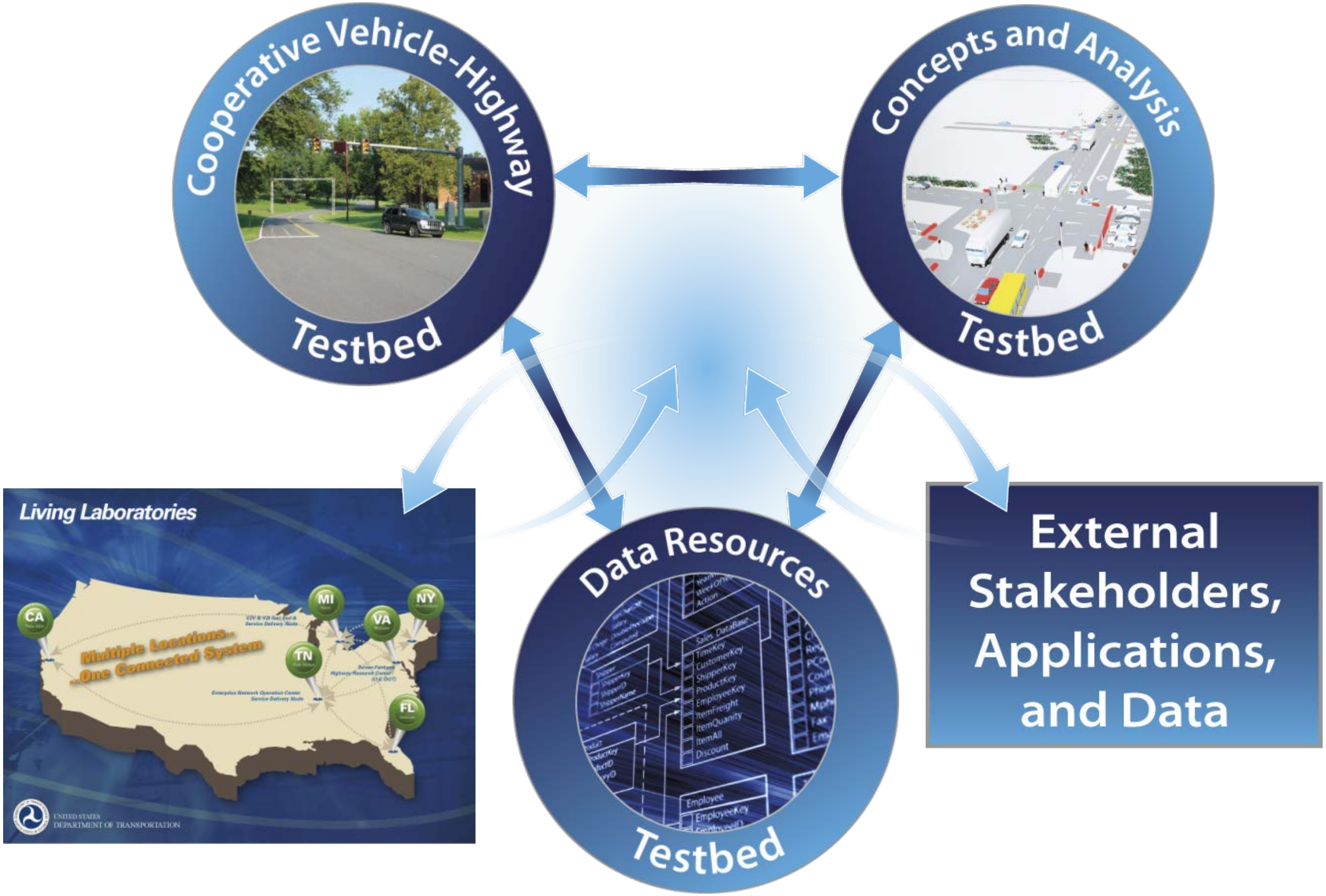
Driving Future Highways

Welcome to the Saxton Transportation Operations Laboratory

Vision of the Saxton Lab

