Welcome

Greg Larson (Caltrans and Chair of the Strategic Initiatives Technical Working Group 1) welcomed everyone to the webinar.

Approximately 53 members and guests joined the webinar. A list of those in attendance is provided at the end of these notes. This list may not be comprehensive, as attendees may have joined late and were not identified on the webinar. Please contact Dean Deeter at deeter@acconsultants.org to be added to the list.

Connected Fleet Challenge Outreach

Joe Averkamp was unable to attend so an update on the Connected Fleet Challenge Outreach was postponed until next time.

Patrick Son led a discussion about the current role of the NOCoE website in disseminating the resources related to the SPaT Challenge and tracking progress of the SPaT Challenge.

Greg recognized that there is a need to establish a web presence for the Connected Fleet Challenge and to be able to track progress with the challenge. Greg will discuss this off-line with Mark Kopko and others and share a proposed plan during the next webinar.

Resource Area #1: Existing OBU Procurement Documents

Tom Timcho prepared a list of links to resources related to on-board unit (OBU) deployment/deployment. These resources relate specifically to OBU deployments on large trucks. A copy of the titles and links to the resources is attached to this webinar summary as “Connected Fleet Resources”.

Tom reported that some sites are moving from planned to operational specifications for OBU deployments, and he will continue to update members as new resources are available.

Resource Area #2: OBU Mounting Lessons Learned

Matt Smith shared information he received from Danlaw, specifically related to issues with the use of antennae. Since the webinar, Matt received permission from Danlaw to share the PPT presentation that he referred to during his update. A copy of this presentation is attached to this webinar summary.
Some highlights and lessons learned are:

- During large scale installations, standardizing all cable links and connectors and placing them in individual packages has helped a lot to reduce the need for customization during installation.

- Antennas need to be able to operate in various environments. The ability to have data locking capability was extremely important.

- Antenna mounts are important:
  - A through the glass installation showed minimal signal loss and has proved to be the most advantageous so far in the New York pilot.
  - Interior only mounts don’t work in a DSRC environment because they are not directional.
  - Exterior mounts involve either using magnets or drilling holes and neither option is desirable.
  - Mounting antennae is a combination of art and science – a strong adhesive must be used but the adhesive must also be able to be removed cleanly.

- Human Machine Interface (HMI) is complex.
  - In the New York City pilot, a speaker and LED array seem to be the most effective.
  - HMI does not need to be elaborate – in fact, that may do more harm than good.
  - It is desirable to interface with many V2I applications.

**Resource Area #3: Basic Safety Message (BSM) Information**

Deb Curtis had shared a PDF file related to BSM. The document recaps the fundamentals of BSM and describes the key elements of BSM Part 2 that are needed for mobility applications. The presentation also describes elements of BSM Part 2 that do not require 10 times per second BSMs and could be communicated using cellular. (a copy was circulated to members prior to the webinar and is attached to this meeting summary).

Deb was not able to join this webinar but should be available for future webinars to answer any questions.

**Close**

Dean reported that the CAT Coalition website now exists and is hosted by the National Operations Center of Excellence (NOCoE). The Strategic Initiatives Technical Working Group web page will be used to post monthly webinar summaries and is located at: https://transportationops.org/CATCoalition/strategic_initiative_WG

Greg reminded members that the November webinar is the only webinar of the Strategic Initiatives WG being held between November and December. This working group will resume webinars in 2019.

**The next meeting is scheduled for Thursday, January 24, 2019, at 2pm Eastern.**
TWG 1 November 8, 2018 Webinar Participants

- Greg Larson, Chair
- Susan Catlett
- Justin Chan
- James Chang
- Patrick Chuang
- Ray Derr
- Bob Dockmeyer
- Gary Duncan
- Paul Duncan
- Mohammed Hadi
- Cliff Heise
- Shah Imran
- Ahmad Jawad
- Mark Kopko
- Christian Kulus
- Sean Laffey
- Steve Lockwood
- Jianming Ma
- Roxane Mukai
- Suzanne Murtha
- Gummada Murthy
- Jon Obenberger
- Lev Pinelis
- Mark Peters
- Jonathan Riehl
- John Roman
- Joerg Rosenbohm
- Mike Schagrin
- Jeremy Schroeder
- Matt Smith
- Patrick Son
- Chris Stanley
- Michael Stelts
- Gary Strack
- Bob Taylor
- Curtis Thompson
- Peter Thompson
- Thomas Timcho
- Hoki Tse
- Joey Yang
- Ken Yang
- Dean Deeter
Attachment A
Connected Fleet Challenge - Resources

