



CONNECTED VEHICLE PILOT Deployment Program



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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



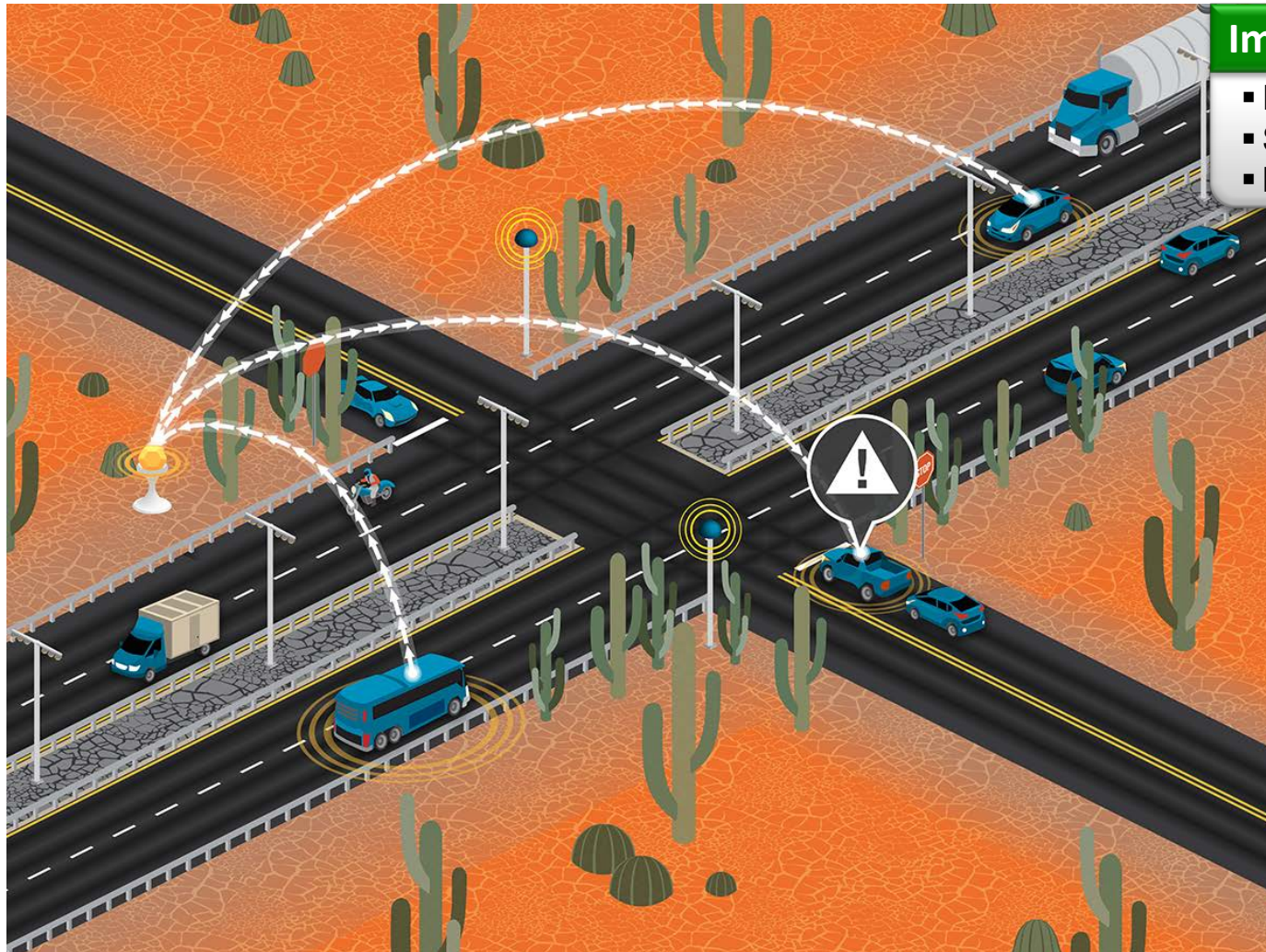
- CV Pilot Program seeks an appropriate role for DSRC but open to all approaches – do what works
 - 5.9 GHz DSRC
 - 4G and older 3G cellular networks provide high-bandwidth data communications
 - Other wireless technologies such as Wi-Fi, satellite, and HD radio will likely have roles to play