Saxton Lab Capabilities



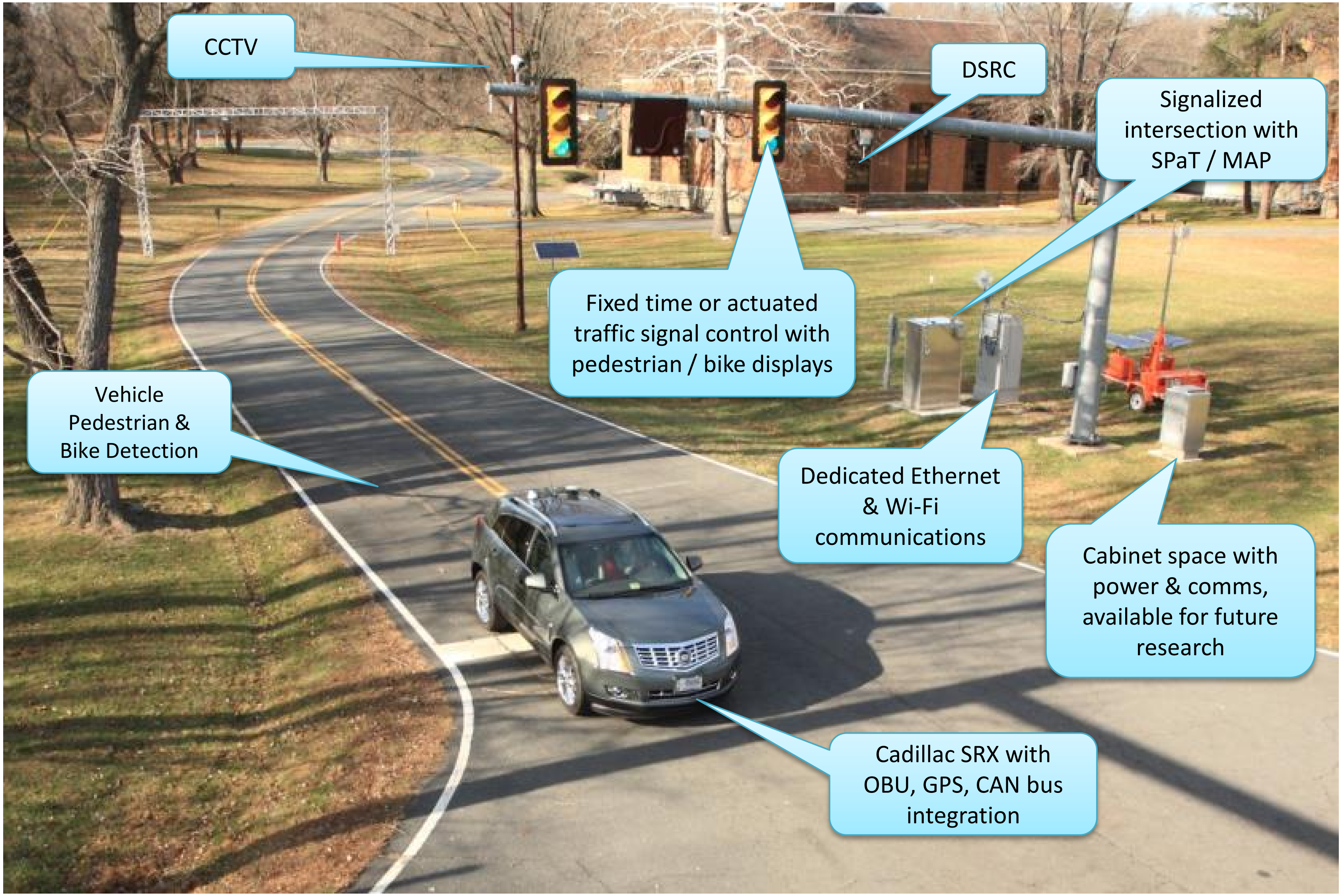
Development Platform for FHWA Innovation Research Vehicles

