CONNECTED VEHICLE PILOT
Deployment Program

Ben McKeever and Walt Fehr

TODAY'S AGENDA

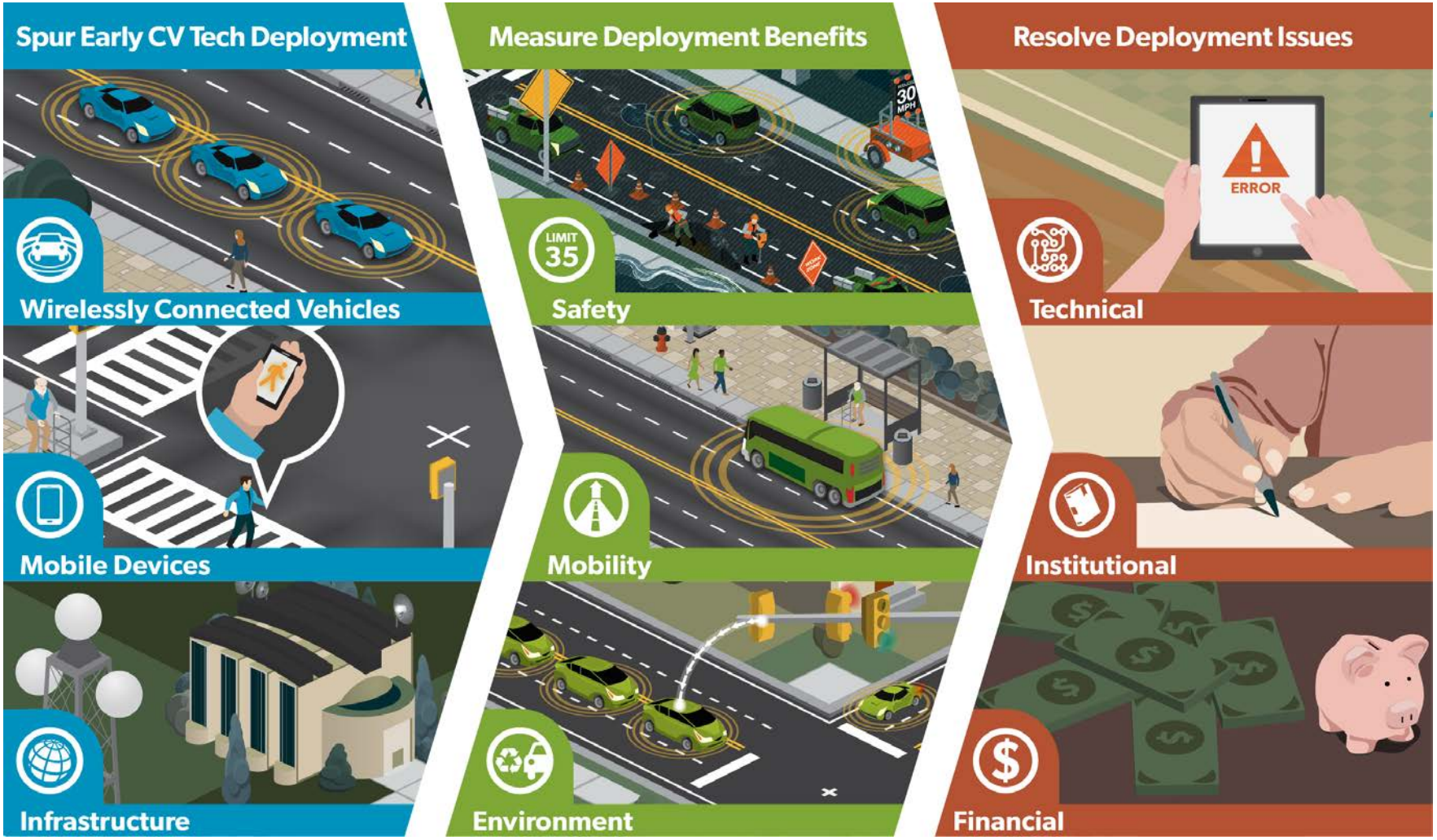
- Ben McKeever
  Team Leader, Transportation Operations Applications, FHWA R&D
  - Connected Vehicle Pilot Deployment Program Overview
  - Connected Vehicle Communication Technologies

