Connected Vehicle Pilot Deployment Workshop 2014

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USDOT Intelligent Transportation Systems
Program Manager, CV Pilot Deployment Program

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Workshop Purpose

- **Set the vision** for the connected vehicle pilot deployment program
- **Inform stakeholders** on the resources available to assist in the successful planning and execution of pilot deployments
- **Motivate participation** in the pilot deployment program among public sector agencies, industry and the research community
- **Capture stakeholder feedback** and adapt our plans as appropriate

Welcome

Ken Leonard
USDOT Intelligent Transportation Systems
Joint Program Office Director

Workshop Agenda

Session	Title/Speaker	Time
1	Connected Vehicle Research Program Brian Cronin, ITS JPO	8:45 - 9:15 AM
2	Connected Vehicle Pilot Deployment Program Kate Hartman, ITS JPO	9:15 - 9:45 AM
3	Creating CV Pilot Deployment Concepts Panel Moderator: Jeff Spencer, FTA	10:00 AM - Noon
4	CV Pilot Request for Information Summary Kate Hartman, ITS JPO	1:00 - 1:30 PM
5	Breakout Sessions (Round 1) Breakout Sessions (Round 2)	1:45 - 2:45 PM 3:00 - 4:00 PM
6	Breakout Reports	4:15 - 5:00 PM

Connected Vehicle Research Program Overview

Brian Cronin
USDOT ITS JPO
Team Leader, ITS Research and Demonstration

Connected Vehicle Research Program Overview

- Introduction to the USDOT Connected Vehicle Research Program
- Program Products
  - Applications Research and Development
  - Enabling Technologies Research
  - Reference Implementation Architecture
  - Standards Development
  - Affiliated Test Beds
  - Research Data Exchange (RDE)
- Key Research Findings
  - Why we think the timing is right for an opportunity to move research products into operational practice

Transportation Challenges

Safety

33,561 highway deaths in 2012
5,615,000 crashes in 2012
Leading cause of death for ages 4, 11-27

