FHWA's GlidePath Project

Osman Altan, FHWA

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-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)*

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)*

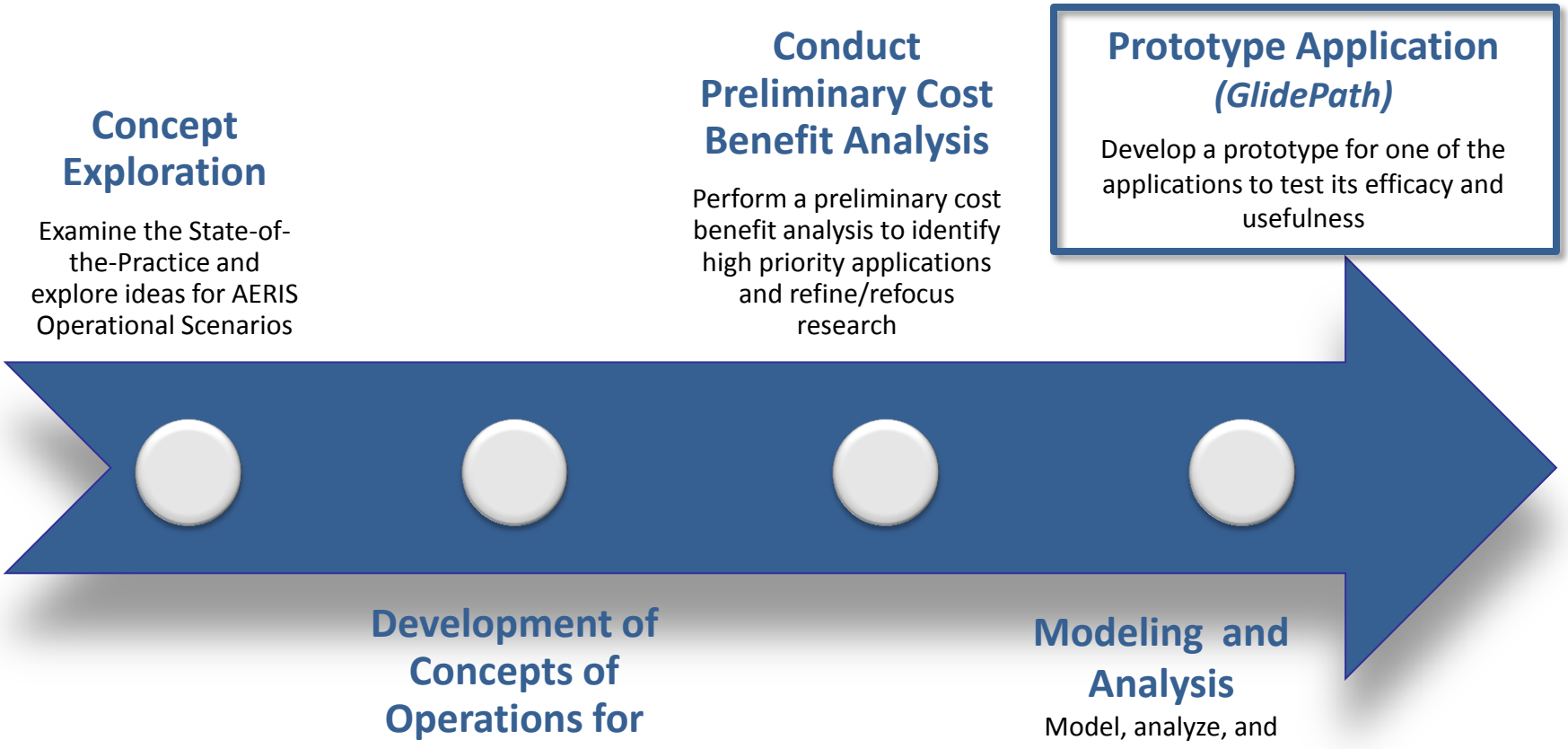
ECO-TRAVELER INFORMATION

- **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-Traveler Information Applications**
- **Incident Management Applications**

The AERIS Approach



Concept Exploration

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

Development of Concepts of Operations for Operational Scenarios

Identify high-level user needs and desired capabilities for each AERIS scenario in terms that all project stakeholders can understand