- Walt Fehr
  System Engineering Program Manager, ITS JPO
  - Role of DSRC in CV Pilots
  - Preparing for Interoperability

- Stakeholder Q&A

Connected Vehicle Pilot Deployment Program Overview

PROGRAM GOALS



Organizing Principles and Requirements

- **Organizing Principles**
  - Problem-Driven
  - Multiple Pilot Sites
  - Large-Scale and Multi-Modal
  - Multiple Applications Deployed Together

- **Deployment Requirements**
  - Data Capture and Sharing
  - Quantifiable Performance Measures
  - Security and Credentialing Management System
  - Multiple Forms of Communication Technologies
    - DSRC desired as one communication technology
    - Integrated or carry-in devices for connected vehicles capable of generating an SAE J2735 Basic Safety Message (BSM)

Connected Vehicle Applications

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)

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

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

Road Weather

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

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

CONNECTED VEHICLE PILOT DEPLOYMENT SCHEDULE

- 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**

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

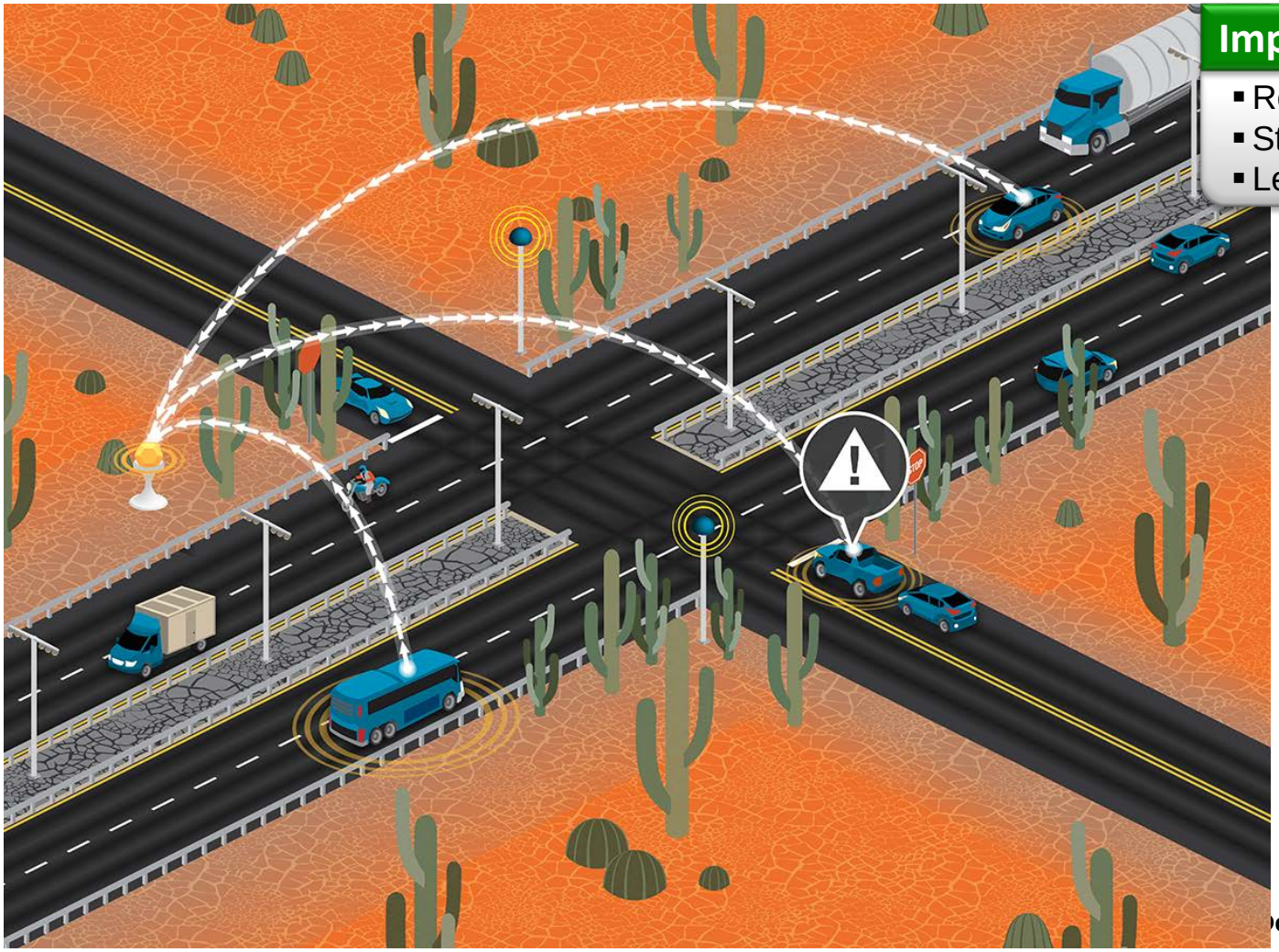
Connected Vehicle Communication Technologies

