Connected and Automated Vehicle Research in the United States

United Nations Economic Committee for Europe

Kevin Gay
U.S. Department of Transportation

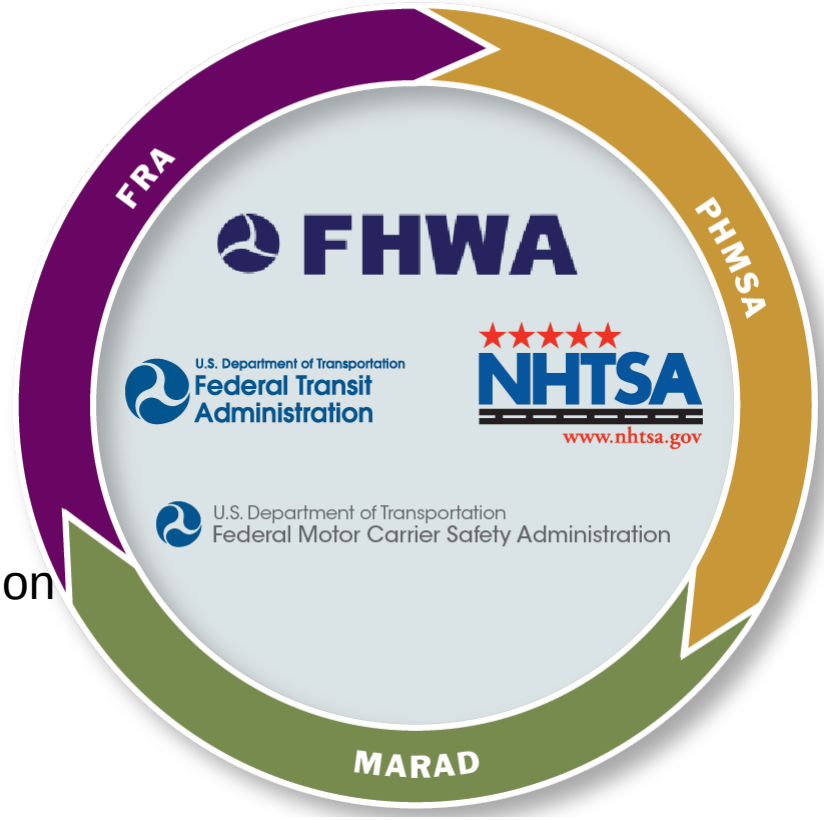
PRESENTATION OVERVIEW

- U.S. DOT Overview
- Connected Vehicle Research
  - Safety
  - Mobility
  - Environment
- Moving forward with Vehicle to Vehicle and Vehicle to Infrastructure Communications
- Connected Vehicle Pilot Deployment and Automation Programs

ITS JOINT PROGRAM OFFICE

The ITS JPO has Department-wide authority in coordinating the ITS program and initiatives among the following DOT Offices:

- Federal Highway Administration (FHWA)
- Federal Motor Carrier Safety Administration (FMCSA)
- Federal Transit Administration (FTA)
- Federal Railroad Administration (FRA)
- National Highway Traffic Safety Administration (NHTSA)
- Maritime Administration (MARAD).



Connected Vehicle Research

USDOT Connected Vehicle Program Overview

Applications

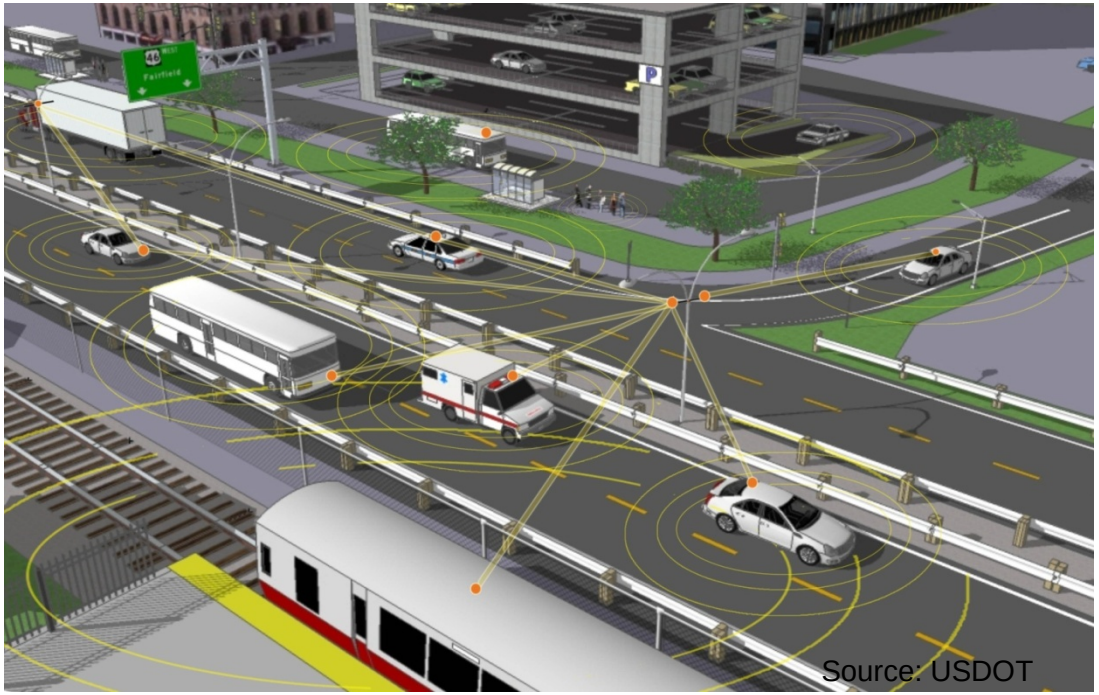
- Safety
- Mobility
- Environment

Technology

- Systems Engineering
- Certification
- Test Environments
- Human Factors
- Architecture and Standards

