Opportunities for Connected Automation to Improve Safety

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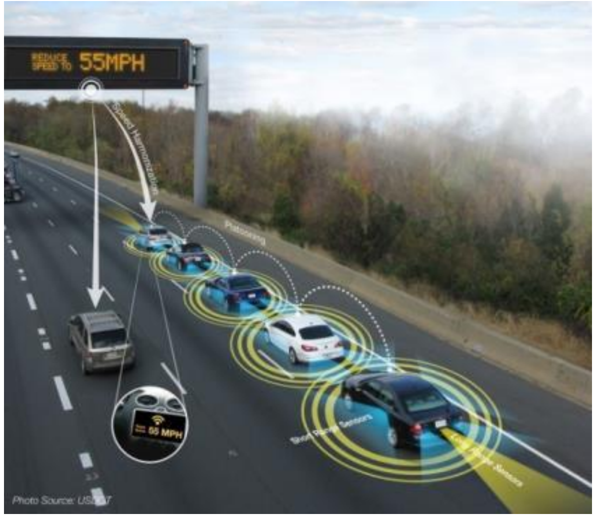
Presentation Overview

- How can automation solve transportation problems and improve safety?
- What is Connected Automation?
- Light vehicle human factors research
- Heavy truck human factors research
- Questions and discussion

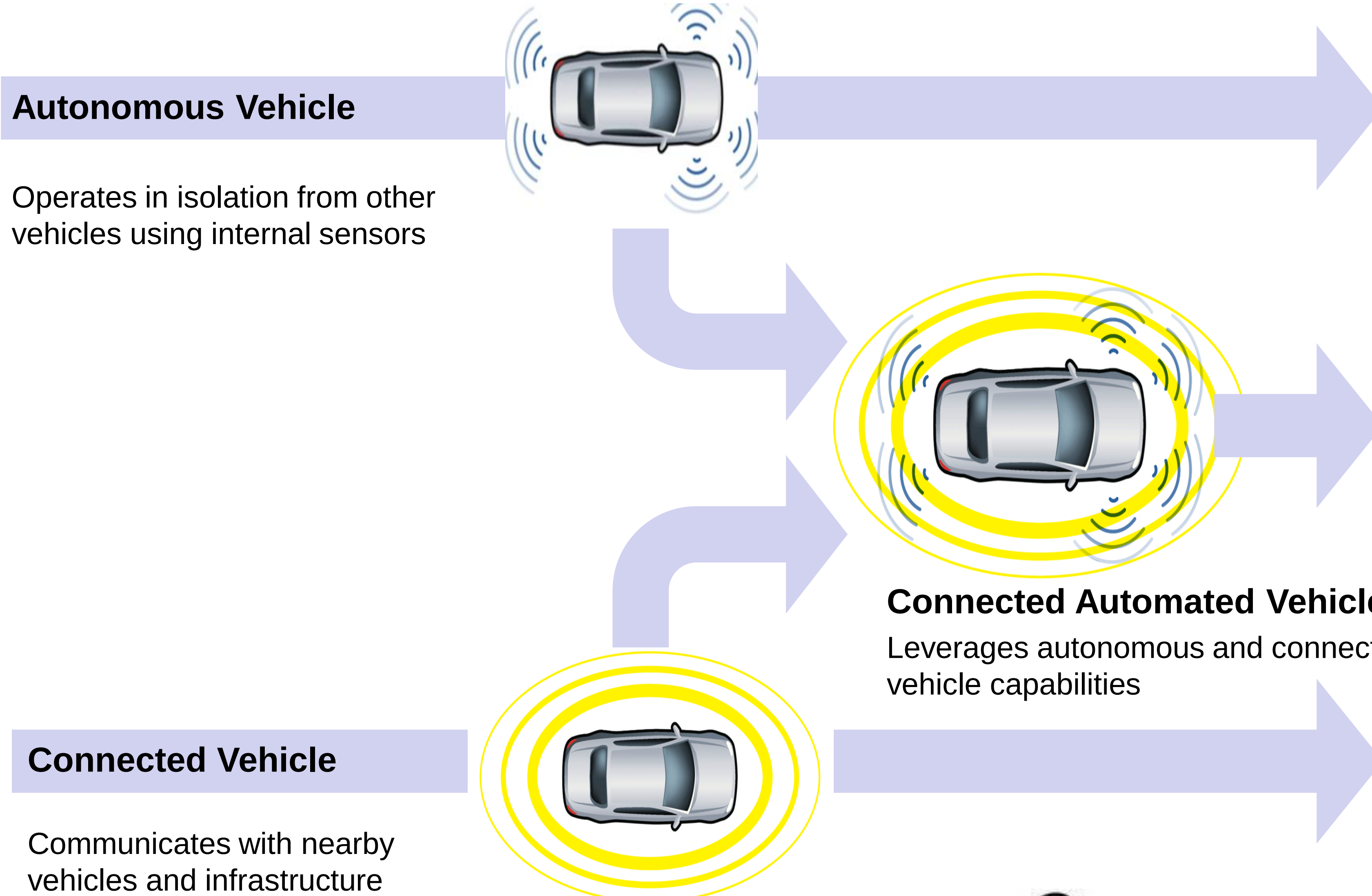
Automation Can Be a Tool for Solving Transportation Problems