CONNECTED VEHICLE COMMUNICATION TECHNOLOGIES

- CV Pilot Program seeks an appropriate role for DSRC but open to all approaches – do what works
  - 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 will likely have roles to play

GREYPOOL COUNTY SCENARIO - SAFETY

- An example of using short-range communication technologies (e.g., **DSRC)** for **Safety Applications**



Improve Safety

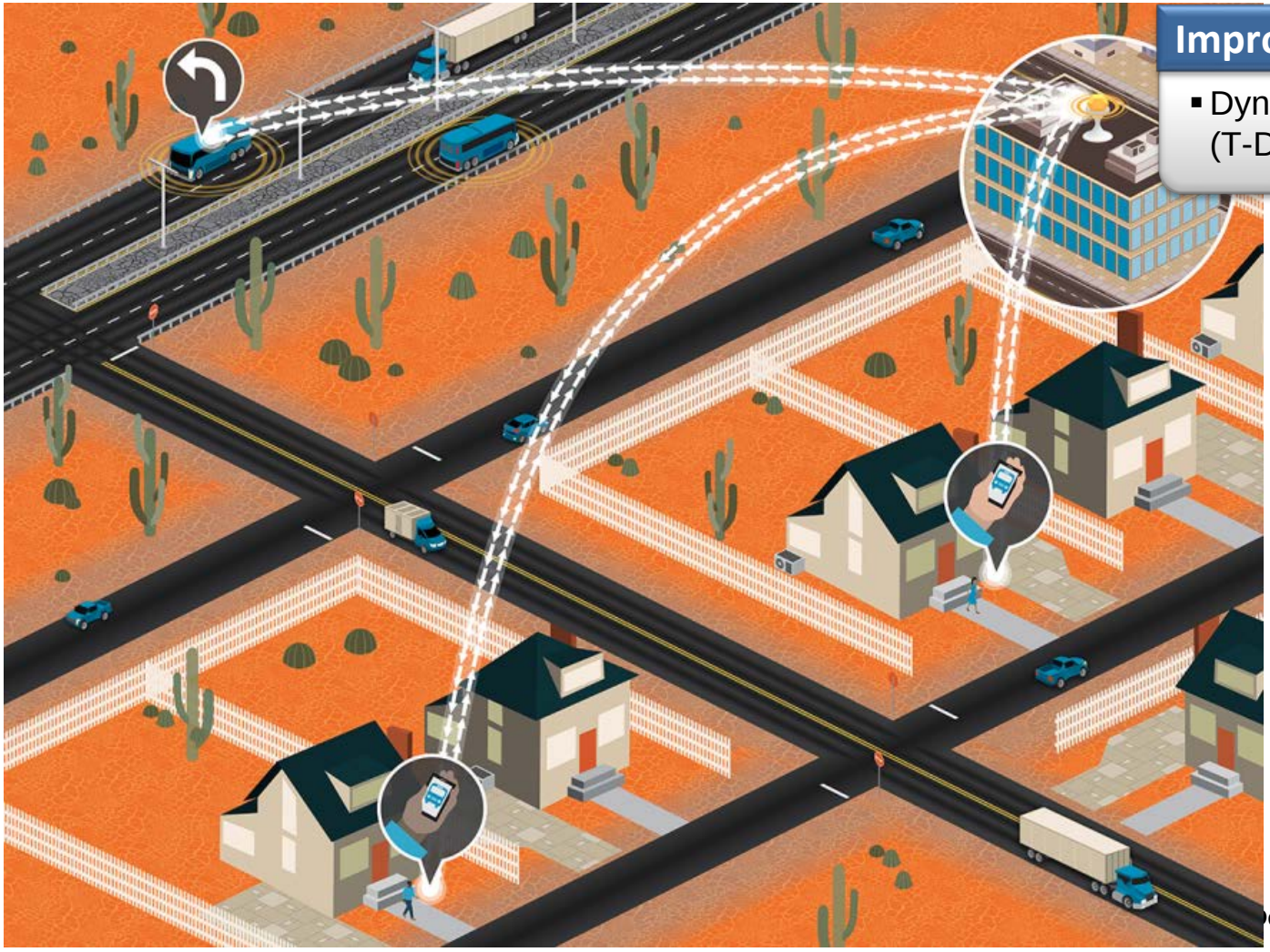
- Red Light Violation Warning
- Stop Sign Gap Assist
- Left Turn Assist