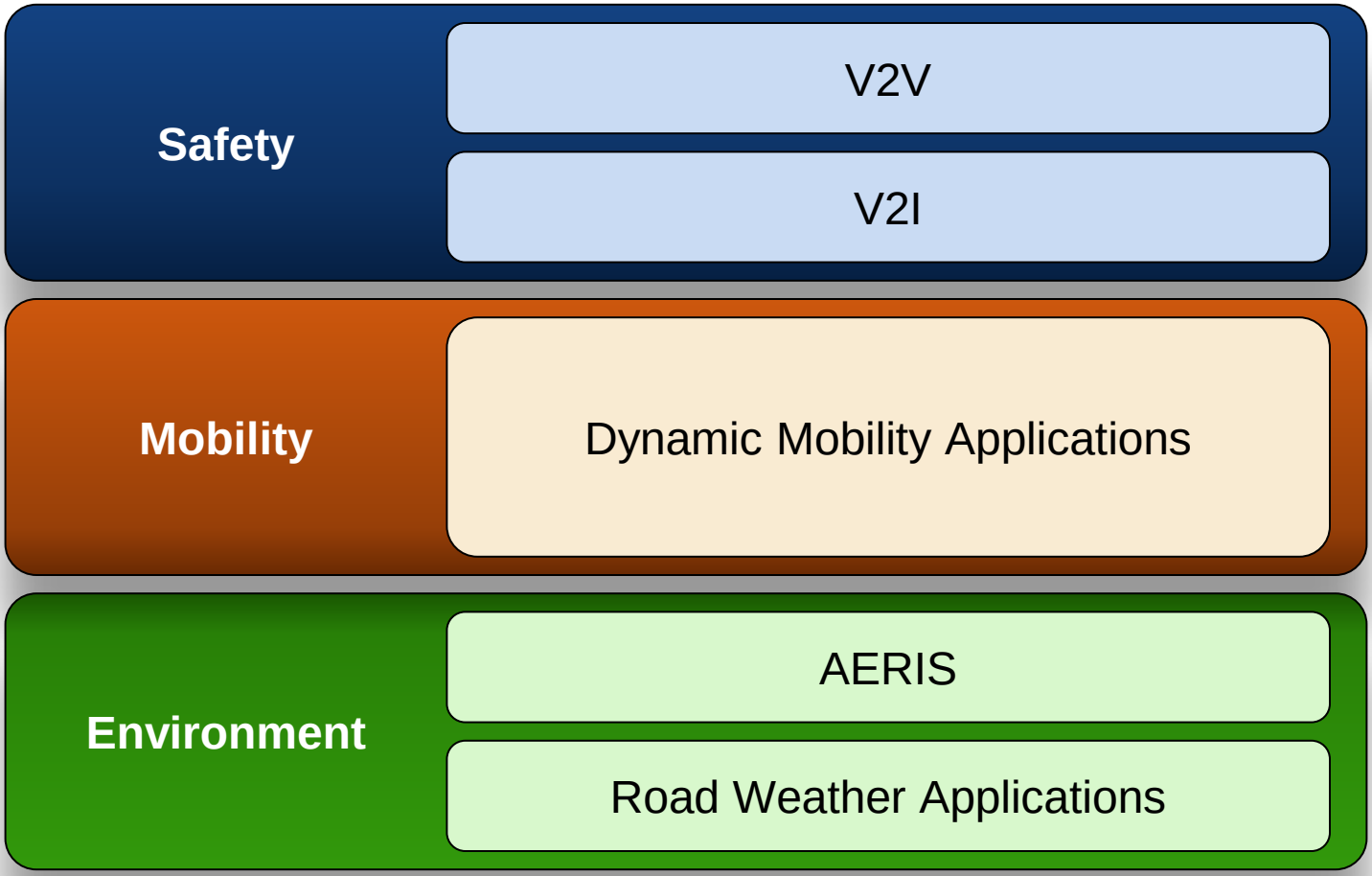
Policy

- Deployment Scenarios
- Investment Models
- Operations and Governance
- Institutional Issues
- Standards Harmonization



Why It Matters: Up to 80% of non-impaired crash types may be impacted by connected vehicle technology

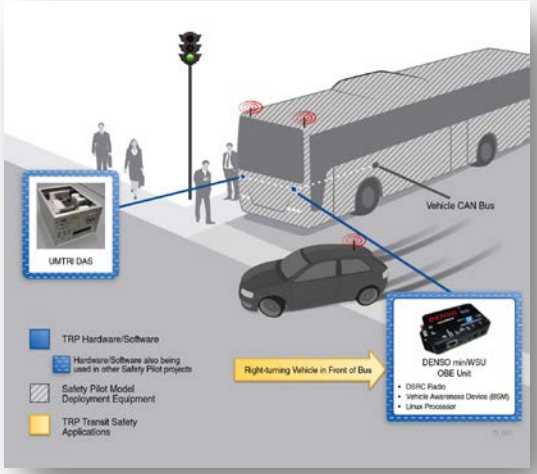
CONNECTED VEHICLE APPLICATIONS



SAFETY – CONNECTED VEHICLE APPLICATIONS

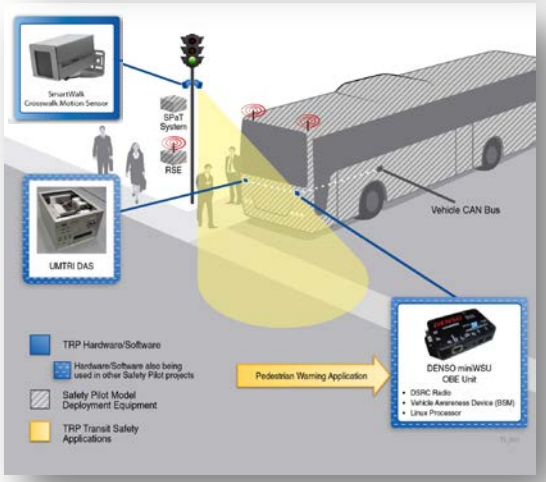
V2V

- Forward Collision Warning (FCW)
- Emergency Electronic Brake Light (EEBL)
- Blind Spot/Lane Change Warning (BSW/LCW)
- Do Not Pass Warning (DNPW)
- Intersection Movement Assist (IMA)
- Left Turn Assist (LTA)



V2I

- Curve Speed Warning (CSW)
- Red Light Violation Warning (RLVW)
- Stop Sign Gap Assist (SSGA)
- Transit Pedestrian Warning



Source: USDOT

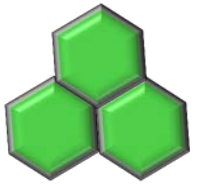
Transit

- Right Turn in Front Crash Warning (V2V)
- Pedestrian vs. Turning Bus Crash Warning (V2I)

Dynamic Mobility Applications Program

Vision

- Expedite development, testing, commercialization, and deployment of innovative mobility application
  - maximize system productivity
  - enhance mobility of individuals within the system



•Transformative Mobility Applications

•(May have more impact when BUNDLED together)

Objectives

- Create applications using frequently collected and rapidly disseminated multi-source data from connected travelers, vehicles (automobiles, transit, freight) and infrastructure
- Develop and assess applications showing potential to improve nature, accuracy, precision and/or speed of dynamic decision
- Demonstrate promising applications predicted to significantly improve capability of transportation system
- Determine required infrastructure for transformative applications implementation, along with associated costs and benefits

Project Partners

- Strong internal and external participation
  - ITS JPO, FTA, FHWA R&D, FHWA Office of Operations, FMCSA, NHTSA, FHWA Office of Safety

DMA Bundles

MMITSS: Multimodal Intelligent Traffic Signal System

Apps: Intelligent Traffic Signal System (I-SIG), Transit and Freight Signal Priority (TSP and FSP)
Mobile Accessible Pedestrian Signal System (PED-SIG), Emergency Vehicle Preemption

INFLO: Intelligent Network Flow Optimization

Apps: Dynamic Speed Harmonization (SPD-HARM), Queue Warning (Q-WARN)
Cooperative Adaptive Cruise Control (CACC)

R.E.S.C.U.M.E.: Response, Emergency Staging and Communications, Uniform Management, and Evacuation

Apps: 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)

Enable ATIS: Enable Advanced Traveler Information Systems

Apps: EnableATIS (Advanced Traveler Information System 2.0)

IDTO: Integrated Dynamic Transit Operations

Apps: Connection Protection (T-CONNECT), Dynamic Transit Operations (T-DISP)
Dynamic Ridesharing (D-RIDE)

FRATIS: Freight Advanced Traveler Information Systems

Apps: Freight-Specific Dynamic Travel Planning and Performance, Drayage Optimization (DR-OPT)

