

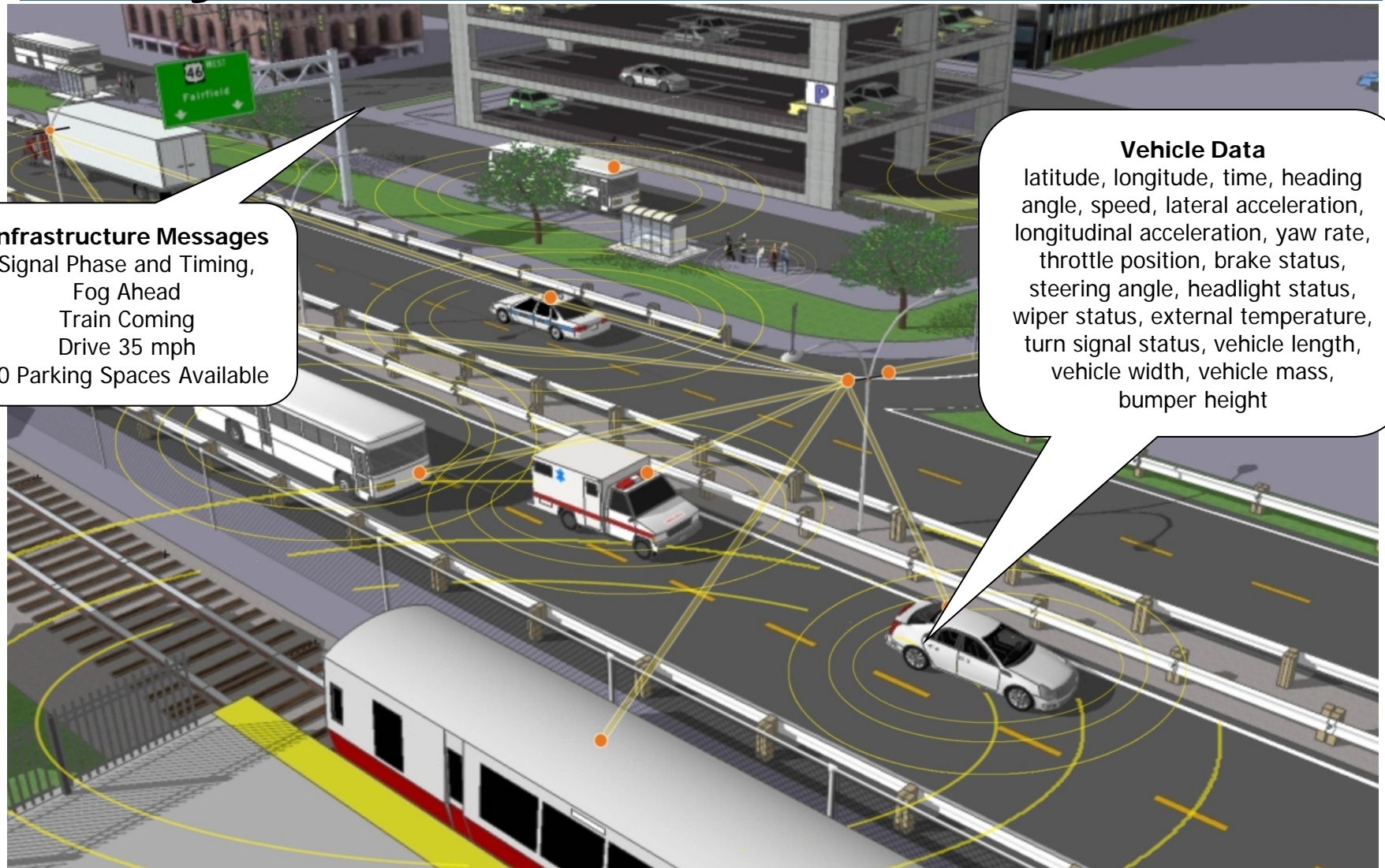


*UNITED STATES*  
**DEPARTMENT OF TRANSPORTATION**

# Connected Vehicle Update

Brian Cronin, Team Leader, Research,  
Intelligent Transportation Systems Joint Program Office  
Research and Innovative Technology Administration, USDOT  
[Brian.Cronin@DOT.GOV](mailto:Brian.Cronin@DOT.GOV)

