Connected Automation

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Automation Can Be a Tool for Solving Transportation Problems

- Improving safety
  - Reduce and mitigate crashes

- Increasing mobility and accessibility
  - Expand capacity of roadway infrastructure
  - Enhance traffic flow dynamics
  - More personal mobility options for disabled and aging population

- Reducing energy use and emissions
  - Aerodynamic “drafting”
  - Improve traffic flow dynamics

…but connectivity is critical to achieving the greatest benefits
Connected Automation for Greatest Benefits

**Autonomous Vehicle**
Operates in isolation from other vehicles using internal sensors

**Connected Vehicle**
Communicates with nearby vehicles and infrastructure

**Connected Automated Vehicle**
Leverages autonomous and connected vehicle capabilities
## Example Systems at Each Automation Level

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<th>Example Systems</th>
<th>Driver Roles</th>
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<td>Must drive <strong>other</strong> functions and monitor driving environment</td>
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<td>Adaptive Cruise Control AND Lane Keeping Assistance Traffic Jam Assist</td>
<td>Must monitor driving environment (system nags driver to try to ensure it)</td>
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<td>3</td>
<td>Traffic Jam Pilot Automated parking Highway Autopilot</td>
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<td>Closed campus driverless shuttle Valet parking in garage ‘Fully automated’ in certain conditions</td>
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Source: California PATH
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Current L1 Connected Automation R&D

- Cooperative Adaptive Cruise Control (CACC) development
- Traffic Operations Applications
- Eco-Approach and Departure from Signals
- Truck Platooning
CACC Development Projects

- Enabling CACC High Performance Vehicle Streams
- CACC Field Tests
- OEM Assessment of CACC concepts and prototype
- Driver Acceptance of L1 Applications
Freeway Traffic Operations Applications

- Freeway Speed Harmonization
- Lane Change/Merge Operations

Lane change, merge, and weave maneuvers

[Graph showing Normalized Power Spectral Density]
Eco GlidePath at Signalized Intersections

1. Traffic Signal Controller
   - The roadside unit transmits SPaT and MAP messages using DSRC.

2. SPaT Black Box

3. Roadside Unit

4. Onboard Unit
   - Onboard Computer with Automated Longitudinal Control Capabilities

5. Backhaul: Communications back to TMC

6. Driver-Vehicle Interface
   - Back Office: A local TMC processes data from roads and vehicles

7. Back Office: A local TMC processes data from roads and vehicles
Truck Platooning

- Two projects underway
  - Auburn U/Peterbilt (2-truck platoons)
  - Caltrans/UC Berkeley/Volvo (3-truck platoons)
- Concept: longitudinal control only; all drivers steer
Assessing the Impacts of Automation

[Diagram showing the interrelations between various factors such as safety, vehicle operations, energy/emissions, network efficiency, travel behavior, personal mobility, public health, land use, socio-economic impacts, and their temporal and spatial resolutions.]
Impact Mechanism Example

Vehicle operations and road capacity

- Car following
  - Affects lane capacity for an uninterrupted facility
  - Human driver: minimum safe headway, speed variation
  - Autonomous: reduced speed variation
  - Connected / automated: may enable reduced headways with real-time information from lead vehicle(s)

- Gap acceptance
  - Affects intersection capacity
  - Human driver: depends on perception and judgment
  - Autonomous: may have less variability than humans
  - Connected / automated: possibility of cooperation with other vehicles

- Interruptions to traffic flow
  - Affects link and intersection capacity
  - Connected / automated: possibility of cooperation with infrastructure (GlidePath), and with other vehicles to reduce interruptions
Plans for 2016-2017

• Identify data sources and automation applications for initial modeling
• Examine linkages between micro and regional mobility models
• Develop AV impact models
  • Start with Safety, Mobility and Environment
  • Continue to other areas
• Coordinate with U.S. and international evaluation efforts