Partial Automation for Truck Platooning

Observations and Lessons Learned to Date from California's Experience with Truck Platooning

Matt Hanson
2017 ITS CA Conference
September 18, 2017 – Burlingame, CA
Partial Automation for Truck Platooning

Background

- Funded under FHWA Exploratory Advanced Research Program (EARP) competitive solicitation (proposal in March 2013)

- Cooperative Agreement Btwn. FHWA & Caltrans
  Caltrans Subcontract with UCB-PATH
  UCB-PATH Subs to Volvo & Cambridge Systematics

- 20% cost share requirement met by combination of Caltrans, LA Metro and Volvo

- Work started August 2014, planned to end March 2018

- About $1.64M federal, $490k cost share
Partial Automation for Truck Platooning

Project Team

- FHWA - EARP
- Caltrans DRISI
- U.C. Berkeley PATH Program
- L.A. MTA (L.A. Metro)
- Gateway Cities COG
- Peloton Technology
- Volvo Technology Americas (VTA)
- Cambridge Systematics, Inc. (CSI)
Goals

- **Research questions:**
  - What performance is achievable with truck Cooperative Adaptive Cruise Control (CACC) in mixed traffic?
  - Driver preferences for CACC time gaps?
  - Energy savings from drag reductions?
  - Traffic flow (stability and throughput increases)
  - Benefits in truck lane capacity, energy and emissions?

- **Public policy:**
  - Deployment strategies for truck CACC
  - Synergy with I-710 truck lane development
  - Attractiveness to public and officials
Partial Automation for Truck Platooning

Project Work Plan

• Phase I (August 2014 - July 2016)
  • Identify industry needs and opportunities
  • Define operational concepts
  • Prepare for experiments and demos

• Phase II (September 2014 - June 2017)
  • Develop truck CACC, from existing Volvo ACC
  • Measure energy savings at preferred gaps
  • Public demonstration in southern California

• Phase III (December 2016 – September 2017)
  • Test driver preferences for gap settings
  • Public demonstration near FHWA – TFHRC
  • Broader outreach
Partial Automation for Truck Platooning

Platooning Concept

Cruise Control → Adaptive (ACC) → Cooperative (CACC)

**Large Gap**
Large gaps needed to ensure driver has the time to react

**Independent**

**Airflow**

**Cooperative**
Cooperation allows shorter gaps without compromising safety

**DSRC Wireless Communication**
Partial Automation for Truck Platooning

Platooning Concept
Partial Automation for Truck Platooning

Benefits

- Reduced drag leads to fuel & emissions reductions
  - Cost savings for driver/fleet
  - Reduced greenhouse gases, pollutants, particulates

- Increase in capacity and throughput
  - Improved freight operations
  - Improved highway operations

- Safety
  - Maintain Safety while getting the above benefits
Partial Automation for Truck Platooning

Modeling, Simulation and Testing

- Model vehicle dynamics (based on previous work)
  - Perform low speed tests to measure truck responses to acceleration and braking
  - Calibrate vehicle dynamic models
  - Perform tests of CACC control at low speed on closed track (2 trucks and then 3 trucks)

- Develop models - truck maneuvers, highway segments, other vehicle traffic
  - Simulate trucks driving individually and in CACC strings of 2, 3 or 4 trucks
  - Perform driving simulator experiments to assess driver reactions - to information display and gap distance
  - Test CACC on open highways
  - Perform energy consumption experiments (closed track) and traffic congestion impacts (for trucks and for all traffic)
  - Perform human factors experiments (open highways) for CACC gap acceptance
Partial Automation for Truck Platooning

Transport Canada Motor Vehicle Test Centre
Blainville, Québec

- Northern suburb of Montreal
- Collaboration with Transport Canada
  - Testing at Different Gap Spaces Between trucks
  - with Standard and Aerodynamic Trailers

4 mile concentric ovals

1 mile
Partial Automation for Truck Platooning

Test Results (17-meter separation)

Total Fuel Savings for 3-Truck Platoon

Aero-trailer shows greater fuel savings from platooning

Greater fuel savings for empty trailer

No significant influence of speed (89 vs. 105 km/h)
Partial Automation for Truck Platooning

On-Road Testing of Gap Preferences

- Key experiment in May and June 2017 to determine which gaps drivers are likely to select.

- 9 drivers, California Class A licenses, at least 3 years experience, clean records.

- Of the five time gaps (0.6 sec to 1.8 sec), drivers prefer using time gaps of 1.2 and 1.5 seconds.

- Only want to partner with reliable drivers.

- Findings reveal truck drivers’ acceptance of the deployment of CACC in their truck fleets
Partial Automation for Truck Platooning

Vehicle Codes and Regulation

Section 21705 of the CA Vehicle Code: “. . . motor vehicles being driven outside of a business or residence district in a caravan or motorcade, whether or not towing other vehicles, to be operated so as to allow sufficient space and in no event less than 100 feet between each vehicle or combination of vehicles so as to enable any other vehicle to overtake or pass.”

SB719 changed Section 14107 of the Government Code so Caltrans in coordination with the California Highway Patrol, may conduct testing of technologies that enable drivers to safely operate motor vehicles with less than 100 feet between each vehicle or combination of vehicles.

- Passing legislation is a heavy lift
- Significant impact to the project schedule
Partial Automation for Truck Platooning

Technology Development – The Issue
Partial Automation for Truck Platooning

Technology Development – A Fix
Partial Automation for Truck Platooning

Questions?

For additional information contact:
Matt.Hanson@dot.ca.gov
916-654-8171
Greg.Larson@dot.ca.gov
916-657-4369