# Fully Connected Vehicle



## Infrastructure Messages

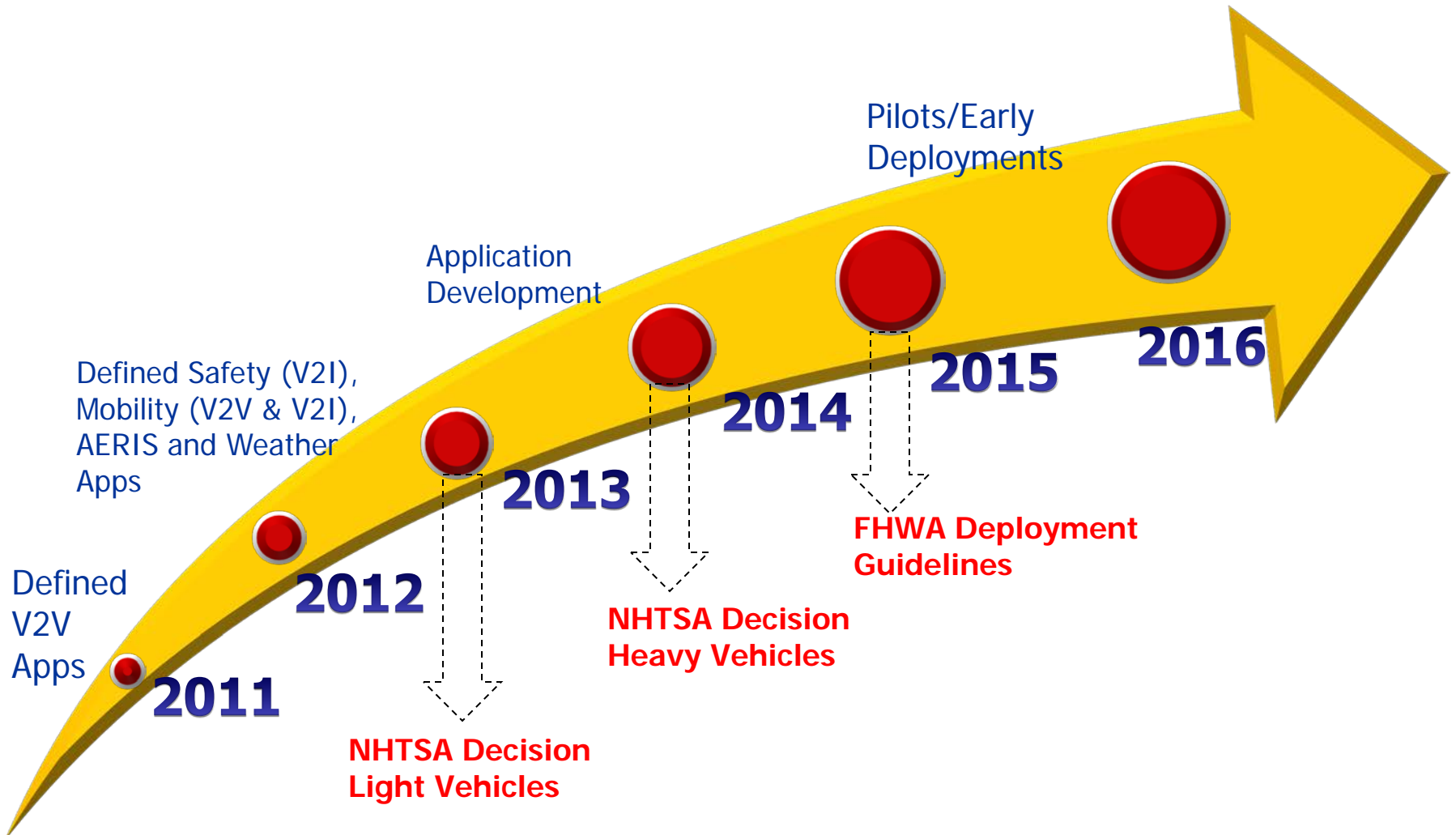
Signal Phase and Timing,  
Fog Ahead  
Train Coming  
Drive 35 mph  
50 Parking Spaces Available