Conduct Preliminary Cost Benefit Analysis

Perform a preliminary cost benefit analysis to identify high priority applications and refine/refocus research

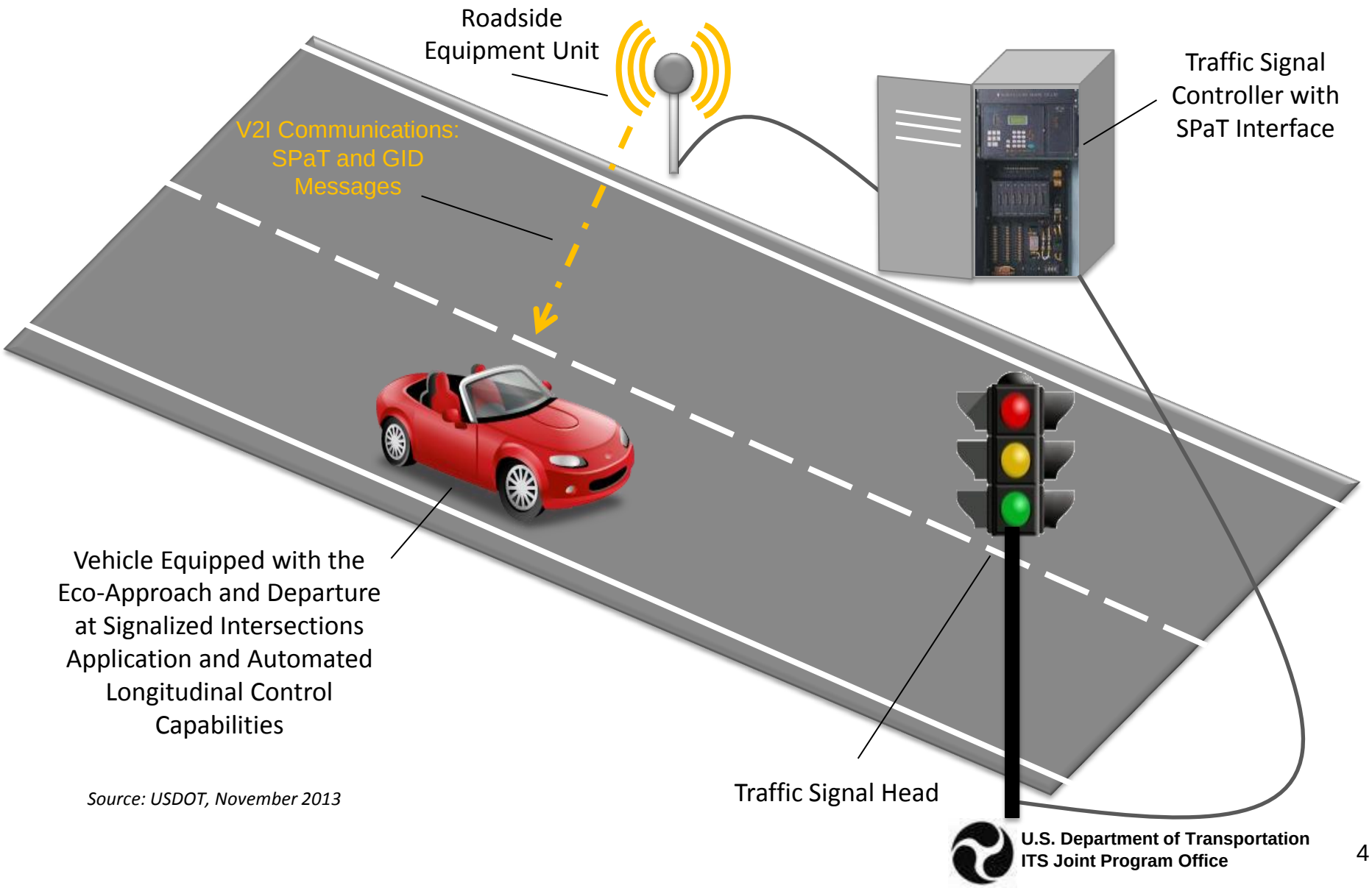
Modeling and Analysis

Model, analyze, and evaluate candidate strategies, scenarios and applications that make sense for further development, evaluation and research