1. Links to OBU Resources

Commercial Vehicle (CV) Retrofit Safety Device (RSD) Kits Project
FHWA-JPO-14-141
SWRI
https://rosap.ntl.bts.gov/view/dot/3521

Connected Commercial Vehicles—Retrofit Safety Device Kit Project: Final Report
FHWA-JPO-14-111
Battelle
https://rosap.ntl.bts.gov/view/dot/3495

FHWA-JPO-14-108
UMTRI/Battelle
https://rosap.ntl.bts.gov/view/dot/3492

Connected Commercial Vehicles—Integrated Truck Project: Vehicle Build and Build Test Plan Final Technical Report
FHWA-JPO-13-103
UMTRI / Battelle
https://rosap.ntl.bts.gov/view/dot/3437

Connected Commercial Vehicles—Integrated Truck Project: Vehicle Build Test Report
FHWA-JPO-13-104
UMTRI / Battelle
https://rosap.ntl.bts.gov/view/dot/3436
Attachment B

Presentation Shared by Matt Smith

(Circulated with permissions form Danlaw)
Paving the Way Towards V2X Technology
Danlaw’s V2X technology enables V2V and V2I communications using DSRC or C-V2X, providing a myriad of safety features.

These applications give drivers access to better information, critical alerts, and safety advice.
Creating Safer Roads

Vehicle-to-everything technology enables cars and infrastructure road side units to relay real-time location and heading information. This technology enables a myriad of benefits, including:

- Reduced traffic congestion
- Shortened commute times
- Emissions reduction
- Traffic accident avoidance
- Improved efficiency in transportation systems
V2X – Vehicle to Anything.

Danlaw’s deep history in Connected Vehicles comes from a decade of Telematics products deployed on over 4 Million vehicles in the field.

Your drivers will get all the safety benefits of our V2X applications plus the capabilities of the acclaimed Danlaw OBD-II DataLogger.

Danlaw began V2X activities in January 2015 with the USDOT Connected Vehicles Certification Test Environment project. We initiated V2X product development soon after the USDOT project was underway to target an Aftermarket Safety Device to support connecting the 265 Million mature vehicle fleet.

Today, our V2X systems are being deployed on two of the largest pilot projects at UMTRI and coming soon in New York City, with numerous others on the horizon.
The Future of Mobility
V2X Pilots

Michigan
UMTRI MCity

Wyoming
Commercial Vehicles Safety

Columbus
Comprehensive plan

New York City
Urban canyons

Tampa
Congestion relief, pedestrians

= USDOT Funded Projects
= Non-DOT Funded Projects
The Future of Mobility
USDOT Sponsored Certification
V2X Equipment

- On-Board Unit
- V2X Antenna
- Roadside Unit
- HMI
V2X OBU
Safety on the Road
Complete solution that collects real-time driving information from other vehicles and roadside equipment. Simplifies integration of connected vehicle functions for V2X pilots.

Connected Insight
Generates predictive insights, providing 360-degree situational awareness for enhanced safety.
Making Safety a Priority

Drivers receive all the capabilities of Danlaw's OBDII DataLogger, plus the safety benefits of V2X applications.

- Forward Collision Warning
- Intersection Movement Assistance
- Left Turn Assistance
- Control Loss Warning
- Emergency Electronic Brake Lights Warning
- Blind Spot Warning
- Curve Speed Warning
- Pedestrian Warning
- Icy Road Warning
- Lane Change Warning
- Emergency Communications & Evacuation Information
V2X Equipment
On-Board Unit

2 V2X Rx/Tx Input Channels
• Ch. 172: BSM, MAP/SPaT, TIM, ...
• Ch. 178: Control Channel for WSA, and switching to peer-to-peer on alternate channels

1 GPS Antenna Input

Ethernet or USB connector (opt.)

