2012 DOE Vehicle Technologies Program Review

Look-ahead Driver Feedback and Powertrain Management

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Project ID: VSS087

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Overview

Timeline

- Start: 10/2011
- Finish: 9/2014
- 15% complete

Budget

- Total project funding
  - DOE: $914k
  - Cost Share: $238k
- Current Phase:10/2011-1/2013
  - $367K (DoE)
- Next Phase:1/2013-1/2014
  - $308k (DoE)

Barriers

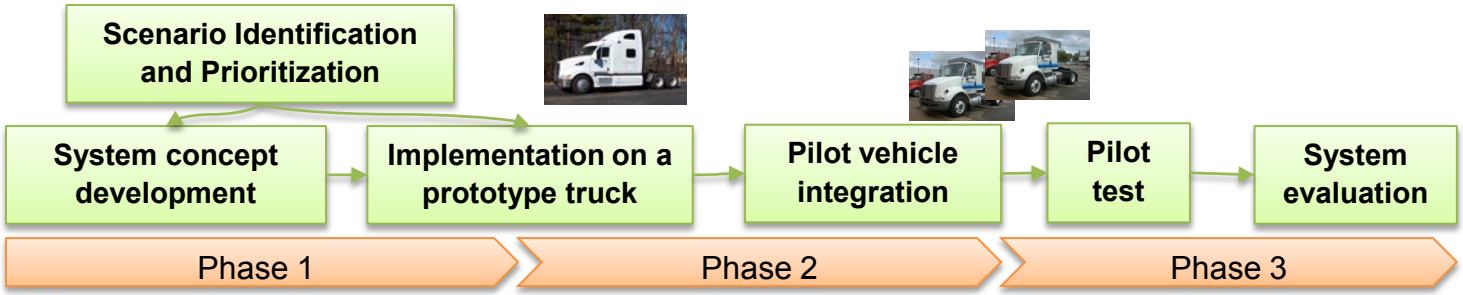
- Driver acceptance
- Safety concerns
- Cost effectiveness

Partners

- UMTRI
  - Driver interface, pilot test
- ORNL:
  - Tech consulting & evaluation
- Con-Way Freight
  - End user