- **Improving safety**
  - Reduce and mitigate crashes
  - Help merging into high density traffic
- **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



Connected Automation Research

- Cooperative Adaptive Cruise Control (CACC)
- Looked at critical human factors safety issues in following areas:
  - Automated vs. manual longitudinal control
  - **Lane Change / Merging behavior**
  - Factors affecting collision avoidance
  - Performance as a function of gap size

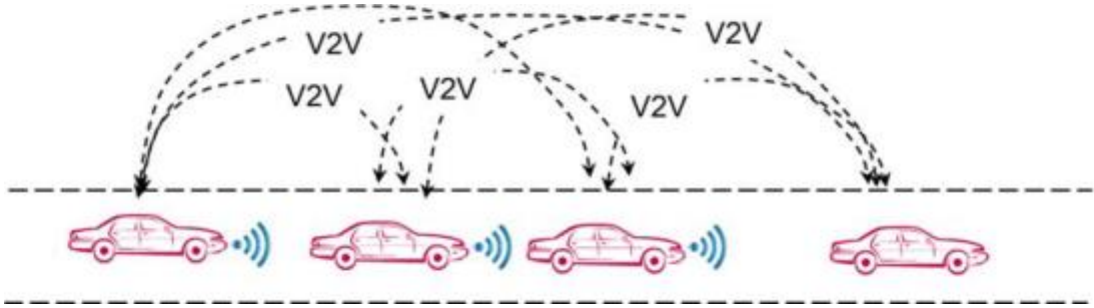
Cooperative Adaptive Cruise Control (CACC) Evolution

