Project No. 0007-0250: Berlin Turnpike (US Rte. 5/Rte. 15) CTSS

Technology Workshop

July 12, 2019

CONNECTICUT DEPARTMENT OF TRANSPORTATION

Gannett Fleming

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ISO 9001:2015 CERTIFIED

Agenda

9:00 am	Introductions
	Workshop Goals and Objectives
	Project Overview
9:15 am	Update of Traffic Signal Management Plan (TSMP)
	Systems Engineering Management Plan (SEMP)
	Adaptive Traffic Signal Control (ATSC) Technology
	Fiber Communications
10:00 am	Detection Technology
	Automated Traffic Signal Performance Measures (ATSPM)
10:30 am	Break
10:45 am	Vendor Demonstration
12:00 pm	Lunch
12:45 pm	Connected Vehicle Technology
1:45 pm	Snow Plow Pre-emption or Priority
2:00 pm	Break
2:15 pm	Other Traffic Signal Equipment

Project Schedule and Next Steps
Open Discussion

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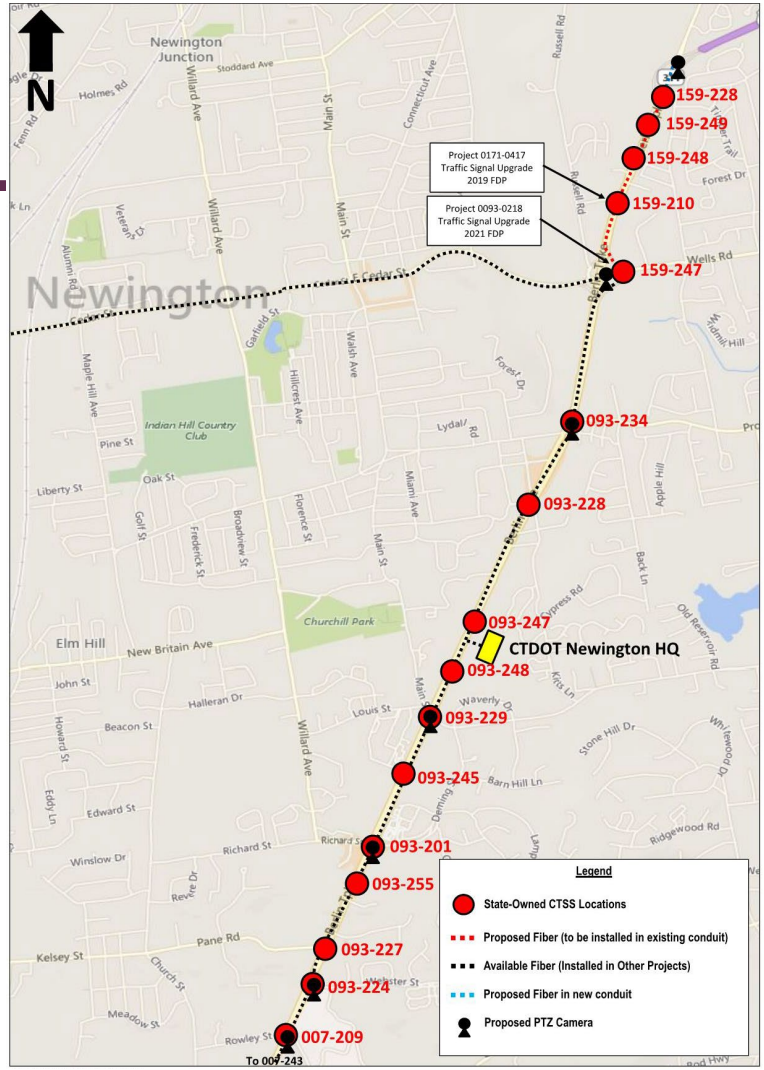
Workshop Goals & Objectives

- Familiarity with the project
- Knowledge of the process and design needs
- Understanding of the technology

Project Overview

- Berlin Turnpike – Phase 1
- 15 Intersections along US 5/US 15 from Nott St. to Selden St./Rowley St.
- New signal equipment
- Coordinated Traffic Signal System (Adaptive Traffic Signal Control)
- Automated Traffic Signal Performance Measures
- Connected Vehicle Technology (Signal Phasing and Timing)
- Pan/Tilt/Zoom CCTV cameras

Project Location



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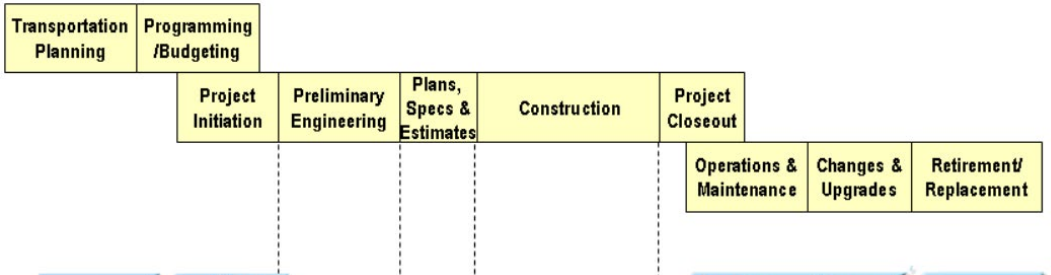
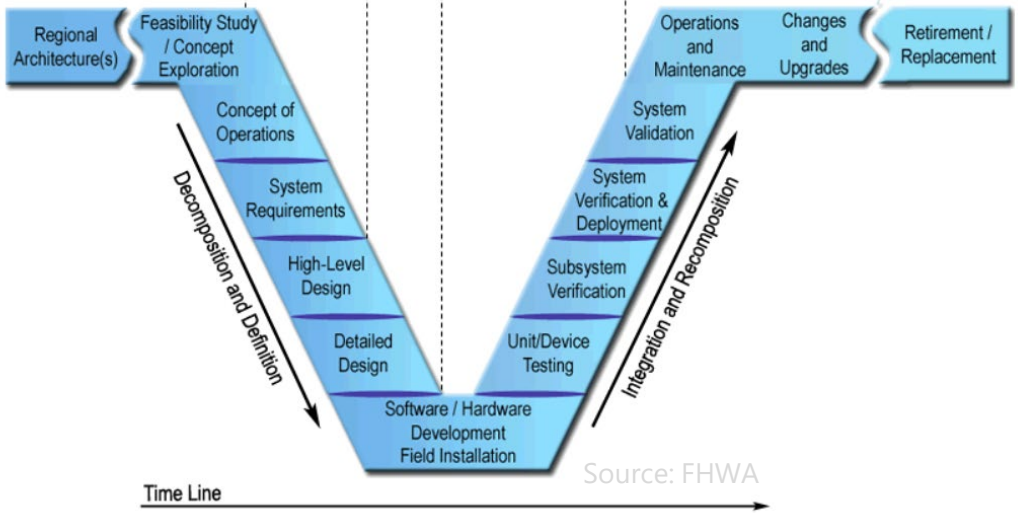
Update of Traffic Signal Management Plan (TSMP)

FHWA Comparison of Traditional with Systems Engineering Process

Traditional Project Delivery Process



Systems Engineering Process ("V" Diagram)