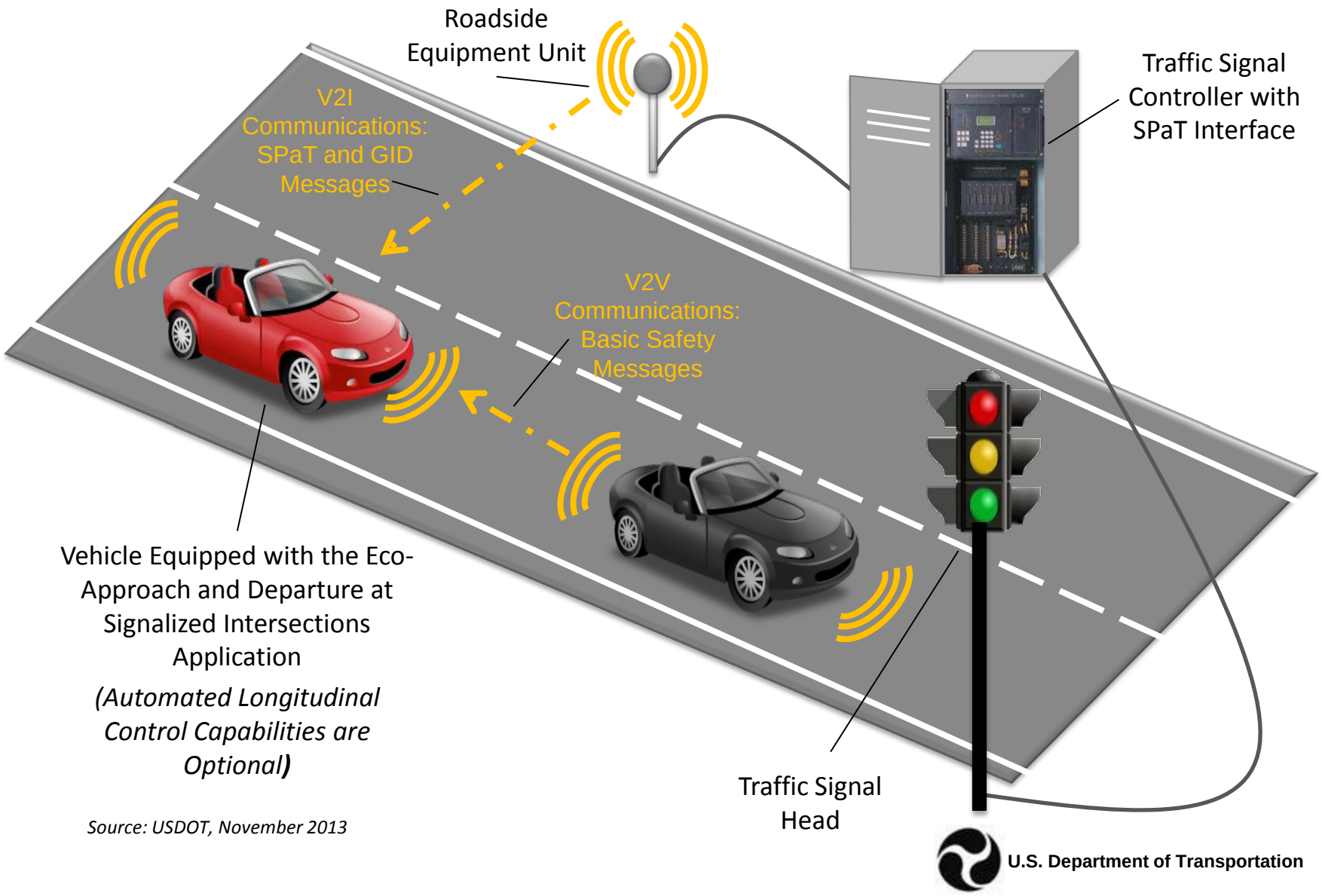
AERIS

Applications for the Environment: Real-Time Information Synthesis

- **Vision** – Cleaner Air through Smarter Transportation
- **Objectives** – Investigate whether it is possible and feasible to:
  - Identify connected vehicle applications that could **provide environmental impact reduction benefits via reduced fuel use, improved vehicle efficiency, and reduced emissions.**
  - **Facilitate and incentivize "green choices"** by transportation service consumers (i.e., system users, system operators, policy decision makers, etc.).
  - **Identify vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), and vehicle-to-grid (V2G) data (and other) exchanges** via wireless technologies of various types.
  - **Model and analyze connected vehicle applications** to estimate the potential environmental impact reduction benefits.
  - **Develop a prototype for one of the applications** to test its efficacy and usefulness.

AERIS

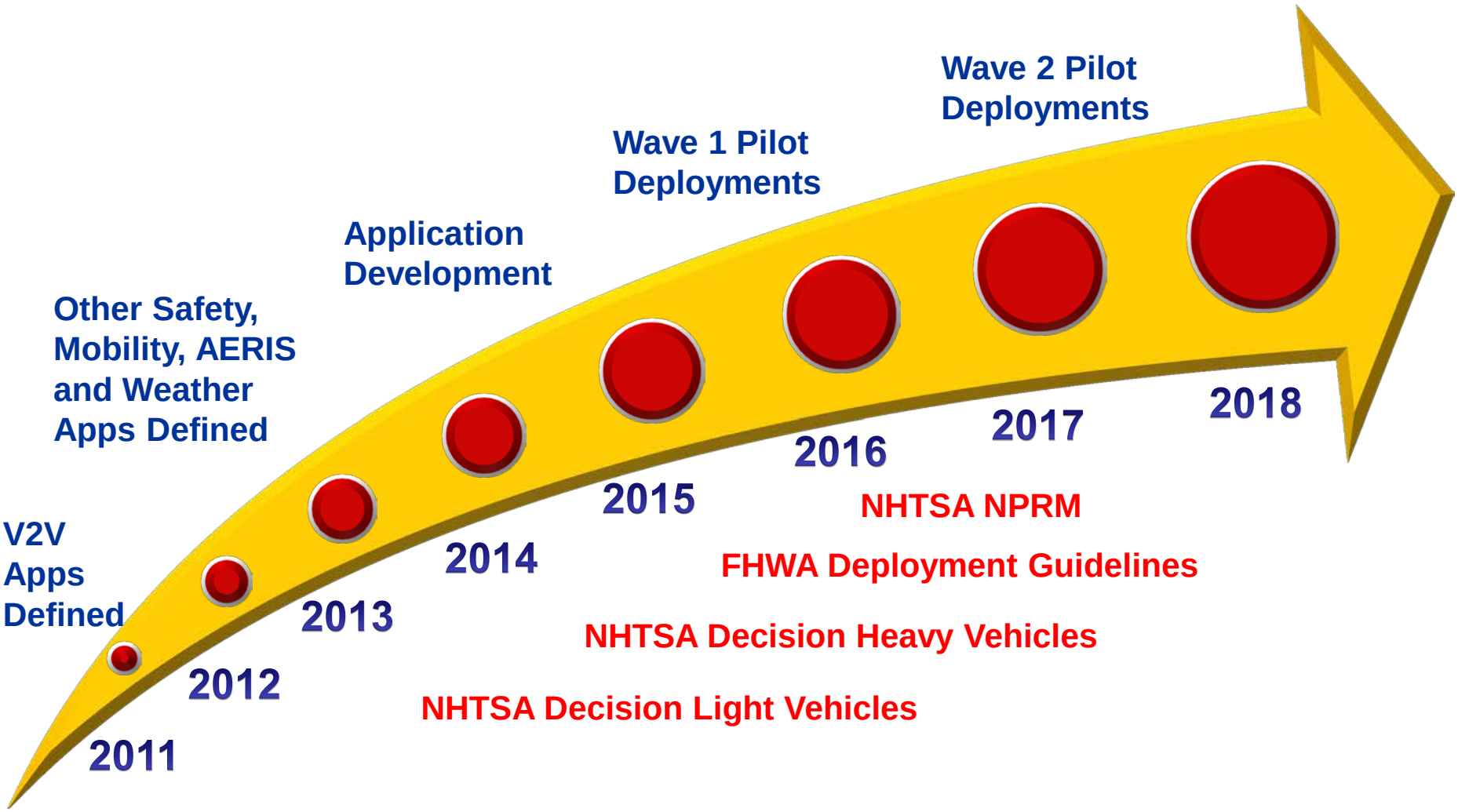
Eco-Approach and Departure at Signalized Intersections



