

# SPaT Challenge Webinar Series

## Webinar #7: Operational SPaT Deployments

2:00 – 3:30 PM (Eastern) | July 17, 2018

# Webinar Logistics

- All lines are muted
- Webinar will be recorded
- Submit questions and comments in chat or Q&A section of webinar window
- Questions will be answered at webinar conclusion

# Agenda

- Welcome and Introduction
  - Blaine Leonard, Utah DOT
- Operational SPaT Deployments
  - Joanna Wadsworth, City of Las Vegas
  - Liz White, Virginia Tech Transportation Institute (VTTI)
  - Blaine Leonard, Utah DOT
- Q&A

# SPaT Challenge

To challenge state and local public sector transportation infrastructure owners and operators (IOOs) to deploy DSRC infrastructure with SPaT (and MAP) broadcasts in at least one corridor or network (approximately 20 signalized intersections) in each state by January 2020

**20 intersections in 50 states by 2020!**



Two years of progress:  
35 Locations  
25 States

500 RSUs Operating

2340 RSUs Planned

# SPaT Challenge Webinars to Date

<https://transportationops.org/spatchallenge/webinarseries>

- Six webinars conducted to date
  - Recordings available in full or by topic on SPaT Challenge website
- 1. Initial SPaT Challenge Activities (March 6)
  - SPaT Challenge introduction
  - Systems Engineering Approach
  - Overview of Model Concept of Operations and Requirements documents
  - Costs, Procurement, and Corridor Selection

# SPaT Challenge Webinars to Date

<https://transportationops.org/spatchallenge/webinarseries>

2. Design Considerations, Part 1 (March 20)
  - SPaT Messages, Data Assembly, and the Signal Controller Interface
  - V2I Hub Overview
  - Agency experience with deploying on-board units
  
3. Design Considerations, Part 2 (April 17)
  - Overview of MAP Messages
  - Utah DOT's MAP Message Creation Approach
  - Vehicle Position Correction Need and Solutions

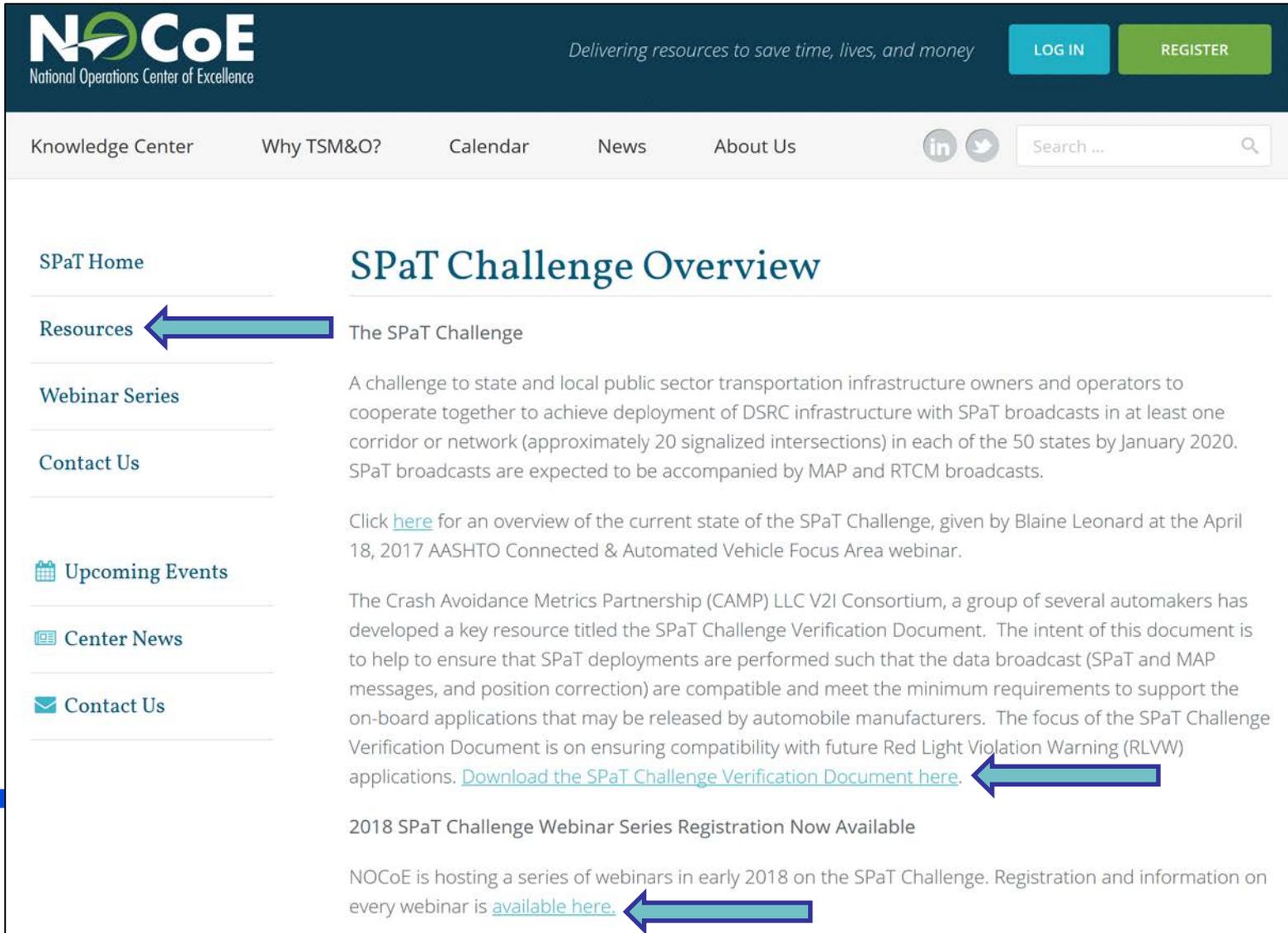
# SPaT Challenge Webinars to Date

<https://transportationops.org/spatchallenge/webinarseries>

4. MAP Creator Tool Demonstration (April 24)
  - USDOT MAP Creator Tool (Leidos / Saxton Lab)
  - Information about accessing/using the Tool
5. Design Considerations, Part 3 (May 15)
  - RSU Specification v4.1
  - Roadside Equipment & Backhaul Communications
  - DSRC Licensing
6. Deployment and Validation (June 12)
  - Security Credential Management
  - Verifying SPaT Deployments' Compatibility with Vehicles
  - Michigan DOT Completed SPaT Deployment Verification
  - USDOT CAV Support Services

# SPaT Challenge Website

<https://transportationops.org/spatchallenge>



The screenshot shows the website's header with the NOCoE logo and navigation links. The main content area features a sidebar with menu items and a main section titled 'SPaT Challenge Overview'. Three blue arrows point to specific links: 'Resources', 'Download the SPaT Challenge Verification Document here', and 'available here'.

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National Operations Center of Excellence

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## SPaT Challenge Overview

The SPaT Challenge

A challenge to state and local public sector transportation infrastructure owners and operators 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 of the 50 states by January 2020. SPaT broadcasts are expected to be accompanied by MAP and RTCM broadcasts.

Click [here](#) for an overview of the current state of the SPaT Challenge, given by Blaine Leonard at the April 18, 2017 AASHTO Connected & Automated Vehicle Focus Area webinar.

The Crash Avoidance Metrics Partnership (CAMP) LLC V2I Consortium, a group of several automakers has developed a key resource titled the SPaT Challenge Verification Document. The intent of this document is to help to ensure that SPaT deployments are performed such that the data broadcast (SPaT and MAP messages, and position correction) are compatible and meet the minimum requirements to support the on-board applications that may be released by automobile manufacturers. The focus of the SPaT Challenge Verification Document is on ensuring compatibility with future Red Light Violation Warning (RLVW) applications. [Download the SPaT Challenge Verification Document here.](#)

### 2018 SPaT Challenge Webinar Series Registration Now Available

NOCoe is hosting a series of webinars in early 2018 on the SPaT Challenge. Registration and information on every webinar is [available here.](#)

# SPaT Challenge Website

<https://transportationops.org/spatchallenge>

## Let Us Know You Are Actively Pursuing the SPaT Challenge

We'd like to hear from every agency who is participating in the challenge. This will allow us to update our national map, and help encourage peer to peer exchange of information, please provide the following information in an e-mail to [nocoe@transportationops.org](mailto:nocoe@transportationops.org) 

- Name, email, phone of local contact
- Corridor Location (City and state)
- Pin Location (intersection or lat/long)
- Timeline for deployment (rough estimate of planned completion date)
  - # of interseptions that are operational
  - # of intersections that are planned to be operational in 2018/2019/2020
- Description (1 paragraph summary of what your agency is doing e.g. "SPaT broadcast at 20 intersections with MAP planned initially and RTCM to come in the following year, goal is to support Red Light Violation warnings")

## Update Us On Your Progress

The SPaT Challenge is an initiative of the V2I Deployment Coalition, led by AASHTO, ITE, and ITS America. A variety of resources and guidance to support you are available at this website. In addition, a number of ITE Technical Committees have offered to respond to email questions from any agency interested in the SPaT Challenge. [Questions may be submitted here.](#)

# SPaT Challenge Resource Page

<https://transportationops.org/spatchallenge/resources>

The screenshot shows the website for the National Operations Center of Excellence (NOCoE). The header includes the NOCoE logo, the tagline "Delivering resources to save time, lives, and money", and buttons for "LOG IN" and "REGISTER". The navigation menu contains "Knowledge Center", "Why TSM&O?", "Calendar", "News", and "About Us", along with social media icons for LinkedIn and Twitter, and a search bar. The main content area is titled "SPaT Challenge Resources" and "SPaT Challenge". It features a list of resources on the left and a central text block with a list of links to various documents and guides. The footer includes logos for AASHTO, ITS AMERICA, and ite.

