Opportunities for Environmental Applications for Near Term Deployments

Marcia Pincus, ITS-JPO

What is the Desired Outcome of the Workshop?

Workshop Participants

- Participants should have a greater understanding of AERIS Research activities and modeling results
- Participants should become familiar with current research efforts and real-world environmental application deployments
- Participants should begin brainstorming connected vehicle applications that have the potential to provide near-term fuel use and emissions reductions

The AERIS Team

- The AERIS Team hopes to learn about local environmental challenges and issues
- The AERIS Team hopes to learn from subject matter experts on the status of environmental research and deployment activities
- The AERIS Team hopes to leave the workshop with a better understanding of applications that stakeholders believe are good candidates for near-term deployment

APPLICATIONS FOR THE ENVIRONMENT: REAL-TIME INFORMATION SYNTHESIS

Who We Are

Cleaner Air through Smarter Transportation

USDOT connected vehicle research aims to tackle some of the biggest challenges in the surface transportation industry in the areas of safety, mobility, and environment.

Employing a multi-modal approach, the AERIS Research Program aims to encourage the development of technologies and applications that support a more sustainable relationship between transportation and the environment chiefly through fuel use reductions and resulting emissions reductions.

AERIS Research Objectives

- 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 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.

The Environmental Problem

28%
of GHG emissions associated with transport sector in the U.S.[1]

83%
of transport sector GHG emissions are associated with surface vehicles[1]

2.9 billion
gallons of wasted fuel resulting from congestion in urban areas[2]

Source: (1) *EPA. Inventory of U.S. Greenhouse Gas Emissions and Sinks, 1990 to 2012. 2014.*
(2) TTI's 2012 Urban Mobility Report: http://mobility.tamu.edu/ums/report/

The AERIS Approach

Concept Exploration
Examine the State-of-the-Practice and explore ideas for AERIS Operational Scenarios

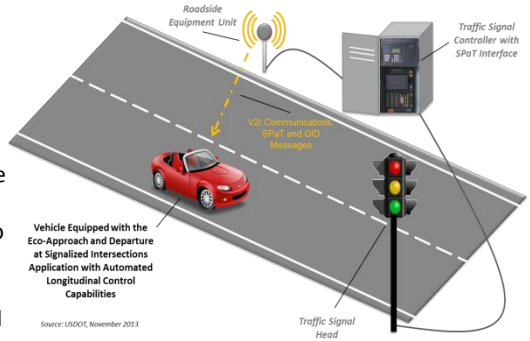
Concept Development
Identify high-level user needs and desired capabilities for each AERIS Operational Scenario

Preliminary Cost Benefit Analysis
Perform a preliminary cost benefit analysis to identify high priority applications

Modeling and Analysis
Model, analyze, and evaluate applications that make sense for development, and further research

AERIS Prototype Application

The AERIS Program will be developing a Proof of Concept Prototype for the Eco-Approach and Departure at Signalized Intersections application. The application will leverage automated longitudinal control capacities helping to reduce driver distraction and improve compliance with the application's speed recommendations.



AERIS Operational Scenarios

Eco-Signal Operations

Uses connected vehicle technologies to decrease fuel consumption emissions by reducing idling, the number of stops, unnecessary accelerations and decelerations, and improving traffic flow at signalized intersections.

Eco-Lanes

Dedicated freeway lanes – similar to managed lanes – optimized for the environment that encourage use from vehicles operating in eco-friendly ways. The lanes may support variable speed limits, eco-cooperative adaptive cruise control (ECACC), and wireless inductive/resonance charging infrastructure embedded in the roadway.

Low Emissions Zones

Geographically defined areas that seek to incentivize "green transportation choices" or restrict specific categories of high-polluting vehicles from entering the zone to improve the air quality within the geographic area. Geo-fencing the boundaries allows the possibility for these areas to be responsive to real-time traffic and environmental conditions.

Eco-Traveler Information

Enables development of new, advanced traveler information applications through integrated, multisource, multimodal data. An open data/open source approach is intended to spur innovation and environmental traveler information applications.

Eco-ICM

Considers partnering among operators of various surface transportation agencies to treat travel corridors as an integrated asset, coordinating their operations simultaneously with a focus on decreasing fuel consumption and emissions.

AERIS OPERATIONAL SCENARIOS & APPLICATIONS

ECO-SIGNAL OPERATIONS

- **Eco-Approach and Departure at Signalized Intersections** *(similar to SPaT)*
- **Eco-Traffic Signal Timing** *(similar to adaptive traffic signal systems)*
- **Eco-Traffic Signal Priority** *(similar to traffic signal priority)*
- **Connected Eco-Driving** *(similar to eco-driving strategies)*
- **Wireless Inductive/Resonance Charging**

ECO-TRAVELER INFORMATION

- **AFV Charging/Fueling Information** *(similar to navigation systems providing information on gas station locations)*
- **Eco-Smart Parking** *(similar to parking applications)*
- **Dynamic Eco-Routing** *(similar to navigation systems)*
- **Dynamic Eco-Transit Routing** *(similar to AVL routing)*
- **Dynamic Eco-Freight Routing** *(similar to AVL routing)*
- **Multimodal Traveler Information** *(similar to ATIS)*
- **Connected Eco-Driving** *(similar to eco-driving strategies)*

ECO-LANES

- **Eco-Lanes Management** ***(similar to HOV Lanes)***
- **Eco-Speed Harmonization** ***(similar to variable speed limits)***
- **Eco-Cooperative Adaptive Cruise Control** *(similar to adaptive cruise control)*
- **Eco-Ramp Metering** *(similar to ramp metering)*
- **Connected Eco-Driving** *(similar to eco-driving)*
- **Wireless Inductive/Resonance Charging**
- **Eco-Traveler Information Applications** *(similar to ATIS)*