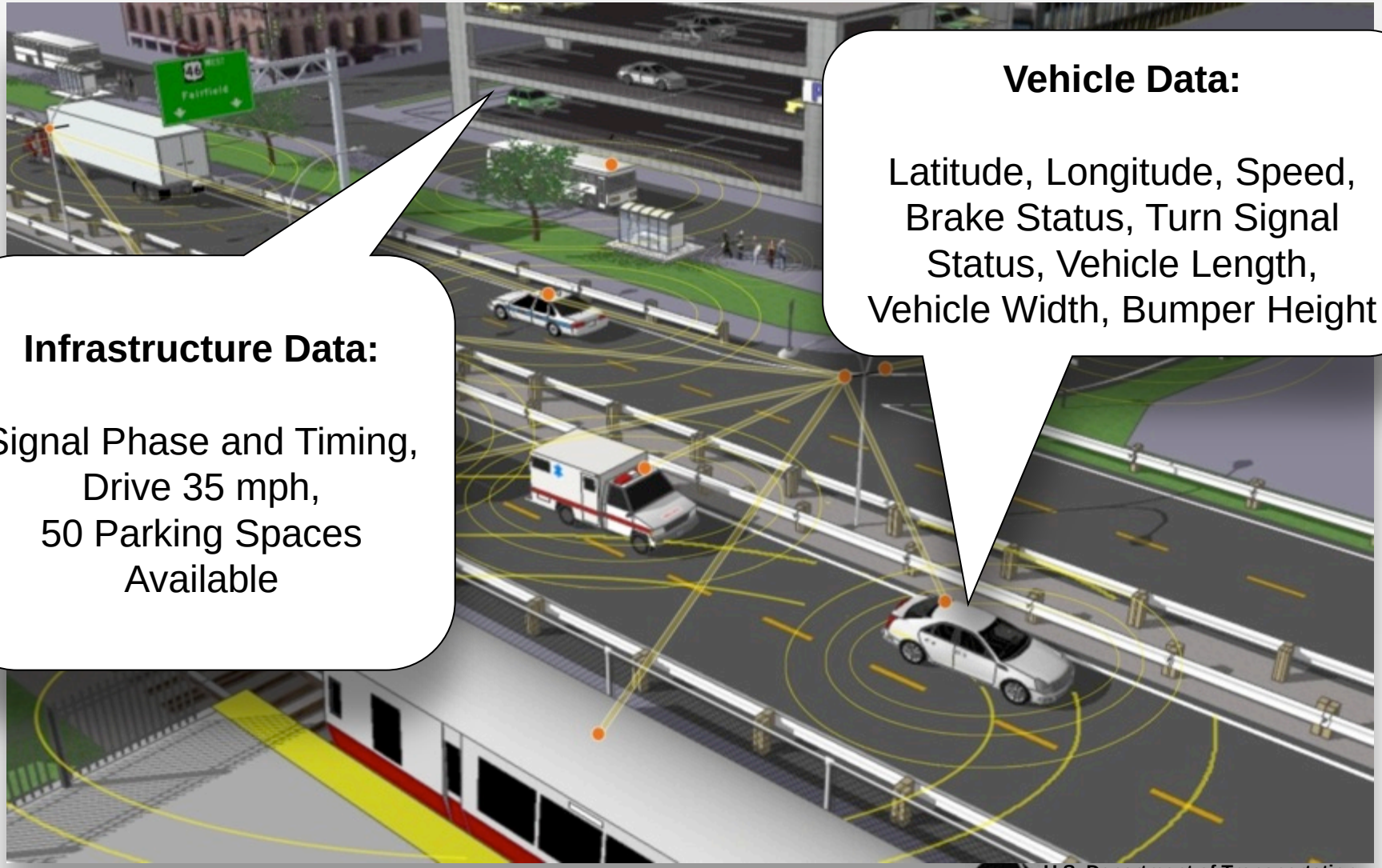
Mobility

5.5 billion hours of travel delay
$121 billion cost of urban congestion

Environment

2.9 billion gallons of wasted fuel
56 billion lbs. of additional CO_2

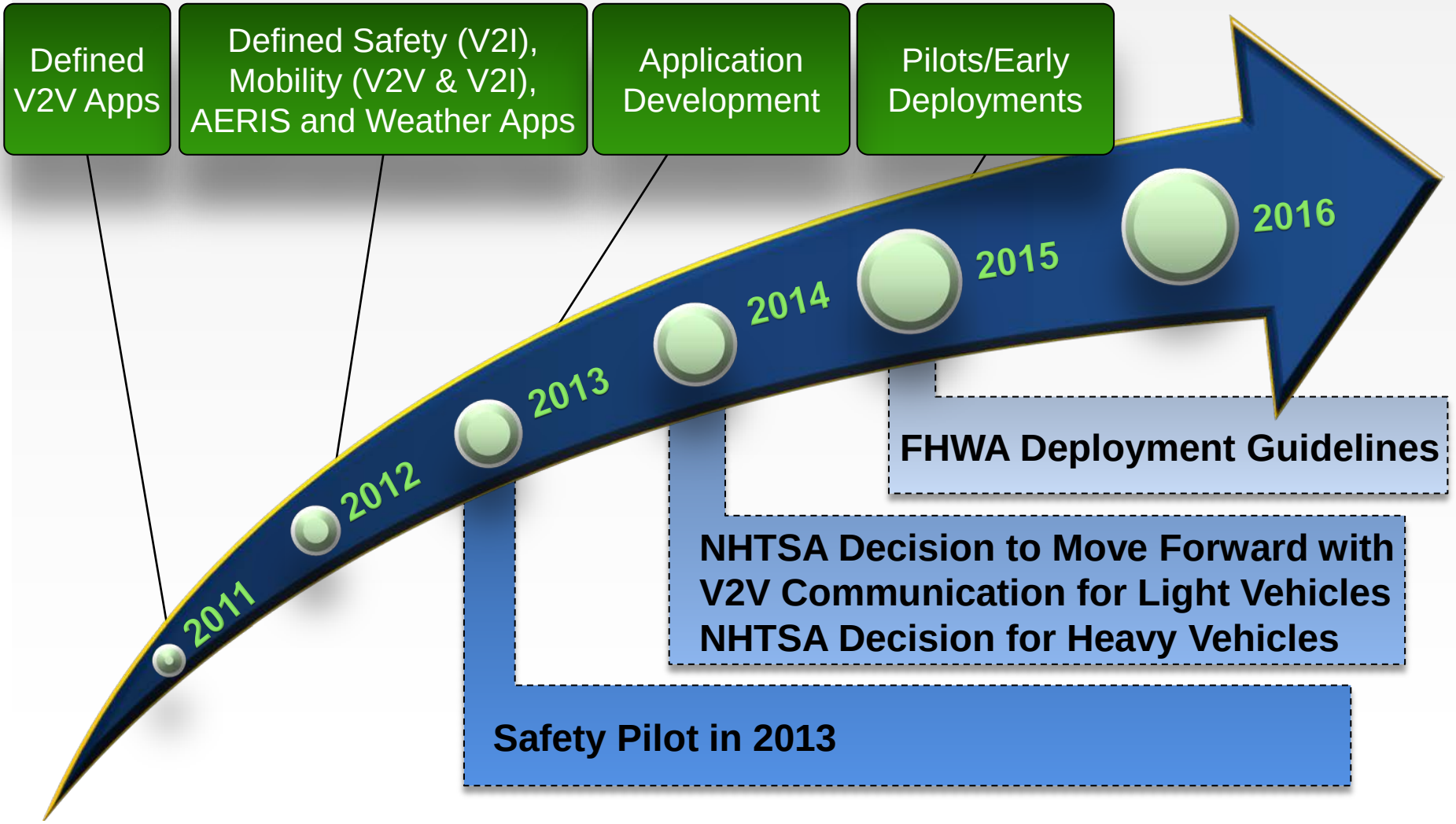
Connected Vehicles



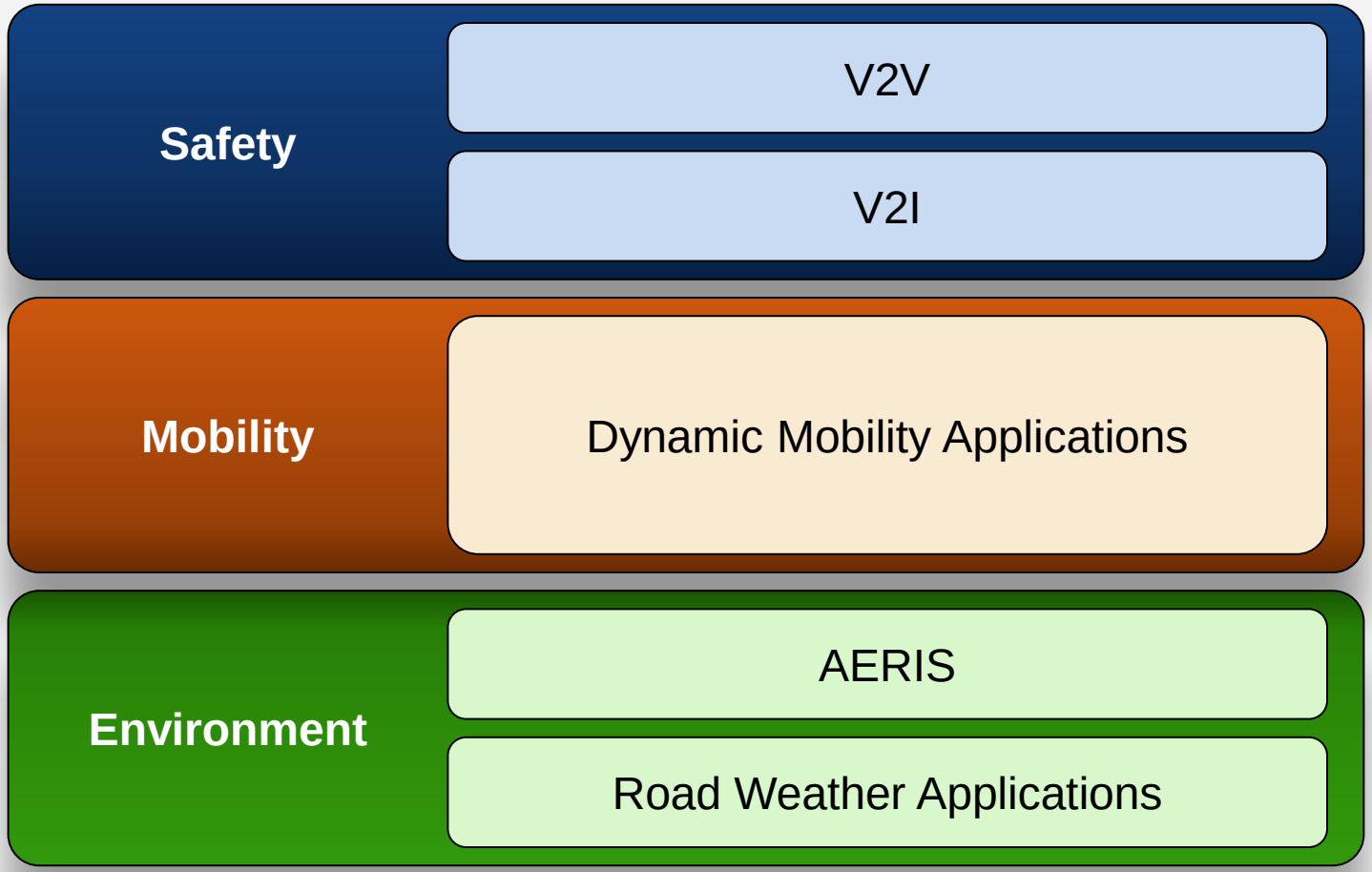
Connected Vehicle Communications Technology

- 5.9 GHz DSRC
- 4G and older 3G cellular networks provide high-bandwidth data communications
- Other wireless technologies such as Wi-Fi, satellite, and HD radio may have roles to play

Path to Deployment



Connected Vehicle Application Research and Development Programs



Connected Vehicle Applications

- The USDOT has made a significant investment in foundational research and initial development of connected vehicle applications
  - Concepts of Operations
  - System Requirements
  - Prototype Design and Testing
  - Prototype Impacts Assessment
  - Analytics, Modeling and Simulation to Assess Potential Long-Term Impacts
- Not all CV Application efforts are in the same state of maturity, few are complete
  - But a large number of application development efforts across multiple programs will be substantively complete in late 2014

Connected Vehicle Applications

Please see your handout

V2I Safety

- Red Light Violation Warning
- Curve Speed Warning
- Stop Sign Gap Assist
- Spot Weather Impact Warning
- Reduced Speed/Work Zone Warning
- Pedestrian in Signalized Crosswalk Warning (Transit)

V2V Safety

- Emergency Electronic Brake Lights (EEBL)
- Forward Collision Warning (FCW)
- Intersection Movement Assist (IMA)
- Left Turn Assist (LTA)
- Blind Spot/Lane Change Warning (BSW/LCW)
- Do Not Pass Warning (DNPW)
- Vehicle Turning Right in Front of Bus Warning (Transit)

