V2V and V2I Safety Applications

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Outline

Vehicle Communications for Safety Applications

- Vehicle – Vehicle Communications Safety Applications Examples
- Vehicle – Infrastructure Communications Safety Application Examples

Infrastructure Support for Autonomous Driving

Implications for Future Infrastructure

Outlook

Motivation

Vehicle communications has the potential to revolutionize traffic and traffic operations

- Fewer accidents
- Better signal timing and speed harmonization for improved traffic flow
- Better information for DOTs for decision making
- Improved operations

But

- Requires new equipment
- RSEs, possible replacement of old signal controllers and/or protocols (170s, AB 3418)

Communication based safety applications

Applications use 5.9GHz Dedicated Short Range Communication (DSRC) or mobile communications to communicate vehicle and infrastructure status information

Two basic types:

- Vehicle-Infrastructure communication (V2I)
- Vehicle-Vehicle communication (V2V)

Systems use absolute positioning and relative positioning

- This includes differential corrections

Maps are sent from the infrastructure to the vehicle

Positioning based on GPS and dead reckoning

V2V communication based safety applications

Information is transmitted between vehicles

Enables vehicles to know where the vehicles in its vicinity are and what they are doing

Applications include

- Forward Collision Warning
- Emergency Electronic Brake Light
- Blind Spot/Lane Change Warning
- Intersection Movement Assist
- Do Not Pass Warning
- Control Loss Warning

<Position>
<Speed>
<Heading>
<Yaw Rate>
<Path History>
<Acceleration>
<GPS corrections>

- Currently the applications are warning only, but could include braking later on

Basic Safety Message as per SAE J2735

BSM Part I
DE_DSRCMsgID
DE_MsgCount
DE_TemporaryID
DE_Dsecond
DE_Latitude
DE_Longitude
DE_Elevation
DF_PositionalAccuracy
DF_TransmissionAndSpeed Speed Transmission
DE_Heading
DE_SteeringWheelAngle
DF_AccelerationSet4Way LongitudinalAcceleration LateralAcceleration VerticalAcceleration Yaw
DF_BrakeSystemStatus
DF_VehicleSize

BSM Part II
Event Flags (EEBL, CLW)
Path History
Path Prediction
RTCM DATA
Exterior Lights
Wiper Status
Vehicle Height
Bumper Heights
Throttle Position
Vehicle Type

BSM Part I with every broadcast

BSM Part II Path History and Path Prediction with every broadcast

Part II Events as occuring

Other data as needed

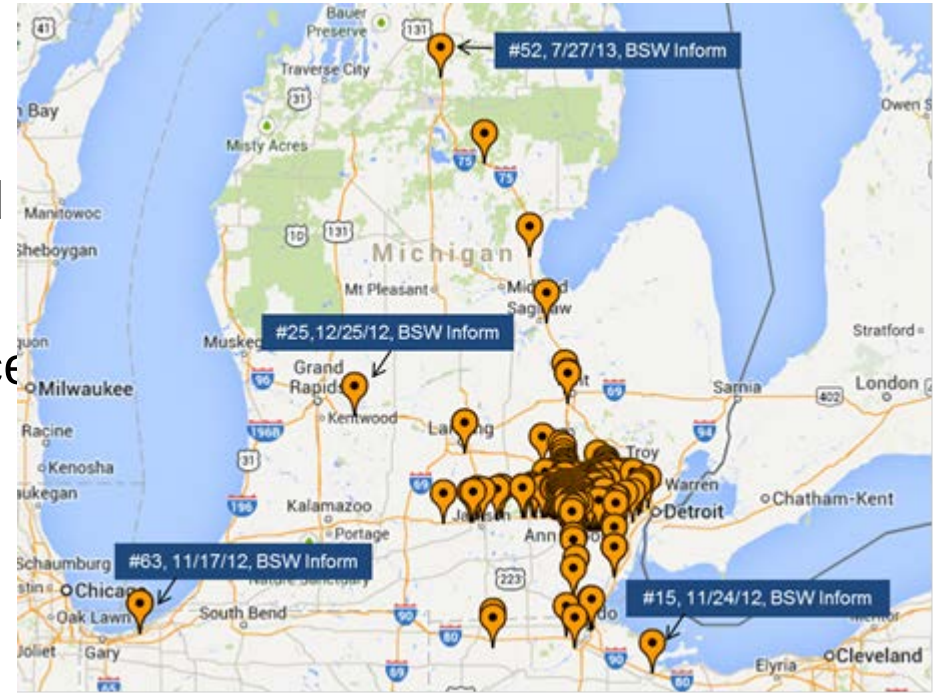
Where are we with this?

- V2V was developed and tested successfully in the Model Deployment in Ann Arbor, MI
- Nearly 3000 vehicles – cars, busses and trucks equipped with V2V communication technology
- Mixture of fully integrated vehicles (64) and carry-in device

Possible NPRM in 2016 for the V2V communications technology

Increasing number of connected vehicles on the road

- Broadcasting and receiving information to and from vehicles and infrastructure
- Large source of data
- Is the BSM enough or do infrastructure operators need other information



V2I communication based safety applications

Information is transmitted from the infrastructure to a vehicle

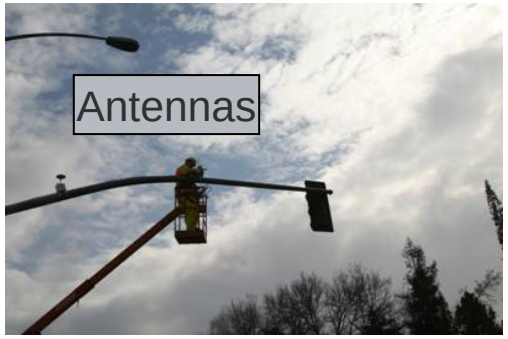
Infrastructure uses Roadside Equipment (RSE) that includes a DSRC radio

Examples are

- Cooperative Intersection Collision Avoidance Systems
- Road departure warning
- Danger zones
- Speed limits
- Weather based hazards

Information can contain a local map

CICAS application will be described in more detail



<Position>
<Signal Phase
<Position>
<Dynamic Info>
<Path History>
<Other probe data>
<Security>
ACC Speed

Roadside Equipment RSE

Infrastructure support for Autonomous Driving

Traffic signal information

Intersection maps and updates

Stop sign and stop location information

Recommended speed

Position correction

Lane closures

Hazards/Construction sites

Weather related information

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Some implications for future infrastructure

Future Infrastructure needs to be networked, equipped with communications

Infrastructure communications needs to be part of the overall security system

The denser the network of RSEs, the more information about traffic can be gained

Data analysis/data mining capabilities in TMCs

There will be different communication channels for different applications

- Mobile Communications
- DSRC

What are the data needs and how can they be satisfied

Outlook

Upcoming USDOT/FHWA projects will address infrastructure

- Safety
- Mobility
- Weather

The projects will address application development and field tests

Opportunity to promote CA cities as field test opportunities