Source: FHWA

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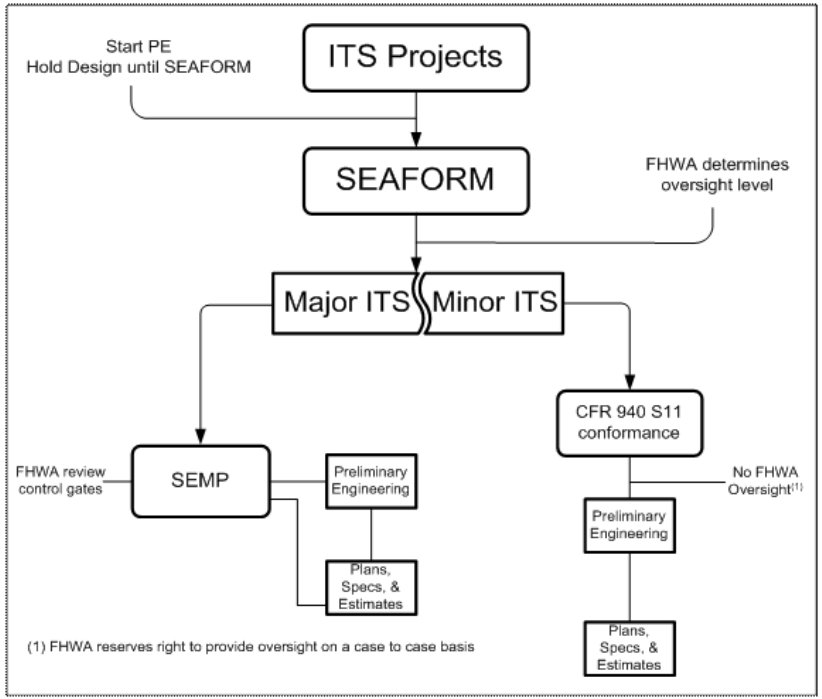
Systems Engineering Management Plan (SEMP)

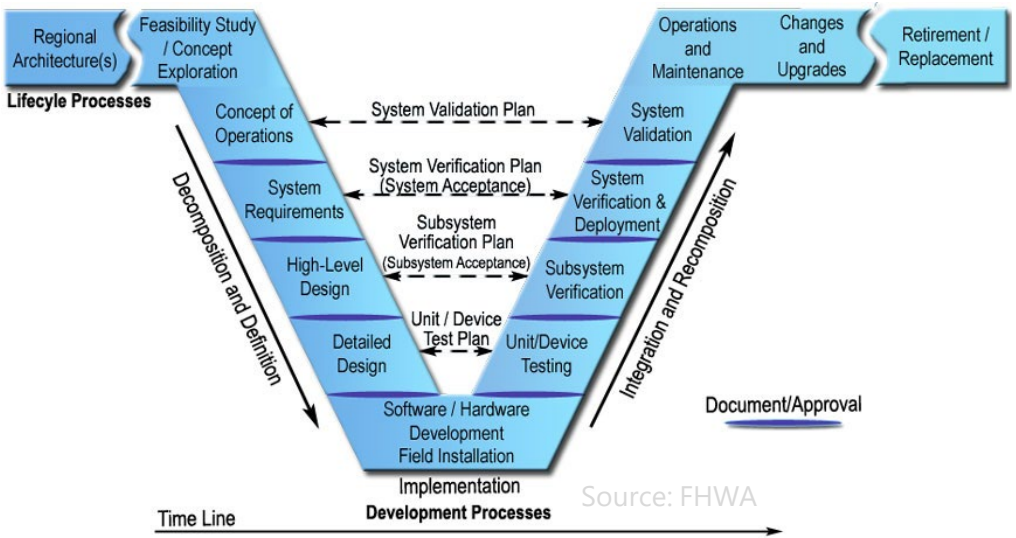
- ConnDOT Stewardship & Oversight Implementation Manual
  - Major ITS project with new technologies



Source: FHWA

Systems Engineering Management Plan (SEMP)

- SEMP
  - Scope of the Project
  - Technical Planning & Control
  - Systems Engineering Process
  - Architecture Update
- Research
  - Adaptive Traffic Signal Control
  - Connected Vehicles



Adaptive Traffic Signal Control (ATSC) Technology – Background

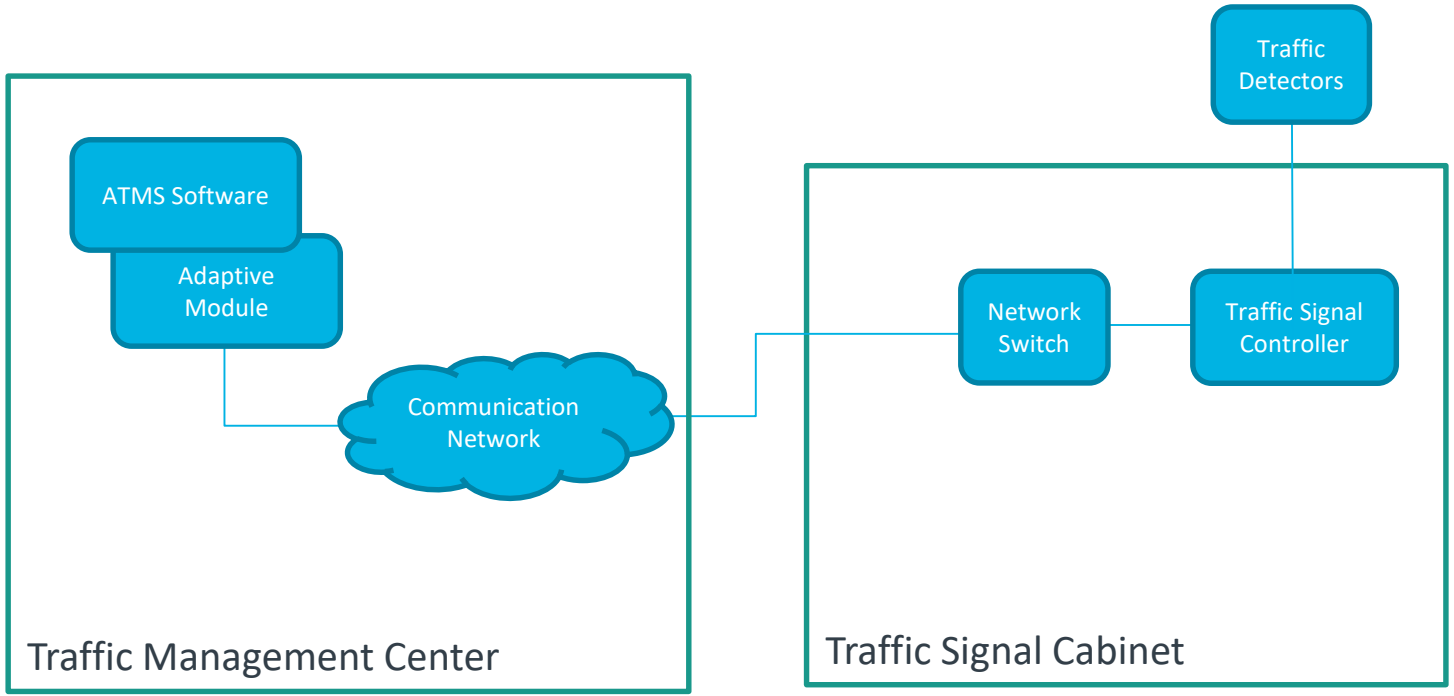
- Traditional time-of-day signal timing plans
- FHWA Every Day Counts – Round 1 (EDC-1) https://www.fhwa.dot.gov/innovation/everydaycounts/edc-1/asct.cfm
- Adjusts the timing of the signals based on data
  - Continuously distribute green time
  - Improve travel time reliability
  - Reduce congestion
  - More efficient traffic signals