Source: USDOT, November 2013

Moving forward with Vehicle to Vehicle and Vehicle to Infrastructure Communications

Path to Deployment



NHTSA Regulation of V2V Technology

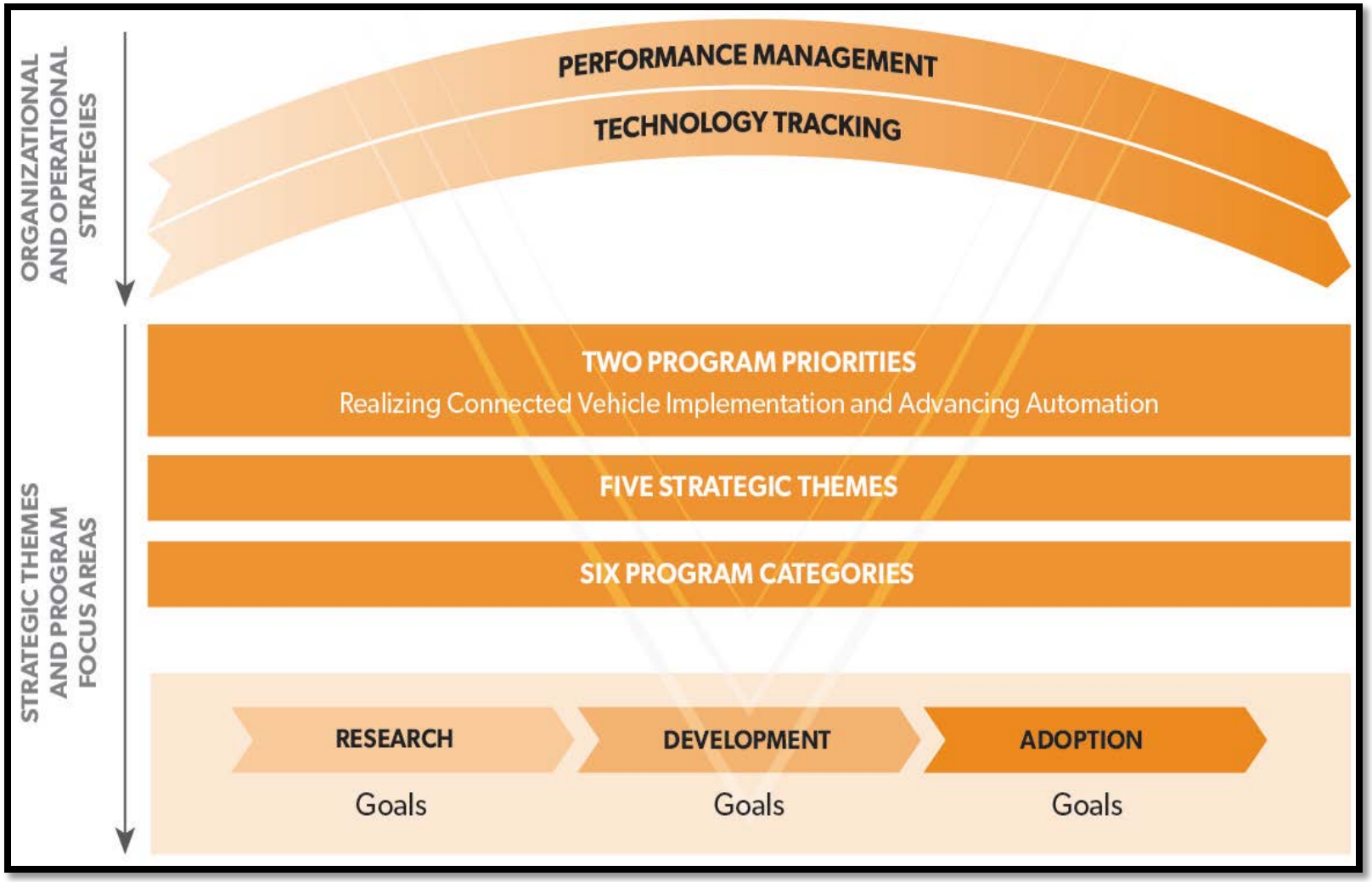
- February 3, 2014 NHTSA announcements to move forward with V2V technology for Light Vehicles
- August 18, 2014 USDOT Issues Advance Notice of Proposed Rulemaking (ANPRM)
  - Includes release of V2V Research Report
  - 60 day comment period (October 20, 2014)
- Vehicle-to-Vehicle Security Credential Management System; Request for Information
- NPRM to be issued 2016

FHWA GUIDANCE FOR V2I TECHNOLOGY

- The FHWA is developing policy positions, guidance, guidelines, whitepapers, and practitioner tools to promote the smooth deployment of V2I technology by transportation system owners/ operators.
- **The FHWA will issue initial guidance in late 2015**. This initial guidance is intended to assist in planning for future investments and deployment of V2I systems.
- The guidance **does not impose any new requirements** on local governments.
- This work will be harmonized with related efforts by other USDOT modal agencies.
- Subsequent guidance updates will also incorporate ITS research findings. http://www.its.dot.gov/meetings/v2i_feedback.htm