## 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



# Moving towards Infrastructure Deployment



# Application Development

## SAFETY APPS (V2V)

- Forward Collision Warning (FCW)
- Emergency Electronic Brake Light (EEBL)
- Intersection Movement Ass (IMA)
- Blind Spot Warning (BSW)
- Change Warning (LCWA)
- Left Turn Dire

## 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 *AERIS*

- Dynamic Low Emissions Zone
- Dynamic Eco-Lanes
- Eco-Traveler Information
- Eco-Signal Operations
- Eco-ICM
- Support AFV Operations

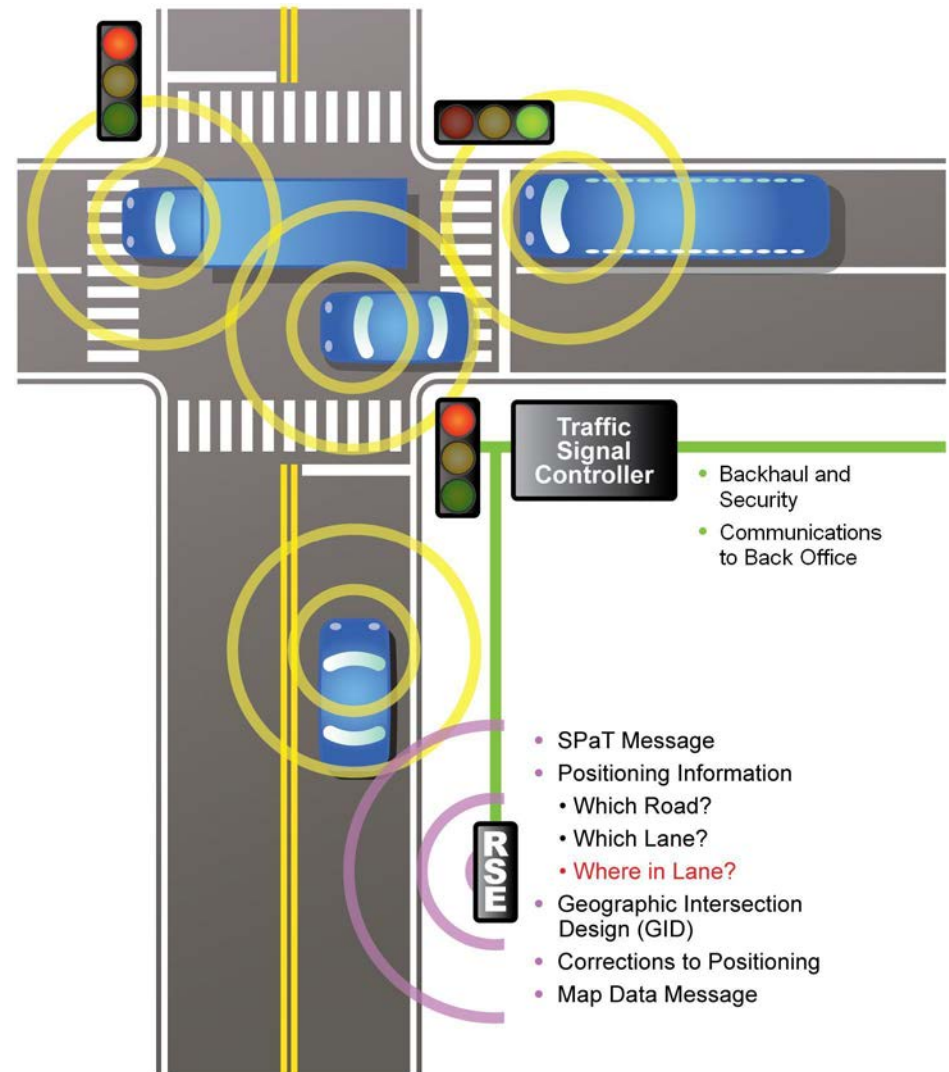
## ENVIRONMENT APPS *Road Weather*

- 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



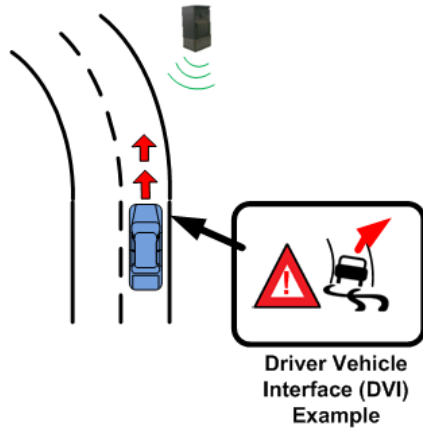
# V2I Reference Implementation – Concept

- 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.