ECO-INTEGRATED CORRIDOR MANAGEMENT

- **Eco-ICM Decision Support System** *(similar to ICM)*
- **Eco-Signal Operations Applications**
- **Eco-Lanes Applications**
- **Low Emissions Zones Applications**
- **Eco-Traveler Information Applications**
- **Incident Management Applications**

LOW EMISSIONS ZONES

- **Low Emissions Zone Management** *(similar to Low Emissions Zones)*
- **Connected Eco-Driving** *(similar to eco-driving strategies)*
- **Eco-Traveler Information Applications** *(similar to ATIS)*

Moving Toward Deployment

- The AERIS Program is focused on near-term deployment of connected vehicle applications relevant to environmental outcomes and focused on environmental performance measures

- Environmentally-focused connected vehicle applications may include:
  1. Mobility and/or safety applications that also provide environmental benefits (e.g., Traffic Signal Priority or V2I Safety apps that reduce non-recurring congestion and thus emissions)
  2. Environmental-centric applications (e.g., Eco-Driving, Eco-Routing, Eco-Approach and Departure at Signalized Intersection)
  3. Applications that perform dual roles – apps that can be optimized for mobility or the environment (e.g., Speed Harmonization or Signal Timing)

- The AERIS Program is primarily focused on two performance measures:
  - Fuel use reductions
  - Emissions reductions

Moving Toward Deployment

- There are many paths to deployment – the Connected Vehicle Pilot Demonstrations are one, but not the only path to near-term deployment

- Metropolitan Planning Organizations (MPOs), Local Public Agencies (LPAs), transit operators, and states should begin considering connected vehicle strategies in their long range planning

- To support V2I planning for connected vehicles, the USDOT is developing several products/tools to assist the adopter community:
  - Vehicle-to-Infrastructure Deployment Guidance and Products: http://www.its.dot.gov/meetings/v2i_feedback.htm
  - A Connected Vehicle Reference Implementation Architecture (CVRIA): http://www.iteris.com/cvria/

AERIS Tools and Resources

- The AERIS Program developed several tools to assist the adopter community in moving environmental applications toward deployment
  - Concepts of Operations – Eco-Signal Operations, Eco-Lanes, Low Emissions Zones
  - Simulation, Modeling, and Benefit-Cost Analysis Results
  - Algorithms (primarily developed for modeling and analysis)
    - Eco-Approach and Departure at Signalized Intersections
    - Eco-Traffic Signal Timing
    - Eco-Traffic Signal Priority (Transit and Freight)
    - Connected Eco-Driving
    - Eco-Speed Harmonization
  - Eco-Approach and Departure at Signalized Intersections Prototype
    - Requirements
    - System Architecture and Design

Moving Toward Deployment – 3 Step Process

1

IDENTIFY LOCAL NEEDS

Identify local problems, challenges, and/or issues you are trying to address

2

SET PERFORMANCE GOALS

Set measurable goals and objectives that allow you to address local needs

3

SELECT CONNECTED VEHICLE APPLICATIONS THAT WORK TOGETHER TO MEET THOSE GOALS

Identify potential solutions – including connected vehicle applications – that help you meet your goals and objectives

Moving Toward Deployment – 3 Step Process

IDENTIFY LOCAL NEEDS

Identify local problems, challenges, and/or issues you are trying to address

SAMPLE LOCAL NEEDS

- **Mobility:** Congested arterials and freeways
- **Safety:** High number of crashes and fatalities
- **Environment:** Emissions and air quality issues
  - **City/Region:** Nonattainment area – poor air quality
  - **Truck / Delivery Fleets:** High operating costs (fuel costs)
  - **Individuals:** High operating costs (fuel costs); range anxiety for drivers of electric vehicles; lack of multimodal travel options

Moving Toward Deployment – 3 Step Process

2

SET PERFORMANCE GOALS

Set measurable goals and objectives that allow you to address local needs

SAMPLE PERFORMANCE GOALS

- **Vision Statement:** Cleaner Air Through Smarter Transportation

- **Goals and Objectives**
  - **Goal #1: Reduce Environmental Impacts**
    - Reduce CO_2 emissions by X percent by Y
    - Reduce excess fuel consumed by X percent by Y
  - **Goal #2: Support "Green Transportation Decisions" by Travelers and Operating Entities**
    - Increase modal shifts to transit, walking, bicycling, carpooling, and vanpooling by X percent by Y
  - **Goal #3: Reduce Transit Operating Costs**
    - Reduce fuel costs associated with operating a transit fleet by X percent by Y

Moving Toward Deployment – 3 Step Process

3

SELECT CONNECTED VEHICLE APPLICATIONS THAT WORK TOGETHER TO MEET THOSE GOALS

Identify potential solutions – including connected vehicle applications – that help you meet your goals and objectives

SAMPLE CV APPLICATIONS

- **Mobility and safety applications that result in environmental benefits**
  - Traffic Signal Priority applications may improve transit performance, but may also result in fuel consumption and emissions reductions
- **Environmental-centric applications**
  - Eco-Driving, Eco-Routing, Eco-Approach and Departure at Signalized Intersections
- **Applications that can perform dual roles**
  - Speed Harmonization or Traffic Signal Timing applications may be optimized for mobility and at other times may optimize for the environment

The Charge for Today

Expectations for today's workshop:

1. Through open engaging discussion, learn from each other about the state of the practice in environmental research and real-world deployments

2. Identify examples of local environmental issues and challenges that directly impact you (or your jurisdiction) that connected vehicle technologies can solve

3. Think outside the box to begin identifying connected vehicle applications that can be deployed in the near-term to address local environmental issues and challenges

Questions and Answers