Connected Vehicle Pilot Deployment and Automation Programs

ITS STRATEGIC PLAN'S FRAMEWORK



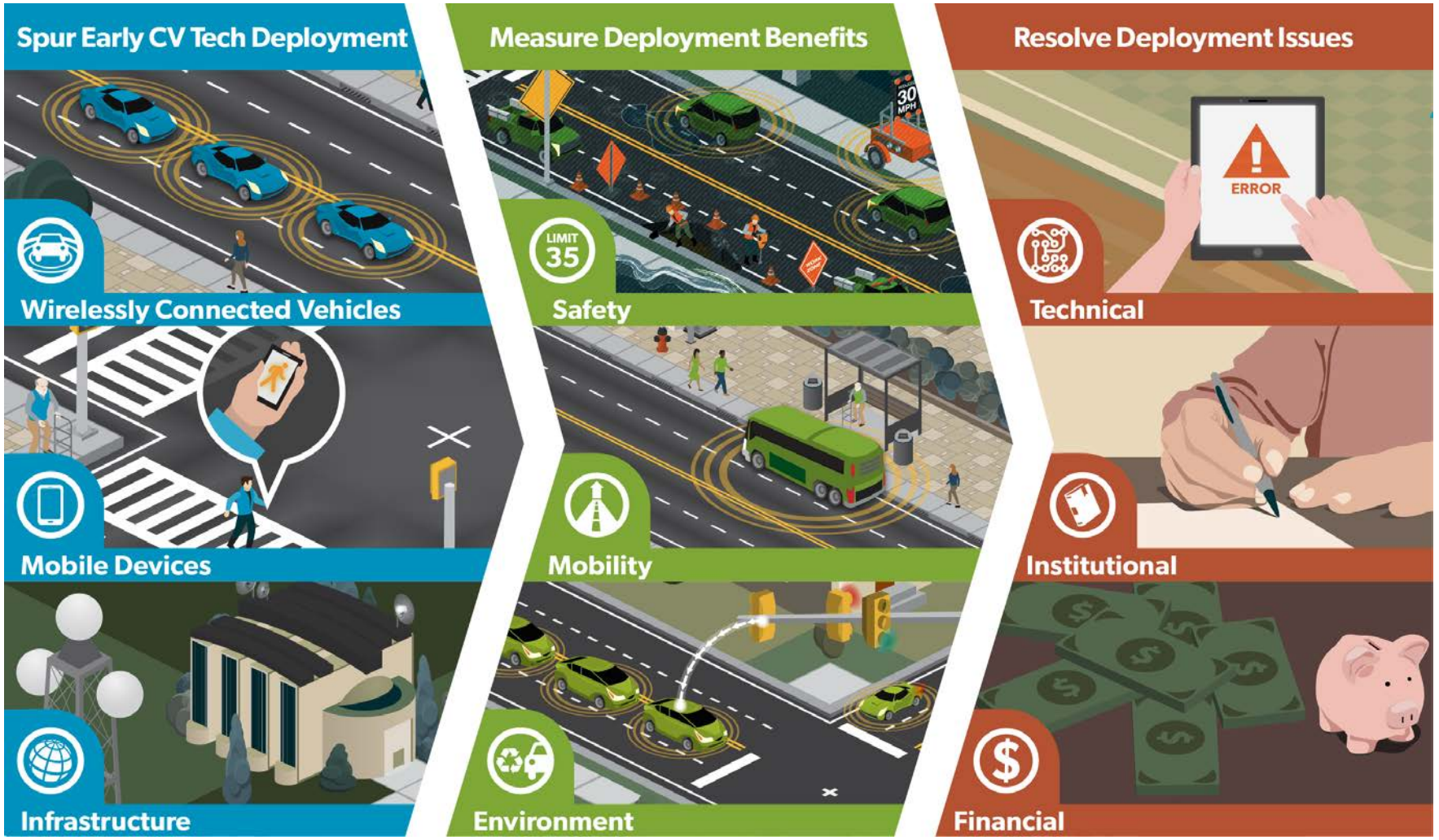
STRATEGIC PRIORITIES

- Two Strategic Priorities reflect a sense of where the bulk of transportation research and innovation is heading. These priorities are not exclusive of other technologies or research areas.

  - ***Realizing Connected Vehicle Implementation***
    - builds on the substantial progress made in recent years around design, testing, and planning for connected vehicles to be deployed across the nation.

  - ***Advancing Automation***
    - shapes the ITS Program around research, development, and adoption of automation related technologies as they emerge.

CV Pilot Program Goals



ORGANIZING PRINCIPLES

- Pilots will be *pilot deployments*, that is, real-world environment deployments
  - If successful, deployed technologies are expected to remain as permanent operational elements
- There will be *multiple* pilot sites over time
  - Each site will have different needs, focus and applications
    - That is, pilot deployments must address a critical problem
    - The needs of each site must drive the application selection process
- Pilot deployments are expected to be both *large-scale and multi-modal*
  - *Large-scale* implies pilot deployments will have measureable impact, not a specific minimum geographic or vehicle fleet size
  - Sites will deploy *multiple applications* drawing on the products of USDOT and other connected vehicle research

Pilot Deployment Process

- **Pilot Deployment Concept Development Process**
  - Identify Local Needs
  - Set Performance Goals
  - Select CV Applications That Work Together Meet Those Goals

- **USDOT Sample Pilot Concepts from Hypothetical Locations**
  - Hypothetical, but realistic examples of localities applying the pilot deployment concept development process

SAMPLE DEPLOYMENT CONCEPT – Downtown Sunnyside

~ Improving Congestion in an Urban Arterial Network ~

Improve Transit Reliability

- Connection Protection
- Transit Signal Priority

Improve Pedestrian Safety

- Mobile Accessible Pedestrian Signal System
- Pedestrian in Signalized Crosswalk Warning
- Intersection Movement Assist

Improve Air Quality

- Eco-Approach and Departure at Signalized Intersections
- Eco-Traffic Signal Timing

Synergies among applications increase benefits and reduce costs

SAMPLE DEPLOYMENT CONCEPT – Halleck Expressway
~ Improving Travel Time Reliability on an Urban Expressway~

Reduce Incident Delay

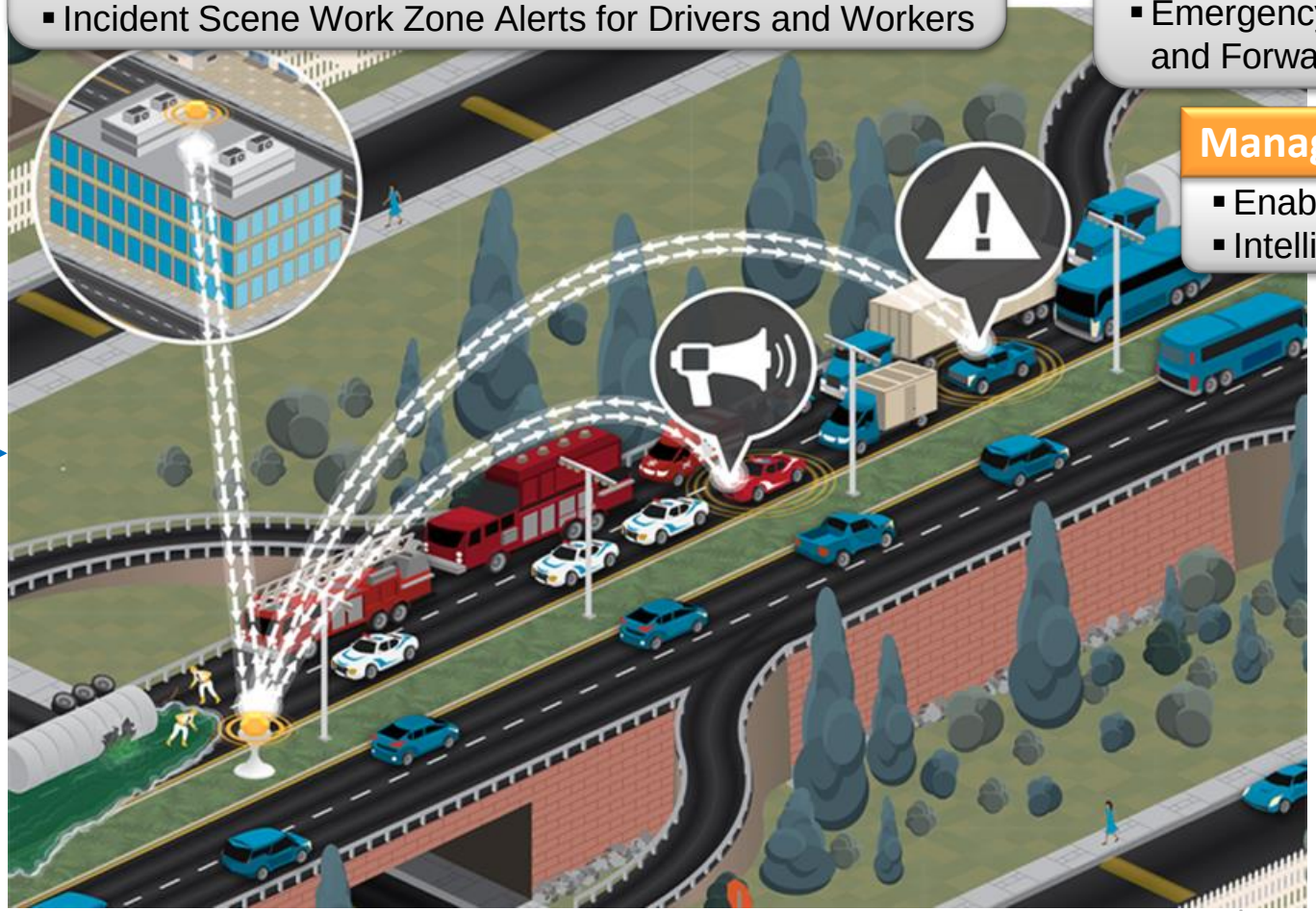
- Incident Scene Pre-Arrival Staging Guidance for Emergency Responders
- Incident Scene Work Zone Alerts for Drivers and Workers