- 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

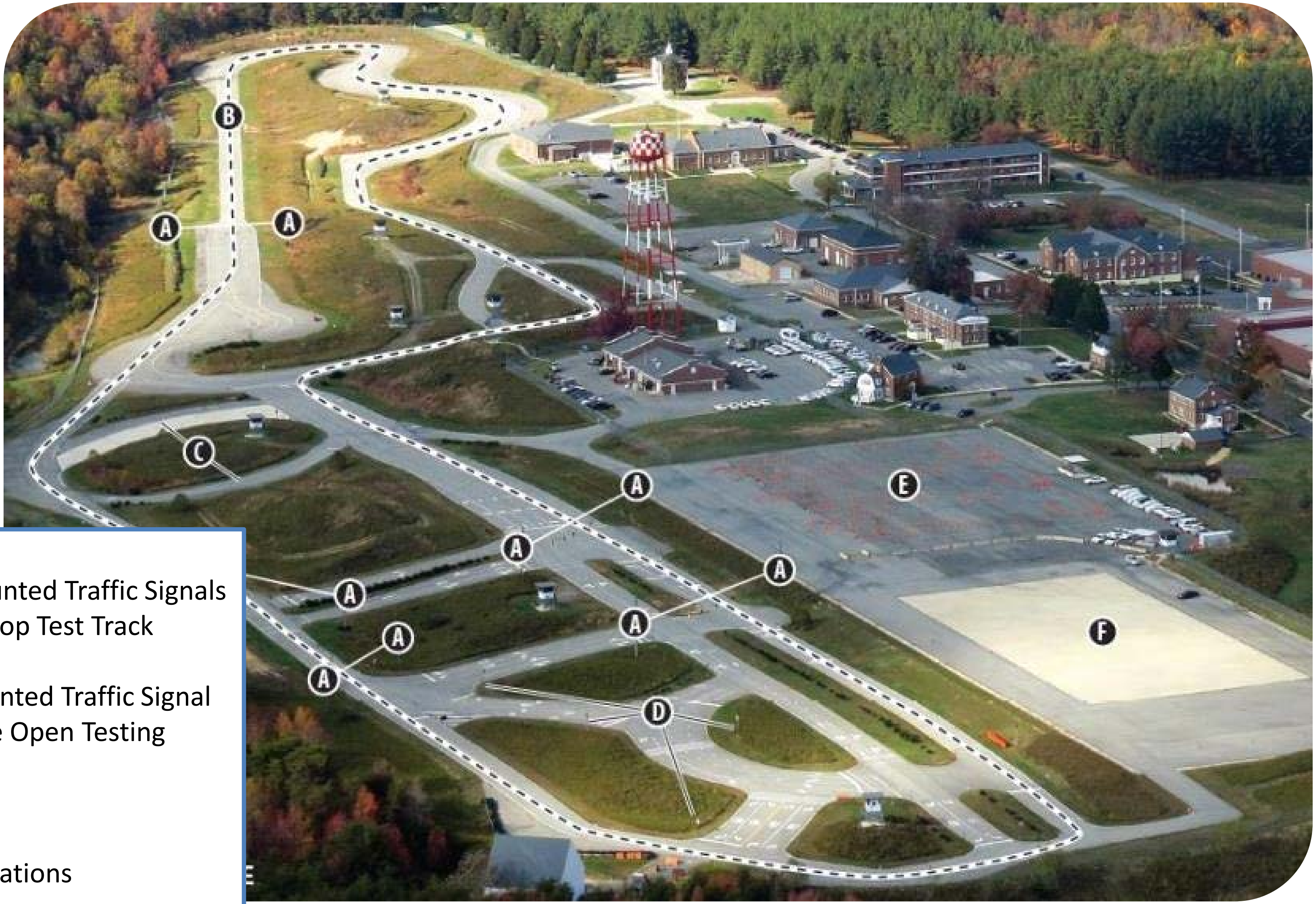
Connected Laboratory

- 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

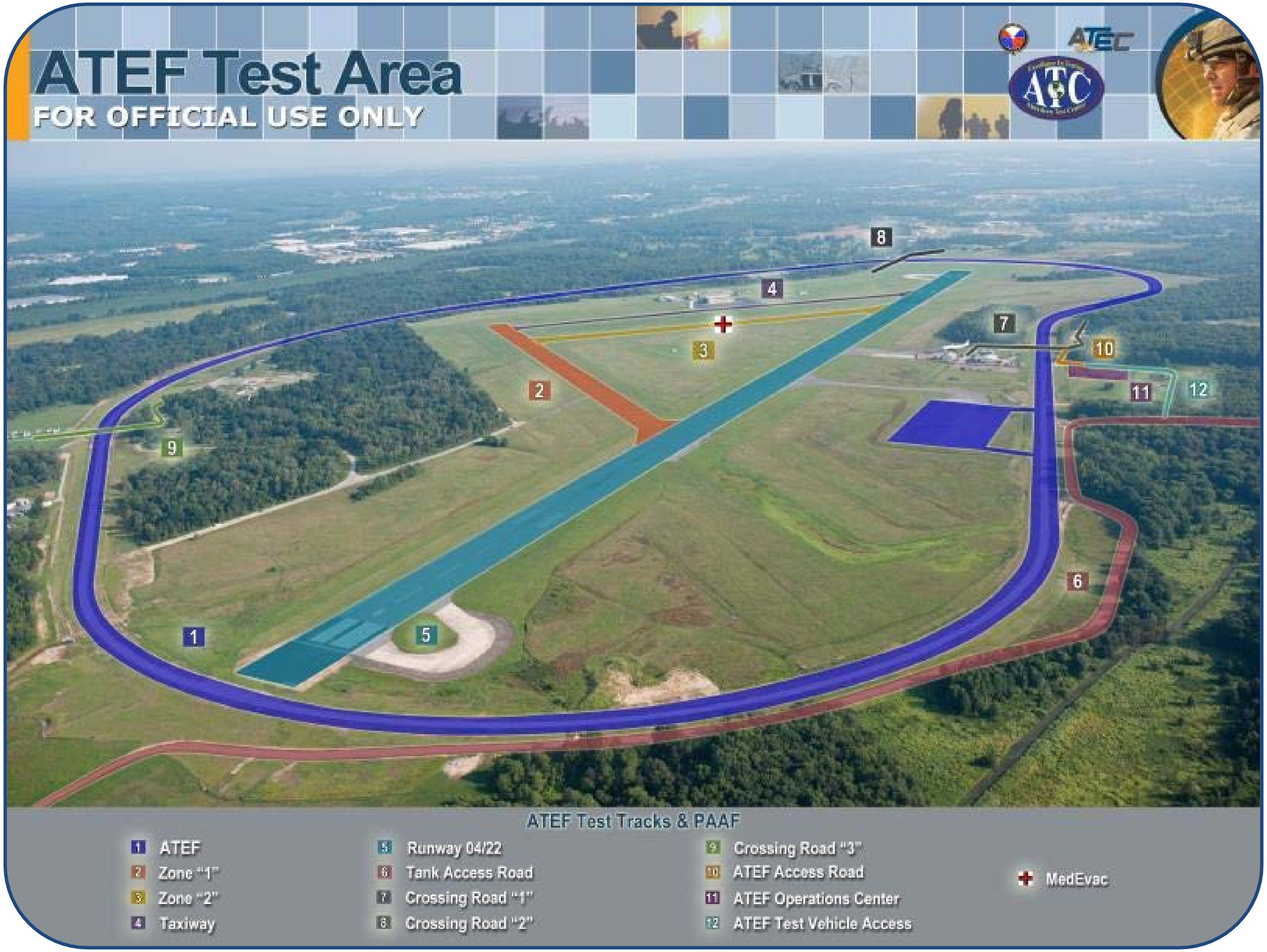


MOU with DHS
Federal Law Enforcement Training Center



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

SAEL evel	Example Systems	Driver Roles
1	Adaptive Cruise Control OR Lane Keeping Assistance	Must drive <u>other</u> functions and monitor driving environment
2	Adaptive Cruise Control AND Lane Keeping Assistance Traffic Jam Assist	Must monitor driving environment (system nags driver to try to ensure it)
3	Traffic Jam Pilot Automated parking Highway Autopilot	May read a book, text, or web surf, but be prepared to intervene when needed
4	Closed campus driverless shuttle Valet parking in garage 'Fully automated' in certain conditions	May sleep, and system can revert to minimum risk condition if needed
5	Automated taxi Car-share repositioning system	No driver needed

Source: California PATH

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Research in Applications for Connected Automation

Connected Automation Applications for Public Benefits:

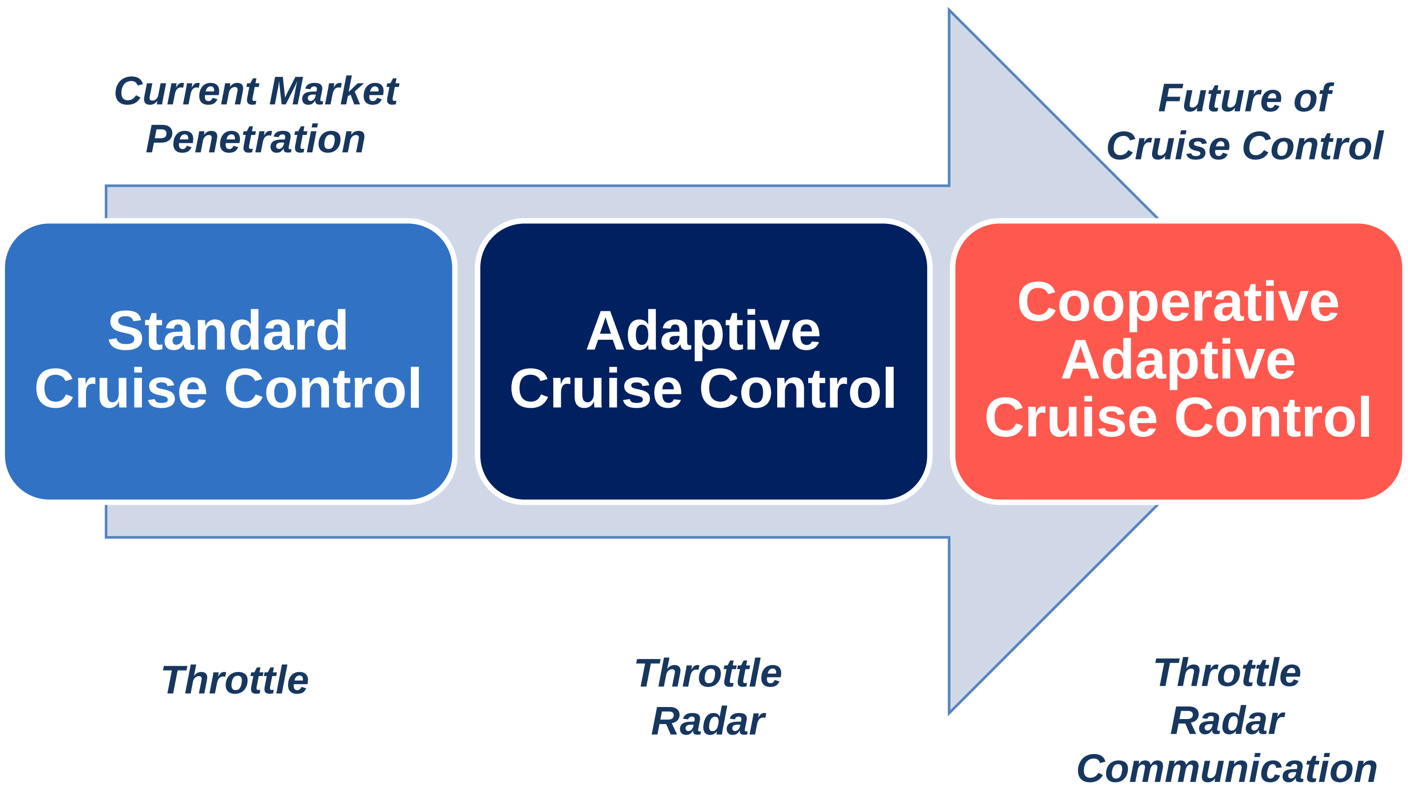
- Cooperative Adaptive Cruise Control (CACC): Adds V2V communication to commercial ACC and allows platoons of cars or trucks. Can reduce traffic congestion, reduce fuel consumption, and improve safety.
- Eco-Approach and Departure (Glidepath): Uses V2I communication from traffic signals to allow vehicles 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**