**NOCoE**  
National Operations Center of Excellence

Delivering resources to save time, lives, and money

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**SPaT Home**

**Resources**

- DSRC licensing information
- Implementation guidance
- Guidelines for selecting corridors
- Infrastructure System Model Concept of Operations
- Infrastructure System Model Requirements
- Frequently Asked Questions (FAQs)
- Additional Links

**Webinar Series**

**Contact Us**

## SPaT Challenge Resources

### SPaT Challenge

The following resources have been compiled or created by members of the V2I Deployment Coalition and are available or will soon be available.

- [SPaT Challenge Folio \(Quick facts and message\)](#)
- [DSRC licensing information](#)
- [Implementation guidance](#)
- Estimated costs (install & maintenance) - *Coming Soon*
- Sample SPaT documentation - *Coming Soon*
- [Guidelines for selecting corridors](#)
- [Infrastructure System Model Concept of Operations](#)
- [Infrastructure System Model Requirements](#)
- Procurement Guidance - *Coming Soon*
- Identifying existing funding sources to consider - *Coming Soon*
- [Frequently Asked Questions \(FAQs\)](#)
- [Webinar Schedule and Recordings](#)
- [Additional Links](#)

# Upcoming SPaT Challenge Webinar

- **Beyond the SPaT Challenge**
  - **August 14, 2018 2:00-3:30pm ET**
  - Presentations on applications and the Connected Fleet Challenge, which leverage SPaT broadcasts
  - Register and find more information at:  
<https://transportationops.org/spatchallenge/webinarseries>

# Operational SPaT Deployments

# SPaT Challenge: Overview of City of Las Vegas Operational Deployments

Presented by:  
Joanna Wadsworth  
July 17, 2018





## Strategic Master Planning Efforts

- Multimodal Mobility Master Plan Goals:
  - Transportation System that is Safe, Efficient, & Convenient with Modal Choices
  - Study recognized the benefits of emerging technologies
- Smart City Challenge Solutions & Applications:
  - Connected Vehicles
  - Autonomous Vehicles
  - V2X Safety Applications
  - Advanced Mobility Solutions



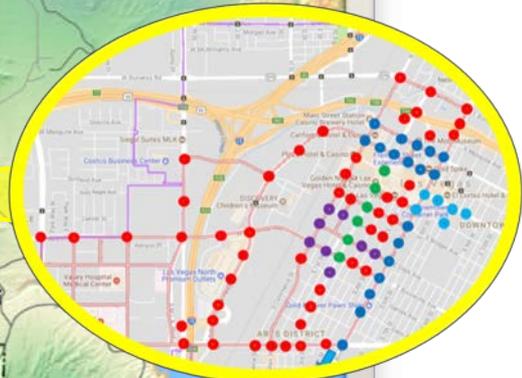
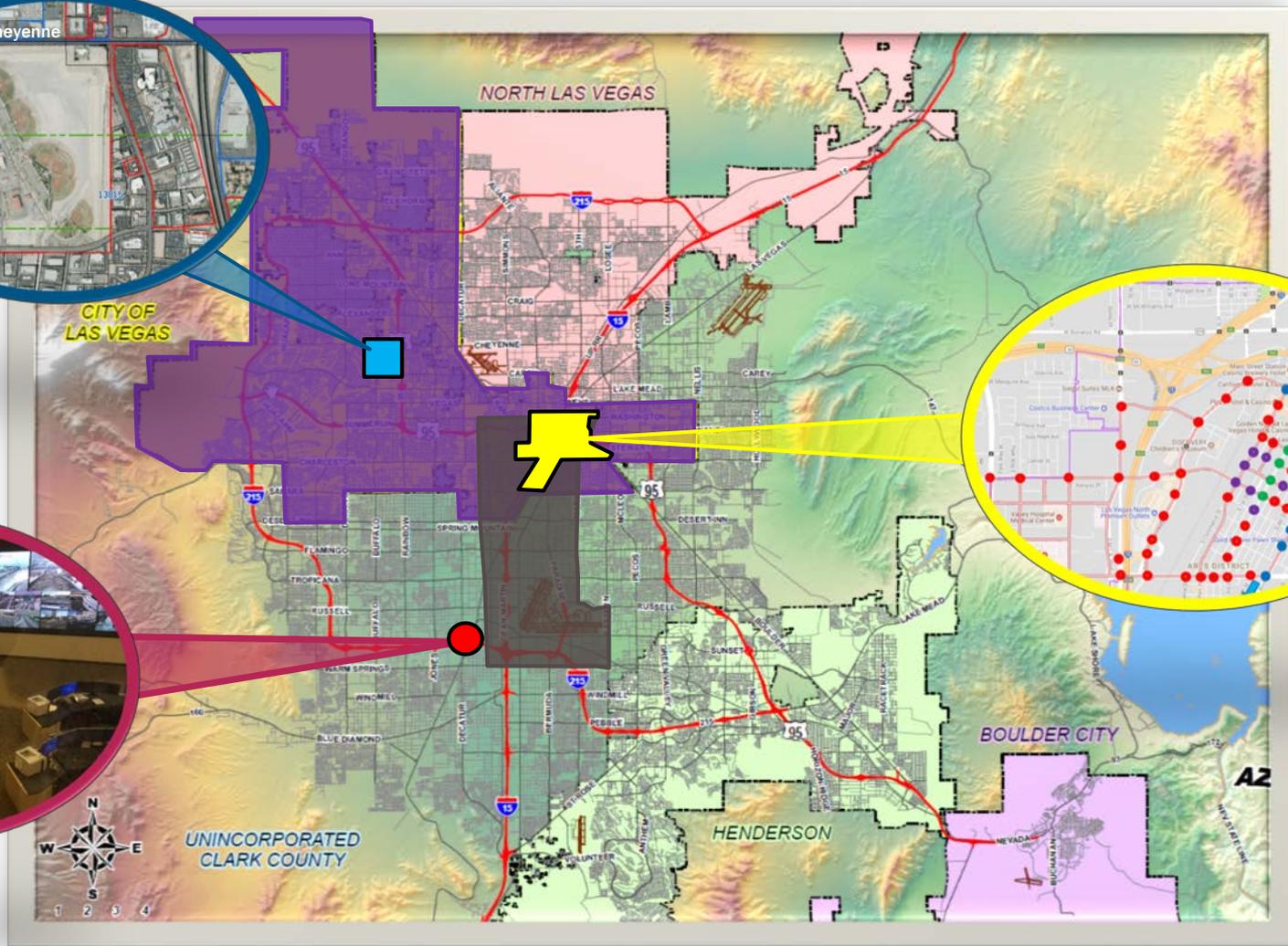
Create a “Smart City” with  
Intelligent Infrastructure



Traffic Engineering Field Operations Facility



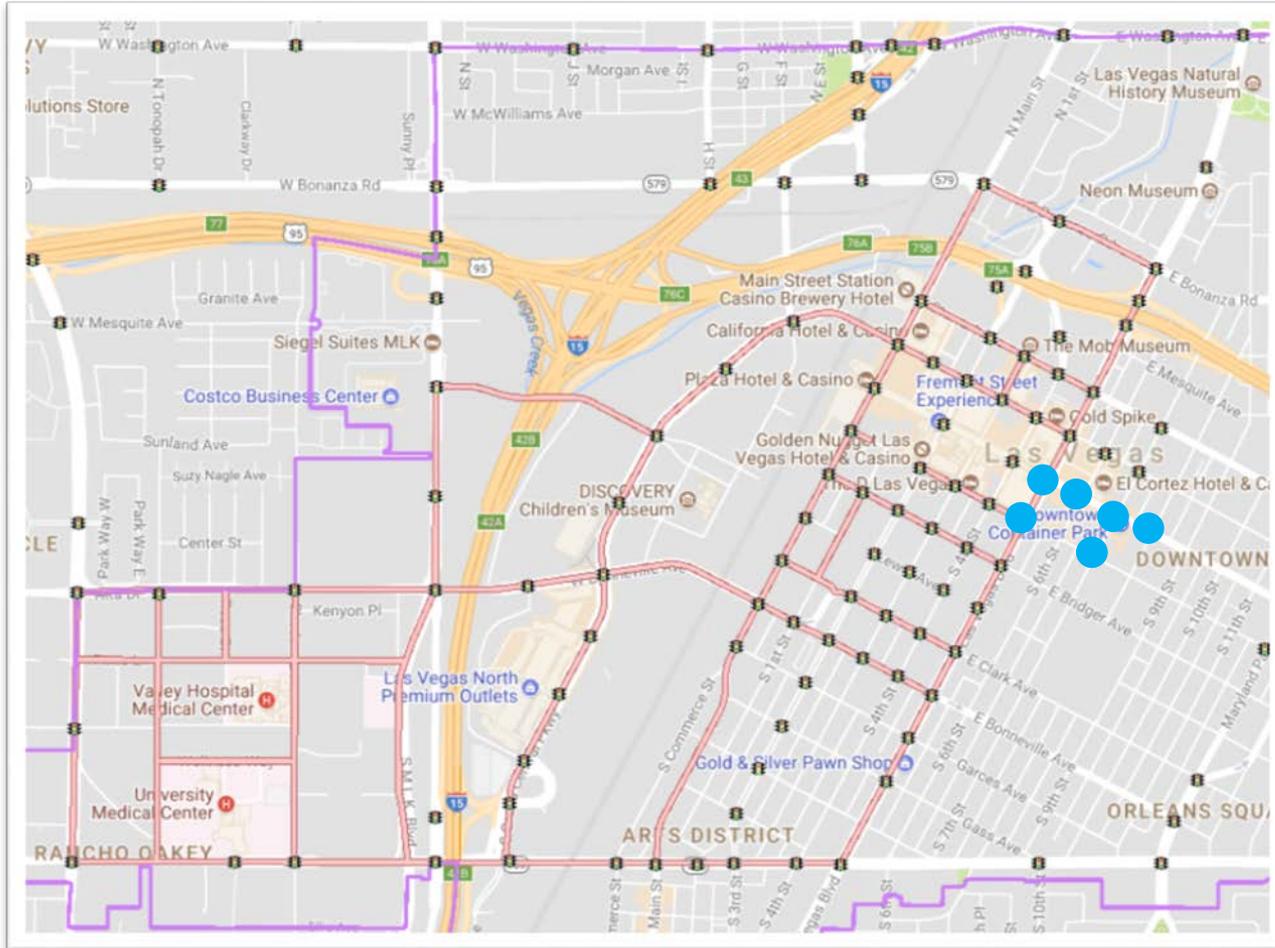
Regional Transportation Commission FAST Transportation Management Center