Improve Bottleneck Throughput

- Speed Harmonization and Queue Warning
- Emergency Electronic Brake Lights and Forward Collision Warning

Manage Diversions Better

- EnableATIS
- Intelligent Signal Control



Synergies among applications increase benefits and reduce costs

SAMPLE DEPLOYMENT CONCEPTS – Greypool County

~ Improving Safety and Mobility in a Rural Area ~

Increase Accessibility

- Dynamic Transit Operations

Improve Safety

- Red Light Violation Warning
- Stop Sign Gap Assist
- Left Turn Assist

Informing Drivers During Bad Weather

- Weather Response Traffic Information

Synergies among applications increase benefits and reduce costs

SAMPLE DEPLOYMENT CONCEPT – District 13 Operations

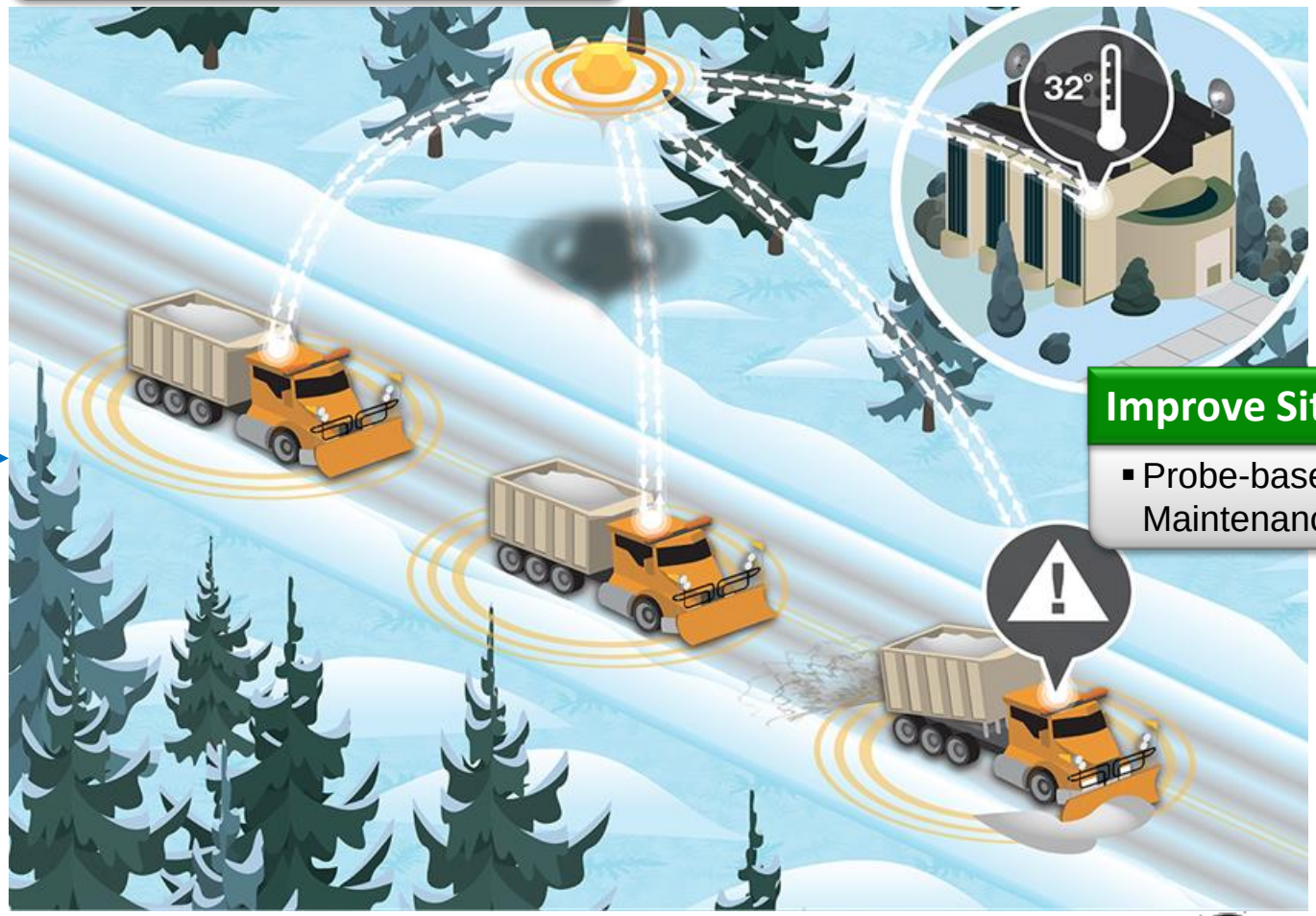
~ Improving the Efficiency of Road Maintenance ~

Improve Snow Removal

- Enhanced Maintenance Decision Support System

Improve Management of Work Zones

- Work Zone Traveler Information



Improve Situational Awareness

- Probe-based Pavement Maintenance

Synergies among applications increase benefits and reduce costs

SAMPLE DEPLOYMENT CONCEPT – I-876 Corridor

~ Improving Freight Movement in an Inter-State Corridor ~

Improve Freight Productivity

- Freight Advanced Traveler Information System
- Drayage Optimization
- Freight Signal Priority

