TRAFFIC CONTROL
in a Connected Vehicle World

Preparing for the advent of Connected Vehicles and their impact on traffic management and signalized intersection control.

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The Next 15 Years…

- The vehicle awareness of Connected Vehicles opens the door to a myriad of radical improvements in Safety, Mobility and the Environment.

- Many expect the impact on transportation to be bigger than anything since the signalized intersection or even the invention of the automobile.

- In safety alone, Connected Vehicles have the potential of addressing approximately 80% of the vehicle crash scenarios involving unimpaired drivers!
Our Current Challenges

SAFETY
Over 33,000 roadway fatalities occur annually in the US; 21% occur at the intersection. 165,000 motorists, cyclists and pedestrians are injured annually by Red Light Runners. 7 fatal and 1,000 injury crashes every day at signalized intersections in the US.

EFFICIENCY
Traffic congestion costs Americans an estimated $160 billion in wasted time and fuel each year. Cost to society of all crashes exceeds $230 billion annually. $28 billion related to trucks. 6.9 billion hours in extra time. 3.1 billion gallons of wasted fuel.

AIR QUALITY
56 billion pounds of additional CO₂. Light-, medium- and heavy-duty vehicles and trucks account for 84% of transportation-related Greenhouse Gas Emissions in the US, and 24% of the total across all sectors.

Connected Vehicles

A LOOK AT THE TECHNOLOGY REQUIREMENTS!
Key Technology Enabler
– 5.9 GHz Dedicated Short Range Communications (DSRC)

Broadcast by Vehicle
▶ BSM (Basic Safety Message)
▶ Vehicle position, speed, heading, acceleration, brake status, size, steering
▶ Every 100 milliseconds

Broadcast by Infrastructure
▶ SPaT (Signal Phase and Timing)
▶ Every 100 milliseconds
▶ GID/MAP (Intersection Map)

Specific Standards
▶ SAE J2945 - on-board vehicle-to-vehicle (V2V) safety communications system for light vehicles,
▶ Transmit and receive SAE J2735-defined Basic Safety Message (BSM)
▶ Using Dedicated Short Range Communications (DSRC) wireless communications
▶ Defined in the Institute of Electrical and Electronics Engineers (IEEE) 1609 suite and IEEE 802.11 standards
Intersection Requirements

- Modern Traffic Signal Controller
- Require NTCIP 1202 v3.05 (support for SAE J2735 messages)
- Consider ATC standard controller with communications module slot
- Processor to run Connected Vehicle Applications
  - Standalone black box, or
  - Integrated into controller, or
  - Run some applications in RSU
The Connected Vehicle Intersection

An integrated network hub to manage and utilize real time traffic information
Vehicle to Infrastructure (V2I / I2V) Connected Vehicle Applications – Available CV App Development and Management Platform

Platform for DOTs to manage third-party CV Apps:

**Mobility APPs**
- RESCUME (Response, Emergency Staging and Communications, Uniform Management, and Evacuation)
- Incident Scene Work Zone Alerts
- Queue Warning
- Cooperative Adaptive Cruise Control
- Dynamic Speed Harmonization

**Safety APPs**
- Red Light Violation Warning
- Curve Speed Warning
- Spot Weather Information Warning

**MMITSS App (Included)**

Multi-Modal Intelligent Traffic Signal System
Consistent with NTCIP 1211 – Object Definitions for Signal Control and Prioritization
- Transit Signal Priority
- Freight Signal Priority
- Emergency Vehicle Preemption
- Mobile Accessible Pedestrian Signal System

**Cobalt ATC Traffic Signal Controller Connected Vehicle CoProcessor Card (CVCP)**
Infrastructure Requirements

- One or more DSRC radios (RSU)
  - Geometry could require more than one for good coverage
  - In-cabinet equipment to support the RSU (i.e. surge protection)
  - POE will require 48VDC source (ATC Cabinet)

- Network backhaul with sufficient bandwidth
  - For security management, data, and path to Internet for cellular/Wi-Fi apps
  - May be able to use existing network or high speed cellular

- Design/Planning, installation, setup, training, maintenance, on-going software license fees
Connected Vehicle Infrastructure Costs...

- **AASHTO DSRC RSE Cost Estimates (per site)**
  - Site deployment costs - $17-18K
  - Backhaul costs - $4-40K (depending on existing network)
  - Ongoing O&M costs - $2-3K per year

- **No specific funding has been set aside by the FHWA for DSRC deployment other than Pilot Deployments**
  - Deployment can be funded using typical intersection funding program
A Word About Vehicle Detection

- **Loop Emulation based technology limited**
  - Presence detection at a given point in space has limited use in the future of Connected Vehicle intersections

- **Vector/Trajectory based data is the future**
  - Vehicle tracking within mapped space of the intersection
  - Speed, direction, acceleration and more

- **Vehicle based detection**
  - On board vehicle sensors
  - Precise vehicle position, speed, direction, acceleration
  - Detection inputs via DSRC radio directly to CV intersection, or cellular backhaul