ATSC Technology – Background

Current Applications in Connecticut

- TBC – time-based coordination
- Interconnect for coordinated systems
- Peak hour (AM/PM), set to free on off-peak
- Incident timing plans for Interstate back-ups

ATSC Technology – System Architecture



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ATSC Technology – Researched Systems

- Centracs (Econolite)
- Intelight (Q-Free)
- SynchroGreen (TrafficWare)
- InSync (Rhythm Engineering)

- Common Attributes
  - Provides web interface
  - Customizable
  - Leverages existing detection
  - Provides real time updates to timings

ATSC Technology – Researched Systems

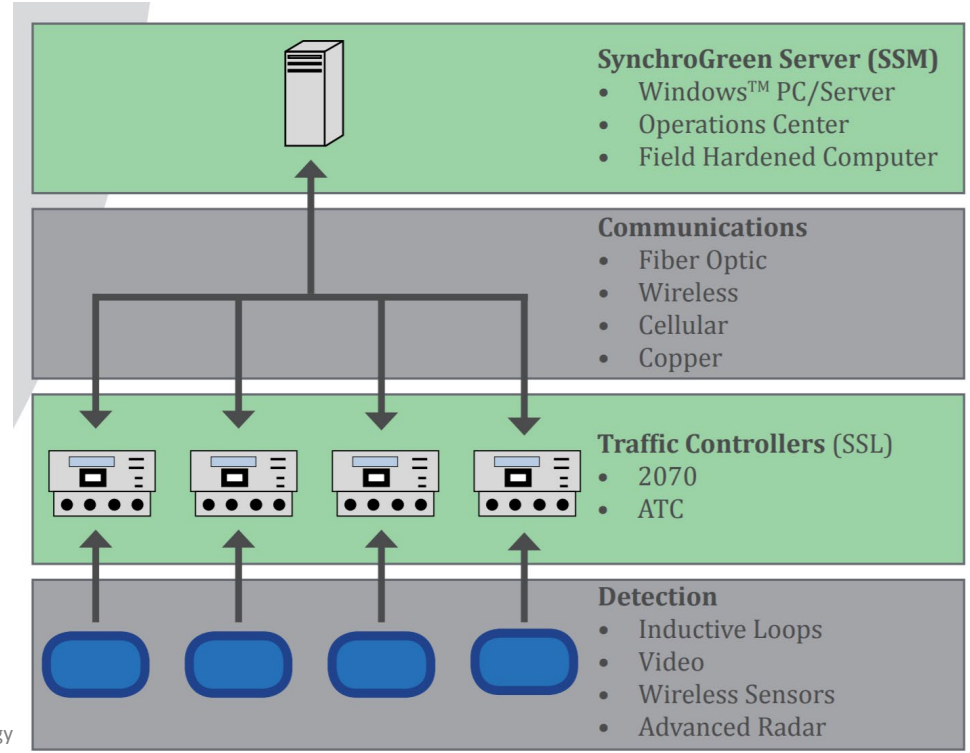
- Centracs (Econolite)

ATSC Technology – Researched Systems

- Intelight (Q-Free)

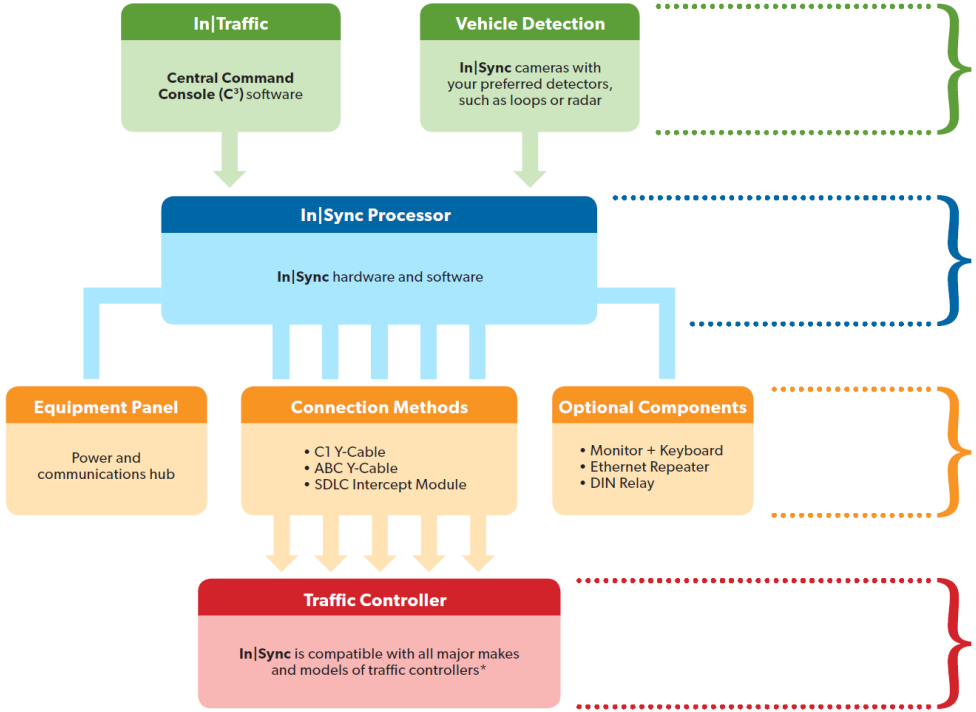
ATSC Technology – Researched Systems

- SynchroGreen (TrafficWare)



ATSC Technology – Researched Systems

- InSync (Rhythm Engineering)



Inputs Layer

In|Sync accepts data from multiple sources to analyze traffic conditions at the intersection and along the corridor every second.

Real-time, Artificial Intelligence-based Optimizer Layer

The **In|Sync Processor**, installed in the traffic cabinet at each intersection, constantly decides how to best optimize traffic flow at the intersection in real-time, while also coordinating progression along the corridor. **In|Sync** does not depend on a central server; rather, intelligence resides at each cabinet and interacts with the corridor's network of all **In|Sync Processors**.