Road Weather

- Motorist Advisories and Warnings (MAW)
- Enhanced MDSS
- Vehicle Data Translator (VDT)
- Weather Response Traffic Information (WxTINFO)

Environment

- Eco-Approach and Departure at Signalized Intersections
- Eco-Traffic Signal Timing
- Eco-Traffic Signal Priority
- Connected Eco-Driving
- Wireless Inductive/Resonance Charging
- Eco-Lanes Management
- Eco-Speed Harmonization
- Eco-Cooperative Adaptive Cruise Control
- Eco-Traveler Information
- Eco-Ramp Metering
- Low Emissions Zone Management
- AFV Charging / Fueling Information
- Eco-Smart Parking
- Dynamic Eco-Routing (light vehicle, transit, freight)
- Eco-ICM Decision Support System

Agency Data

- Probe-based Pavement Maintenance
- Probe-enabled Traffic Monitoring
- Vehicle Classification-based Traffic Studies
- CV-enabled Turning Movement & Intersection Analysis
- CV-enabled Origin-Destination Studies
- Work Zone Traveler Information

Mobility

- Advanced Traveler Information System
- Intelligent Traffic Signal System (I-SIG)
- Signal Priority (transit, freight)
- Mobile Accessible Pedestrian Signal System (PED-SIG)
- Emergency Vehicle Preemption (PREEMPT)
- Dynamic Speed Harmonization (SPD-HARM)
- Queue Warning (Q-WARN)
- Cooperative Adaptive Cruise Control (CACC)
- Incident Scene Pre-Arrival Staging Guidance for Emergency Responders (RESP-STG)
- Incident Scene Work Zone Alerts for Drivers and Workers (INC-ZONE)
- Emergency Communications and Evacuation (EVAC)
- Connection Protection (T-CONNECT)
- Dynamic Transit Operations (T-DISP)
- Dynamic Ridesharing (D-RIDE)
- Freight-Specific Dynamic Travel Planning and Performance
- Drayage Optimization

Smart Roadside

- Wireless Inspection
- Smart Truck Parking

Open Source Application Development Portal

www.itsforge.net

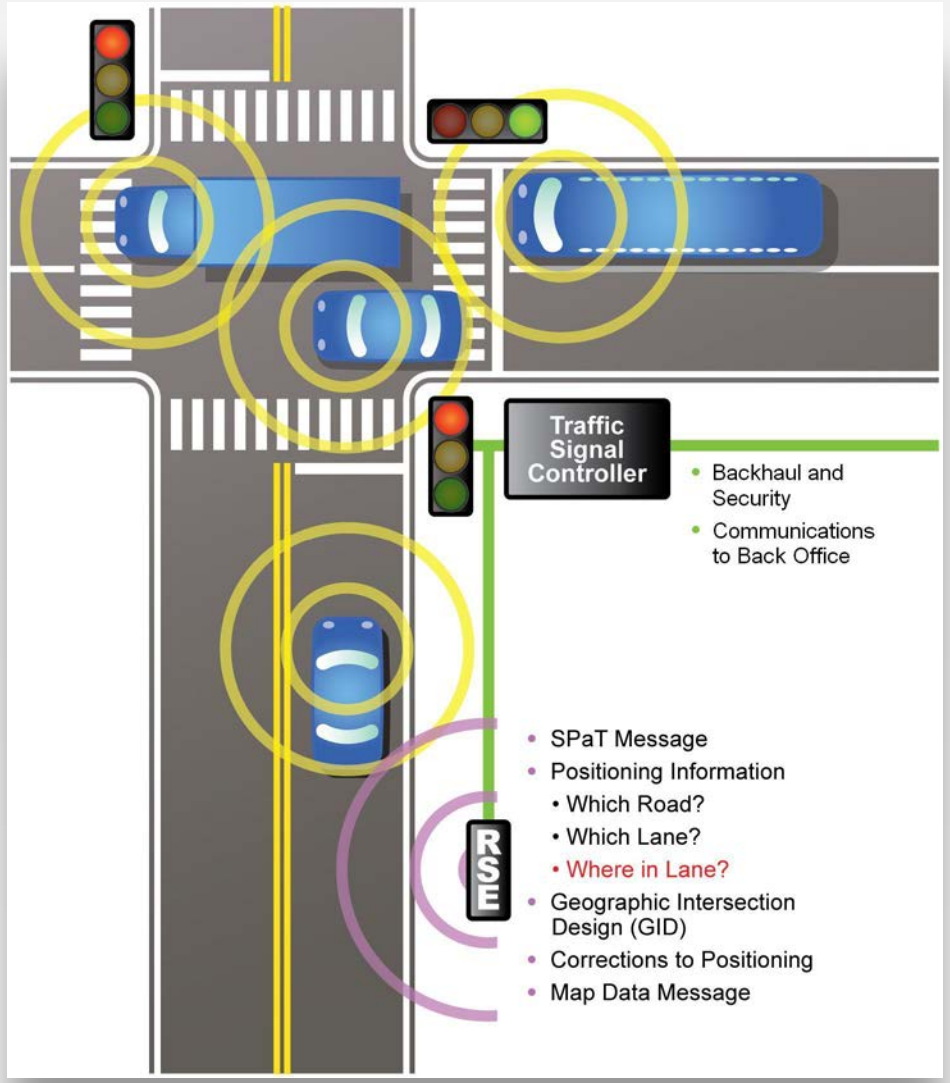
- Portal for sharing documentation and source code from USDOT-sponsored application prototyping efforts
- By end of 2014, will be populated with materials describing 20+ connected vehicle applications
- Contributed code must meet documentation guidelines
- Search and download functions
- In prototype form now
  - Enhanced Release 1 expected summer 2014

