Opportunities for Environmental Applications for Near Term Deployments
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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

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

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<thead>
<tr>
<th>Category</th>
<th>Description</th>
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<tr>
<td>28%</td>
<td>of GHG emissions associated with transport sector in the U.S.¹</td>
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<td>83%</td>
<td>of transport sector GHG emissions are associated with surface vehicles¹</td>
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<td>2.9 billion</td>
<td>gallons of wasted fuel resulting from congestion in urban areas²</td>
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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.
**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-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-Traveller Information Applications (similar to ATIS)

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

**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-INTEGRATED CORRIDOR MANAGEMENT**
- Eco-ICM Decision Support System (similar to ICM)
- Eco-Signal Operations Applications
- Eco-Lanes Applications
- Low Emissions Zones Applications
- Eco-Traveller Information Applications
- Incident Management Applications
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](http://www.its.dot.gov/meetings/v2i_feedback.htm)
The AERIS Program developed several tools to assist the adopter community in moving environmental applications toward deployment

- 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

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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 CO₂ 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
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