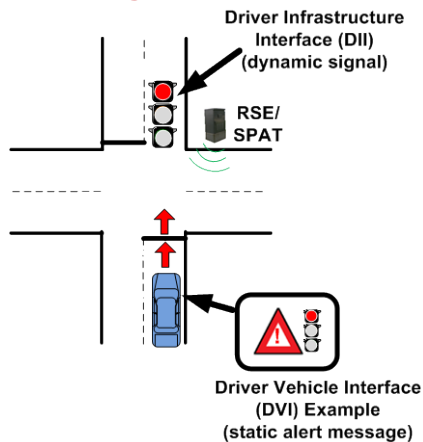


# V2I Communications for Safety

## Curve Speed Warning



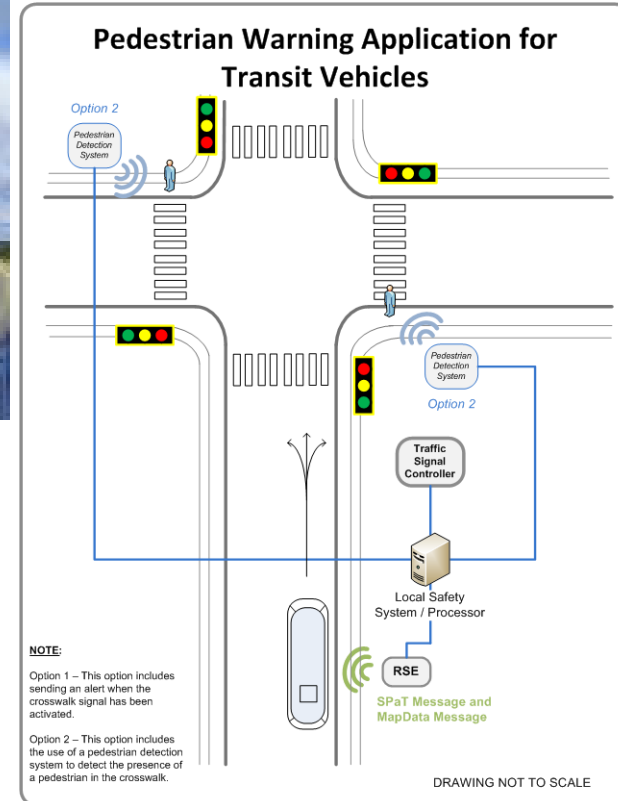
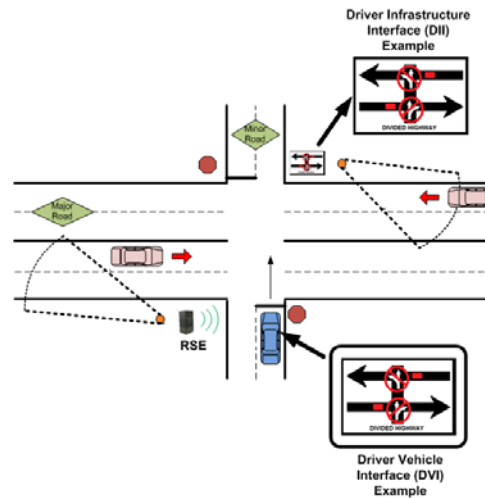
## Red Light Violation Warning