Improve Truck Safety

- Curve Speed Warning
- Do Not Pass Warning/Lane Change Warning

Synergies among applications increase benefits and reduce costs

CV Pilots Deployment Schedule and Resources

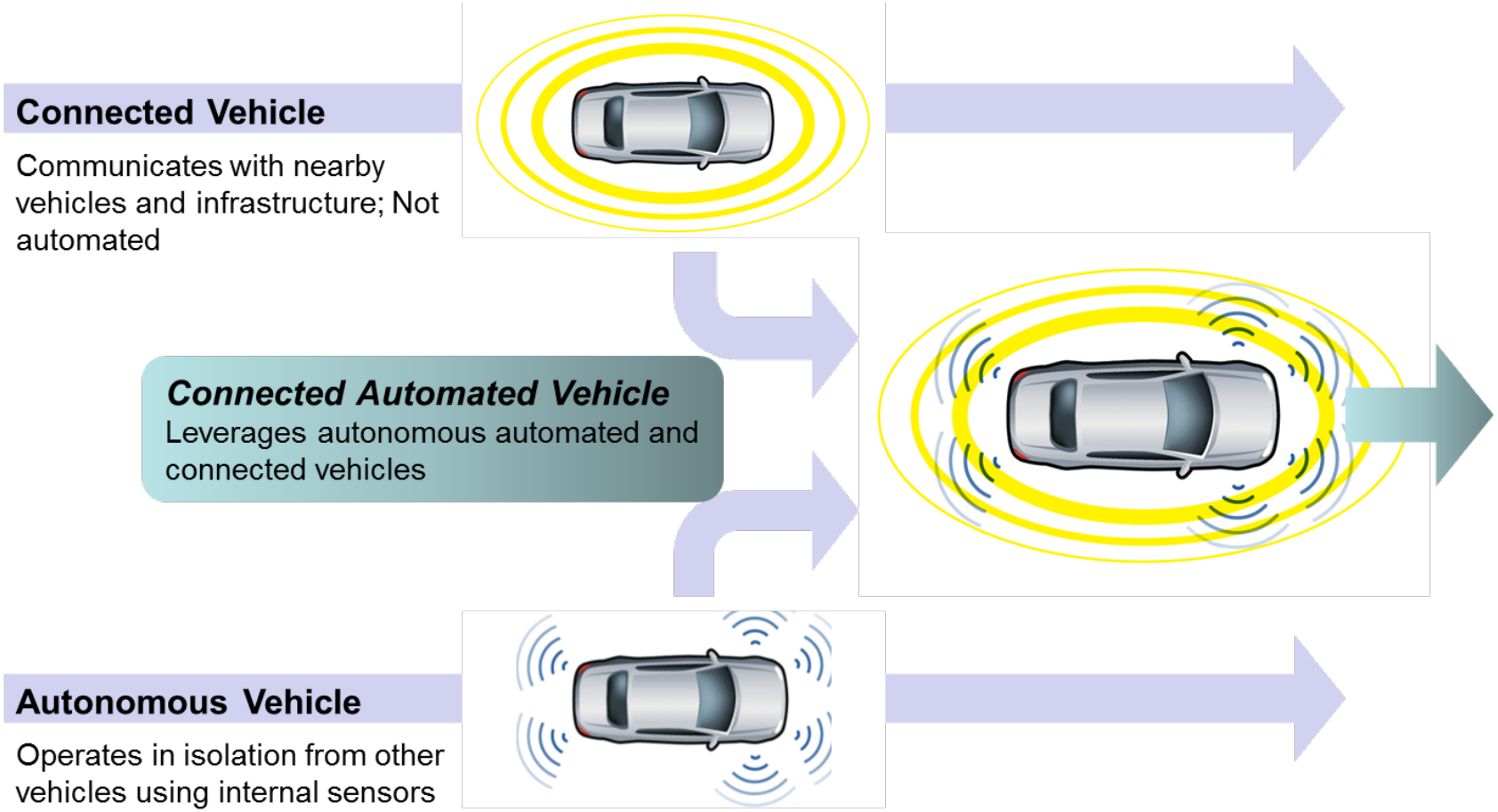
- Proposed CV Pilots Deployment Schedule

Schedule Item	Date
Regional Pre-Deployment Workshop/Webinar Series	**Summer-Fall 2014**
Solicitation for Wave 1 Pilot Deployment Concepts	**Early 2015**
Wave 1 Pilot Deployments Award(s) Concept Development Phase (6-9 months) Design/Build/Test Phase (10-14 months) Operate and Maintain Phase (18 months)	**September 2015**
Solicitation for Wave 2 Pilot Deployment Concepts	**Early 2017**
Wave 2 Pilot Deployments Award(s) Concept Development Phase (6-9 months) Design/Build/Test Phase (10-14 months) Operate and Maintain Phase (18 months)	**September 2017**
Pilot Deployments Complete	**September 2020**

- Resources
  - ITS JPO Website: http://www.its.dot.gov/
  - CV Pilots Program Website: http://www.its.dot.gov/pilots

THE EVOLUTION OF CONNECTED TO AUTOMATED VEHICLES

The path toward connected vehicles will ultimately lead to automated vehicles.



