Connected Vehicle Update

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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

Infrastructure Messages
Signal Phase and Timing, Fog Ahead, Train Coming, Drive 35 mph, 50 Parking Spaces Available
Application Development

SAFETY APPS (V2V)
- Forward Collision Warning (FCW)
- Emergency Electronic Brake Light (EEBL)
- Intersection Movement Assist (IMA)
- Blind Spot Warning (BSW), Lane Change Warning (LCW)
- Left Turn Across Path / Opposite Direction (LTAP)
- Do Not Pass Warning

SAFETY APPS (V2I)
- Red Light Violation Warning
- Curve Speed Warning
- Stop Sign Gap Assist
- Stop Sign Violation
- Railroad Crossing Violation Warning
- Spot Weather Impact Warning
- Oversize Vehicle Warning
- Reduced Speed/ Work Zone Warning
- Pedestrian Warning for Transit Vehicles
- Smart Roadside

MOBILITY APPS
- Integrated Dynamic Transit Operations (IDTO)
- Intelligent Network Flow Optimization (INFLO)
- Multi-Modal Intelligent Traffic Signal System (M-ISIG)
- Response, Emergency Staging and Communications, Uniform Management, and Evacuation (R.E.S.C.U.M.E.)
- Enable Advanced Traveler Information System (EnableATIS)
- Freight Advanced Traveler Information System (FRATIS)

ENVIRONMENT APPS
- Enhanced Maintenance Decision Support System
- Information for Maintenance and Fleet Management Systems
- Variable Speed Limits for Weather-Responsive Traffic Management
- Motorist Advisories and Warnings
- Information for Freight Carriers
- Information and Routing Support for Emergency Responders

AERIS
- Dynamic Low Emissions Zone
- Dynamic Eco-Lanes
- Eco-Traveler Information
- Eco-Signal Operations
- Eco-ICM
- Support AFV Operations
V2I Reference Implementation – Concept

- A system of specifications and requirements that allow the various components of V2I hardware, software and firmware to work together.
- An agency will be able to select the capabilities and applications desired at a given installation.
V2I Communications for Safety

Curve Speed Warning

Red Light Violation Warning

Smart Roadside

Stop Sign Gap Assist
Mobility, Weather, and AERIS
Background

- 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 ~300 meters)

- The BSM is tailored for low latency, localized broadcast required by V2V safety applications
BSM Analysis Results

- **DMA**
  - The data is the right set of data. Some Applications will work (spot specific). Need storage capabilities and likely other communication mechanisms to truly gain value. Possible approach:
    - Vehicles transmit BSM Part 1 plus key Part 2 elements less frequently
    - Transmit via DSRC when available, Cellular otherwise

- **Weather**
  - The Data in BSM is sufficient. Possible approach:
    - “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)
BSM Analysis Results

- AERIS
  - 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)
  - Need additional data not in BSM for some apps, such as emissions, fuel type, fuel consumption, road grade, road type, engine temperature
Affiliated Connected Vehicle Test Beds

- Real-world, operational test beds that offer the supporting vehicles, infrastructure, and equipment to serve the needs of public and private sector testing and certification activities

- Draft Memorandum of Cooperation (MOC) - create an affiliation of 5.9GHz DSRC infrastructure device makers, operators of V2I installations, and developers of applications that use V2I communication
  - Agreements will help to facilitate the sharing of tools and resources across all facilities to bring about the future deployment of 5.9GHz DSRC and other V2I wireless communication technology
  - MOC commenting period ended recently (Jan 11, 2013); currently assimilating input; lots of interest from stakeholders

- Finalized MOC expected for review shortly (starting 1st quarter of 2013)
To Do in 2013

1. Partner with NHTSA on the V2V Safety Decision
2. Understand the Market Potential for New Vehicle Based Data Enabled by Connected Vehicles
3. Partner with the Community to Define and Test Applications based on additional SAE J2735 Messages (Probe Data, Environment …)
4. Understand the landscape for Data Aggregation in a Connected Vehicle World
What’s New?

- New Strategic Plan
  - Offer your input at: http://itsstrategicplan.ideascale.com/