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

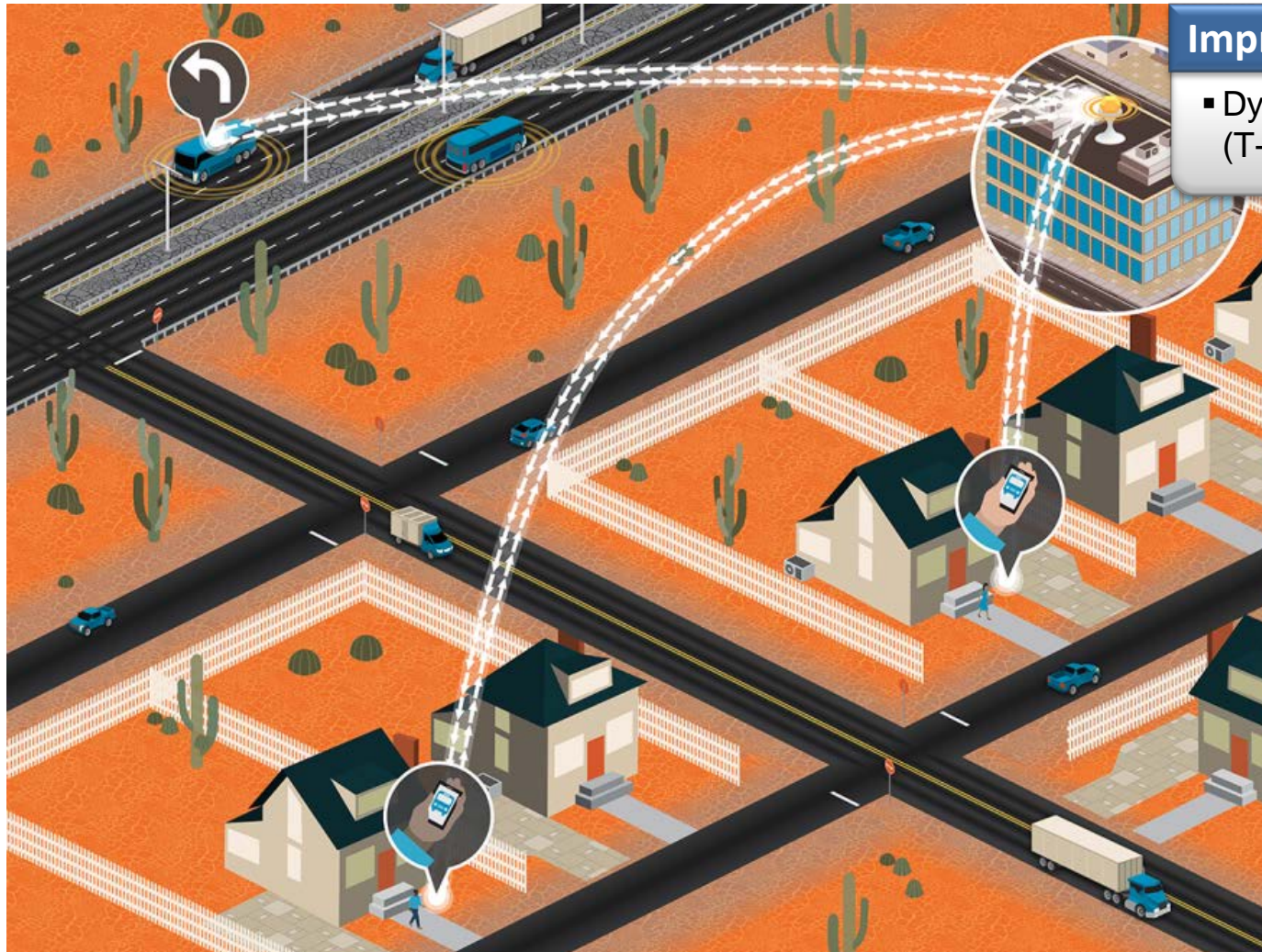
Every **Safety Application** may not require short-range communications technologies

