols
- Cyber Security
- Big Data

*Solving Transportation needs
with data analytics and
technology*

Thank you!



Neil Boudreau

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