Enabling Technologies: Roadside Equipment for Connected Vehicles

Equipment
USDOT tested devices for placement on the Research Qualified Products List (RQPL). Five vendors of connected vehicle roadside equipment are currently on the list. Devices are based on RSE Specification v3.0.
Roadside Unit (RSU) Specification v4.0 will be available spring 2014. It contains updates to the physical hardware, management information base (MIB), and firmware. Devices compliant with the 5.9 GHz DSRC RSU Specification v4.0 are expected to be available fall 2014.
Other connected vehicle deployments are encouraged to use equipment compliant with the RSU specification v4.0.
Results from Safety Pilot and Integrated V2I Prototype development will be used to develop a V2I reference implementation.

V2I Reference Implementation

- 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
- Under development now
  - Initial testing Summer 2014
  - Field testing in Orlando late 2014



Enabling Technologies: Connected Vehicle Data

Data

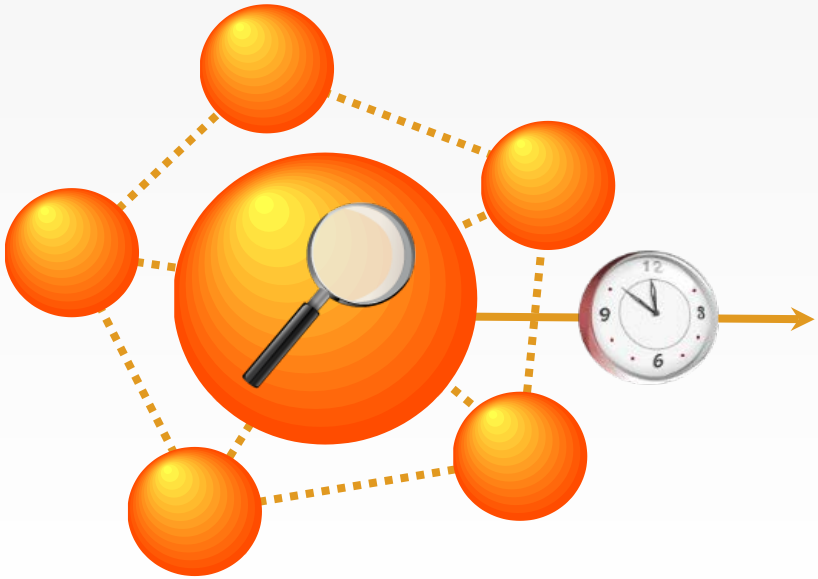
V2I Communications Support Safety, Mobility, and Environmental Applications:

- Signal Phase and Timing (SPaT) data supports red light violation warning (safety), arterial speed harmonization (mobility), and eco-signal operations (environment).
- The Basic Safety Message, developed for V2V safety applications, also supports the intelligent traffic signal systems mobility application.
- Probe data supports transportation operations, traveler information, transportation planning, and asset management.

Common functions shared across applications: positioning, mapping, and communications.

Research Data Exchange

www.its-rde.net



- Promotes sharing of archived and real-time connected vehicle data collected in USDOT-sponsored research efforts and field tests
- 2 TB of well-organized and documented data
- Drawn from a dozen geographic locations across the country
- Multi-source data (traditional sensor plus probe and connected vehicle data)
- Search and download functions
- Available now