Every **Safety Application** may not require short-range communications technologies

The goal is to use short-range communications where needed

Greypool County Scenario - Mobility

- An example of using **other types** of communication technologies for **Mobility Applications**



Improve Transit Reliability

- Dynamic Transit Operations (T-DISP)

Every **Mobility Application** may not require wide-area communications technologies

The goal is to use wide-area communications to support applications that require or work best with a wide-area approach

COMMUNICATION TECHNOLOGIES IN CV PILOTS

- *Multiple forms* of communications technologies are desired

- DSRC is intended for *safety applications* but we are open to any technology that is available now to help us to improve mobility, safety and environmental impacts

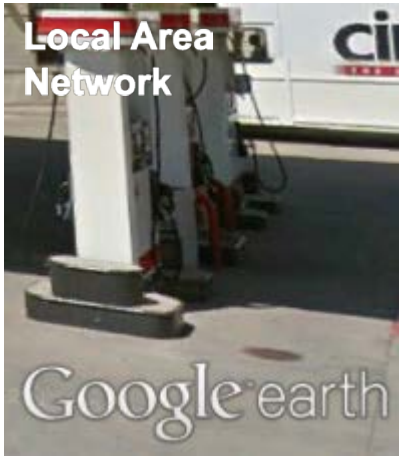
- Pilot concept developers should consider DSRC *only where it is appropriate*.

- Pilot concepts are sought where *DSRC is included as one form* of communications technology

Role of DSRC

A Variety of Communication Media Ranges

- Communication Resources
  - Wired, wireless and the Internet
  - 3,000 miles, 3,000 meters, 300 meters, 3 meters
- Communication Requirements
  - Two types of information distribution: To all, To one



WHY USE DSRC?

- In October 1999, the Federal Communications Commission (FCC) allocated 75 MHz of spectrum in the 5.9 GHz band for ITS applications, primarily public safety oriented.

- The USDOT's commitment to DSRC highlights two critical points
  - Safety is the highest priority for the Department and will form the central focus for the connected vehicle technologies.
  - A detail analysis illustrates that DSRC is the only established communication option available in the near-term that offers the latency, accuracy, and reliability needed for active safety.

DSRC Compared to other communication technologies

- Fast Network Acquisition
  - Active safety applications require immediate establishment of communication
- Low Latency
  - Active safety applications must execute in the smallest amount of time possible
- High Reliability when Required
  - Active safety applications require high level of link reliability
- Priority for Safety Applications
  - Safety applications on DSRC are given priority over non-safety applications
- Security and Privacy
  - DSRC provides safety message authentication and privacy

BENEFITS AND CHALLENGES OF DSRC

- Benefits of the DSRC communications technology
  - Reduced price
  - Improved reliability → fewer false alarms
  - Increased performance → addresses more crash scenarios

- Challenges of the DSRC communications technology
  - Both parties (vehicle/vehicle or vehicle/infrastructure) need to be equipped to gain benefit
  - Requires security infrastructure

Benefits and Challenges of Cellular Technology

- Benefits of 4G and 3G cellular technology:
  - Widely deployed commercial networks
  - Increasingly available in vehicles
  - Mobility and environmental applications

- Challenge of 4G and 3G cellular technology:
  - May not be suitable for safety applications that require low latency

CV Pilots Workshop Questions on DSRC

- Questions from Stakeholders We Heard
  - What are Benefits and Challenges of using DSRC in CV Pilots?
  - Where would DSRC be most useful? Least useful? Where would another type of communications be more useful?
  - Are the messages the same whether they are carried by DSRC or another communications method?
  - What alternative communications methodologies are considered and for what purpose?