Prototype Application *(GlidePath)*

Develop a prototype for one of the applications to test its efficacy and usefulness

GlidePath Prototype Application



Source: USDOT, November 2013

Project Introduction

- **Project Background**
  - Completed AERIS Proof of Concept Testing (Fall 2012)
    - University of California at Riverside (UCR) developed and tested an Eco-Approach and Departure (EAD) Trajectory Planning Algorithm that showed up to 18% fuel savings at a signalized intersection

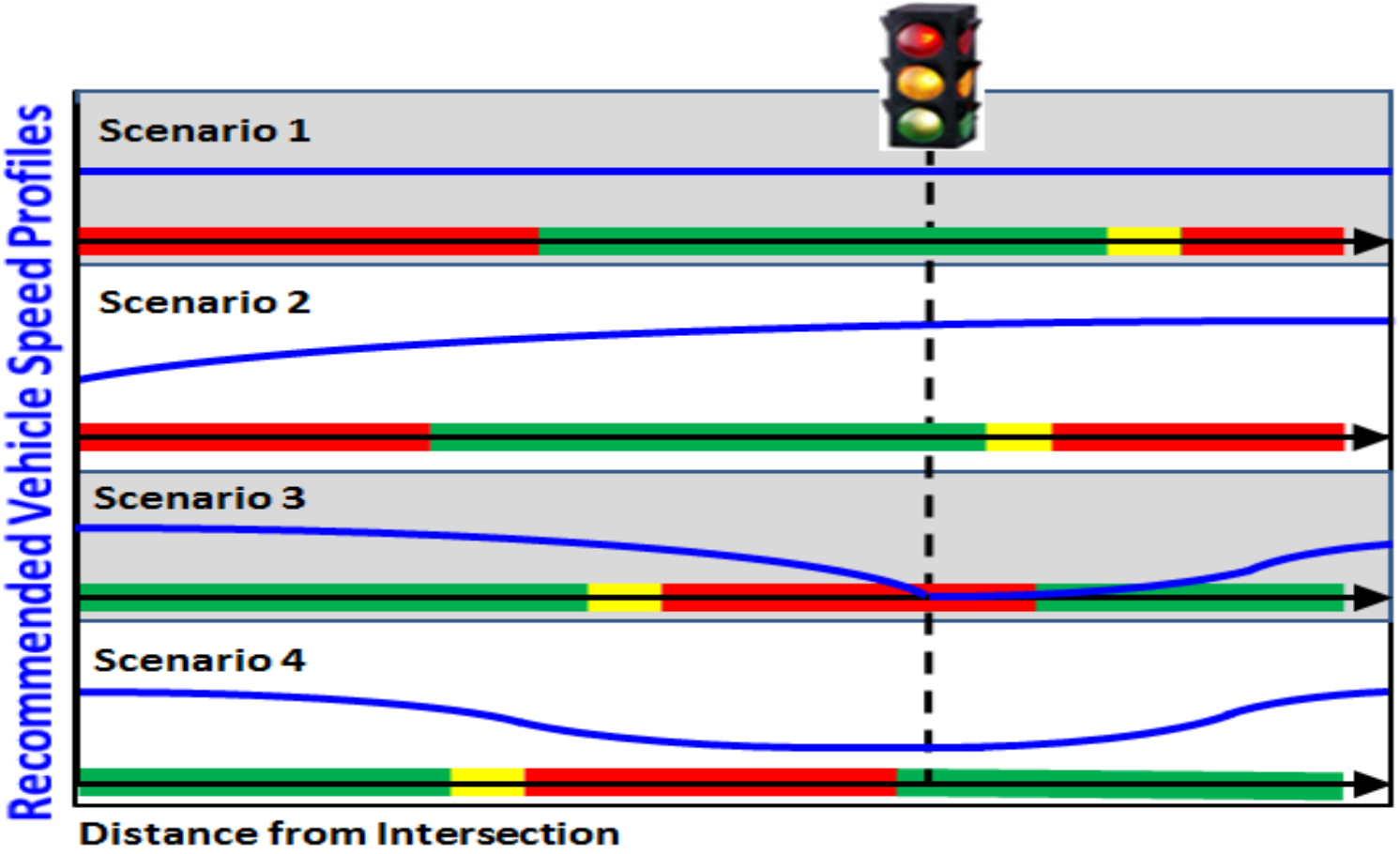
- **Next Phase – Automated GlidePath Prototype**
  - Scope: Develop prototype for 1 vehicle at 1 intersection
  - Period of Performance: May 2014 through November 2015