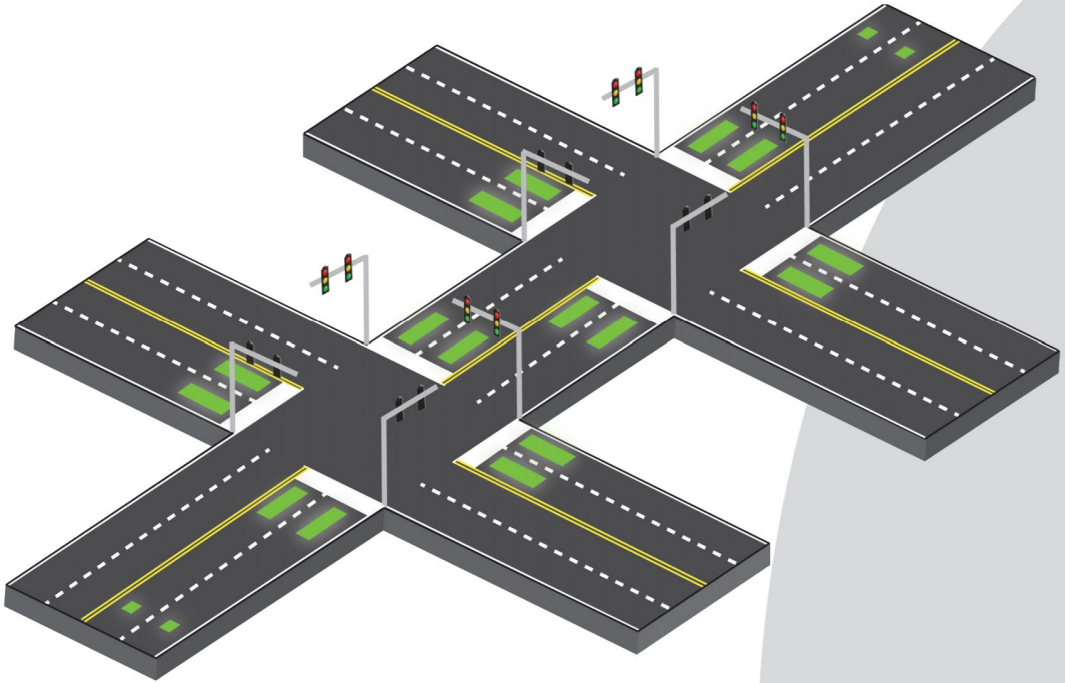
Auxiliary Equipment Layer

These components provide the power, Ethernet and intra-cabinet connectivity that **In|Sync** requires. Rhythm Engineering provides one-on-one guidance to help you choose the auxiliary components that best integrate with your existing equipment and support your adaptive traffic control goals.

Your Traffic Controller and Signals

Your traffic controller runs in free mode so it can accept calls from **In|Sync**.
In|Sync enables your traffic signals to adapt to real-time demand.
In|Sync is compatible with all models of traffic signal controllers.

ATSC Technology – Detection is Key!



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Fiber Communications

- Signals are currently connected via an existing copper line
- Existing fiber backbone will be used for future connections
- Connectivity to traffic lab, TMC and other future systems
- Not interrupting connection to copper during construction

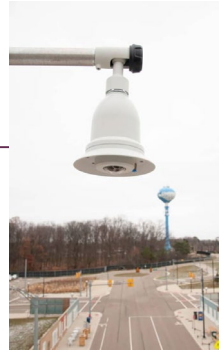
Detection Technology

- GRIDSMART at Stop bar
- Wavetronix for Advanced detection
- Detectors on all approaches

Detection Technology - GRIDSMART

- Bell Camera (single fisheye)
- GS_2 Processor
- GRIDSMART Client

Detection Technology - GRIDSMART



- Bell Camera (single fisheye)
  - Single camera provides Horizon to Horizon image of intersection
  - Virtual Pan-Tilt-Zoom
  - Traffic Counts – cars, trucks, motorcycles, bicycles, & pedestrians

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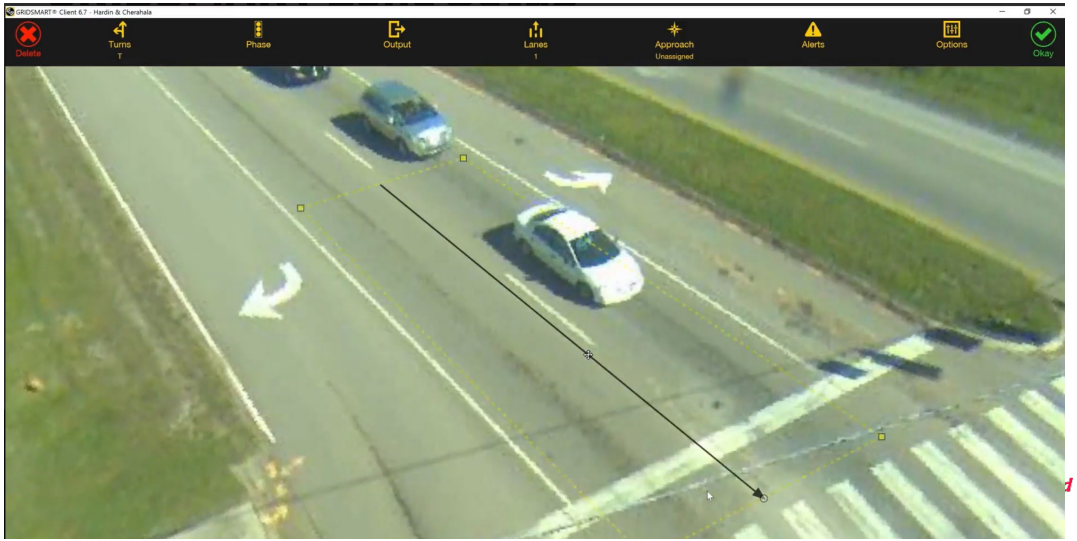
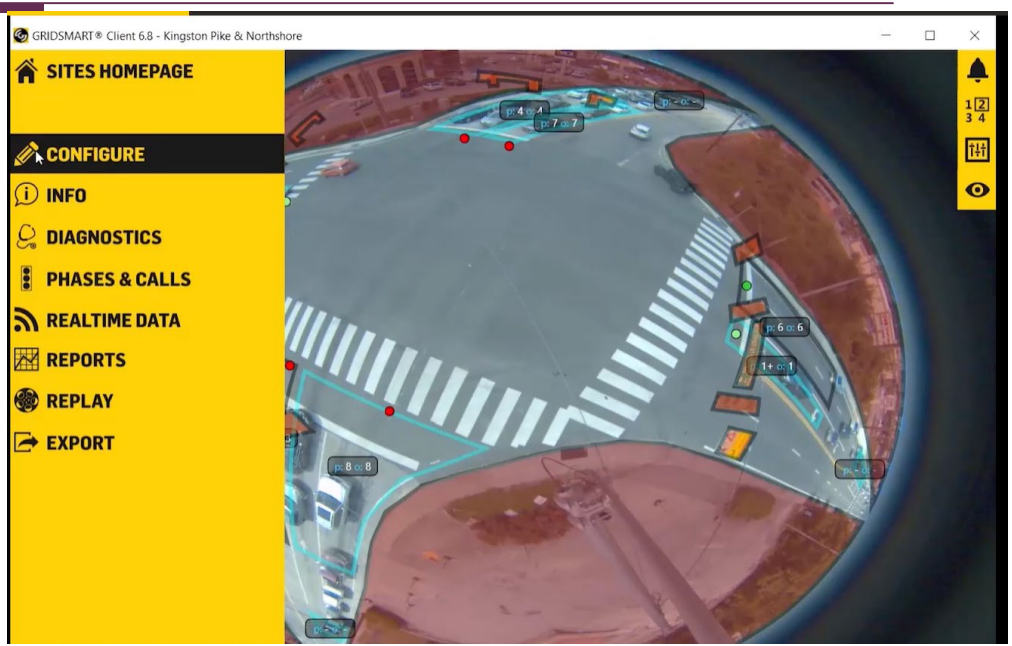
Detection Technology - GRIDSMART

- GS_2 Processor
  - Tracks objects through the defined zones and intersection
  - Can support up to 2 fisheye cameras
  - Provides edge computing in the cabinet
  - Used for vehicle counts and actuation



Detection Technology - GRIDSMART

- GRIDSMART Client
  - Provides real-time access to data
  - Cloud back-up
  - View camera image
  - Generate performance reports
  - Automatic alerts