- Stakeholder Feedback on DSRC
  - Varying views on keeping DSRC as a requirement: encourage but not require
  - Safety requires DSRC, other apps should be able to use other methods if they meet requirements
  - We want CV pilots to be test of DSRC channel utilization – will usage for mobility apps interfere with safety apps?
  - DSRC is more than sending BSMs. Other apps may use DSRC also
  - We want to leverage data from vehicles beyond currently available commercial offerings

Preparing for Interoperability

INTEROPERABILITY RESEARCH

- Connected Vehicles Interoperability research is primarily focused on adoption and eventual deployment.
  - The ability for vehicles to interface with other vehicles

- Emerging Technologies will focus on identifying existing technologies in other industry areas that might be brought into the Connected Vehicle program to speed adoption.

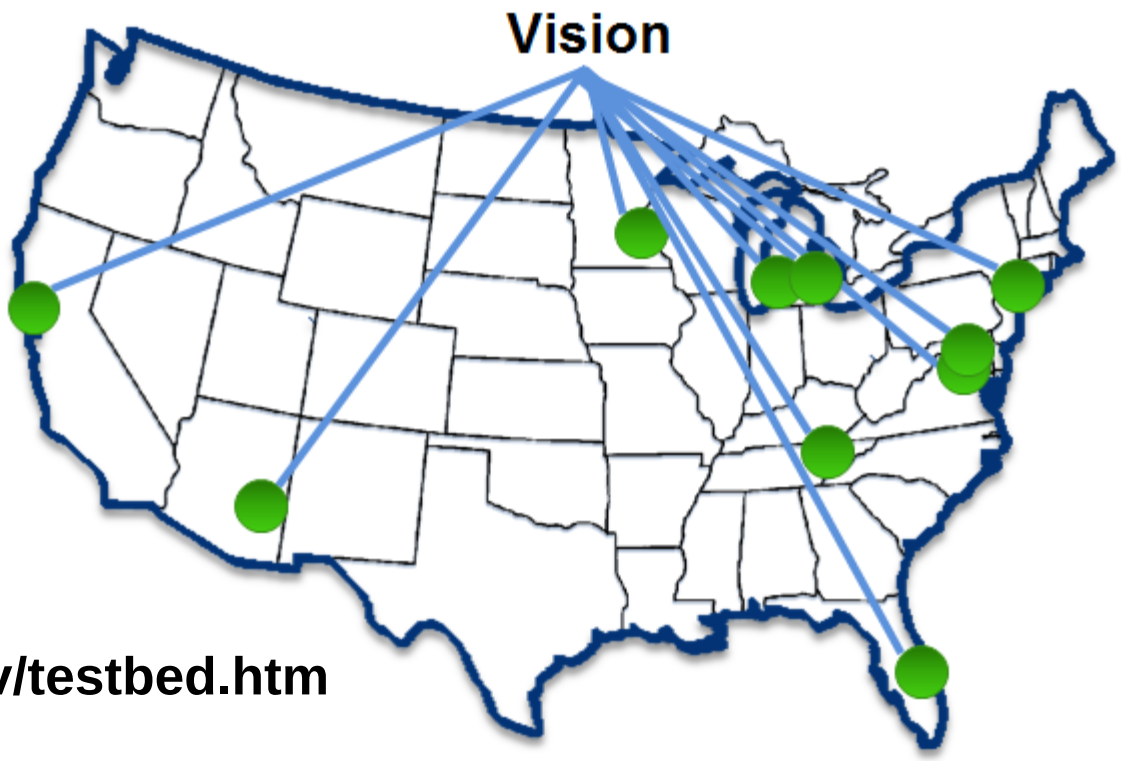
COMMUNICATION INTEROPERABILITY

- Communications-based sensor systems could potentially be a low-cost means of enabling hazard detection capability on all vehicle classes, but requires vehicles and infrastructure to be outfitted with interoperable communications capabilities.