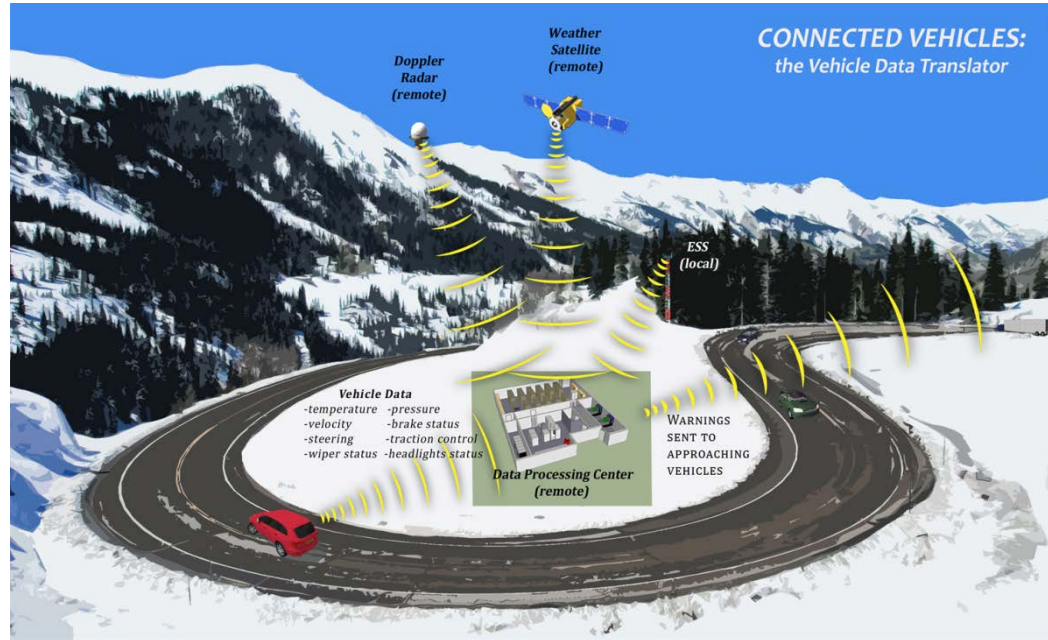
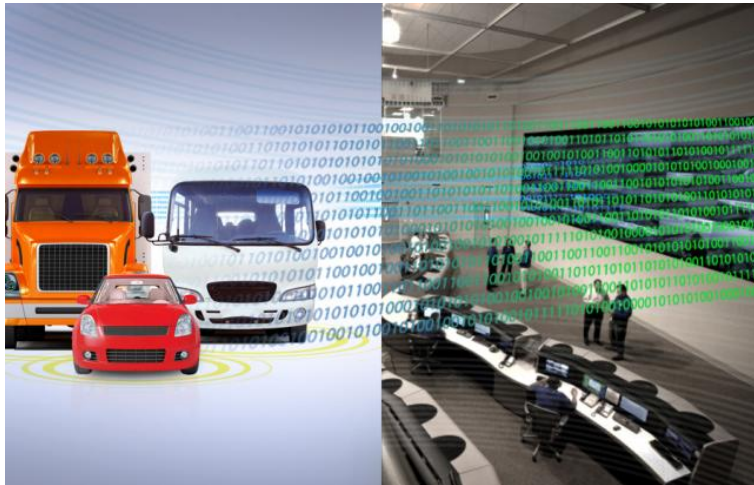
## Smart Roadside



## Stop Sign Gap Assist



# Mobility, Weather, and AERIS



# Analyzed BSM for DMA, Weather and AERIS

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## 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

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- 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)