SD Card (opt.)

Vehicle Connector
• Battery, Ignition, Ground, CAN, and HMI outputs
**Additional Features**

- Available to support DataLogger applications
  - User Based Insurance
  - Fleet Management
  - Road Usage Charging
- Secure Over-the-air update through RSU or cellular communications supported by Danlaw server
- Flexible Vehicle Event Data Recording and Reporting
- Custom User features available on request

**Communications Agnostic**

DSRC, C-V2X, 4G LTE, 5G LTE, …
V2X Antenna
**Superior Adaptability**

Dual-Radio, glass-mounted antenna with coupling pair to pass 5.9 GHz V2X RF signals from the interior to the exterior of the vehicle and adjustable to any windshield angle.

**Easy Installation**

The glass coupler and integrated stub antenna simplifies antenna installation, eliminating the need to drill holes through the vehicle or pass cables through a window opening. And it’s car wash safe!
Why a Through-Glass V2X Antenna?

- We are focused on connecting the 265M mature aftermarket vehicle fleet.
- Interior antennas cannot achieve omni-directional range due to RF signal blockages so exterior location is needed.
- Exterior antenna connection requires access hole in roof or through top of side window, not customer accepted.
- OEMs are able to connect through the roof for new vehicle installations, not possible for aftermarket acceptance.
- Danlaw’s Through Glass antenna provides the best performance possible to aftermarket installations.
V2X Antenna Options

V2X/GPS Antenna
2 channel V2X and integrated GPS

Types

Danlaw Glass Through coupler with integrated antenna
Glues to front or back glass

Danlaw Glass Through coupler only
Connect to any standard exterior antenna without the need to drill holes in the roof
V2X RSU
Roadside units (RSUs) focus on safety and congestion.

- Alerts drivers of impending traffic issues or adverse road conditions
- Enables pre-emption for first responders
- Priority for buses and service vehicles
Connected Infrastructure

Danlaw’s RSU enables a wide variety of V2I applications, including:

- Red light violation warning
- Traffic signal violation warning
- Reduced speed zone warning
- Curve speed warning
- Intersection movement assist
- Left turn assist
V2X Equipment
HMI Options

**Visual**
LED Array
Aftermarket Head Up Display

**Audible**
Speakers
### V2X Equipment

**HMI LED Array**

Separate unit from OBU; on top of dashboard or attached to glass

LIN interface to OBU

LEDs for V2V safety warnings

Visual indication as addition to audio warnings

<table>
<thead>
<tr>
<th>LED Position</th>
<th>Warning Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>EEBL</td>
<td>Front, RED</td>
</tr>
<tr>
<td>FCW</td>
<td>Front, RED</td>
</tr>
<tr>
<td>IMA</td>
<td>Front, RED</td>
</tr>
<tr>
<td>LTA</td>
<td>Front, RED</td>
</tr>
<tr>
<td>LCW/BSW</td>
<td>Left &amp; Front, YELLOW</td>
</tr>
<tr>
<td>CLW</td>
<td>Front, RED</td>
</tr>
</tbody>
</table>
V2X Applications
V2V Applications

- Blind Spot Monitoring
- Control Loss Warning
- Lane Departure Warning
- Left Turn Assist
- Emergency Electronic Brake Light
- Forward Collision Warning
- Intersection Collision Warning
- Vehicle Turning Right in Front of Bus
V2I Applications

- Speed Compliance Warning
- Curve Speed Warning
- Speed in Work Zone Warning
- Red Light Violation Warning
- Oversize Vehicle Compliance
- Emergency Communications & Evacuation Information
- Pedestrian in Intersection Warning
- Icy Road Warning
- Vulnerable Road User Warning
- Traffic Signal Violation Warning
- Reduced Speed Zone Warning
Thank you.