Three different types of cruise control

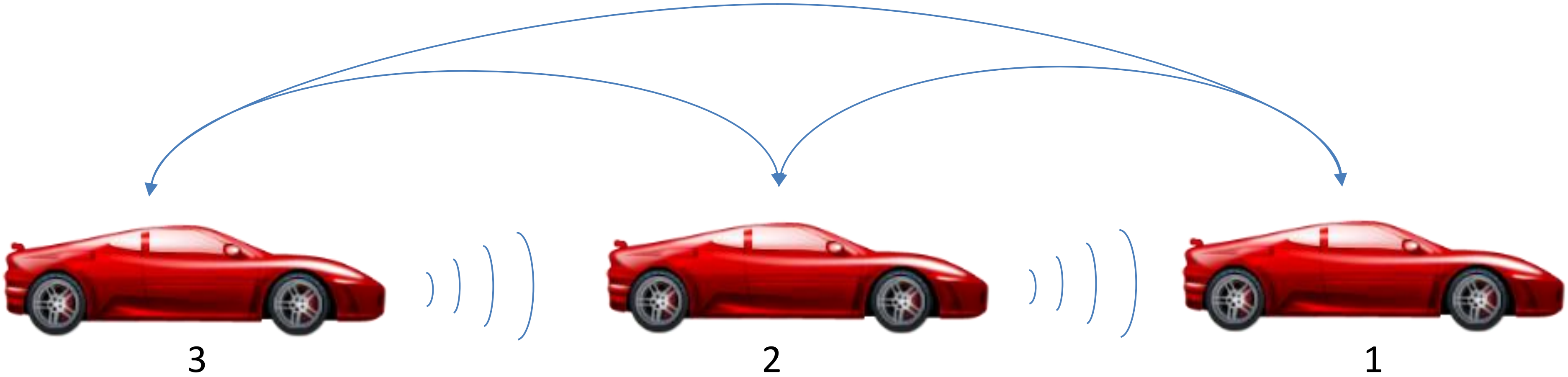
Current Market Penetration

Future of Cruise Control

Standard Cruise Control	Adaptive Cruise Control	Cooperative Adaptive Cruise Control
Throttle	Throttle Radar	Throttle Radar Communication



Cooperative Adaptive Cruise Control



Set Speed and Distance: Communications between vehicles lets your car know what vehicles around you are doing

3rd car can react as soon as 1st car brakes

Highway Driving Simulator

Ability to Join CACC Platoons

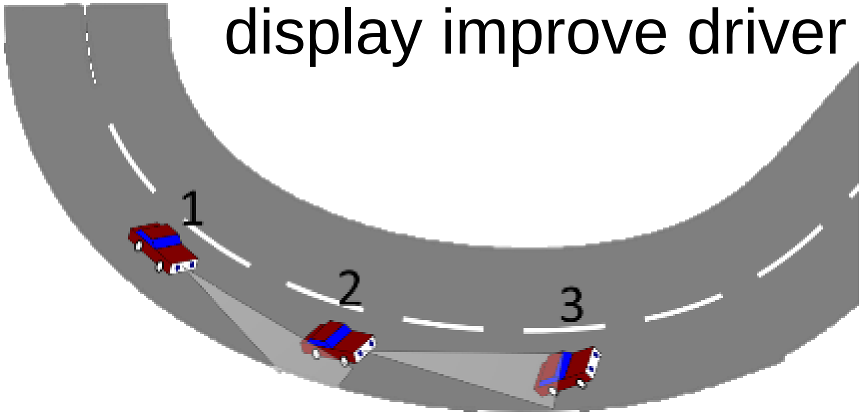
- CACC platoons travel with set speeds and gaps, merging presents unique set of challenges
- Drivers have to merge into a string of cars with short gaps
- Experiment focused on whether drivers were better at merging manually, or using the automation to control speed

Ability to Join CACC Platoons

- CACC reduces perceived driver workload
- CACC with merge assistance drivers did not experience any crashes (as defined by the system)
- Drivers that manually adjusted speed during merge experienced collisions18% of time

L1 Experiment - Curves

- Adaptive Cruise Control can lose lock in curves and on hills
- Questions:
  - Do simulated vehicle to vehicle (V2V) communications that increase radar/LIDAR performance (i.e., CACC) improve driver acceptance and use of the system?
  - Does the amount of information available on the display improve driver acceptance and use?



L1 Experiment - Curves

- No difference in workload between CACC & ACC
- Participants trusted CACC more than ACC
- Amount of time looking at the display was greater with more visual information