Standards in Connected Vehicles

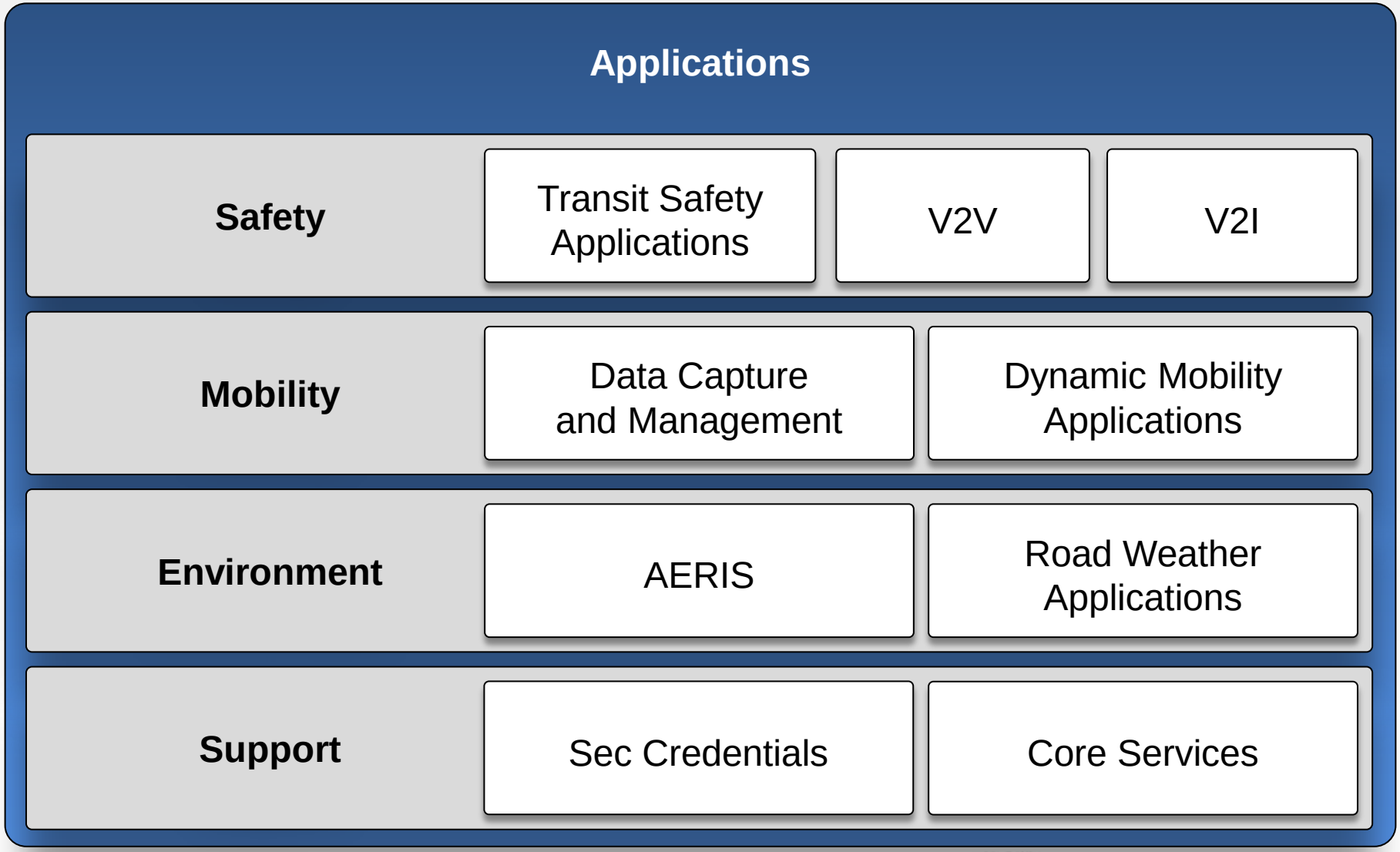
Standards

Interface Standards Are Essential

USDOT is working with public and private sectors to define:

- Communications standards for DSRC
- Other media, e.g., 4G LTE and/or HD radio may be used for appropriate applications
- Information exchange standards:
  - Message sets for V2X [SAE J2735]
  - Minimum performance requirements for V2X messaging [SAE J2945.x]
  - Signal controller messages
  - Certification processes will also be established to ensure off-the-shelf interoperability of devices

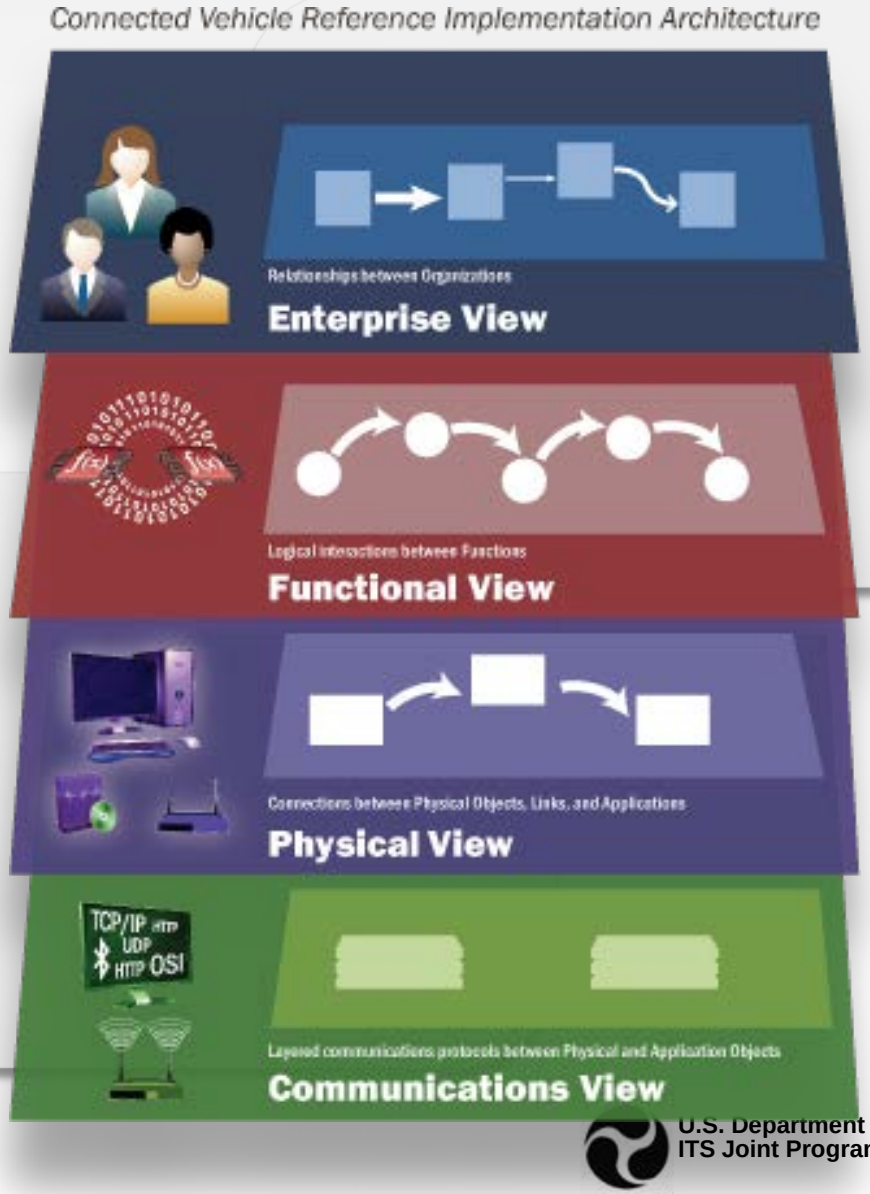
Connected Vehicle Reference Implementation Architecture (CVRIA)