Project Objectives

- Create a working prototype GlidePath application with automated longitudinal control for demonstration and future research;
- Evaluate the performance of the algorithm and automated prototype;
- Conduct testing and demonstrations of the application at TFHRC

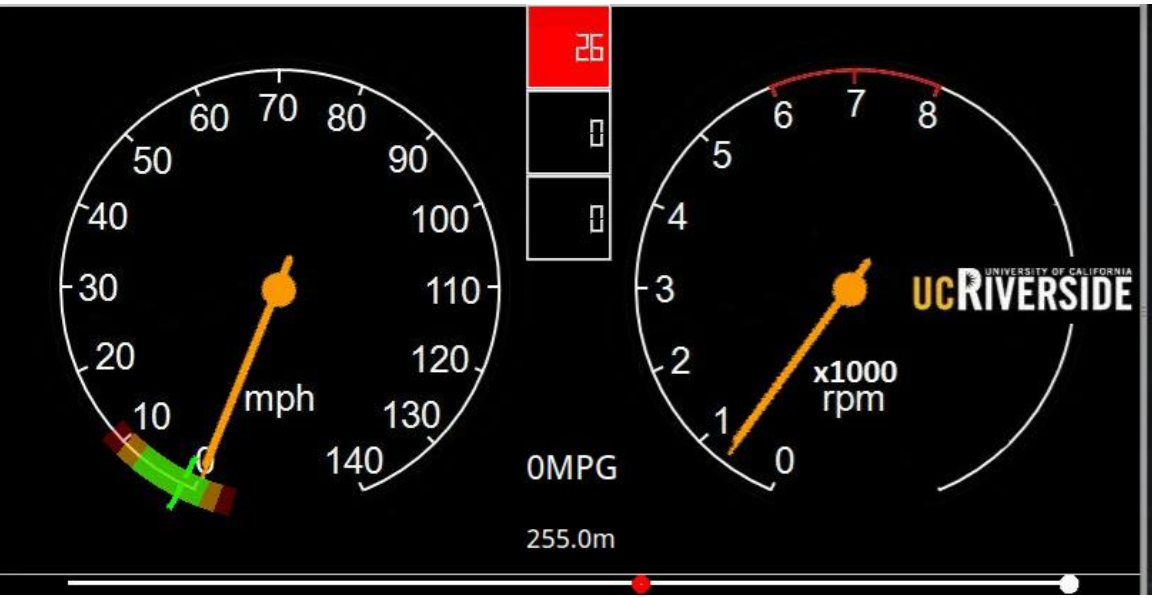
Previous Work – AERIS EcoDrive Application

Reduce fuel consumption by providing speed guidance near signalized intersections



Previous Work – AERIS EcoDrive

Scenario 4: Slightly Reduce Speed to Avoid Red Light



Previous Work – AERIS EcoDrive Study Results

Reduced Fuel Consumption

Speed (mph)	Average Fuel Savings (ml)	Sigma	Average % Improvement
20	13.0	-	2.5%
25	111.0	10.9	18.1%
30	76.0	15.7	11.2%
35	73.8	19.6	6.3%
40	107	14.6	9.5%