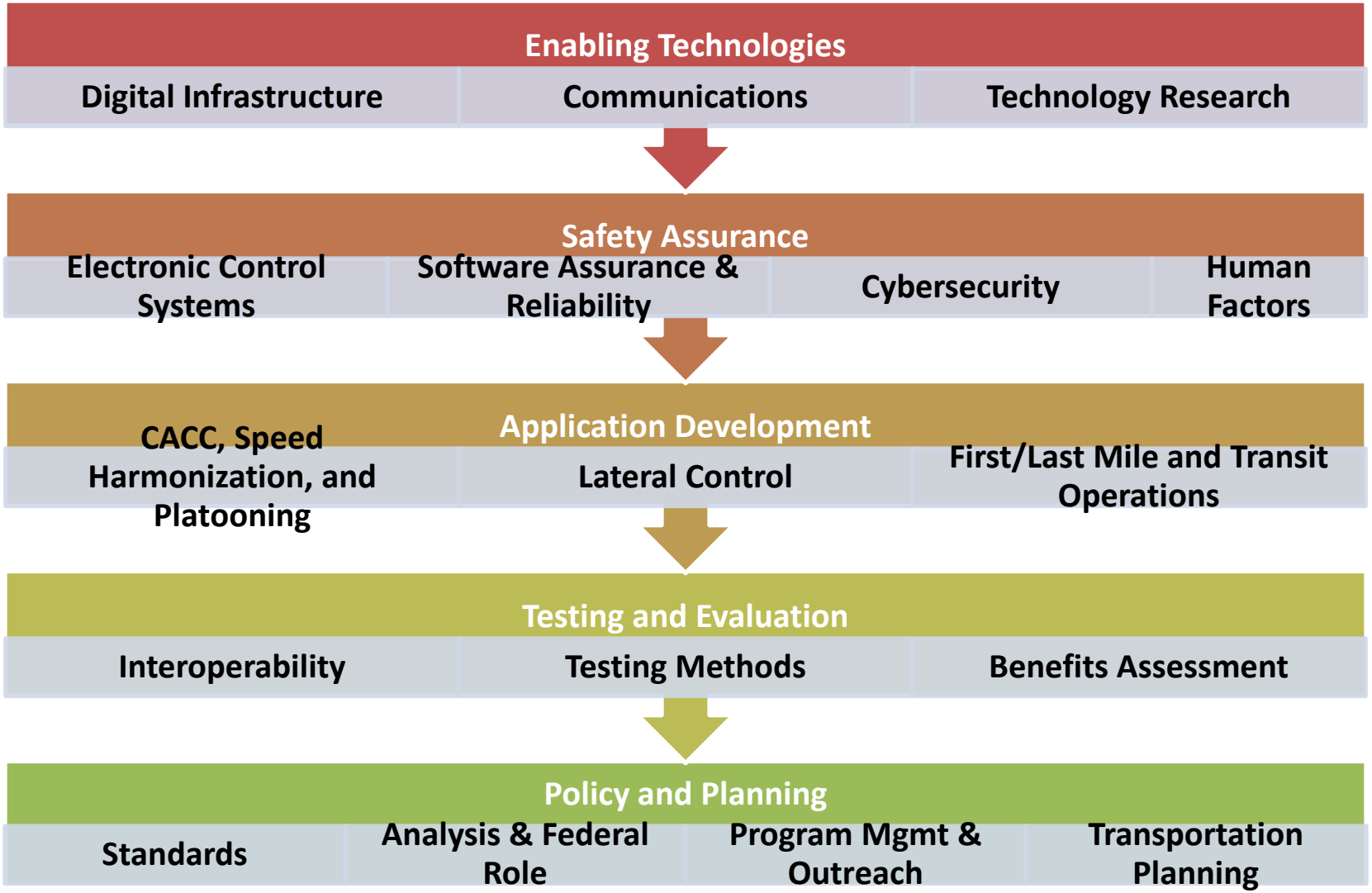
USDOT's Role in Vehicle Automation

- Facilitate development and deployment of automated transportation systems that enhance safety, mobility, and sustainability
- Identify benefit opportunities in automated vehicle technology
- Invest in research areas that further industry investments and support realization of benefit opportunities
- Establish Federal Motor Vehicle Safety Standards
- Ensure a safe transitional period during mixed traffic operations

We are also collaborating internationally with Japan and Europe on vehicle automation through a Tri-lateral Working Group on Automation in Road Transportation.

EU★US★JAPAN
ITS COOPERATION

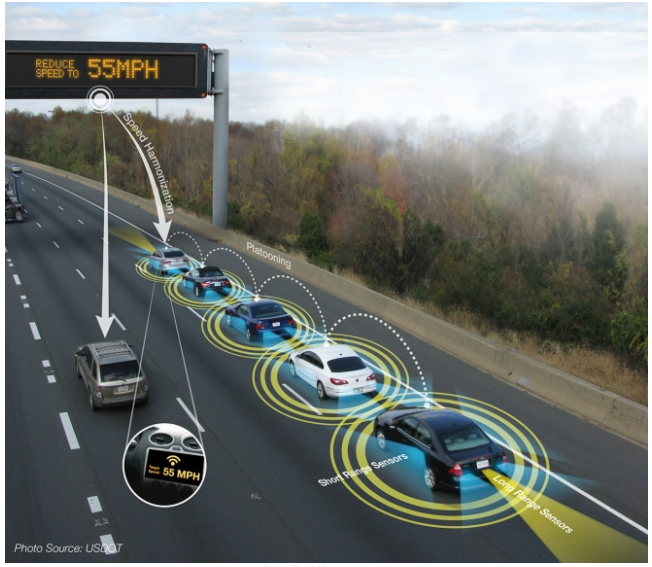
Research Tracks and Topics



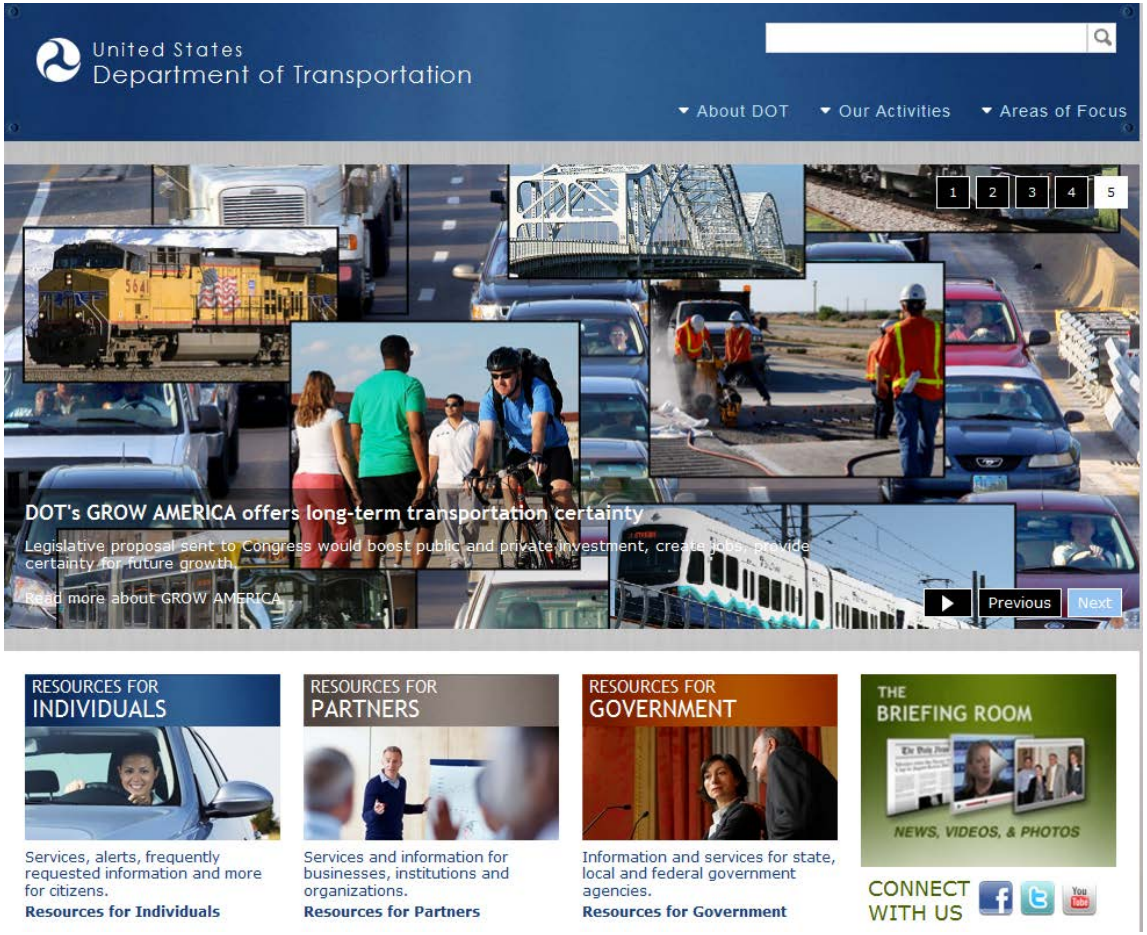
THE FUTURE OF CONNECTIVITY

The full benefits of vehicle automation can be achieved only through connectivity.

By integrating connected with automated vehicles, we can improve the safety of our roads, expand our transportation capabilities, and greatly extend mobility options to everyone—from the disabled, the elderly, to the inexperienced teenage driver.



FOR MORE INFORMATION



http://www.dot.gov/

Kevin Gay
US DOT / Volpe Center
Kevin.Gay@dot.gov

Kevin Dopart
US DOT / ITS JPO
Kevin.Dopart@dot.gov