Raju Dandu,  
Founder

Phone: +1 248 476 5571  
RajuD@Danlawinc.com

Corporate Headquarters  
41131 Vincenti Ct.  
Novi, MI 48375
Attachment C

Document Describing BSM Part 2 Data Needs

(Shared by Deb Curtis)
Vehicle Based Data and Availability

Brian Cronin, Team Leader, Research, Intelligent Transportation Systems Joint Program Office Research and Innovative Technology Administration, USDOT Brian.Cronin@DOT.GOV
Fully Connected Vehicle

Vehicle Data
latitude, longitude, time, heading angle, speed, lateral acceleration, longitudinal acceleration, yaw rate, throttle position, brake status, steering angle, headlight status, wiper status, external temperature, turn signal status, vehicle length, vehicle width, vehicle mass, bumper height
Basic Safety Message (BSM) Fundamentals

- Connected V2V safety applications are built around the SAE J2735 BSM, which has two parts
  - BSM Part 1:
    - Contains the core data elements (vehicle size, position, speed, heading acceleration, brake system status)
    - Transmitted approximately 10x per second
  - BSM Part 2:
    - Added to part 1 depending upon events (e.g., ABS activated)
    - Contains a variable set of data elements drawn from many optional data elements (availability by vehicle model varies)
    - Transmitted less frequently
  - No on-vehicle BSM storage of BSM data
  - The BSM is transmitted over DSRC (range ~1,000 meters)

- The BSM is tailored for low latency, localized broadcast required by V2V safety applications
Key Elements of BSM Part 2 Needed for Mobility Applications

- BSM Parts 1 and 2 via DSRC provides the vehicle data needed to support some localized mobility applications.

<table>
<thead>
<tr>
<th>MOBILITY APPLICATIONS (where roadside units deployed)</th>
<th>KEY PART 2 DATA ELEMENTS TO SUPPLEMENT PART 1 DATA</th>
</tr>
</thead>
<tbody>
<tr>
<td>- Cooperative Adaptive Cruise Control</td>
<td>- Weather Data (with examples)</td>
</tr>
<tr>
<td>- Speed Harmonization</td>
<td>- Ambient Temperature</td>
</tr>
<tr>
<td>- Queue Warning</td>
<td>- Ambient Air Pressure</td>
</tr>
<tr>
<td>- Transit Signal Priority</td>
<td>- Traction Control Status</td>
</tr>
<tr>
<td>- Incident Scene Work Alerts</td>
<td>- Wiper Status</td>
</tr>
</tbody>
</table>

- HOWEVER: DSRC link burdened by redundant Part 2 elements, critical data elements and their required latencies may vary with operational conditions.
Using Cellular Messages to Augment BSM for Mobility Applications

- Most mobility applications do not require BSMs 10 times per second
- Many applications require data captured over a wide area, not just localized data near a roadside unit (storage and/or wide-area communications needed)

Possible Approach:
- Vehicles transmit BSM Part 1 plus key Part 2 elements less frequently
- Transmit via DSRC when available, Cellular otherwise

Augmenting BSM with key Part 2 elements via Cellular provides the vehicle data needed to support nearly all mobility applications

- Cooperative Adaptive Cruise Control
- Speed Harmonization
- Queue Warning
- Intelligent Traffic Signal System
- Transit Signal Priority
- Mobile Accessible Pedestrian Signal System
- Emergency Communications and Evacuation
- Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
- Incidents Scene Work Zone Alerts for Drivers and Workers
- Next Generation Integrated Corridor Management
- Transit Connection Protection
- Dynamic Transit Operations
- Dynamic Ridesharing
- Freight Traveler Information
- Traveler Information
### Weather Priority Vehicular Data

#### BSM Part 1
- Brake system status
  - Brake applied status
  - Traction control status
  - Anti-lock brake status
  - Stability control status

#### BSM Part 2
- Vehicle status
  - Exterior lights
  - Wipers
  - Brake system status
  - Roadway friction
  - Rain sensor
  - Ambient air temperature
  - Ambient pressure
  - Yaw rate

- “Black Ice” warning requires near-instantaneous information while other algorithms operate with data rates from once per second to once every 30 seconds
- 15 observations per segment (e.g., 1 mile) per time step (e.g., 15 min) should be sufficient for confidence in the application outputs
- Bandwidth required for data transmission is minimal (85-365 bytes)
## AERIS - BSM Assessment – Data Results