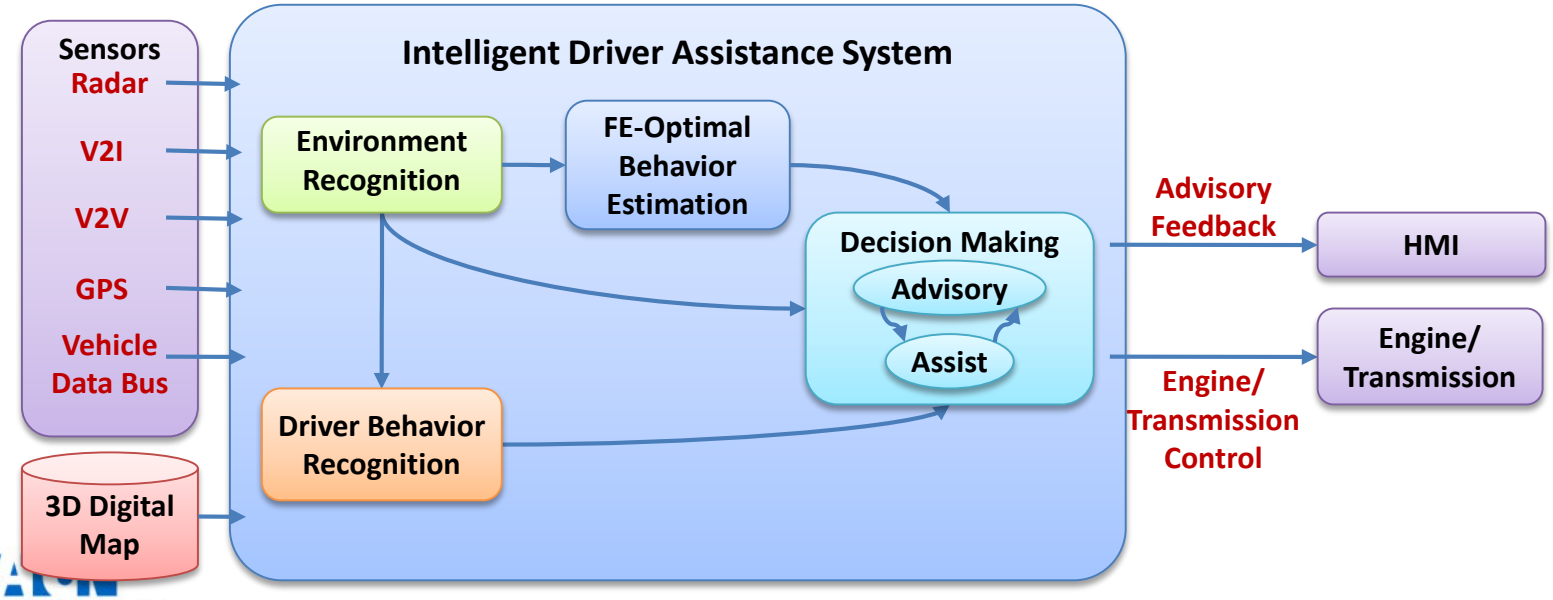
Relevance

- Overall Project Objective
  - Develop and demonstrate on real vehicles a driver assistance technology to reduce commercial fleet average fuel consumption by at least 2%
- Phase 1 Goals
  - Develop functional requirement specifications
  - Identify driver scenarios that impacts fuel consumption the most
  - Develop feedback strategy for target scenarios
  - Develop candidate driver interface and scenarios for driving simulator workload study



Approach

- Built upon existing and next-gen sensor and information technology
  - Will assess the impact of various options and their commercialization potential
- Scenario-specific feedback strategy
  - Leverage over 600k miles of naturalistic driving data from a recent DoT study
  - Separate environment caused inefficiency from driver caused inefficiency
- A combination of powertrain control and advisory feedback
  - Maximize fuel saving potential with minimum distraction



Key Milestones in Phase I

Month/Year	Milestone or Go/No-go Decision
1/2012	Milestone: Decide on target driving scenarios for fuel consumption impact analysis
3/2012	Milestone: Completion of look-ahead controller hardware design
6/2012	Milestone: Identify and prioritize the driving scenarios that have the most impact on fuel consumption
9/2012	Milestone: Completion of functional requirement specifications development
12/2012	Milestone: Completion of the development of driver interface candidates and the simulation study plan
12/2012	Go/No-go: Demonstrate through simulation the feasibility of the technology and the target fuel economy improvement

Technical Accomplishments and Progress

- Task 2.1: Voice-of-customer collection and functional requirements development
  - Interviewed one large trucking company
    - Acknowledged large fuel economy variation among drivers
    - Showed strong willingness to try the proposed technology
  - Evaluated various implementation options
    - Identified the minimum integration requirements with existing transmission and engine controls
  - Worked with sensor and map suppliers to define required features and communication interface