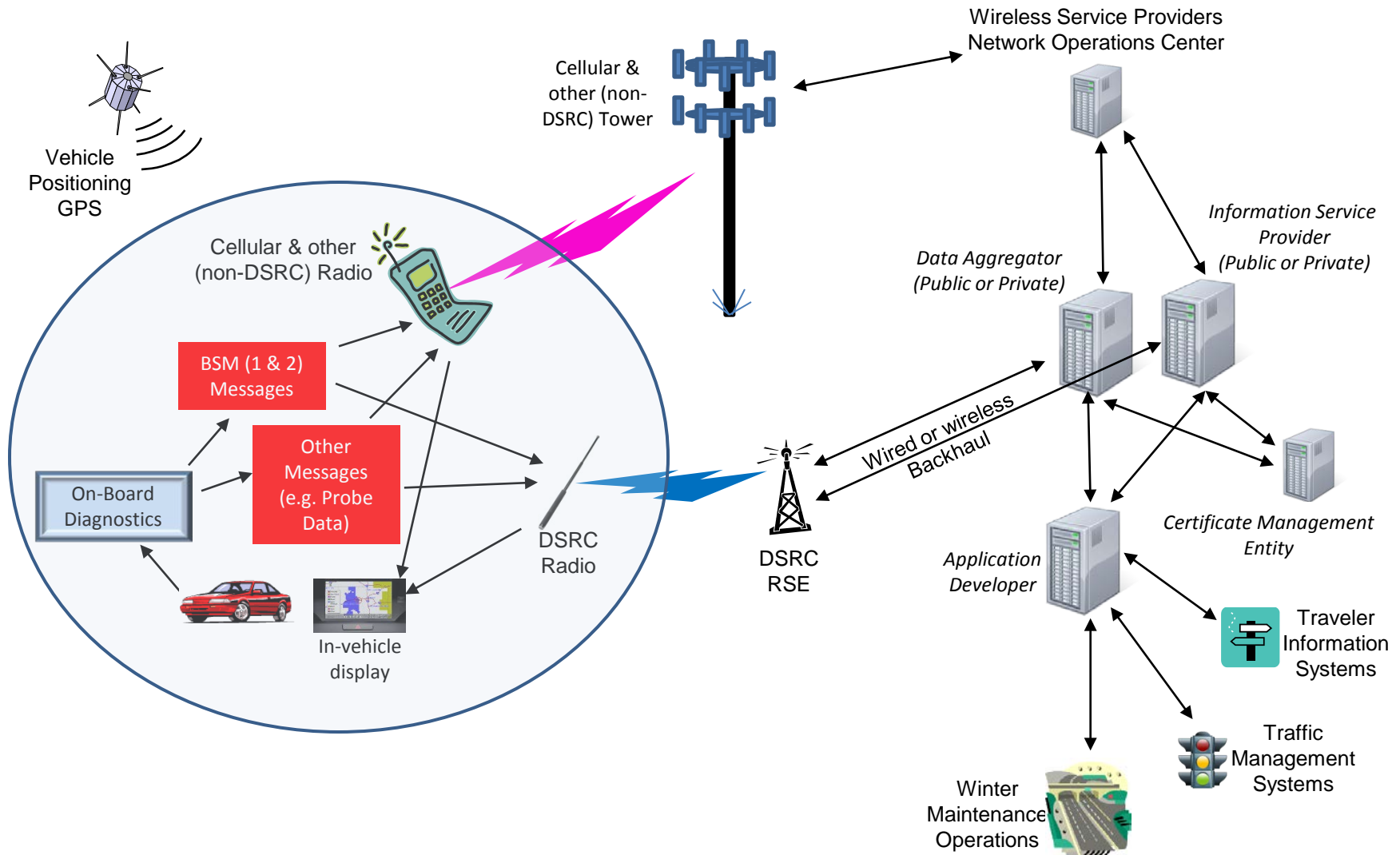
# BSM Analysis Results

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- 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