Innovation District & Connected Corridors



# Innovation District DSRC Deployments



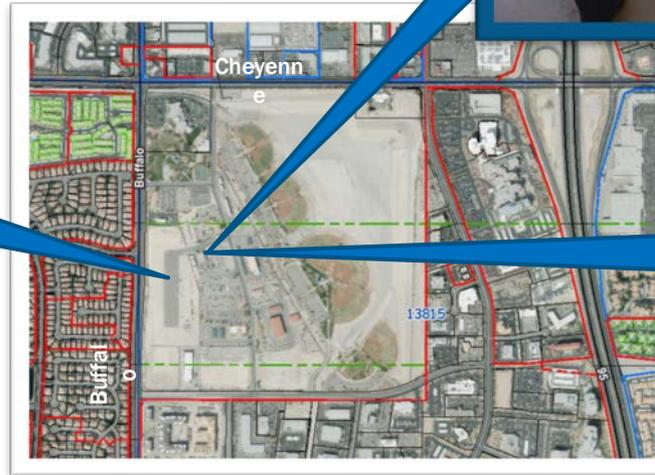
## Legend

- Driverless Shuttle Deployment Route
- DSRC: Commsignia
- Controllers: Trafficware
- Messages: SPaT



# Traffic Engineering Field Operations Facility

- Operational DSRC and traffic signal cabinet/controller
- Ability to test and integrate DSRC prior to field deployments
- Provides ease of programming and set-up
- Adjacent test track for vehicle testing & integration





# Driverless Shuttle Deployment (Launched November 8, 2017)

- Operates Tuesday thru Sunday
  - 4:30 pm to 9:00 pm
- 0.6 mile loop
- Private Funding (Keolis and AAA of CA/NV/UT)
- More Information
  - [www.AAA.com/HopOn](http://www.AAA.com/HopOn)

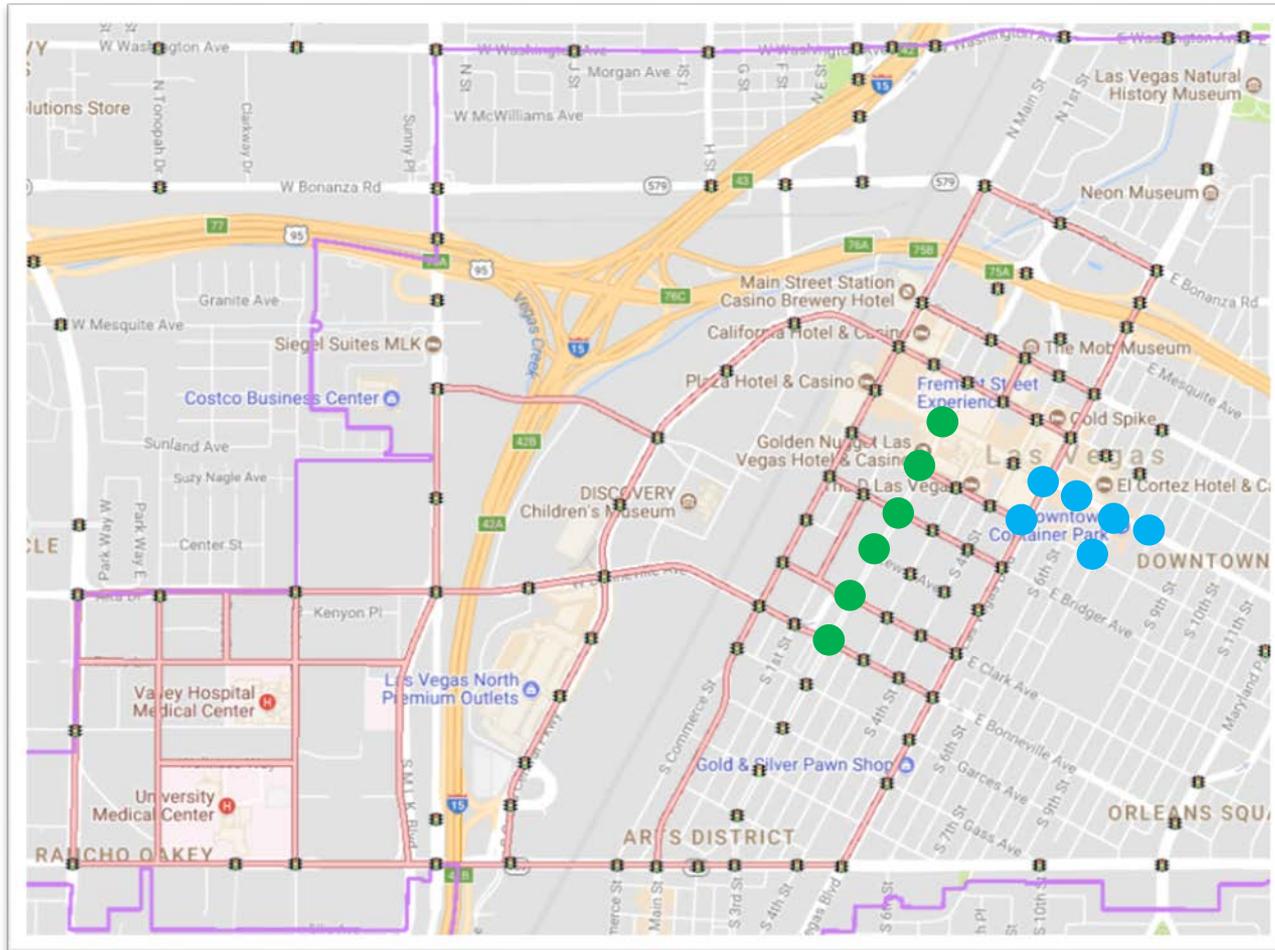


Fremont East Entertainment District





# Innovation District DSRC Deployments

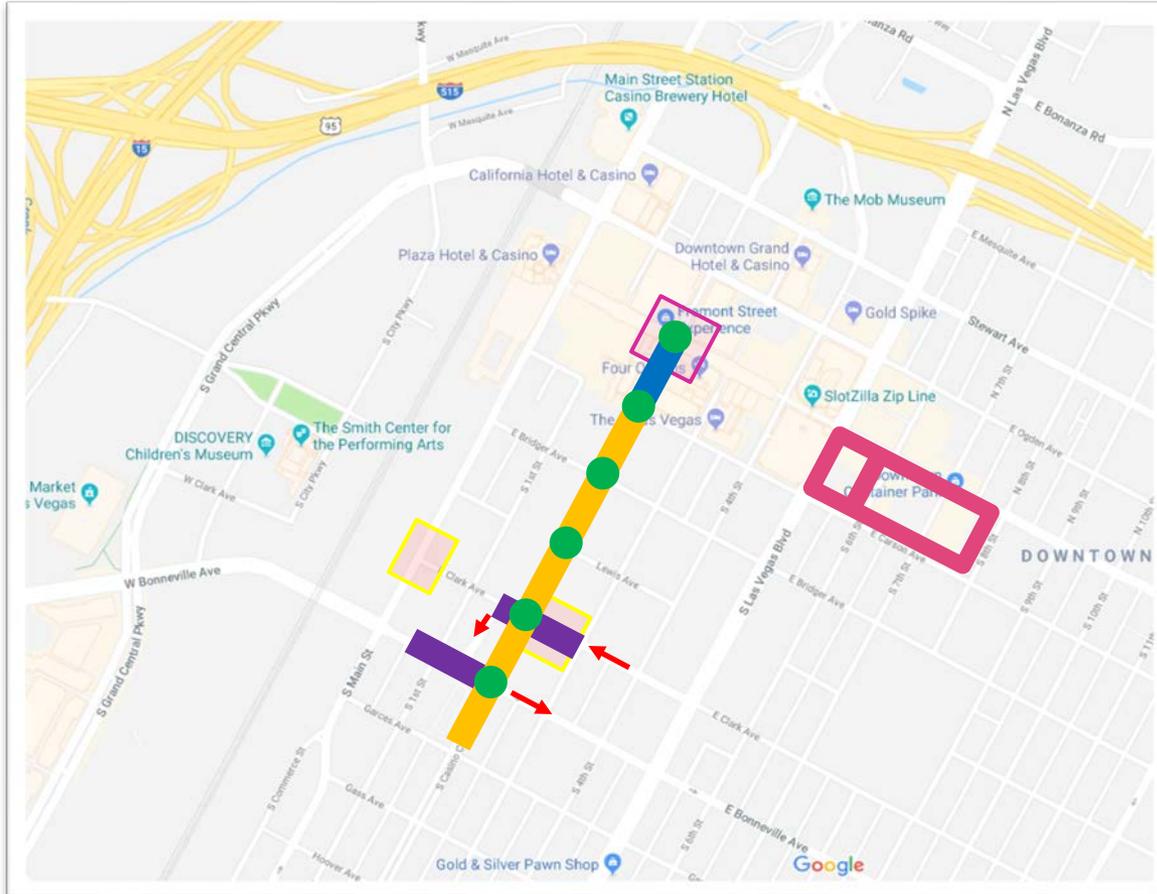


## Legend

- Driverless Shuttle Deployment Route
  - DSRC: Commsignia
  - Controllers: Trafficware
  - Messages: SPaT
- Connected Vehicle Applications
  - DSRC: Siemens
  - Controllers: Trafficware
  - Messages: SPaT and Basic Safety Messages