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Detection Technology - Wavetronix

- Radar Detector
  - Detection over 300' from the stop bar
- Automated Traffic Signal Performance Measures

Automated Traffic Signal Performance Measures (ATSPM)

- FHWA Every Day Counts – Round 4 (EDC-4)
- Allows for continuous monitoring of traffic signal operation using high-resolution data to evaluate performance
- What are Traffic Signal Performance Measures?
  - System or component failures
  - Cycle or Split failures
  - Delay
  - Speed
  - Travel Time
  - Progression Quality
  - Detector Status
  - Pedestrian Actuation
  - Red Light Running
  - Purdue Coordination Diagram
  - Number of Stops
  - Queue Length
  - Arrivals on Red
  - Arrivals on Green

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Automated Traffic Signal Performance Measures (ATSPM)

- Objectives
  - Safety
  - Operations
  - Organizational
  - Maintenance

- How are ATSPM collected?
  - High Definition Controllers
  - Data Loggers or External Devices
  - Adaptive Signal Controllers and Software
  - FHWA Open Source software

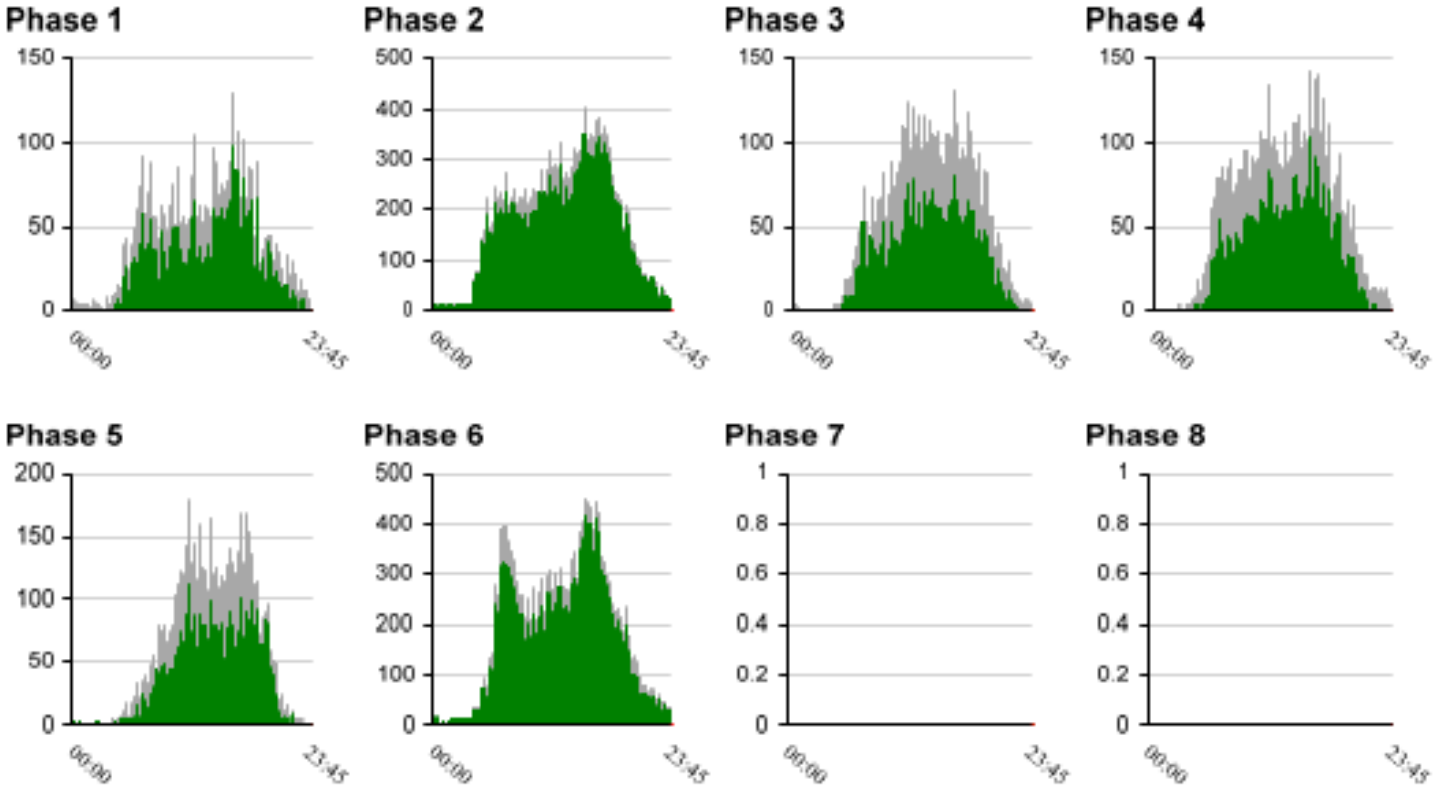
Automated Traffic Signal Performance Measures (ATSPM)

- How do we implement ATSPM?
  - Establish Goals
  - Select corresponding performance measures
  - Select data collection system
    - Advanced Traffic Signal Controllers
  - Establish System Communications
    - Fiber Interconnect to HQ
  - Establish Data Management
    - ATMS Open Source Code