CVRIA: A *Framework* for integrating technologies and identifying interfaces for standardization

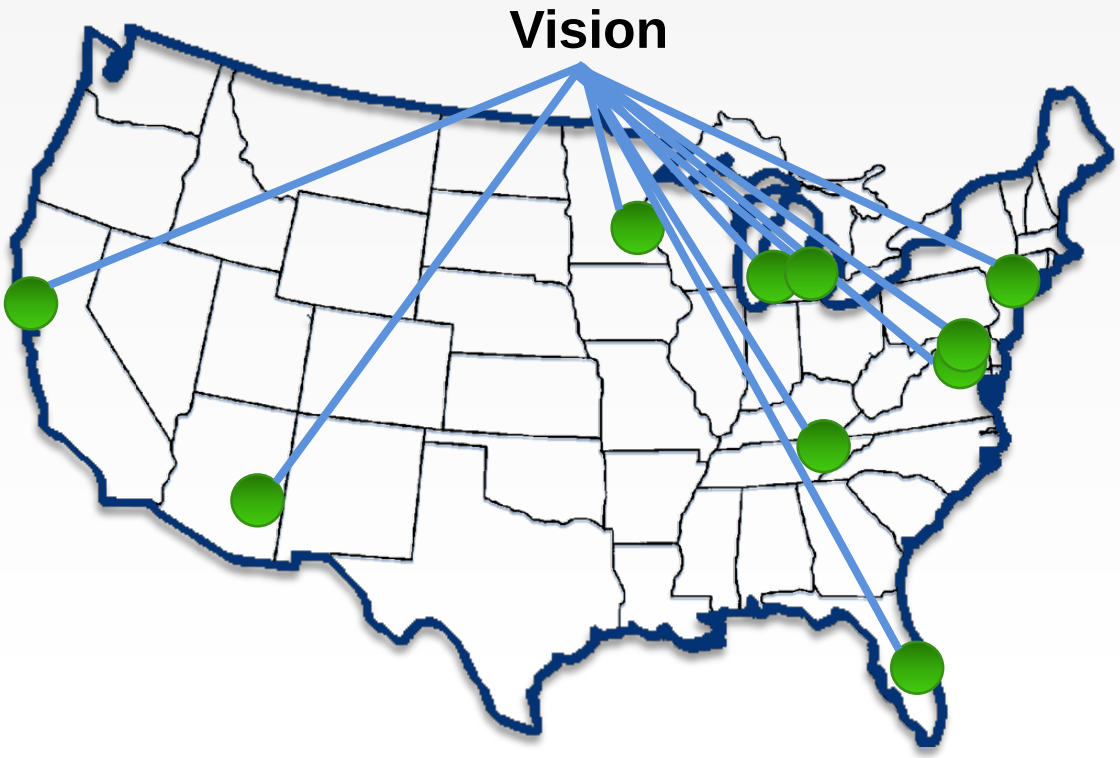
- Enterprise
- Functional
- Physical
- Communications

- Under development now



Affiliated Connected Vehicle Test Beds

- The vision is to have multiple interoperable locations as part of one connected system moving toward nation-wide deployment.
  - Common architecture
  - Common standards
  - Independent operations
  - Shared resources