# Casino Center V2I Applications

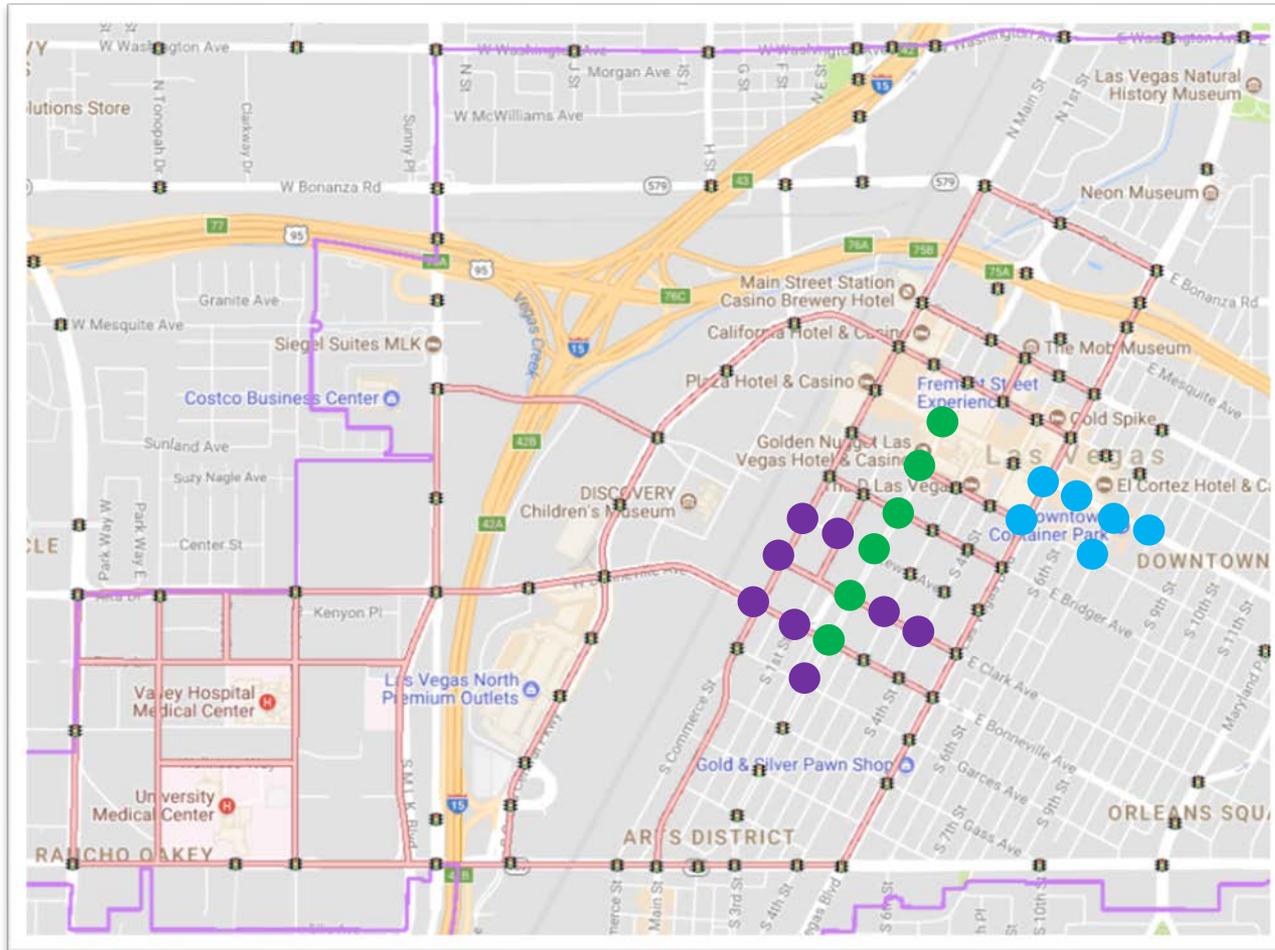


## Legend

-  Driverless Shuttle Loop
-  RSU with SPaT and MAP
-  Pedestrian Safety Application
-  One-Way Street Warnings
-  Lane Restrictions
-  Center Running Bus Lane Warnings
-  Special Event / Road Closure Warnings



# Innovation District DSRC Deployments



## Legend

-  Driverless Shuttle Deployment Route
  - **DSRC:** Commsignia
  - **Controllers:** Trafficware
  - **Messages:** SPaT
-  Connected Vehicle Applications
  - **DSRC:** Siemens
  - **Controllers:** Trafficware
  - **Messages:** SPaT and Basic Safety Messages
-  Connected Vehicle Applications
  - **DSRC:** Cohda Wireless
  - **Controllers:** Trafficware
  - **Messages:** Set-up in Process
  - **Note:** Integrated with Cisco IoT Network; Currently receiving data from CV's