GRIDSMART®

Intersection 093-201 Rts 5 & 15 & Rt 173 & Deming
Date 6/3/2019

Volume & Percent Arrivals on Green



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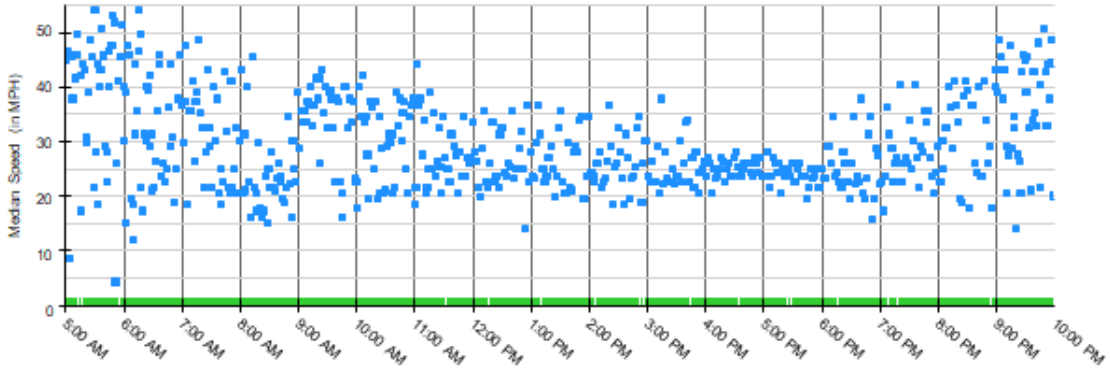
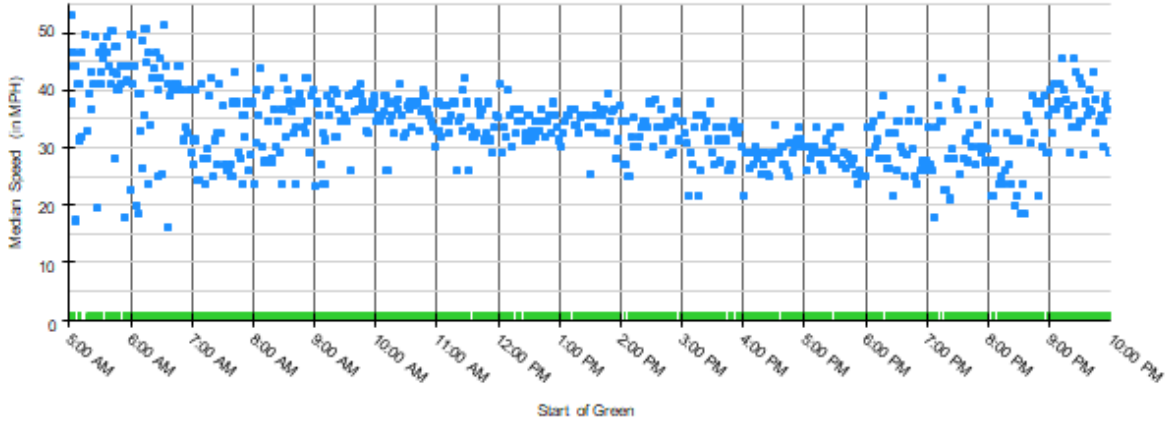
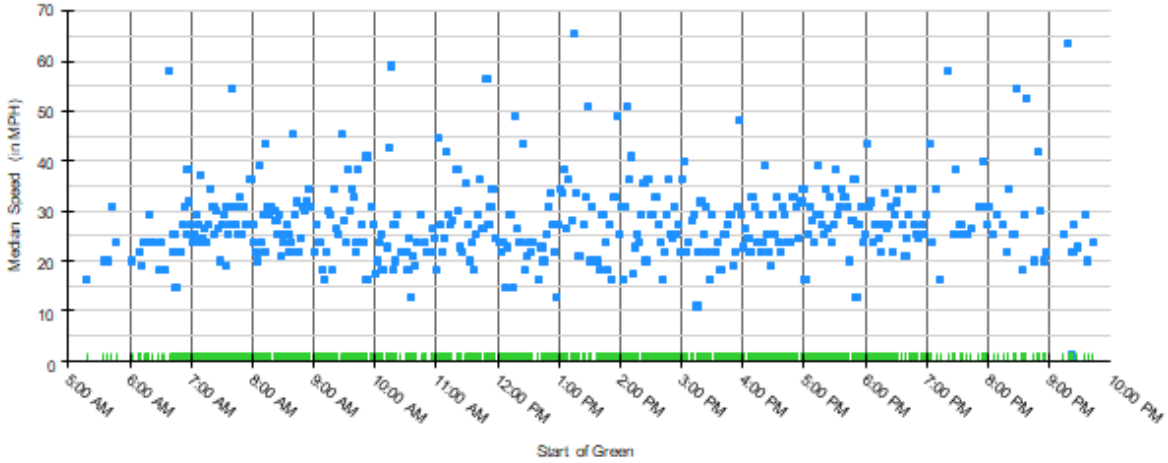
Southbound Phase 2



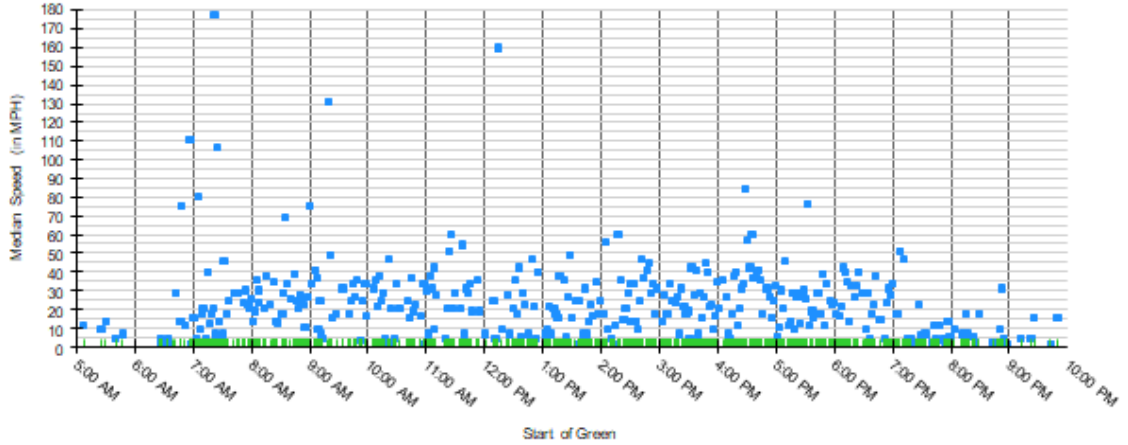
Northbound Phase 6



Westbound Phase 8



Eastbound Phase 4



Automated Traffic Signal Performance Measures (ATSPM)

- Resources
  - FHWA EDC-4: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/atspm.cfm
  - NCHRP Project 03-122: Performance-Based Management of Traffic Signals
  - Signal Performance Metrics Technical Information Purdue e-Pubs: http://docs.lib.purdue.edu/ atspmw/2016/Presentations/
  - AASHTO: http://aii.transportation.org/Pages/AutomatedTrafficSignalPerformanceMeasures.aspx
  - Utah DOT: http://udottraffic.utah.gov/ signalperformancemetrics/

Break

- 15 Minutes

Vendor Demonstration

New England Traffic Solutions

CUBIC

Trafficware®

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Lunch

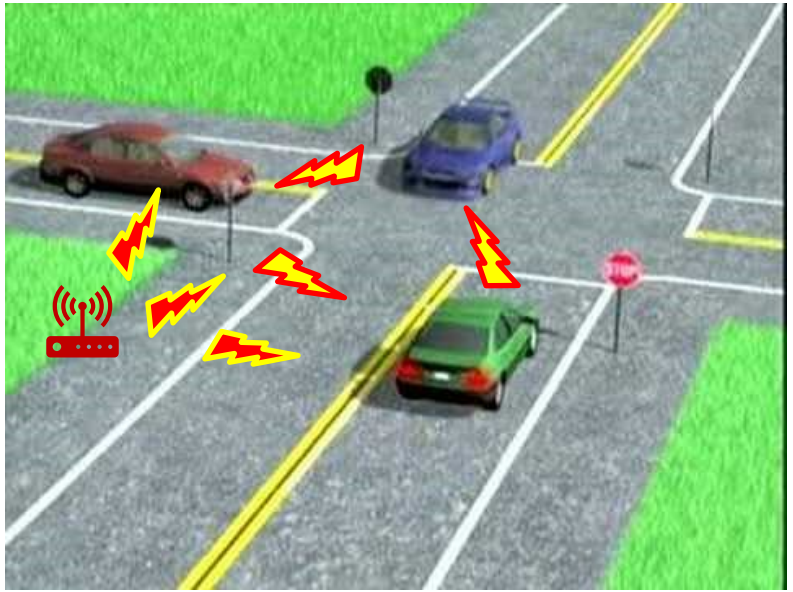
- Restart at 12:45

Connected Vehicle (CV) Technology

- Communication Link
- DSRC vs Cellular (5G C-V2X)
- Messaging
- OBUs & RSUs
- FCC and DSRC Licensing
- System Architecture + Security
- Edge Computing

CV Technology – Communication Link

- Device-to-Device
- Timely Delivery (10x per second)
- Reliable



CV Technology – DSRC & Cellular (5G & C-V2X)