<table>
<thead>
<tr>
<th>HIGH PRIORITY</th>
<th>MEDIUM PRIORITY</th>
<th>NOT IN BSM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Timestamp</td>
<td>SteeringWheel Angle</td>
<td>Fuel type</td>
</tr>
<tr>
<td>Position (lat/long/elev)</td>
<td>Positional Accuracy</td>
<td>Fuel consumption</td>
</tr>
<tr>
<td>Speed and heading</td>
<td>ABS, Traction status</td>
<td>Emissions</td>
</tr>
<tr>
<td>Acceleration</td>
<td>Stability control</td>
<td>Fuel level</td>
</tr>
<tr>
<td>Brake system status</td>
<td>Differential GPS</td>
<td>Road grade</td>
</tr>
<tr>
<td>Vehicle size</td>
<td>Lights status</td>
<td>Engine drive cycle</td>
</tr>
<tr>
<td>Recent braking</td>
<td>Wiper status</td>
<td>Operating mode</td>
</tr>
<tr>
<td>Path prediction</td>
<td>Brake level</td>
<td>Engine temperature</td>
</tr>
<tr>
<td>Throttle position</td>
<td>Coefficient of friction</td>
<td></td>
</tr>
<tr>
<td>Vehicle mass</td>
<td>Rain type</td>
<td></td>
</tr>
<tr>
<td>Trailer weight</td>
<td>Air temperature</td>
<td></td>
</tr>
<tr>
<td>Vehicle type</td>
<td>Air pressure</td>
<td></td>
</tr>
<tr>
<td>Vehicle description</td>
<td>Vehicle identification</td>
<td></td>
</tr>
<tr>
<td>Cargo weight</td>
<td></td>
<td></td>
</tr>
<tr>
<td>GPS status</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Red text indicates BSM Part 1 Data Elements**

**Blue text indicates BSM Part 2 Data Elements**

**Black italic text indicates Data Elements not in BSM**
AERIS BSM Assessment Summary

- Assessment results:
  - The BSM Part I satisfies the major part of several AERIS applications that compute eco-trajectories for vehicles.
  - Additional environmental information can improve eco-trajectory computations, but is not required.
  - Many applications do not require low latency.
  - There are two approaches for collecting emissions data:
    - Estimate emissions using BSM Part I data
    - Collect emissions data from the vehicle (requires additions to J2735)

- The AERIS BSM Assessment Report was shared with the Europeans for consideration for their environmental standards.
- Environmental data needs are being introduced as part of the SAE J2735 Systems Engineering Project.
DSRC Deployment Scenario – Private Vehicles

U.S. Department of Transportation

Vehicle Positioning GPS

Icy Patch

DSRC Radio

Vehicle

On-Board Diagnostics

In-vehicle display

BSM (1 & 2) Messages

Other Messages (e.g. Probe Data)

Data Aggregator (Public or Private)

Certificate Management Entity

Traveler Information Systems

Winter Maintenance Operations

Traffic Management Systems

Application Developer

Information Service Provider (Public or Private)

Wired or wireless Backhaul
Non-DSRC Deployment Scenario – Private Vehicles

- Vehicle Positioning GPS
- Cellular & other (non-DSRC) Tower
- Wireless Service Providers
- Network Operations Center
- Information Service Provider (Public or Private)
- Data Aggregator (Public or Private)
- Certificate Management Entity
- Application Developer
- Traveler Information Systems
- Winter Maintenance Operations

- On-Board Diagnostics
- BSM (1 & 2) Messages
- Other Messages (e.g. Probe Data)
- In-vehicle display
- Cellular & other (non-DSRC) Radio
- Icy Patch
Combined Deployment Scenario – Private Vehicles
Research Questions

- What are the benefits and costs of alternative deployment scenarios?
  - What are the costs for cellular data to support applications?
- Which of the applications’ require RSEs and how many, where, by when?
- Are the deployment scenarios technically feasible end-to-end?
  - What is the feasibility of sending BSMs over cellular?
- What is the market feasibility of the deployment scenarios?
- What are the institutional models for vehicular data aggregation and information delivery?
- What are the fault tolerances for event detection (based on vehicular data) versus information delivery to vehicles?
- Can we have BSMs stored on-board the vehicle to support applications that don’t require immediate transmission?
- What are the business models for OEMs to provide probe data?