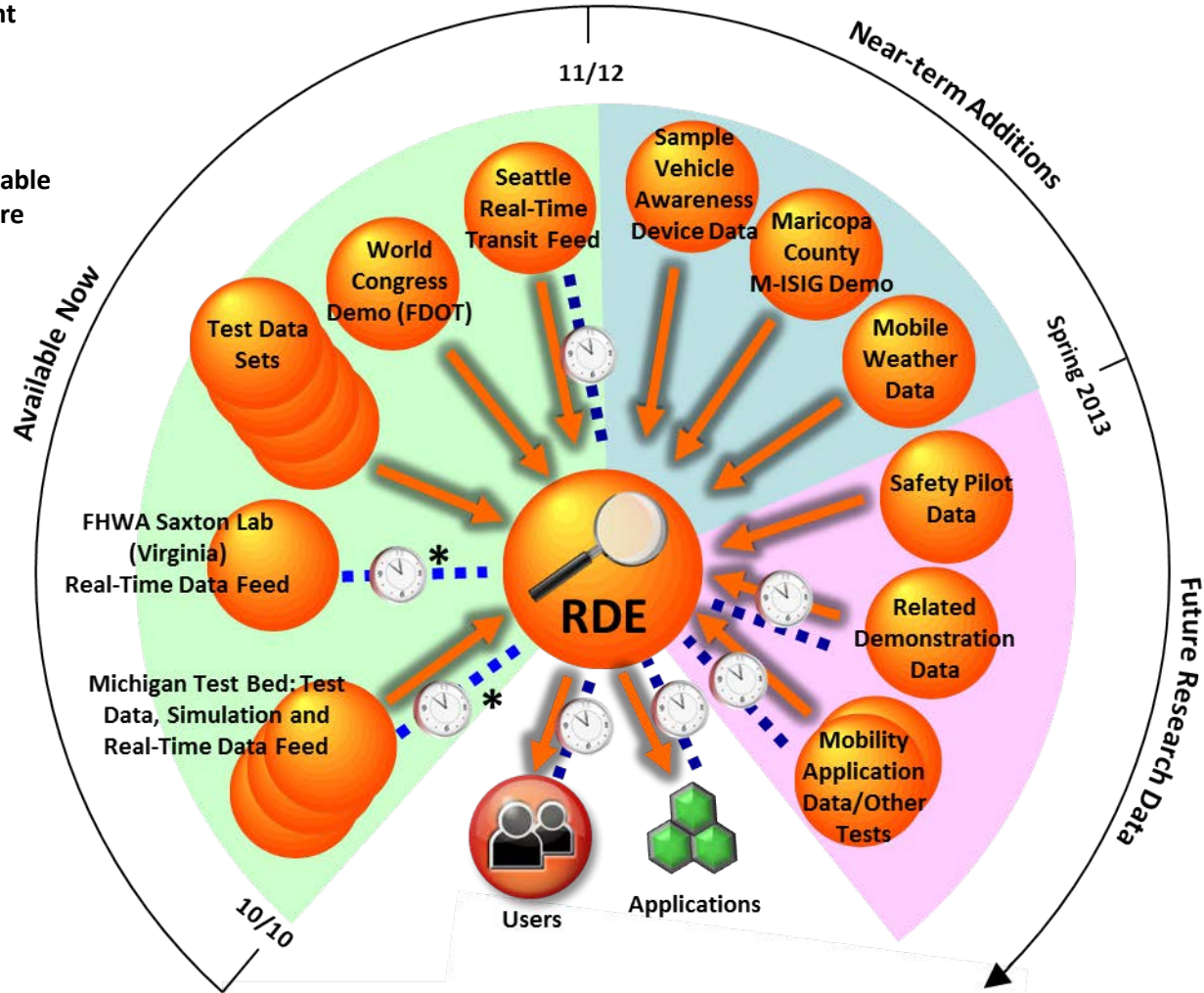


# Deployment Scenario



# Research Data Exchange

-  Data environment
-  Portal
-  Real-time data
- \* Currently unavailable due to architecture reengineering



RDE Website: [www.its-rde.net](http://www.its-rde.net)



# 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 1<sup>st</sup> quarter of 2013)**



# To Do in 2013

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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?

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- **New Strategic Plan**
  - o Offer your input at:  
<http://itsstrategicplan.ideascale.com/>

**AN OPEN DIALOGUE ON THE  
DRAFT FOCUS AND THEMES FOR  
THE NEXT ITS STRATEGIC  
RESEARCH PLAN**

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ENGAGING STAKEHOLDERS IN THEIR DISCUSSION AND  
DEVELOPMENT

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<http://itsstrategicplan.ideascale.com>

[www.its.dot.gov/index.htm](http://www.its.dot.gov/index.htm)  
Final Report — December 2012  
publication number FHWA-JPO-13-032



# For More Information

**RITA** U.S. Department of Transportation  
Research and Innovative Technology Administration

Intelligent Transportation Systems  
Joint Program Office

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Visit the Technology Transfer Portal for tools, training, and resources that support your ITS deployments.

**Procurement Opportunities**  
As we implement the ITS Research Strategic Plan, open procurements may become available through a variety of solicitations. [More >>](#)

**Public Meetings** View >>  
**MARK YOUR CALENDAR**  
The Intelligent Transportation Systems Joint Program Office (ITS JPO) has the following meetings and webinars planned. All events are free and open to the public.

**U.S. DOT Announces Public Meeting and Webinar to Discuss Connected Vehicle Safety Program**  
September 25-27, 2012. [Read more...](#)

**Our Current Research**  
Applications Mode-Specific Cross-Cutting

- Vehicle-to-Vehicle Safety
- Vehicle-to-Infrastructure Safety
- Real-Time Data Capture
- Dynamic Mobility Applications
- Environment
- Road Weather
- Connected Vehicle Policy

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Brian Cronin, Team  
Leader, Research  
RITA, ITS Joint Program  
Office (JPO)  
[Brian.Cronin@dot.gov](mailto:Brian.Cronin@dot.gov)