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 measurable 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
PROPOSED PILOT DEPLOYMENT REQUIREMENTS

- Multiple connected vehicle applications must be deployed together
  - Cost-effectively leveraging captured CV and mobile device data
  - Address multi-modal problems

- Pilot deployments should leverage USDOT-sponsored research
  - Need not include all applications (in fact, this is unlikely to be practical)
  - May include new connected vehicle applications not considered by USDOT
  - All applications selected must work and have an impact

- Pilot deployments should include the capture of data from multiple sources
  - At a minimum, vehicles must represent one source of data used in the pilot deployment
PROPOSED PILOT DEPLOYMENT REQUIREMENTS

- Multiple forms of communications technologies are desired
  - DSRC desired as one communication technology
  - Integrated or carry-in devices for connected vehicles capable of generating an SAE J2735 Basic Safety Message (BSM)

- Well-defined, focused, quantitative performance measures
  - Support an independent evaluation effort

- Share pilot deployment data and lessons learned
  - While protecting privacy and intellectual property

- Security and credentialing management system
PILOT DEPLOYMENT WAVES AND PHASES

The USDOT expects an initial set of pilot deployments (Wave 1) to begin in Fall 2015, and a second wave (Wave 2) in 2017.

Proposed Deployment Phases within each Wave

- Concept Development (6-9 months)
  - Concept of Operations, System Requirements, Preliminary Site Plans
- Design/Build/Test (10-14 months)
  - Develop and integrate applications with legacy systems, test enhanced system
- Operate and Maintain (18 months)
  - Operate enhanced system and assess performance against targets
PARTNERSHIPS

- Strong Partnerships Are An Expected Feature of Pilot Deployments
  - Encourage partnerships of multiple stakeholders, including, as needed:
    - Public sector partners (e.g., agencies, planning organizations, localities)
    - Private sector partners (e.g., technology vendors, integrators, OEMs)
    - Academic and research Institutions
  - Potential organizational structures
    - Options where private sector or public sector organizations may lead
    - Single point of responsibility/control a desired attribute of pilot deployments
    - No “template” for how individual pilot deployments should/must be organized
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

### 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
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
SCENARIO 1: DOWNTOWN SUNNYSIDE
~ IDENTIFY KEY TRANSPORTATION CHALLENGES ~

- **Mobility**
  - Heavy congestion at peak times
  - Transit vehicles schedule reliability

- **Safety**
  - Pedestrian-vehicle conflicts
  - Crashes in unprotected left hand turns

- **Environment**
  - Emissions/Air Quality hot spots
  - Poor progression results in wasted fuel
## Scenario 1: Downtown Sunnyside

### Stakeholders Set Three Performance Targets

<table>
<thead>
<tr>
<th>Goal</th>
<th>Performance Measure</th>
<th>Performance Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Increase transit reliability</td>
<td>Transit schedule adherence</td>
<td>Transit vehicles on schedule 90% of the time</td>
</tr>
<tr>
<td>Improve pedestrian safety</td>
<td>Pedestrian-vehicle conflicts</td>
<td>Reduce pedestrian-vehicle conflicts by 50%</td>
</tr>
<tr>
<td>Improve hot spot air quality</td>
<td>Total emissions</td>
<td>Reduce emissions by 20%</td>
</tr>
</tbody>
</table>
**Scenario 1: Downtown Sunnyside**

**Applications Selected**

<table>
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<tr>
<th>V2I Safety</th>
<th>Environment</th>
<th>Mobility</th>
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<td>Eco-Traffic Signal Timing</td>
<td>Intelligent Traffic Signal System (I-SIG)</td>
</tr>
<tr>
<td>Stop Sign Gap Assist</td>
<td>Eco-Traffic Signal Priority</td>
<td>Signal Priority (transit, freight)</td>
</tr>
<tr>
<td>Pedestrian in Signalized Crosswalk Warning (Transit)</td>
<td>Connected Eco-Driver</td>
<td>Mobile Accessible Pedestrian Signal System (PED-SIG)</td>
</tr>
<tr>
<td>V2V Safety</td>
<td>Wireless Inductive/Resonance Charging</td>
<td>Emergency Vehicle Preemption (PREEMPT)</td>
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<td>Eco-Lanes Management</td>
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<td>Connection Protection (T-CONNECT)</td>
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**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

**Road Weather**

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

**Smart Roadside**

- Wireless Inspection
- Smart Truck Parking
SCENARIO 1: 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
SCENARIO 2: 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
- Enable ATIS
- Intelligent Signal Control

Synergies among applications increase benefits and reduce costs
SCENARIO 3: 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*
SCENARIO 4: 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
SCENARIO 5: 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
### Connected Vehicle Pilot Deployment Schedule

- Proposed CV Pilots Deployment Schedule

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

- CV Pilots Program Website: [http://www.its.dot.gov/pilots](http://www.its.dot.gov/pilots)
UPCOMING OUTREACH ACTIVITY

- **Webinar Series**
  - Kicking off in late August
  - One “hot topic” per month
  - Exact schedule still to be finalized
  - Topics will include: Role of DSRC, Performance Measure Identification, Security and Credential Management, Role of Mobile Devices

- **Workshops**
  - One-hour of CV 101 Workshop at Detroit World Congress will focus on CV Pilots
  - Finalizing plans for workshops in September-November Time Frame

- Check the CV Pilots website ([http://www.its.dot.gov/pilots](http://www.its.dot.gov/pilots)) to keep up to date
  - Adding detail and resources for each CV application over next 8-12 weeks
  - Linking documents and resources associated with each individual application to the CV Pilots website
Resources
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 Fall 2014
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
- Integrated V2I Prototype
  - Initial testing late 2014
  - Field testing in Orlando early 2015
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
- RDE Release 2.0 is now available
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
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

http://www.its.dot.gov/testbed.htm
Stakeholder Q&A

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Program Manager, CV Pilots
Kate.Hartman@dot.gov
202-366-2742