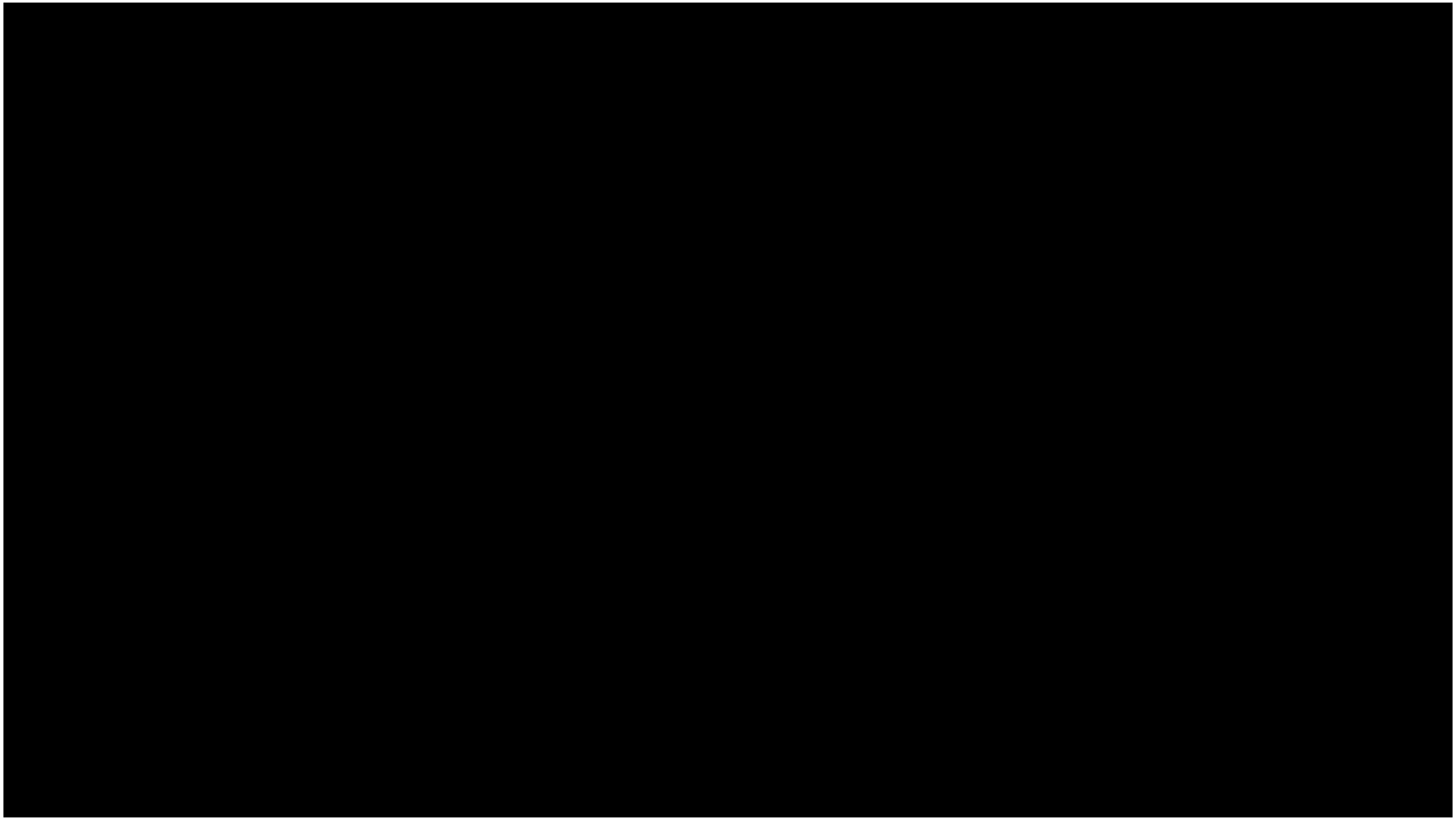
L1 Experiment – Mind Wandering

- Goals:
  - Assess potential mind wandering differences between ACC and standard driving
  - Assess potential arousal differences between ACC and standard driving
- Participants asked to drive on real roads:
  - With AND without ACC
  - With OR without following a lead vehicle
- Mind wandering probed at random intervals
  - “Are you thinking about a task related to driving?”
- Galvanic Skin Response (GSR) recorded

L1 Experiment – Lane Keeping

- Goals:
  - Assess potential differences in:
    - Driving performance
    - System preference
    - System trust
- Participants asked to drive in a simulator with:
  - Lane Departure Warning (haptic feedback), OR
  - Lane Keeping Assist (uses steering wheel torque to maintain lane position)
- Simulated 22 mile road
  - Random wind gusts
  - A single obstacle requiring lane departure to maneuver

Truck Platooning Demonstration



Truck Platooning Project

- Human Factors Issues Related to Truck Platooning Operations
- Objective - to address some critical human factors issues involving how light vehicle drivers behave in the presence of truck platoons.

Truck Platooning Project

- Proposed research topics:
  - **Freeway exit/entry**
    - Visibility of ground signs
    - Merging in between, ahead of, or behind platoon trucks
  - **Visual indication**
    - Display truck platoon operation status
    - Indicate number of trucks in the platoon

To Learn More

- Visit

  Turner-Fairbank Highway Research Center Website:

  http://www.fhwa.dot.gov/research/tfhrc/labs/humanfactors/

- Contact

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Questions and Discussion