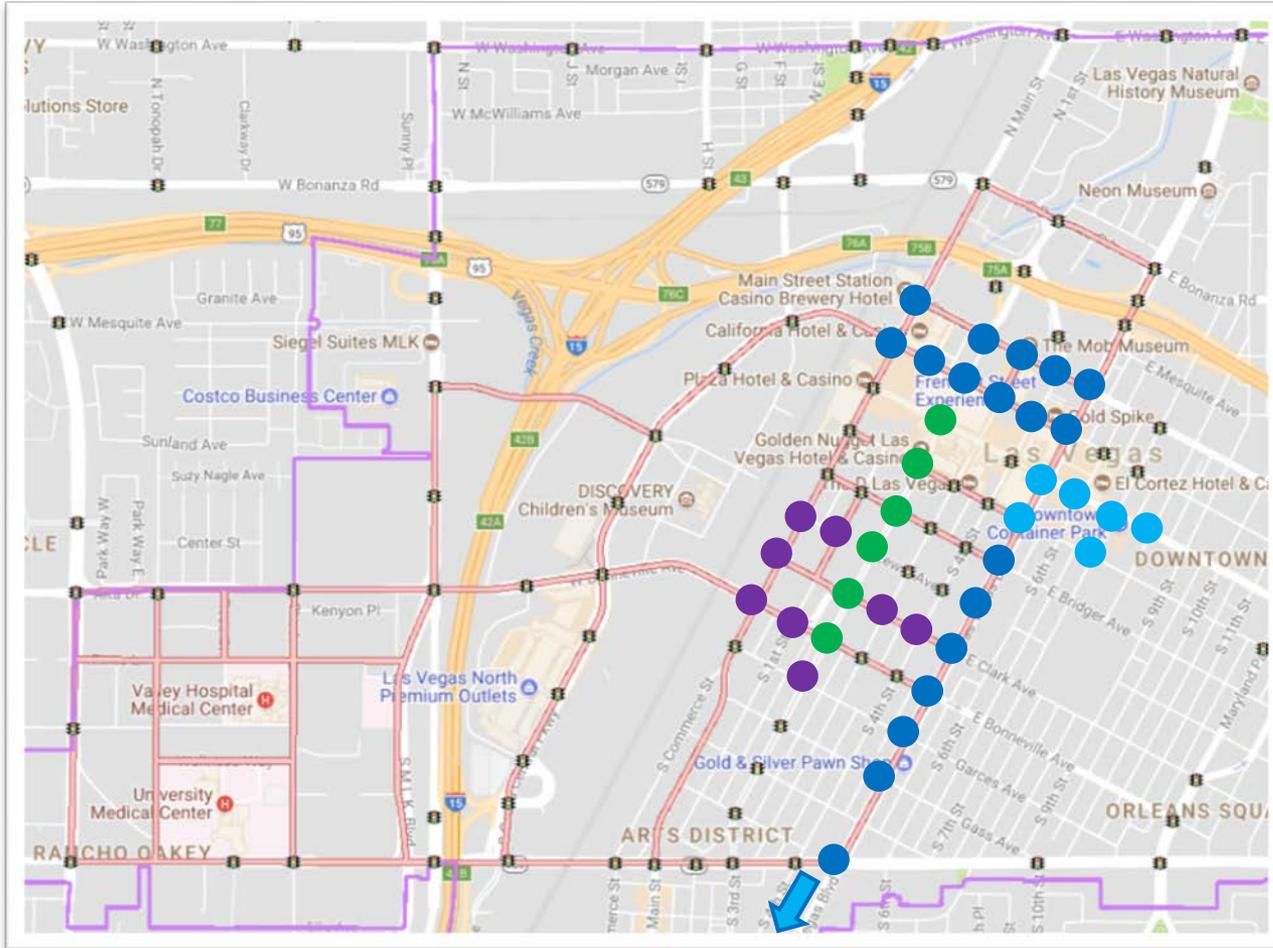


# Connected Vehicle Dashboard





# Innovation District DSRC Deployments

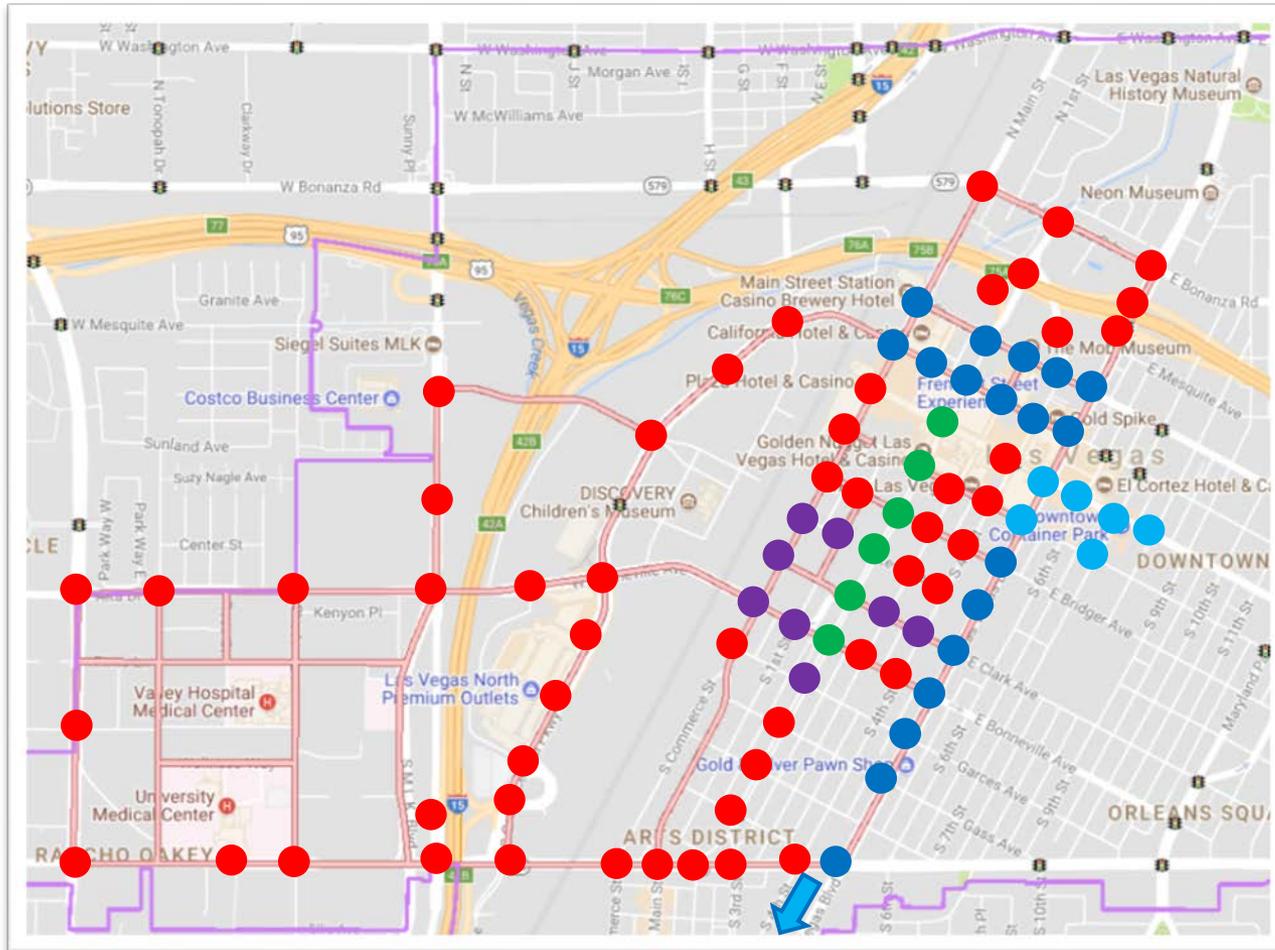


## Legend

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- **Summer 2018 Installations**
  - **DSRC: Commsignia**
  - **Controllers: Trafficware**
  - **Messages: SPaT (Installs south to Sahara)**



# Innovation District DSRC Deployments



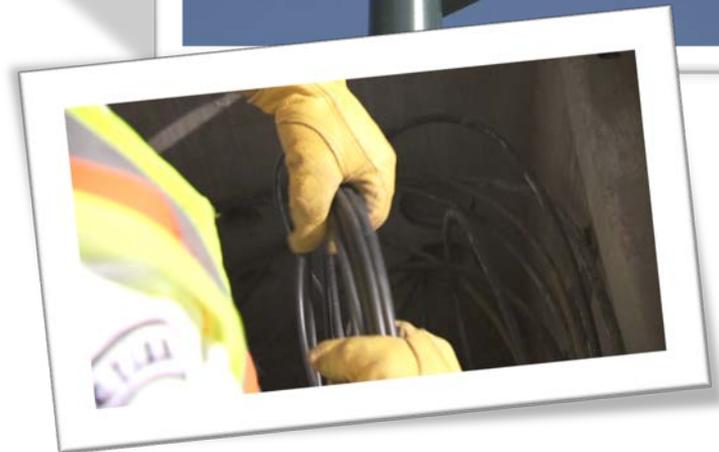
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  - **Controllers:** Trafficware
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  - **Note:** Integrated with Cisco IoT Network; Currently receiving data from CV's
-  Summer 2018 Installations
  - **DSRC:** Commsignia
  - **Controllers:** Trafficware
  - **Messages:** SPaT (Installs south to Sahara)
-  Future Installations



## Lessons Learned

- Facilitate open communication between all project representatives
- Account for installation and integration in project schedules
- Standardize communication between Controller and DSRC





## Next Steps

- Deploy Centralized Management System
  - Programming
  - Monitoring
- Identify Redundancy Plan
- Continue Training of In-House Team
- Expand Connected Vehicle & Autonomous Vehicle Projects
- Integrate with Pedestrian and Bicycle Safety Applications
- Integrate Dashboard into City Planning and Response Services

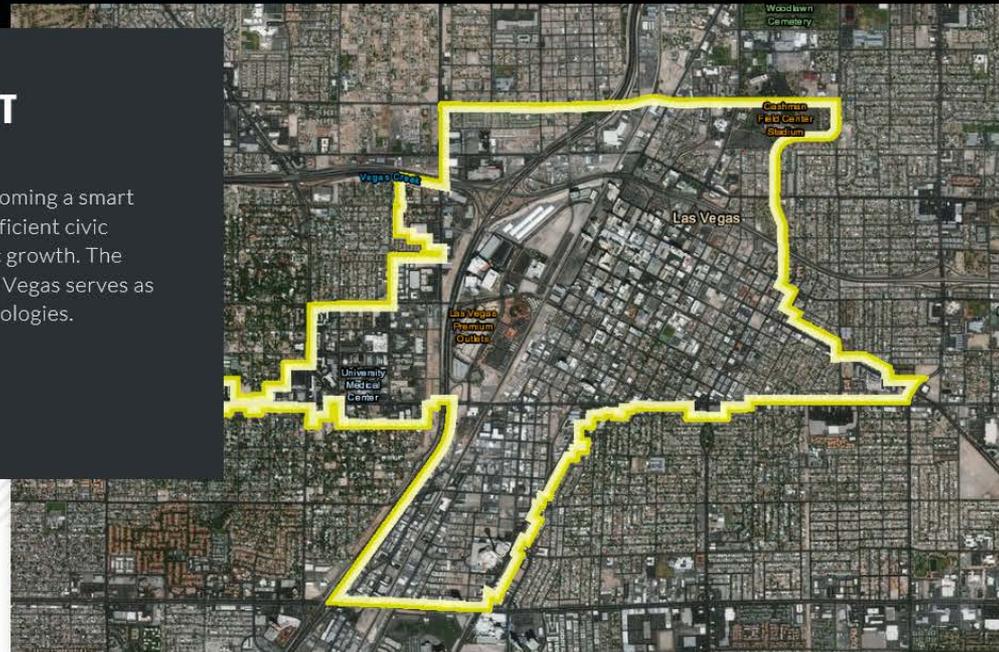




## INNOVATION DISTRICT

The city of Las Vegas charter for becoming a smart city is to provide safe, reliable and efficient civic technology that stimulates economic growth. The Innovation District in downtown Las Vegas serves as a proving ground for emerging technologies.

[Learn More About Us](#)



# Virginia Connected Corridors SPaT Deployment

Elizabeth White

Jean Paul Talledo Vilela

Mike Mollenhauer

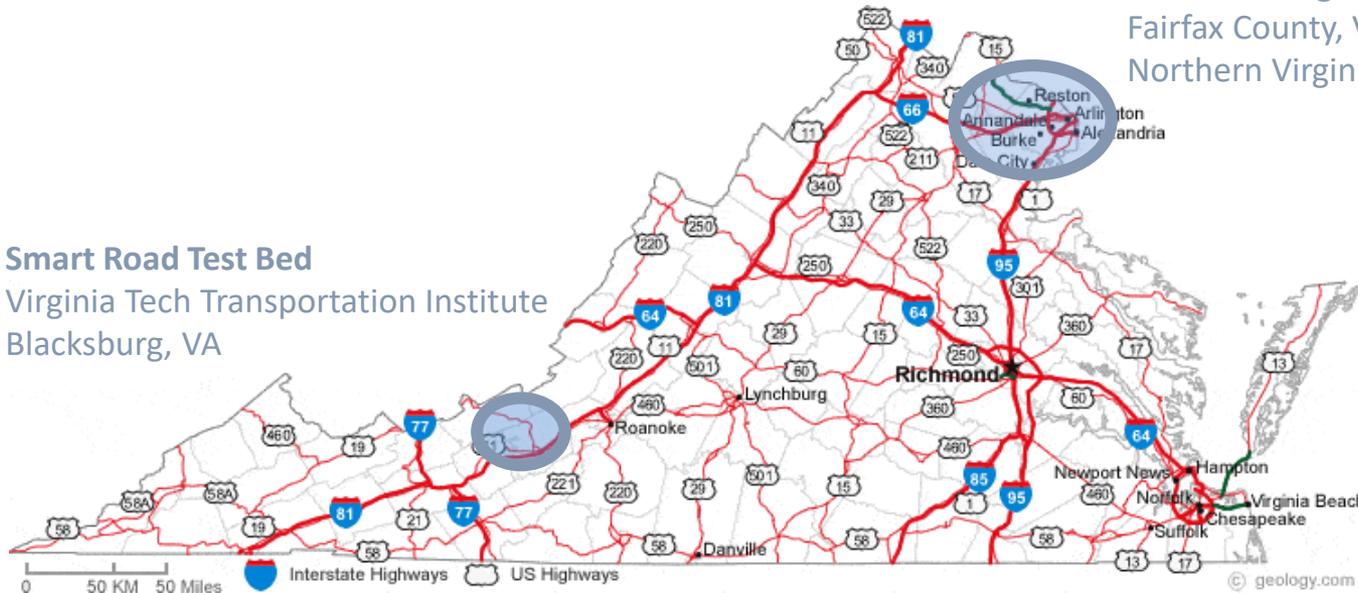


# Virginia Connected Corridors

**Mission:** Provide an open environment where connected vehicle concepts can be developed, tested, deployed, and evaluated in real world operating environments.

