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

Spur Early CV Tech Deployment
- Wirelessly Connected Vehicles
- Mobile Devices
- Infrastructure

Measure Deployment Benefits
- Safety
- Mobility
- Environment

Resolve Deployment Issues
- Technical
- Institutional
- Financial
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
### Proposed CV Pilots Deployment Schedule

<table>
<thead>
<tr>
<th>Schedule Item</th>
<th>Date</th>
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<tbody>
<tr>
<td>Regional Pre-Deployment Workshop/Webinar Series</td>
<td>Summer-Fall 2014</td>
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<tr>
<td>Solicitation for Wave 1 Pilot Deployment Concepts</td>
<td>Early 2015</td>
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<tr>
<td>Wave 1 Pilot Deployments Award(s)</td>
<td>September 2015</td>
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<td>Concept Development Phase (6-9 months)</td>
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<tr>
<td>Design/Build/Test Phase (10-14 months)</td>
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<tr>
<td>Operate and Maintain Phase (18 months)</td>
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<tr>
<td>Solicitation for Wave 2 Pilot Deployment Concepts</td>
<td>Early 2017</td>
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<tr>
<td>Wave 2 Pilot Deployments Award(s)</td>
<td>September 2017</td>
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<tr>
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</tr>
<tr>
<td>Pilot Deployments Complete</td>
<td>September 2020</td>
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- CV Pilots Program Website: [http://www.its.dot.gov/pilots](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

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

- 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.
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.
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)

- Training in November and December
Stakeholder Q&A