- Using communication technology based on widely accepted standards **interpretations** can enable interoperability. It supports both V2V and V2I communications.

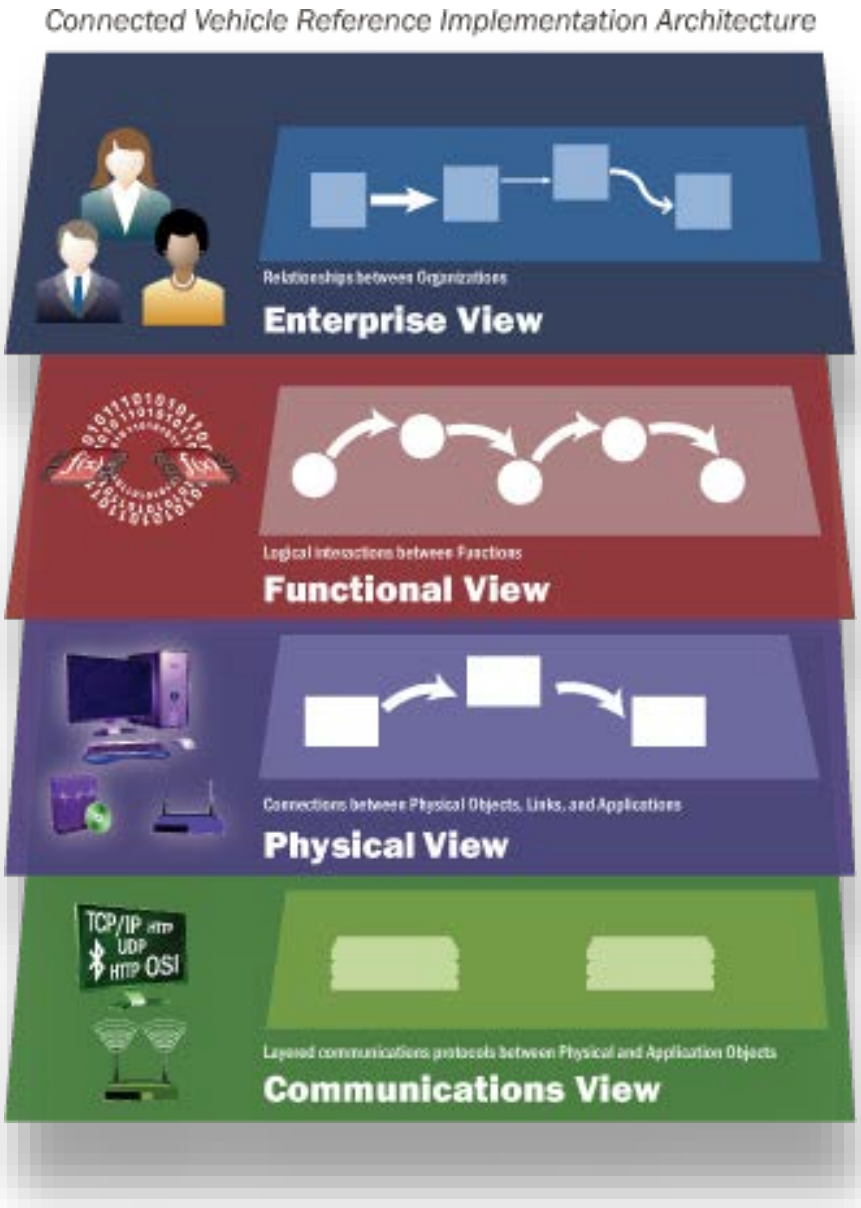
CONNECTED VEHICLE TEST BEDS

- 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



http://www.its.dot.gov/testbed.htm

CVRIA: A FRAMEWORK FOR INTEGRATING TECHNOLOGIES AND IDENTIFYING INTERFACES FOR STANDARDIZATION



http://www.iteris.com/cvria/

- The Systems Engineering Tool for Intelligent Transportation (SET-IT)

SET-IT
Systems Engineering Tool for Intelligent Transportation

- Training in November and December

Stakeholder Q&A