Driving Future Highways

Welcome to the Saxton Transportation Operations Laboratory
Vision of the Saxton Lab

Advance the State of the Art through Transportation Operations Research

- Build Relationships with Universities, Researchers, and Industry
- Promote Professional Development
- Build on Federal Institutional Knowledge
- Develop Technologies and Evaluate Concepts
Saxton Lab Capabilities

Cooperative Vehicle-Highway Testbed

Concepts and Analysis Testbed

Data Resources Testbed

External Stakeholders, Applications, and Data

Living Laboratories
Development Platform for FHWA Innovation Research Vehicles

- Proof of Concept Vehicles
- Research Fleet Communications
  - 5.9GHz DSRC, Cellular/LTE, Corrected GPS
- On-board Technology
  - Connected Vehicle Data Collection and Processing
  - Stock Radar and Ultra-Sonic Sensors
  - Front and rear-facing cameras
Connected Laboratory

• State-of-the-Art Simulation and Analysis Tools
• High-Bandwidth Internet2 Connectivity
• High-Capacity Data Servers
  - Front and rear-facing cameras
Connected Vehicle Highway Testbed – Intelligent Intersection at TFHRC

- CCTV
- DSRC
- Signalized intersection with SPaT / MAP
- Vehicle Pedestrian & Bike Detection
- Fixed time or actuated traffic signal control with pedestrian / bike displays
- Dedicated Ethernet & Wi-Fi communications
- Cabinet space with power & comms, available for future research
- Cadillac SRX with OBU, GPS, CAN bus integration
MOU with DHS
Federal Law Enforcement Training Center

Existing
A. Wire Mounted Traffic Signals
B. Closed-Loop Test Track
C. Ramps
D. Pole-Mounted Traffic Signal
E. Flat Space Open Testing
F. Skid Pad

Future:
DSRC / Wi-Fi
V2I Communications
IAA with U.S. Army
Aberdeen Test and Evaluation Command
## Automation - Example Systems at Each Level

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<th>SAE Level</th>
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<th>Driver Roles</th>
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<td>Adaptive Cruise Control OR Lane Keeping Assistance</td>
<td>Must drive other functions and monitor driving environment</td>
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Source: California PATH
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Research in Applications for Connected Automation

➢ Connected Automation Applications for Public Benefits:

– Cooperative Adaptive Cruise Control (CACC): Adds V2V communication to commercial ACC and allows platoons of cars or trucks. Can reduce traffic congestion, reduce fuel consumption, and improve safety.

– Eco-Approach and Departure (Glidepath): Uses V2I communication from traffic signals to allow vehicles to traverse traffic lights and travel along arterials more efficiently. Can reduce fuel consumption at intersections by 20%

➢ FHWA Roles:

– Develop and analyze concepts with traffic models
– Test concepts and enabling technologies with Lab prototypes on test tracks
– Engage automotive OEM’s to work toward commercial products
– Engage state DOT’s to develop strategies for deployment
Cooperative Adaptive Cruise Control Evolution

Three different types of cruise control

- Standard Cruise Control
- Adaptive Cruise Control
- Cooperative Adaptive Cruise Control

Current Market Penetration

Throttle

Future of Cruise Control

Throttle Radar

Communication
CACC Platooning
Cooperative Adaptive Cruise Control Research

- Create a high-speed and high-capacity managed CACC lane

- Examine the impacts of different CACC operational strategies
  - Dedicated Lane VS. Shared Lane
  - Car-following headway
  - Platoon size
  - Market penetration levels
  - On-ramp and Off-ramp volume
  - Lane-changing criteria between CACC and GP lane
Build the Simulation Testbed
--- CACC Site Selection

- Major urban corridor for commuters
- Severe congestion problems
- Four lanes in each direction
- Existing HOV-2 lane
- Six interchanges
CACC Take-Away Bullets

- The dedicated lane’s capacity increases from 1650 to 3800 vehicles/hour/lane (0.6s headway)

- CACC lane has shorter and more reliable travel time, which will promote CACC technology

- Cooperative lane-changes are important, especially under high speed differentials
GlidePath Prototype Application

Background: Completed AERIS Proof of Concept Testing (Fall 2012)
A field test was conducted at TFHRC with a single vehicle at a single intersection with no traffic

Eco-Approach and Departure at Signalized Intersections Application
GlidePath Prototype Application 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**
  - Computing Platform with EAD Algorithm
  - DSRC OBU
  - High-Accuracy Positioning Solution
  - Driver Indicators/Information Display
  - User-Activated System Resume
  - Data Logging
• HMI-based driving provided a 7% fuel economy benefit
• Partially automated driving provided a 22% benefit
• Minimizing controller lag is important
• Precise positioning is important near the intersection stop bar
To Learn More…

➢ Visit:
  – FHWA Office of Operations Website: http://ops.fhwa.dot.gov/
  – Turner-Fairbank Highway Research Center Website: http://www.fhwa.dot.gov/research/tfhrc/offices/operations/

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