**Northern Virginia Test Bed**  
Fairfax County, VA  
Northern Virginia

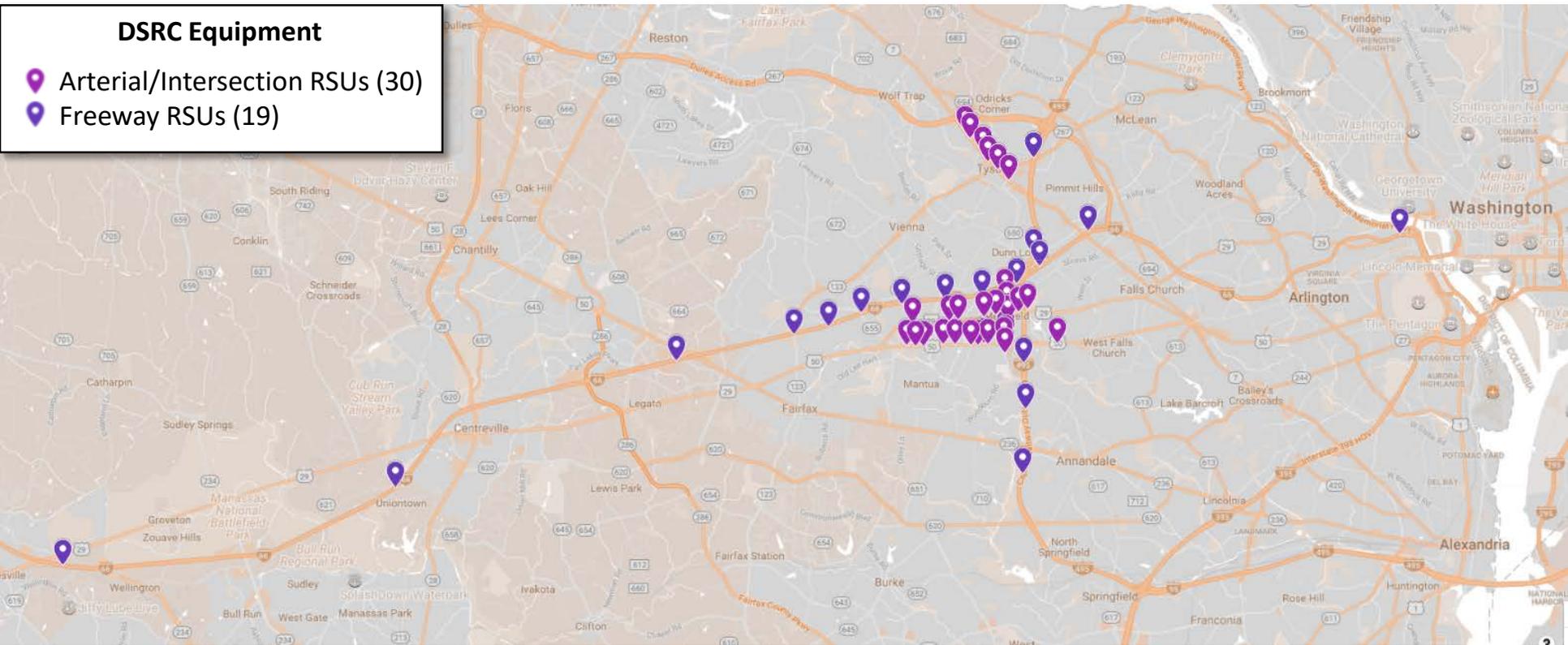
**Smart Road Test Bed**  
Virginia Tech Transportation Institute  
Blacksburg, VA

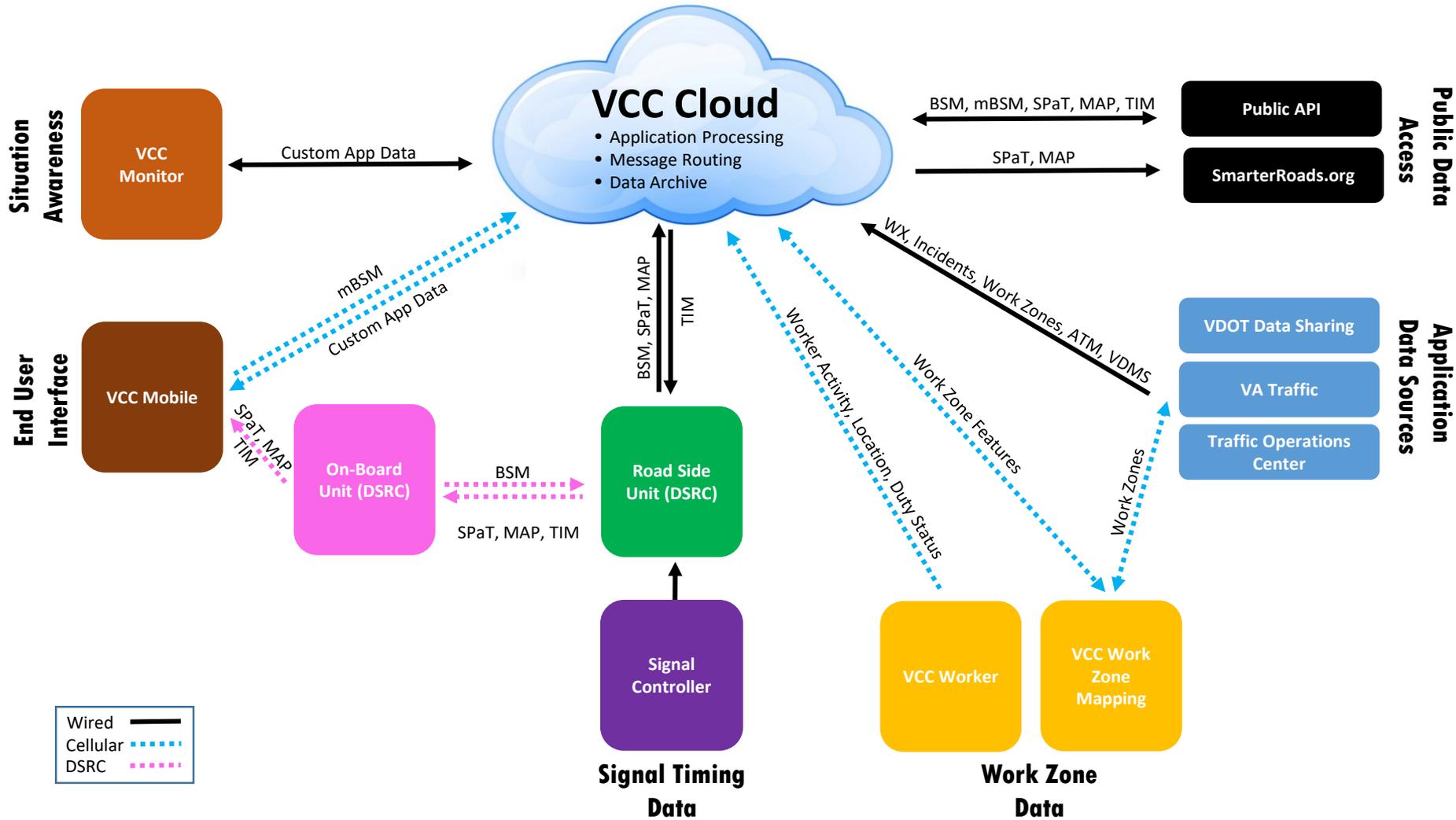


# Northern Virginia Test Bed

## DSRC Equipment

- Arterial/Intersection RSUs (30)
- Freeway RSUs (19)





# SPaT Development Parameters

- Required to work with existing VDOT controller configuration
  - McCain 2070 controller
  - Advanced Traffic Solutions D4 firmware
  - Custom data interface required between controller and RSU
  - One way communications for now to satisfy security concerns
- Contracted ATS to develop custom firmware update
  - SNMP interface to push phase and time data through firewall port
  - Interface is enabled and network parameters configured through controller menus
- VTTI developed RSU data handling
  - Cohda MK5 RSU v4.0
  - Listen to the firewall port for incoming data
  - Build the SAE J2735 v2016 SPaT message, encode, and broadcast
  - Forward SPaT to VCC Cloud for cellular users and additional applications
- Currently not running SCMS security
  - Lack of available providers and increased complexity given size of our deployment