GlidePath Project Partners

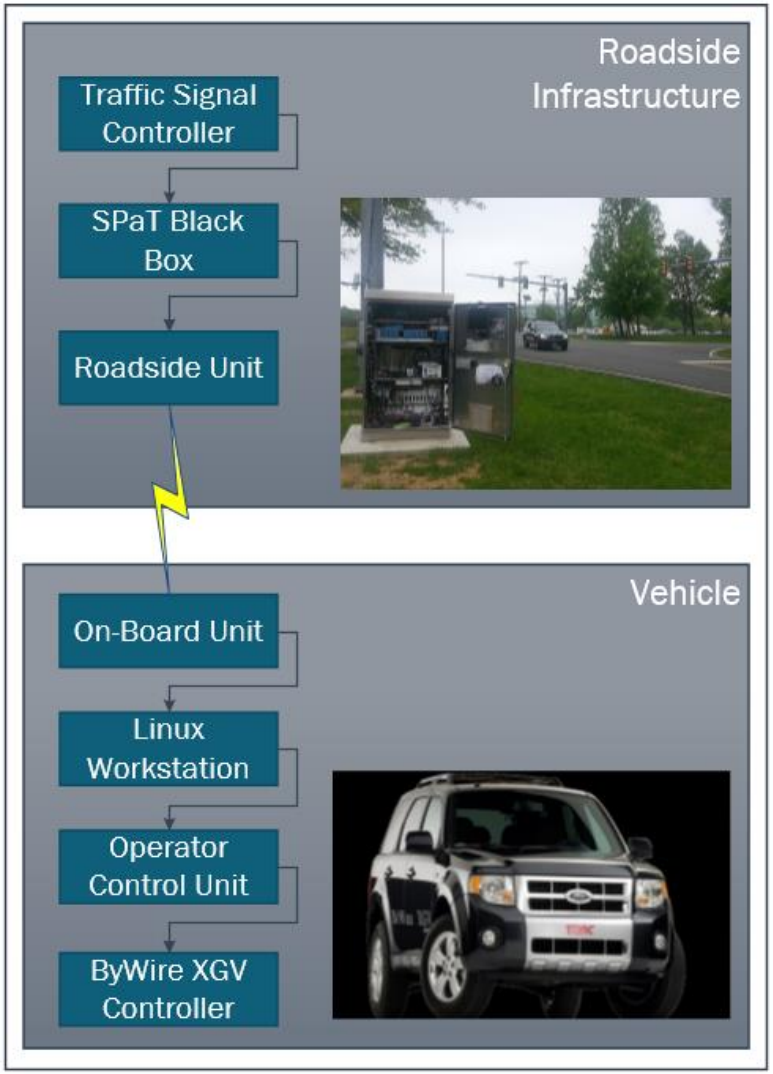
leidos

UNIVERSITY OF CALIFORNIA
UCRIVERSIDE

TORC

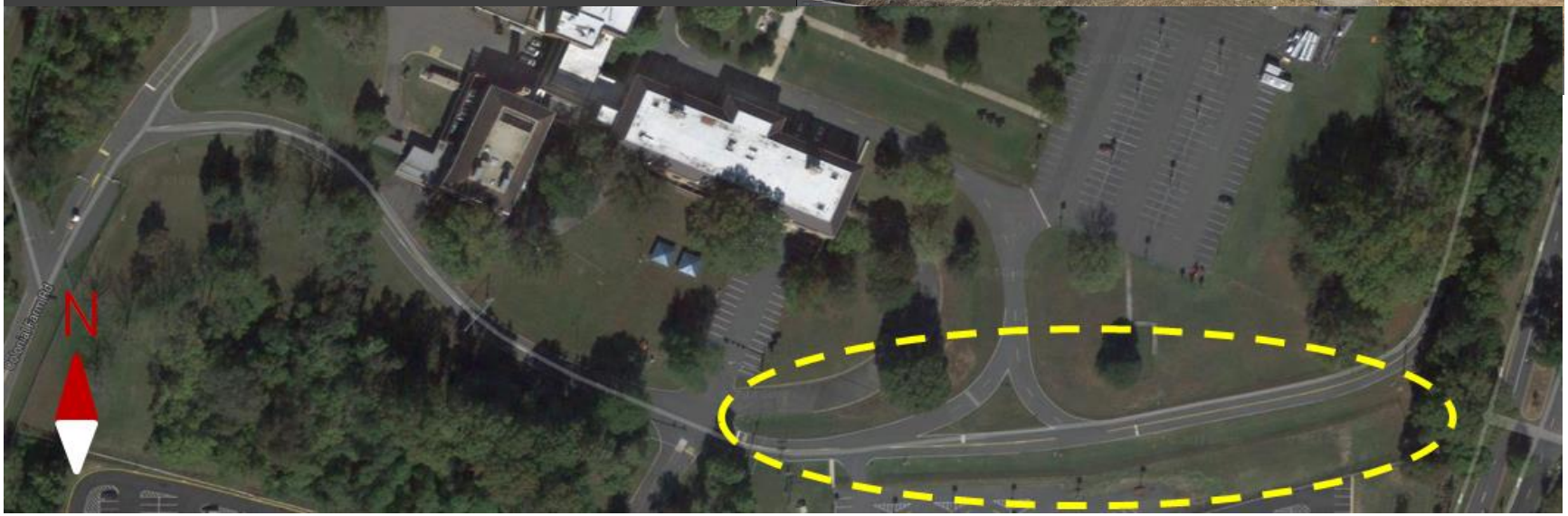
System Components

- High-Level System Architecture
- Component Systems:
  - Roadside Infrastructure
    - Signal Controller, Black Box and DSRC RSU
  - Automated Vehicle
    - Existing Capabilities
    - Additional Functionality
  - Algorithm
    - Objective, Input and Output