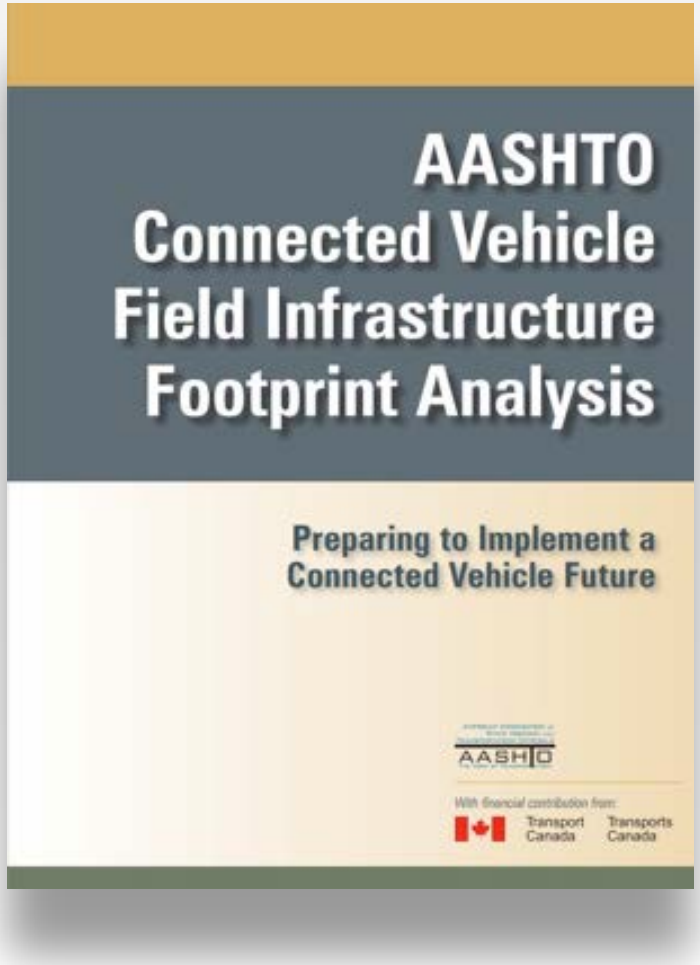


USDOT Test Bed Resources

- Qualified Product List for RSE
  - Five vendors
- Qualified Product List for Onboard Equipment (OBE)
  - Vehicle Awareness Devices
  - Aftermarket Safety Devices
- Portable RSE Trailers
- Network Listeners/Sniffers
- Test Bed Operations Staff
- Signal Phase and Timing (SPaT) Resources
  - Listeners
  - Interface standards from FHWA
- Security Credential Management System (SCMS)
  - 1609.2 certificate management system

Policy Issues: Deployment Scenarios

- USDOT asked AASHTO to create a vision of a national connected vehicle infrastructure
- Provides guidance to state agencies and DOTs, including:
  - Infrastructure needs at regional and national levels
  - Illustrations of typical deployments at signalized intersections, urban freeways, rural roadways, international border crossings, and other locations
  - System and equipment needs and siting requirements
  - Operations, maintenance and institutional issues
  - Deployment cost estimates
- Available now

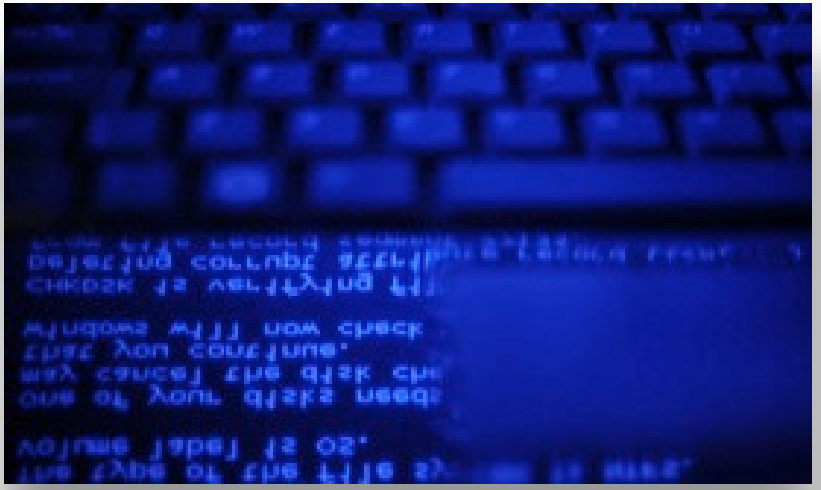


Policy Issues: Security

- Challenges
  - Message validity
  - Security entity
  - Network
  - Business models for security operations
  - Certification Processes for Equipment and Systems
- Security Credential Management System (SCMS)
  - Under development now, will be available in prototype form for pilot deployments

Policy Issues: Privacy

- A user cannot be tracked along his journey or identified without appropriate authorization.
- User privacy can be protected further through policy means. We've done initial privacy analysis of the system and will have privacy experts do a comprehensive review of any final system proposed for implementation



Key Connected Vehicle Research Findings

- Connected Vehicle research is going on not only in USDOT-sponsored efforts but also in the private sector and among agencies
- Initial assessments of potential impacts for connected vehicle technologies are compelling
  - Safety, mobility and environmental
- Interest is high in moving forward with connected vehicle
- Not all current connected vehicle technologies are mature
- Not all institutional and policy issues are resolved
- **HOWEVER, our assessment is that the current state is one of significant opportunity for the pilot deployment of connected vehicle concepts**
  - Plant the seeds that leads to full integration of successful CV concepts into operational practice