Technical Accomplishments and Progress

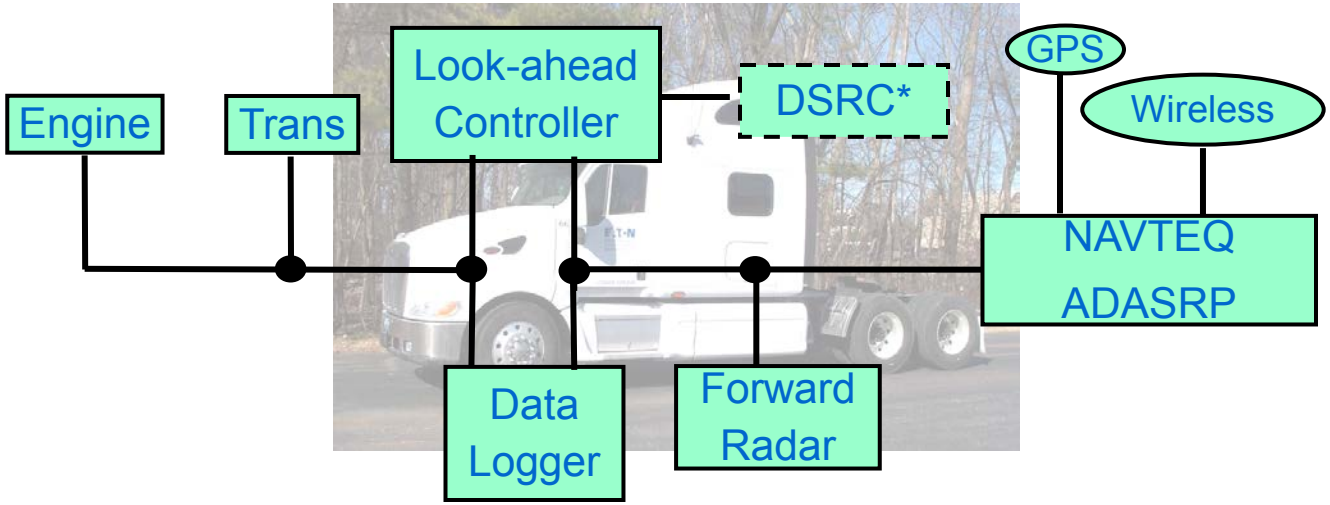
- Task 2.2: High fuel-consumption impact scenario identification
  - Defined scenarios of interest based on simulation and sampled field test data
  - Extracted grade & curve events for exposure and impact analysis

Scenario of interest	High exposure*	High impact*
Up-speed transition	√√	--
Speed-keeping on grade	√	√
Speed-keeping on curves	?	√
Speed-keeping in traffic	√	√√
Down-speed transition	?	√

High exposure scenarios: Scenario that accounts for significant fuel consumption
****High impact scenarios: Scenarios that driver behavior can cause large fuel efficiency variation***

Technical Accomplishments and Progress

- Task 3.1: Look-ahead System Development
  - Narrowed down hardware design to two candidates
  - Initiated integration of the DSRC devices (for V2V and V2I communication) - bench test completed
  - Initiated analysis on software integration with transmission controller (for vehicles with auto transmission)



** Dedicated Short Range Communication*

Collaborations

- Partners
  - UMTRI:
    - Collaborated on scenario exposure and impact analysis
    - Collaborated on driver interface development
  - ORNL:
    - Exchanged experience on previous heavy-truck related studies and truck fuel efficiency measurement
- Others
  - USDoT Volpe Center
    - Helped on identifying additional field test data that can potentially be beneficial to the project
  - USDoT Michigan Test Bed (V2x Communication)
    - Helped on V2x communication integration
  - NavTeq
    - Collaborated on system design and map integration

Future Work

- Remaining of Phase I
  - Complete functional requirement specifications development
  - Decide on feedback strategy based on the analysis and prioritization on high fuel consumption impact scenarios
  - Develop candidate driver interfaces and scenarios for driving simulator workload study
- Phase II
  - Down select and finalize driver interface
  - Finalize the prototype look-ahead system and integrate it onto pilot vehicles
  - Develop and verify the data acquisition system for the pilot vehicles

Summary

- Objective: Improve commercial fleet fuel efficiency by at least 2%
- A scenario-specific approach
  - A combination of advisory feedback and power control based on specific strategies for target scenarios to maximize fuel saving with minimum distraction
- Phase I progress is on-track and we are well positioned to continue the research in Phase II
  - Engaging with target end users to confirm the needs and to guide functional requirements development → paving the path for commercialization
  - Leveraging over 600k miles of naturalistic driving data from a previous study to identify high fuel consumption impact scenarios
  - Engaging with sensor and map suppliers to seek cost effective system design
  - Using the prototype truck to identify and address system design and retrofit risks upfront