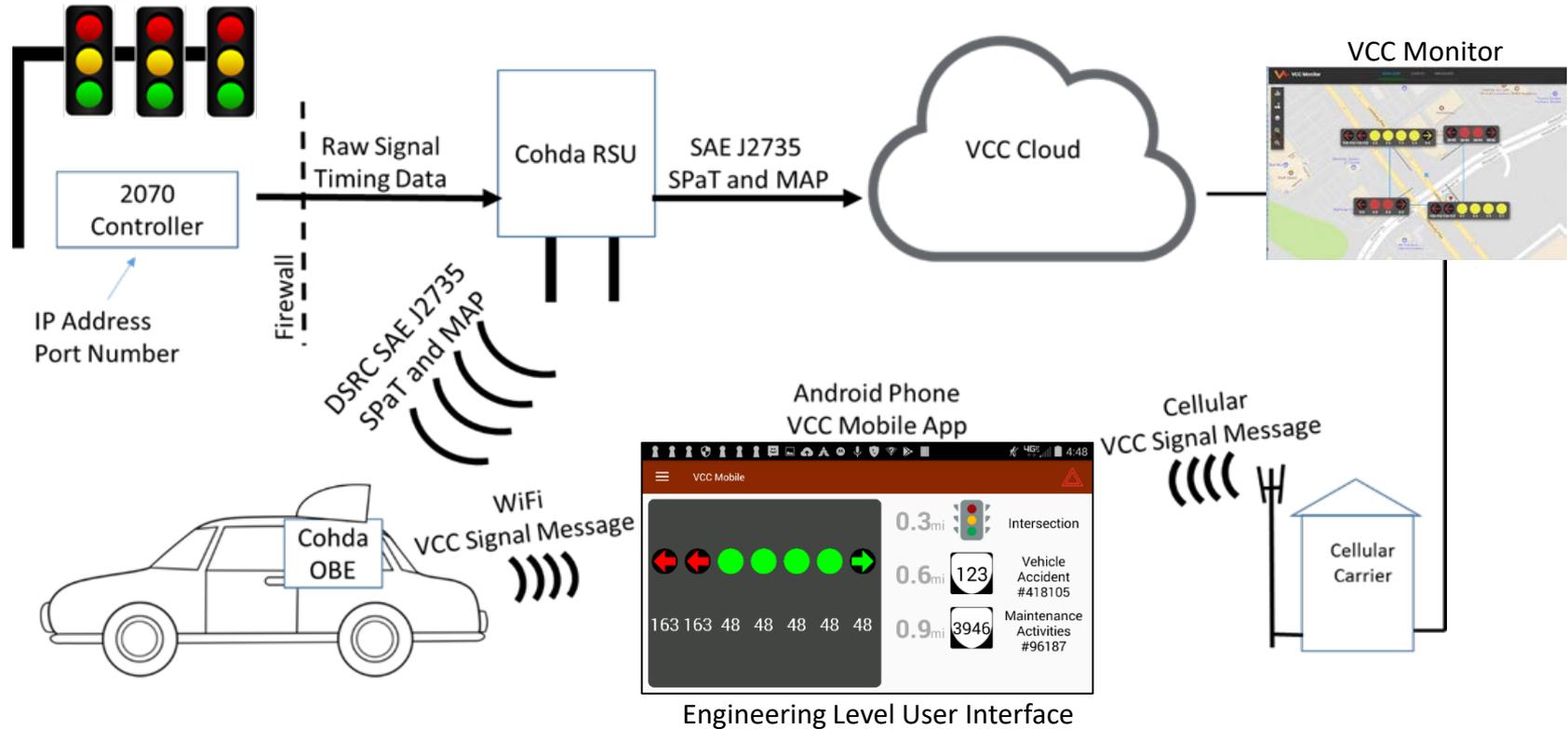


# MAP File Development

- We initially built our own tools to develop MAP files using photogrammetry and our own processing logic (first 6 intersections)
- Switched to US DOT MAP tool after learning of its availability and testing it out
- We take timing plan and configuration information from VDOT's MIST central signal management tool to manually assign phases and complete the MAP file
- Currently MAP files are relatively static in that we are unable to rapidly reconfigure to support construction, etc. but we intend to develop tools for this in future

# SPaT Data Flow Diagram

Each of 4 arterial corridors (US50, US29, Rt 7, Rt 650) has at least 6 and as many as 11 consecutive equipped intersections

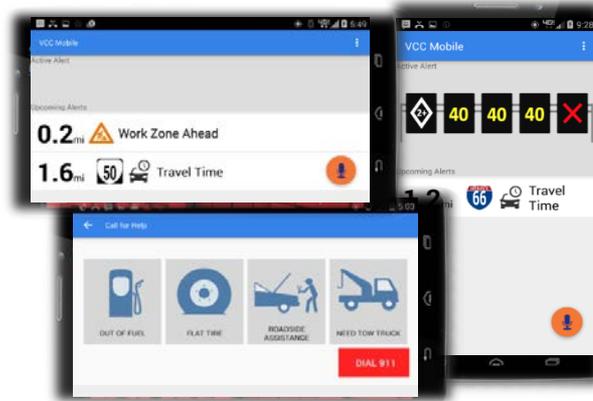


# VCC L2 “Elite” NDS

**Purpose:** Build naturalistic dataset to assess behavior with early production L2 vehicles and responses to a mobile CV application

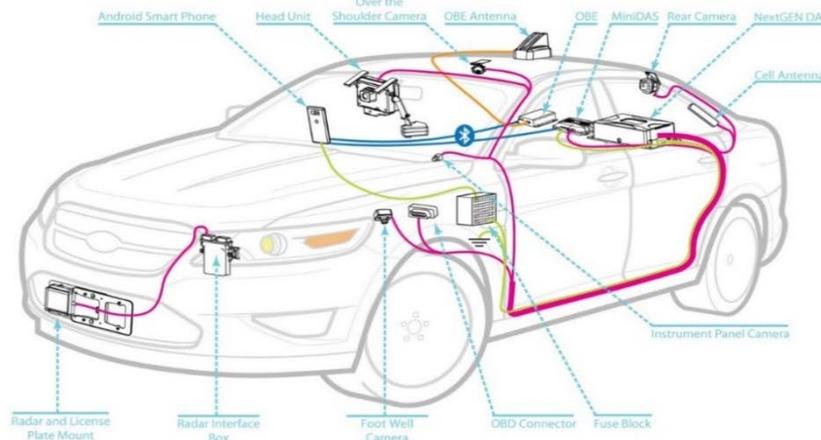
**Details:**

- 50 personally owned production L2 and ADAS equipped vehicles
- 12 months of data collection
- Use of connected vehicle application on the VCC CV environment
- Evaluating drivers interactions with technologies
- Early look at production level 2 automated vehicles



**Equipped Vehicles**

- 11 – Tesla Model S
- 1 – Tesla X
- 2 – Acura RDX
- 1 – Acura MDX
- 2 – Acura TLX
- 3 – Jeep Grand Cherokee
- 4 – Hyundai Genesis
- 3 – Hyundai Sonata
- 1 – Ford Flex
- 4 – Ford Fusion
- 1 – VW Passat
- 5 – Honda Accord
- 1 – Honda Civic
- 1 – Cadillac SRX
- 1 – Mercedes CLS550
- 1 – Nissan 300ZX
- 3 – Toyota Highlander
- 1 – Toyota RAV4
- 1 – Volvo S90
- 1 – Volvo XC 90
- 2 – Chrysler Pacifica Limited
- 1 – Chevrolet Suburban

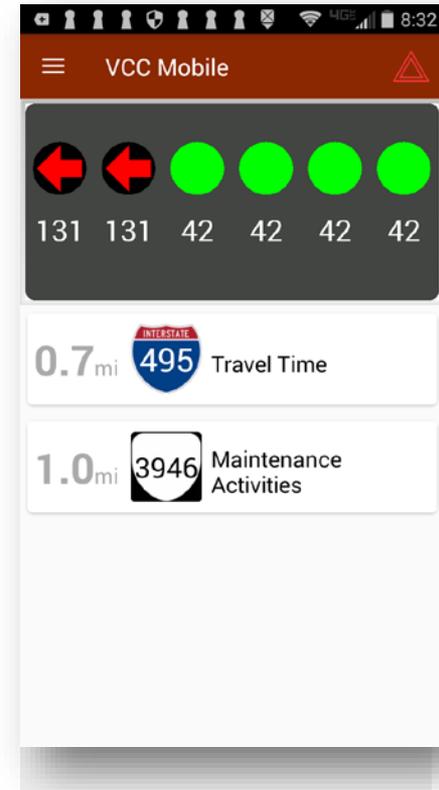


# SPaT / MAP Validation

- Evaluating latency and accuracy of SPaT and MAP messages
  - Added wrapper to collect routing and timing information for messages
  - Onsite data collection with custom VCC Mobile data logging
  - Controller (D4 firmware) to RSU to OBE
  - Controller (D4 firmware) to RSU to VCC Cloud to VCC Mobile smartphone app
- CAMP SPaT Challenge Verification Document v1.2
  - Updated several implementation specifics to adhere to proposed requirements – most having to do with interpreting the standard
  - Modified approach lengths in map files (time consuming)
- Recently added pedestrian phases to support our 3<sup>rd</sup> party application developers interested in pedestrian support applications
- Post-installation and maintenance validation tools
  - VTTI developed and supplied to VDOT roadside contractors
  - OBUs modified to validate the receipt of SPaT, MAP messages and support the debugging process

# Future Plans

- VTTI looks forward to the development and deployment of our own SPaT and MAP enabled applications via our VCC Mobile app
- Some traction with OEMs interested in testing their applications within the VCC
- Still making final decisions on which applications to support
  - Red Light Violation Warning
  - Eco Approach and Departure
  - Transit Priority
  - Emergency Vehicle Preempt
  - Pedestrian Preemption
- Will seek opportunities to expand applications and use cases before deploying additional units

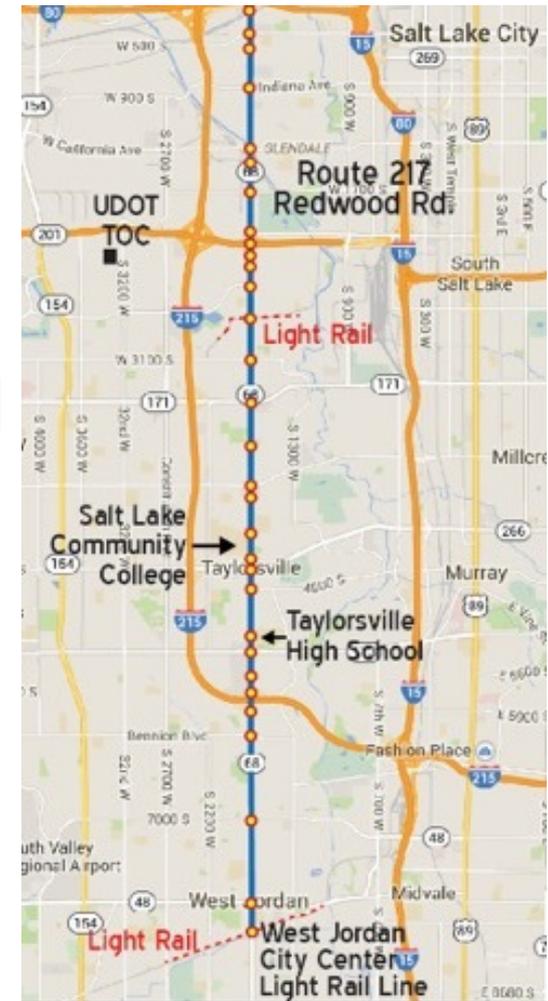


# Lessons Learned

- None of this is easy when working to integrate with existing systems
- Working in high profile traffic environment elevates scrutiny on security, testing, and management of fielded units
- Working with actuated signals and impacts on applications and phase change certainty
- Develop remote monitoring and management capabilities saves time
- MAP files take significant time and effort to develop and validate
- Have regular coordination meetings when different agencies involved