- **Intersection based detection**
  - Technologies capable of detecting and providing vehicle trajectory data
  - Video, Radar, other
Connected Vehicle Initiative Moving Towards Deployment

The Path to Deployment

Source: USDOT
Connected Vehicle Initiative Moving Towards Deployment

- Smart Cities Challenge Winner: City of Columbus, OH
  - Doing our part – Centracs ATMS (Advanced Traffic Management System)
  - SPaT, MAP, Integrated Data Exchange
  - Multi-Modal Intelligent Traffic Signal System (MMITSS)
  - Econolite / HERE collaboration to deliver pedestrian and traveler assistance
Funded Connected Vehicle Pilot Deployments

- CV Safety Pilot Expansions – Safety Pilot Model Deployment and Southeast Michigan Deployment, 2016/17
  - More Intersections
  - More DSRC equipped vehicles

- Phase 1 of Pilot Deployments – 3 projects Under Way
  - New York City
  - Tampa, FL
  - Wyoming

- Phase 2 of Pilot Deployments
  - Procurement & Deployment in 2017
Utilize essential Testbeds for Connected and Automated Vehicles (CAV), like University of Michigan Mobility Transformation Center (MTC) and M-City.
Support Vehicle-to-Infrastructure Deployment Coalition (V2I-DC) – AASHTO – ITSA – ITE

Vehicle-To-Infrastructure (V2I) Deployment Strategies
- The V2I Deployment Coalition will support FHWA's V2I Deployment Guidance efforts.

V2I Readiness
- The V2I Deployment Coalition will evaluate the state of current infrastructure for adaption to CV technologies using the AASHTO Footprint Analysis as a baseline.

V2I Research
- The V2I Deployment Coalition will support technical, policy, and operational research to support CV deployment by coordinating with its stakeholders representing public sector agencies, vendors, and academia.

V2I Standards and Deployment support
- The V2I Deployment Coalition will lead the effort to develop and support publishing of V2I standards, guidelines, and test specifications to accelerate CV technology deployment.

V2I Outreach
- The V2I Deployment Coalition will develop an active outreach program by creating tools, training courses, workshops, webinars, guidance, discussion forums, articles developed by its stakeholders, and experts from the industry.

The National Connected Vehicle Deployment Challenge
20 SPA T Intersections in 50 States by 2020

The Challenge:
To challenge state and local public sector transportation infrastructure owners and operators to cooperate together to achieve deployment of DSRC infrastructure with SPA T broadcasts in at least one corridor or network (approximately 20 signalized intersections) in each of the 50 states by January 2020.

What is SPA T? A Signal Phase and Timing (SPA T) message defines the current intersection signal light phases. The current state of all lanes at the intersection are provided, as well as any active pre-emption or priority. Want to know more about SPA T? Go to this FHWA website: http://www.ops.fhwa.dot.gov/policyguide/intersections/application/JSPAT/

What is DSRC? Dedicated short range radio (DSRC) refers to two-way radio communication operating on the 5.9GHz band for the purpose of supporting traffic operations. FCC has set aside this band for this purpose. The National Highway Traffic Administration (NHTSA) is in the process of requiring all new light vehicles sold in the US to be equipped with DSRC and for those radios to transmit basic information about the performance and location of the vehicle. This will enable agencies to collect this data using roadside installed DSRC radios and to transmit data back into the vehicle with the intent to support safer, more efficient operations: http://www.fhwa.dot.gov/traffic/operations/dsarc_factsheet.htm
Resources – CV Application Development

What is OSADP?
Portal for open source transportation applications!

Welcome to Open Source Application Development Portal!
A channel for distributing and collaborating on transportation related open source applications

Connected Vehicle Dedicated Short-Range Communication Message Parser Now Available for Download...
Public Outreach and Comment
- Vehicle Performance Guidance for Automated Vehicles

Included, “behavioral competencies…”
- Detect Traffic Signals and Stop/Yield Signs
- Respond to Traffic Signals and Stop/Yield Signs
- Navigate Intersections and Perform Turns
The Future, Together

THE CONNECTED VEHICLE ERA – POSITIVE IMPACT ON TRAFFIC MANAGEMENT
Optimizing Mobility

- New MOEs
- Integration
- Connected Vehicle
- Efficiency
- Optimization
- Quality of Life
- Safety
- Big Data

Our Vision

Econolite Group, Inc.
Participation in CV standards development

Joint CV research (academic and commercial)

Controller software under development to use V2I/BSM data from connected vehicles

Algorithm development to improve safety and throughput while reducing delay and congestion

New MOEs and metrics to improve optimization

Connected Vehicle-ready hardware
  - Cobalt ATC has sufficient hardware and display
  - Co-processor to run Connected Vehicle Applications
Path to the Future – Realizing our Best Traffic Management Strategies

- Giving priority to those who need it most and increasing safety for all roadway users
- Multimodal-Based V2I / I2V applications can drive early deployment of needed infrastructure
- To reach our goals will require innovation to take advantage of information-rich traffic data
- Our best/proven traffic management strategies will continue to drive safety, mobility and sustainability…
Thank You

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