Components – Roadside Infrastructure

- Econolite Signal Controller
- SPaT Black Box
- DSRC RSU
- Fiber Backhaul



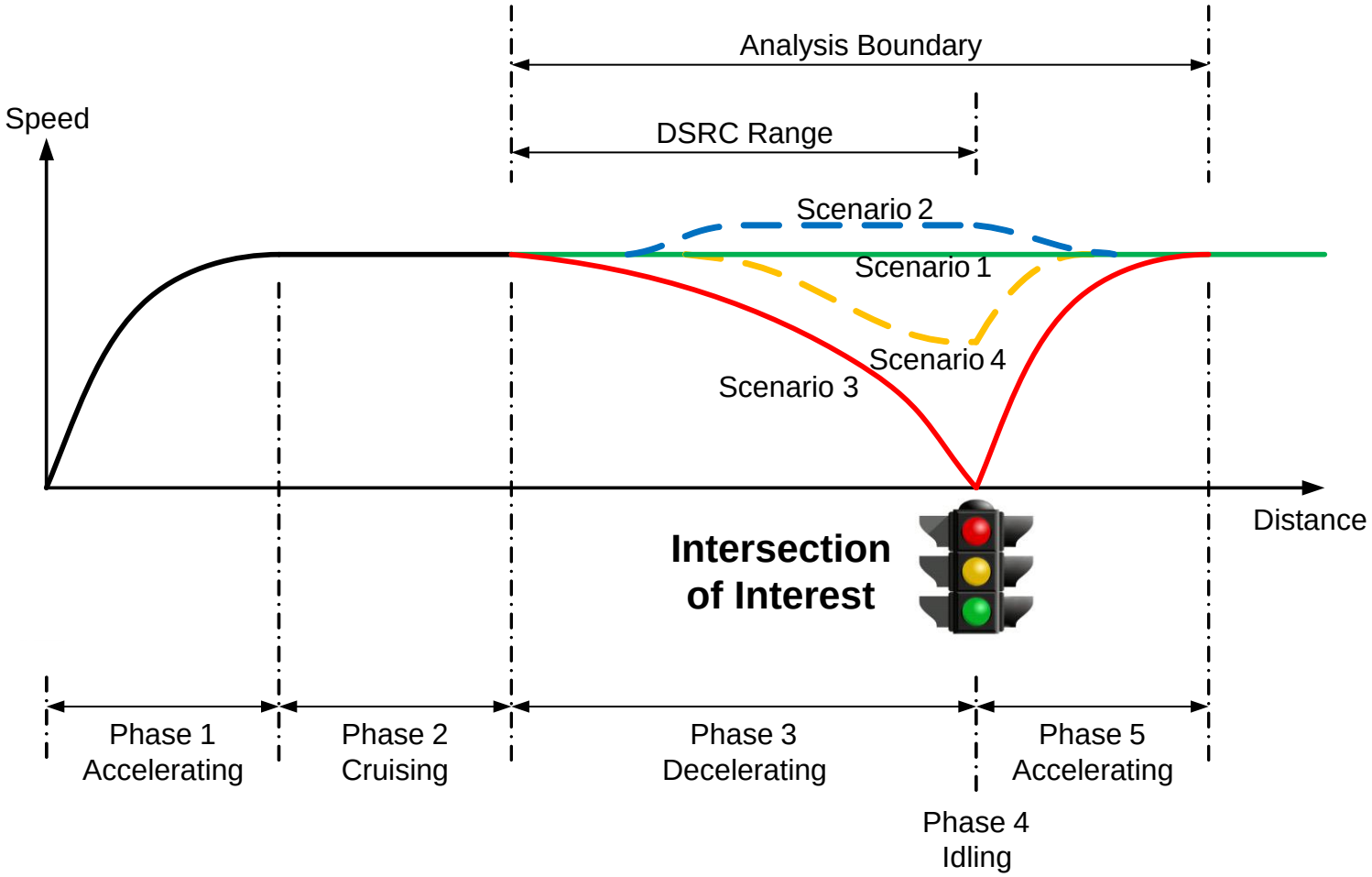
Components – Automated Vehicle

- Ford Escape Hybrid developed by TORC with ByWire XGV System
  - Existing Capabilities
    - Full-Range Longitudinal Speed Control
    - Emergency Stop and Manual Override
  - Additional Functionality
    - DSRC OBU
    - High-Accuracy Positioning Solution
    - Driver Indicators/ Information Display
    - User-Activated System Resume
    - Data Logging

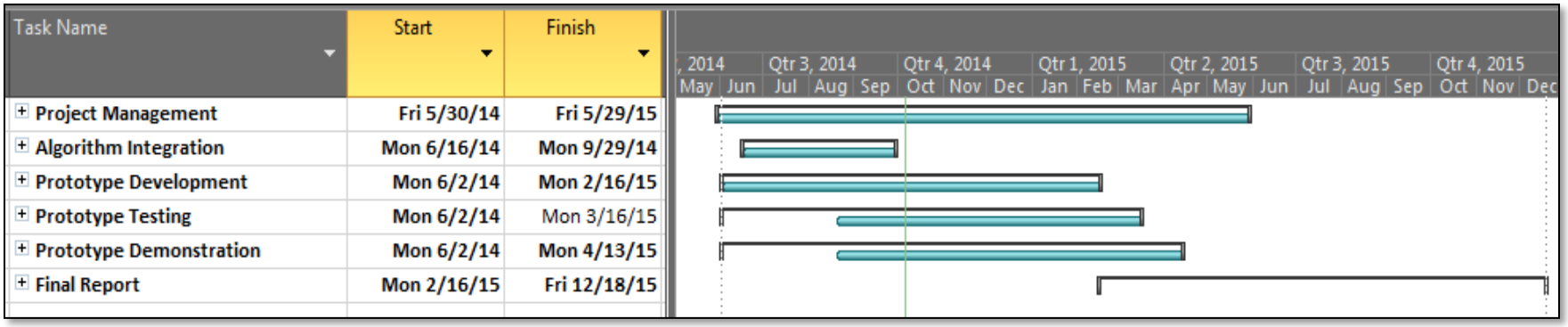
Components – Algorithm

- **Objective:** *Optimize environmental performance of a vehicle approaching a signalized intersection*
- **Input:**
  - Vehicle Location (distance to intersection)
  - Vehicle Speed
  - Signal Phase and Timing (SPaT) and MAP Messages
  - Scenario/Environmental Thresholds:
    - Maximum speed, acceleration, deceleration, jerk, etc.
- **Output:**
  - Speed Trajectory
    - Target Speed at 1Hz
    - Target Acceleration/Deceleration transitions to minimize fuel consumption and bound “jerk” (da/dt) for passenger comfort

Scenario Overview



Schedule Overview



Task Name	Start	Finish
Project Management	Fri 5/30/14	Fri 5/29/15
Algorithm Integration	Mon 6/16/14	Mon 9/29/14
Prototype Development	Mon 6/2/14	Mon 2/16/15
Prototype Testing	Mon 6/2/14	Mon 3/16/15
Prototype Demonstration	Mon 6/2/14	Mon 4/13/15
Final Report	Mon 2/16/15	Fri 12/18/15

Summary

- Upgrade previous advisory system to an automated, longitudinally-controlled prototype, targeting better system performance and environmental benefits

- Serve as the basis for a larger scale AERIS demonstration

Thank You

Osman D ALTAN, Ph.D., EE
Research Transportation Specialist
DOT Federal Highway Administration
Office of Operations R&D, HRDO-30
Email: Osman.Altan@dot.gov
Desk: 202-493-3391

For more information, visit: http://www.its.dot.gov/aeris/