# UDOT CV Deployment

- Full DSRC Corridor
  - Future testing / deployment
  - Prepare for equipped vehicles
- Transit Signal Priority for Improved Schedule Reliability (MMITSS)
  - UTA Bus Route 217 (Redwood Road)
  - Goal: increase from 86% to 94%
  - Minimal impact to other traffic
- Meet the SPaT Challenge



# Redwood Road CV Corridor

11-mile, UDOT-owned arterial

30 signalized intersections

- Full fiber optic connectivity
- All signals connected to central system
  - Intelight MaxView
- Running signal performance metrics
- Two brands of signal controller:
  - 4 - Econolite (Cobalt)
  - 31 – Intelight

RSUs installed on 24 intersections

- Four brands of DSRC RSU
- All actively broadcasting SPaT / MAP



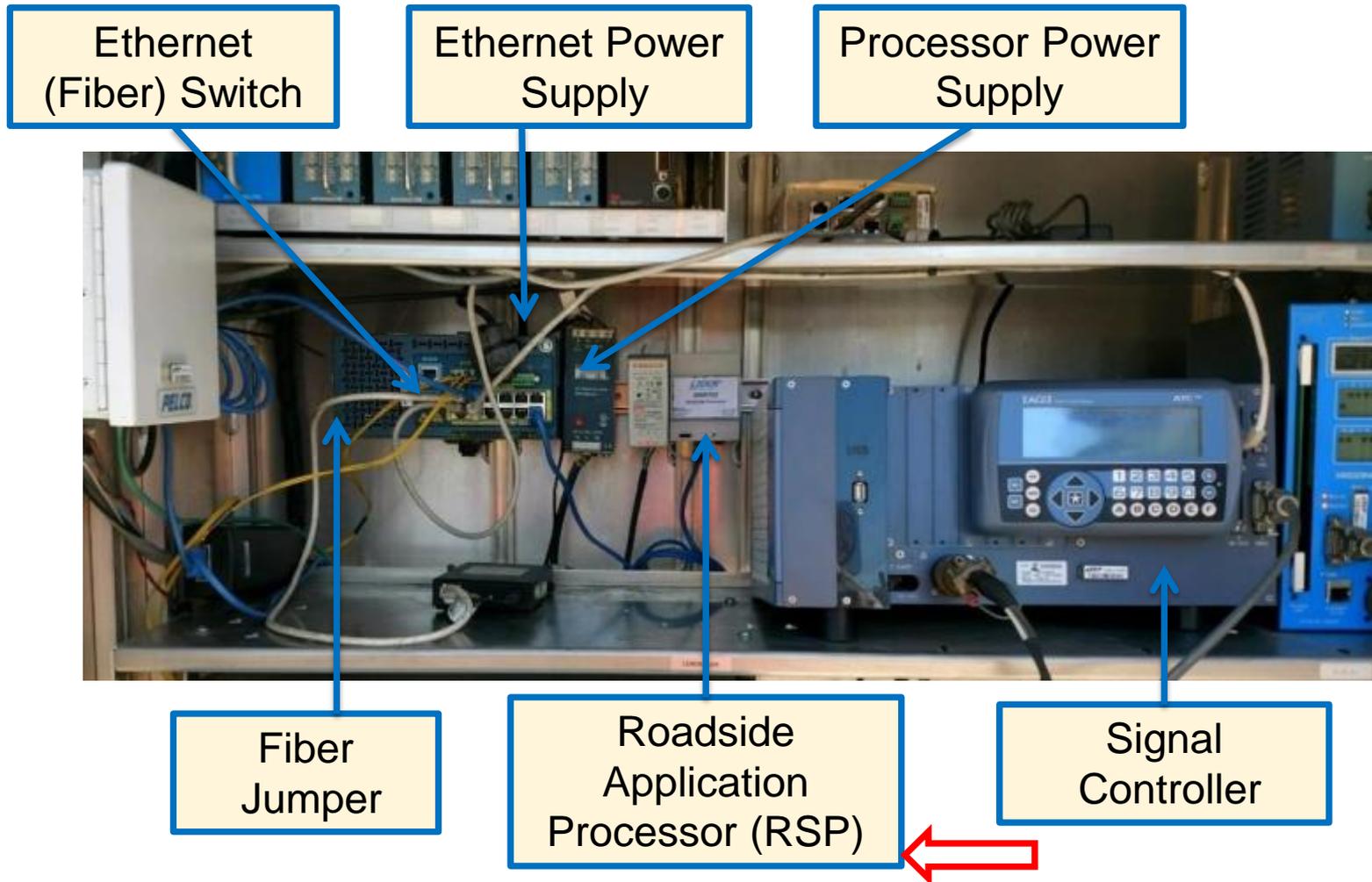
# Redwood Road Installation

- RSU mounted on signal pole, mast arm, luminaire pole
  - Omni-directional antenna, but obstructions can impair signal
- Ethernet cable to cabinet



- Lessons:
  - Hardware installation is straightforward
  - RSU range is much greater than 300m
  - MAP creation isn't trivial – there is no guidance document

# Signal Cabinet Installation



# On-Board Installation

- DSRC OBU
- “Beaglebone” On-board Processor (OBP)
- Power Supply
- Antenna (roof of bus): DSRC & GPS



- Lessons:
  - SPaT Challenge doesn't include vehicles, but . . .
  - RSU-OBU communication verification was challenging
  - Antenna placement is tricky

# DSRC Hardware

- Some of the challenges included:
  - Extracting SPaT data from the Controller
  - DSRC hardware is still maturing (as is vendor capacity)
  - Interoperability is not really there



Hardware Costs:  
OBU: \$1000 – 1500  
RSU: \$1200 – 2600

- Installation Costs:  
Variable . . .
- Installation
  - Spectrum Evaluation
  - Integration
  - Testing
  - Application?
  - Verification

# Next Steps for UDOT

- Provo-Orem TRIP (BRT)
  - 47 Intersections
  - 25 Buses
  - Buses to run 6-minute headway
  - August '18 Completion
- Snow Plow Priority
  - Priority when actively plowing
  - Goal is to improve safety



# Getting Started

- Take Advantage of Lessons from Others
  - NOCOE SPaT Challenge Resources / Webinars
  - Colleagues in other states / local agencies
  - Consultants and vendors with experience
- Prepare a Corridor
  - Modern signal equipment
  - Good backhaul
- Deployment
  - Controller – DSRC compatibility
  - Start small – but with future in mind
  - One step at a time

# Upcoming SPaT Challenge Webinars

- **Beyond the SPaT Challenge**
  - **August 14, 2018 2:00-3:30pm ET**
  - Presentations on applications and the Connected Fleet Challenge, which leverage SPaT broadcasts
  - Register and find more information at:  
<https://transportationops.org/spatchallenge/webinarseries>

# Q&A

Submit questions and comments in chat or Q&A section of webinar window

## Upcoming SPaT Challenge Webinars

Beyond the SPaT Challenge: Applications and the Connected Fleet Challenge

August 14, 2018 2:00-3:30pm ET



# Questions for Discussion

Submit your questions and comments in chat or Q&A section of webinar window

- How many roadside units at intersections has your agency deployed? Are you planning to expand the DSRC deployment?
- How are you developing and managing MAP messages – are you developing them with USDOT MAP Creation Tool, or by other means?
- If a situation comes up where there is work in the intersection (e.g. a flagger directing traffic and altering the lanes of travel through the intersection), what would you do? Would you turn off the SPaT/MAP broadcast, alter the MAP message to accommodate the change in lanes through the intersection, or something else?

# Questions for Discussion

Submit your questions and comments in chat or Q&A section of webinar window

- How are sites obtaining information from controllers (e.g. what devices from what vendors and what kind of controllers)?
- Where are messages generated and/or signed (central office, in field, etc.)?
- Do you have any plans to implement Security Credential Management System or other security measures? If so, what is the approach?
- What is needed to improve RSU & OBU device specifications?

# Questions for Discussion

Submit your questions and comments in chat or Q&A section of webinar window

- When the deployment continues, do you foresee using internal resources to maintain the equipment or outsourcing the maintenance?
- What was your biggest surprise during the process?
- What vehicles are currently accessing the DSRC technologies your agency has deployed? Are the vehicles government fleet, commercial fleet, first responders and/or privately owned?

# Questions for Discussion

Submit your questions and comments in chat or Q&A section of webinar window

- What connected vehicle safety applications are being addressed by the DSRC deployment? Is your agency tracking the number of daily DSRC interactions with vehicles and number of vehicles? Are messages from vehicles verified (even if they would be rare)?
- Have you identified any patterns or trends from the deployments?
- Is your agency working with any OEMS, and if yes how?

# Questions for Discussion

Submit your questions and comments in chat or Q&A section of webinar window

- Have you referenced or used the CAMP Verification document to validate your deployment, or do you have plans to?
- What funding sources did you use? Was this deployment in conjunction with other intersection or signal upgrades?
- Did you need to perform any cost/benefit analysis to obtain the funding? If so, how did you project the benefits and the costs?

# Questions for Discussion

Submit your questions and comments in chat or Q&A section of webinar window

- To what extent did you verify the accuracy of the MAP data before integrating with OBUs, and how did you verify this?
- To what extent did you test the reception of the SPaT/MAP broadcast from all approaches before going live (e.g. to ensure there are no obstructions blocking reception)?

# Questions for Discussion

Submit your questions and comments in chat or Q&A section of webinar window

- If you had to do this deployment again, what would you do differently? (perhaps in the bid documents or vendor selection, installation, or operations)
- Can you share one or two key things that about your SPaT deployment that you think made it successful?

# Questions for Discussion

Submit your questions and comments in chat or Q&A section of webinar window

- Regarding OBU / RSU compatibility: Have you experienced any challenges regarding the deployment of RSUs from different vendors or compatibility of your RSUs with OBUs from one or more vendors, and how have you overcome those challenges?
- (To those integrating with OBUs) Do you have plans in place to accommodate outages in the SPaT broadcast?