- 5G
  - Viable solution – eventually
  - Deployment only recently started
  - Not yet widely available
- Cellular (C-V2X)
  - Revision of LTE standard
  - First release first half of 2017
  - Industry push (Ford, Qualcomm)
  - New technology – not as mature
    - More likely to change
  - No established FCC licensing procedure

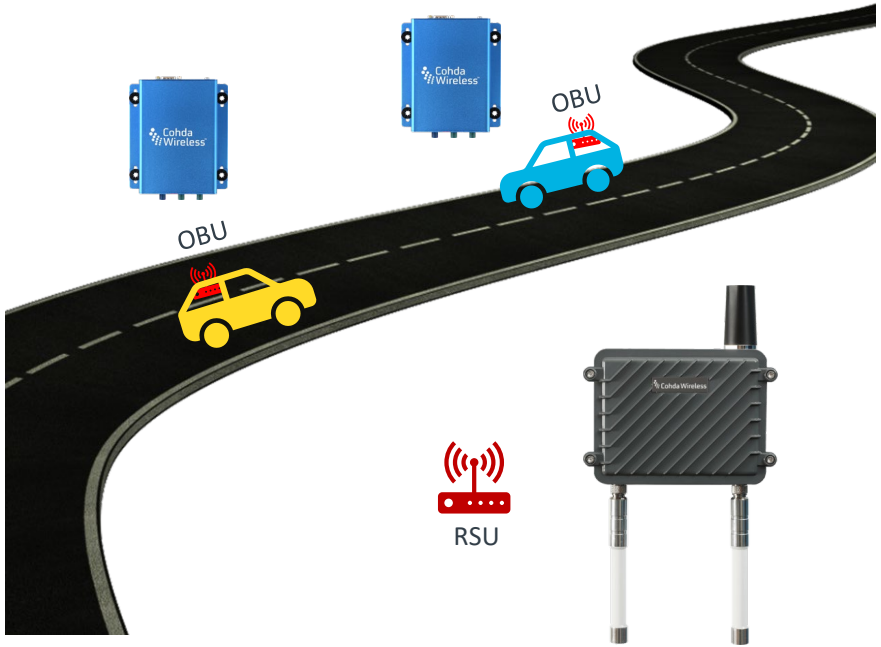
- DSRC
  - Roots back in 1980's
  - FCC allocated spectrum in 1999
  - Based on IEEE 802.11 WiFi
    - adapted for simplified communications high speed moving vehicles (802.11p)
  - Adoption has been slow
  - Technology well tested and proven
  - Mature and developed standards
  - Established FCC licensing procedure
  - SPaT Challenge focus

CV Technology – Messaging

- Once communications link established messages can be exchanged
- Based on SAE J2735 standard
  - Defines:
    - BSM – Basic Safety Message
    - MAP – Map Message
    - SPaT – Signal Phase and Timing
    - TIM – Traveler Information Message
    - and others

CV Technology – OBUs & RSUs

- OBU – On Board Unit
- RSU – Road Side Unit



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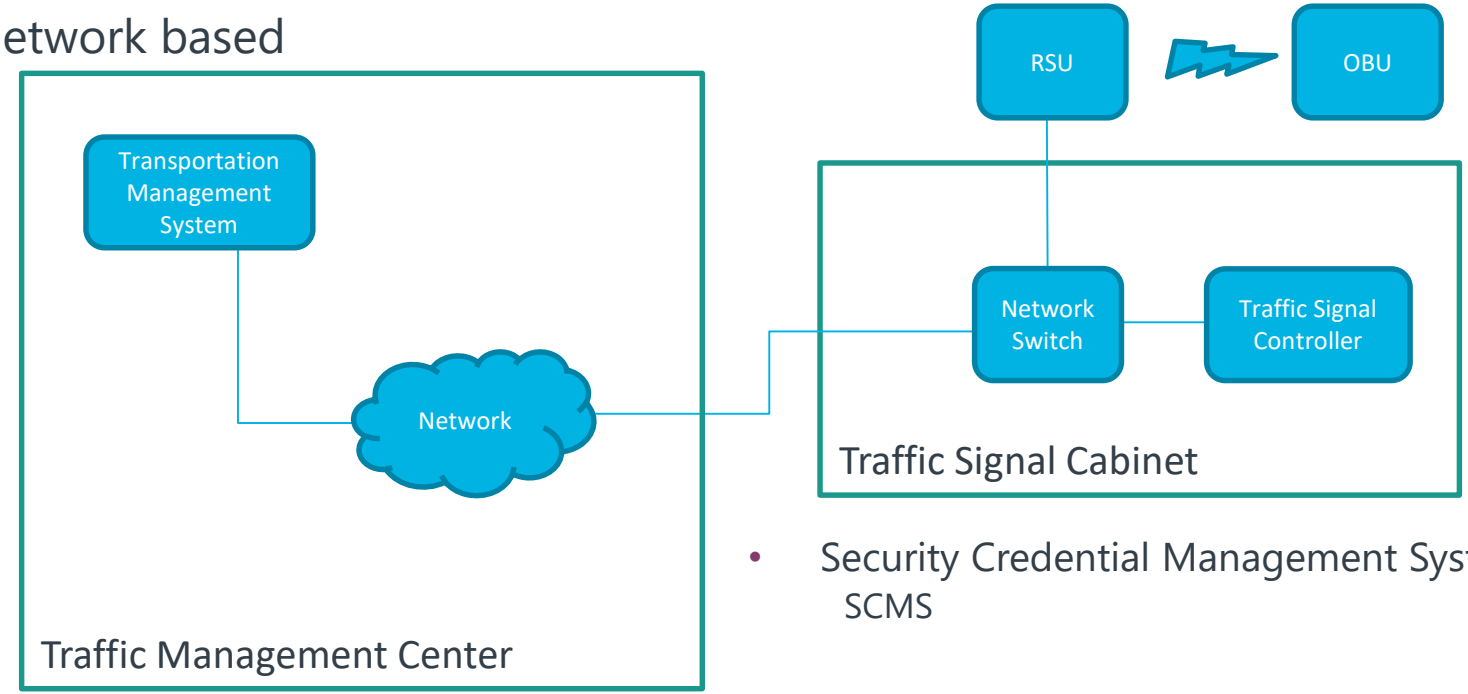
CV Technology – FCC and DSRC Licensing

- Clear Licensing Guidelines
- OBU – CFR 47, Part 95, subpart L
  - Special licensing not required
  - Maximum output power of 1.0 milliwatt
  - Can be mobile
- RSU – CFR 47, Part 90
  - Special Licensing is Required (higher output power)
    - Geographic area license
    - RSUs must be registered
    - Government Radiolocation Services conflicts
      - FCC will facilitate solution
    - Must be stationary while operating
    - Elevation restrictions