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



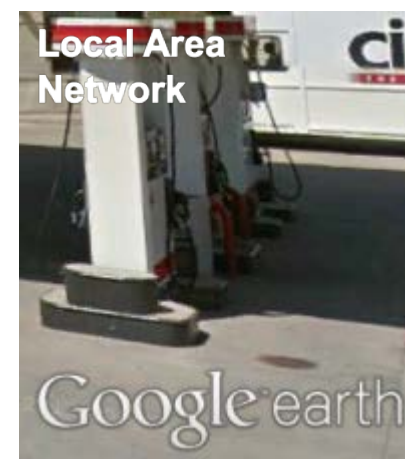


Role of DSRC



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

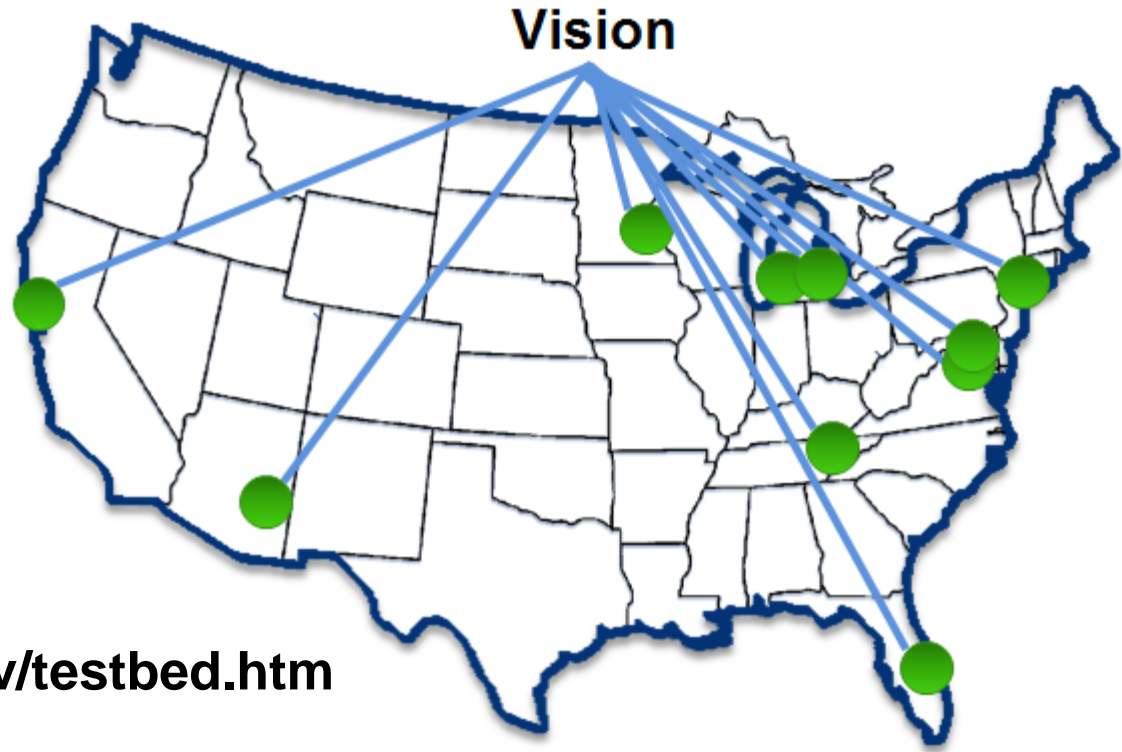
- Communications-based sensor systems could potentially be a low-cost means of enabling hazard detection capability on all vehicle classes, but requires vehicles and infrastructure to be outfitted with interoperable communications capabilities.
- Using communication technology based on widely accepted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



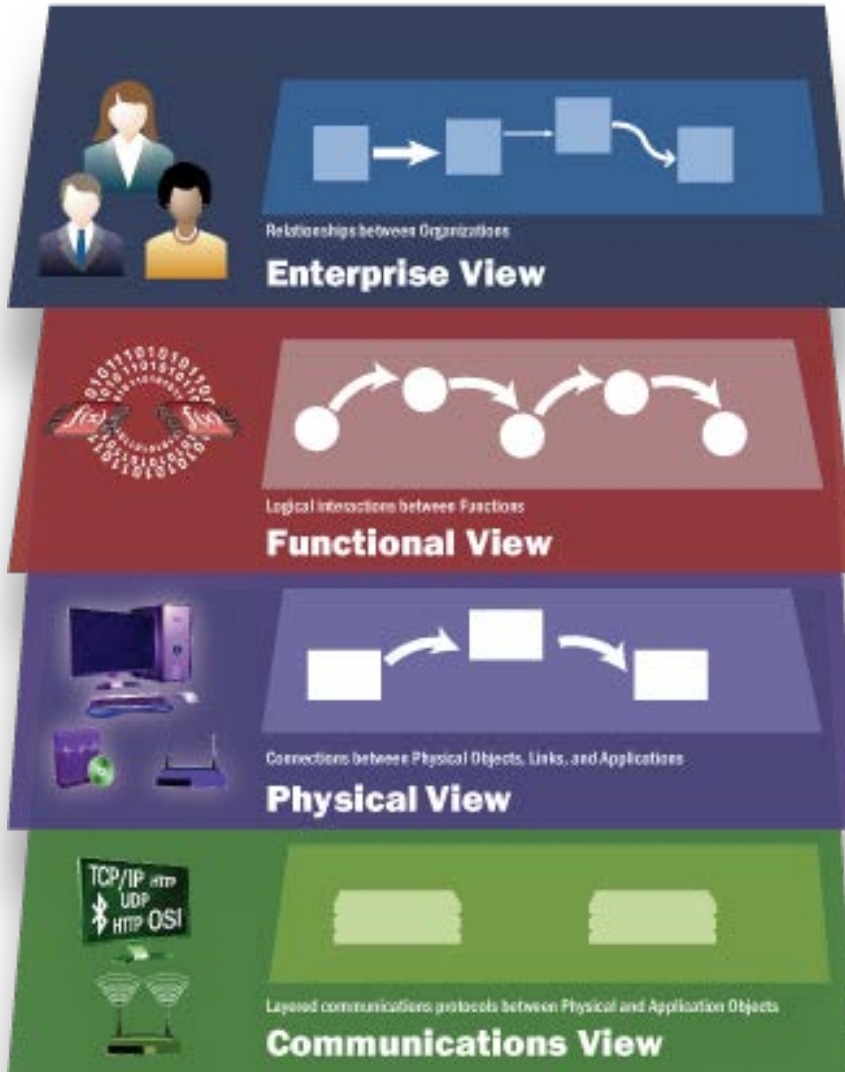
<http://www.its.dot.gov/testbed.htm>



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



Connected Vehicle Reference Implementation Architecture



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

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



- Training in November and December



Stakeholder Q&A