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

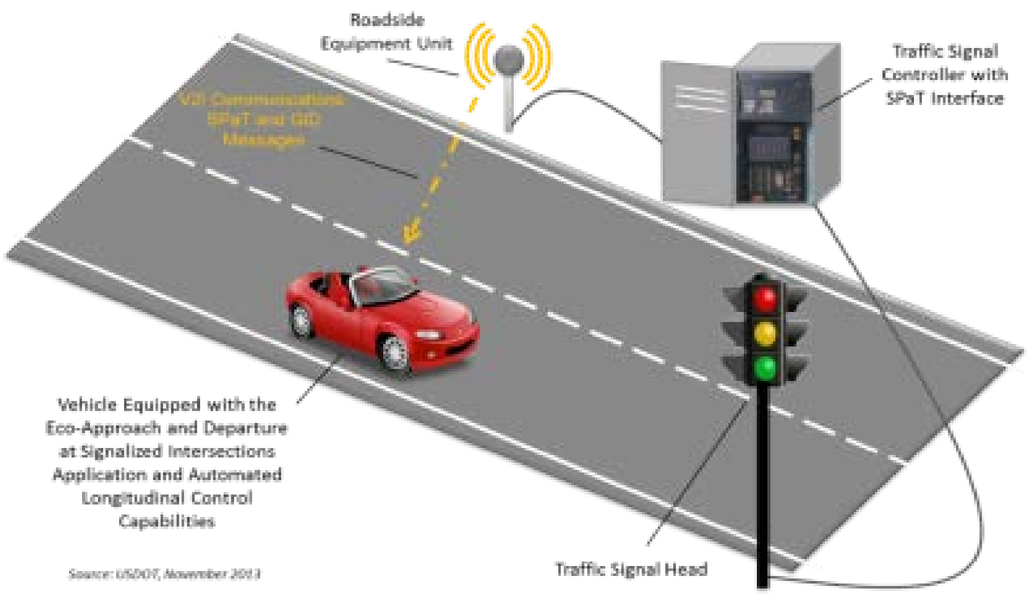
- **The dedicated lane's capacity increases from 1650 to 3800 vehicles/hour/lane (0.6s headway)**
- **CACC lane has shorter and more reliable travel time, which will promote CACC technology**
- **Cooperative lane-changes are important, especially under high speed differentials**

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

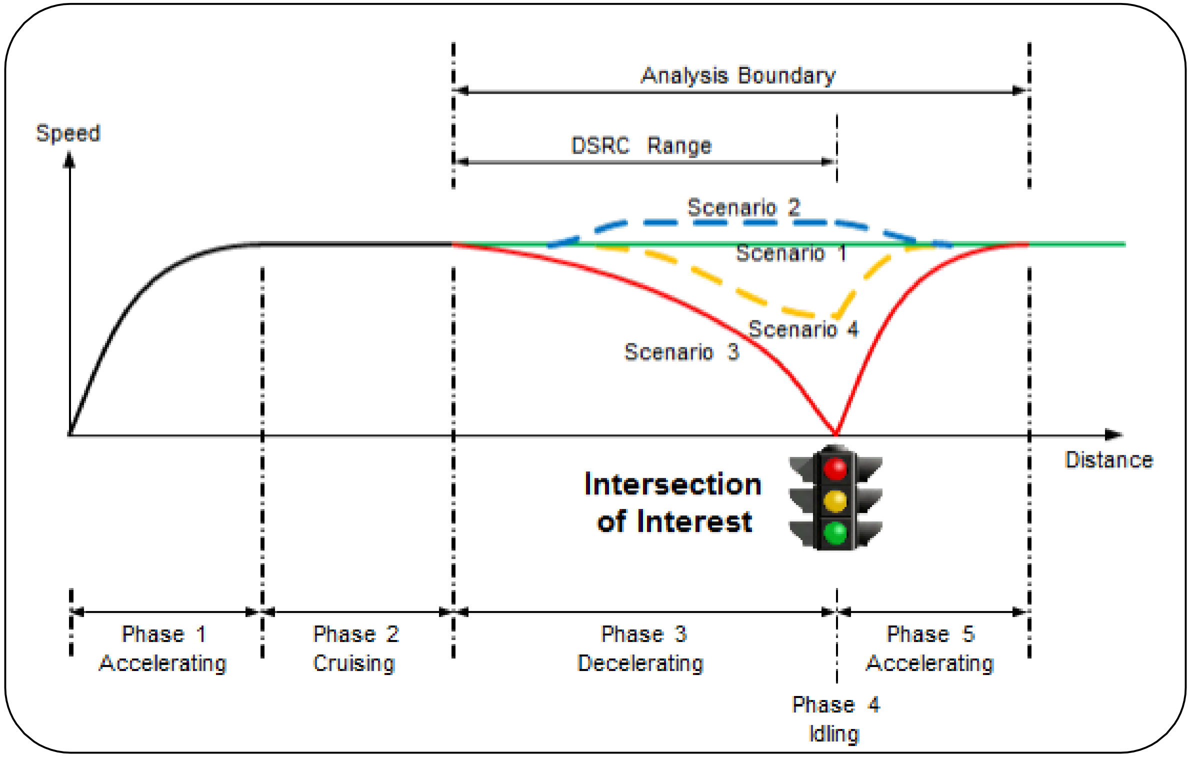
Eco-Approach and Departure at Signalized Intersections Application



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

GlidePath Prototype Application Research Study Findings



- **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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