CV Technology – System Architecture

- Network based



- Security Credential Management System
  SCMS

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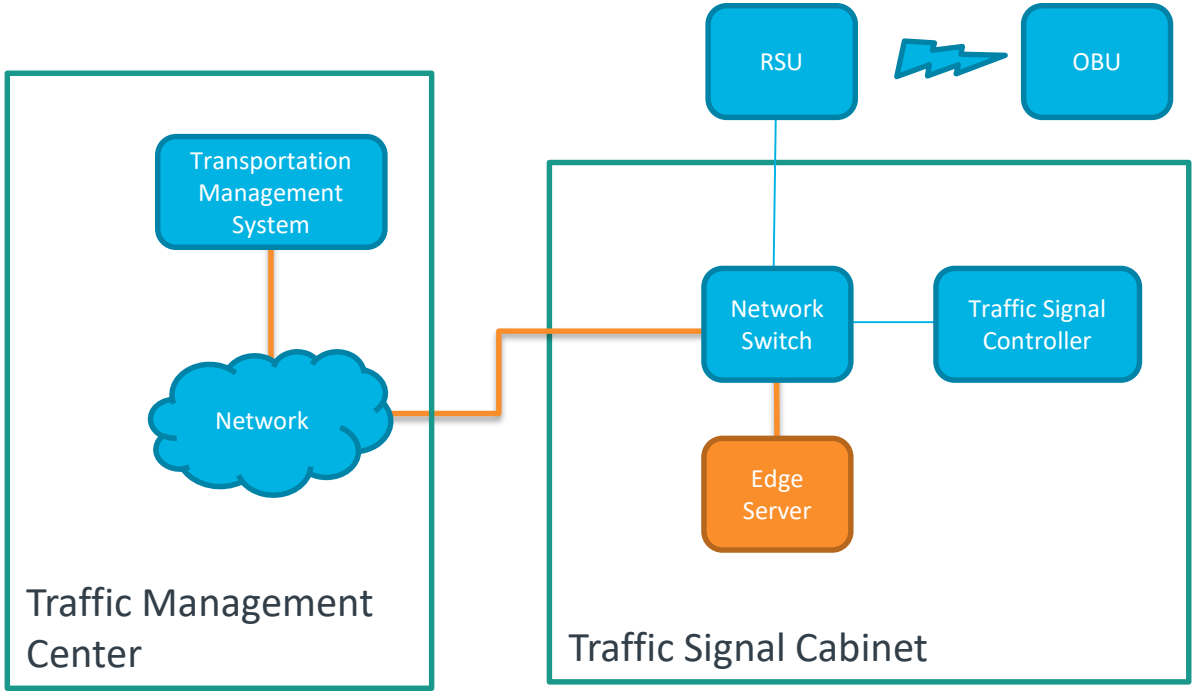
CV Technology – Edge Computing

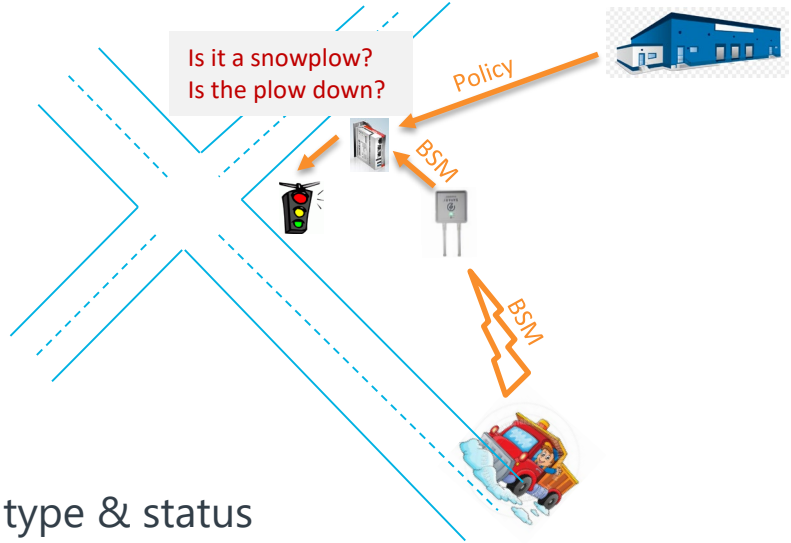
- Local Processing
- Common Interface
- Reliable

- V2I-Hub

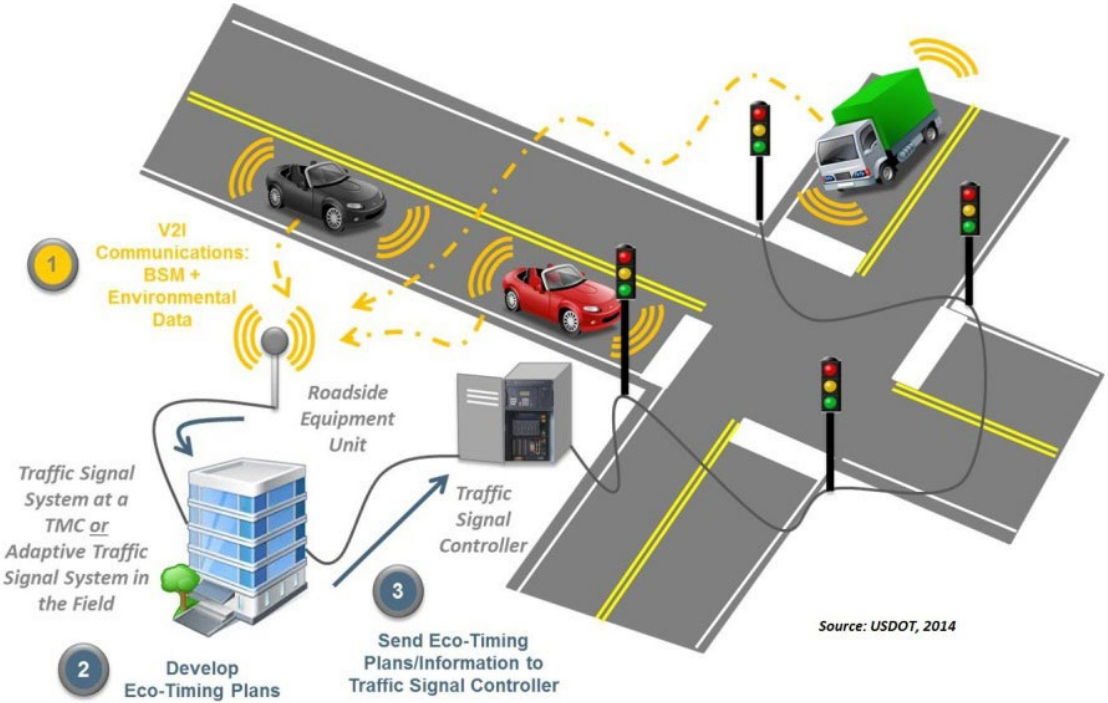


Snow Plow Pre-emption or Priority

- Device Types
  - Acoustic
  - Line of sight
  - Localized RF
  - GPS (requires communication)
    - RF or cellular
- Connected Vehicle Application
  - Vehicle OBU transmits BSM with vehicle type & status
  - Local edge server processes BSM
  - Edge server determine if preemption is required
    - Based on policy programmed from the Traffic Management System



Future Traffic Control with CV Technologies



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Other Traffic Signal Equipment

- All new equipment
- Mast arms vs. Span wire
- Mast arm and foundation standards and details
- Backplates with yellow borders
- Polycarbonate signal heads
- Pedestrian crossings at select intersections
- Flashing yellow right/left turn arrows during pedestrian actuation at select intersections

Project Schedule

- Preliminary Engineering – September 2019
- Preliminary Design – February 2020
- Semi-Final Design - August 2020
- Final Design - November 2020
- Design Completion – March 2021
- Contractor Award - August 2021

Next Steps

- Complete PE and draft SEMP
- Consensus on conceptual mast arm traffic signal layouts
- Perform structural analysis of traffic signal mast arms

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