

# U.S. DOT Automated Vehicle Research Activities

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April 2019

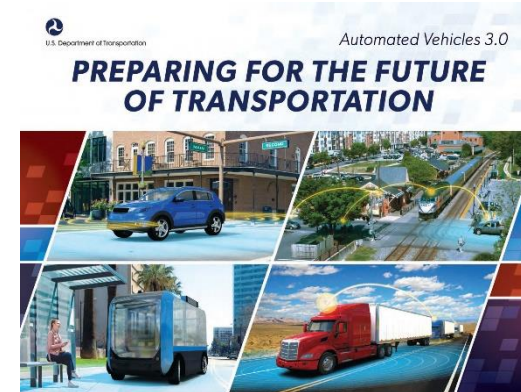
European Connected and Automated Driving Conference

# U.S. DOT and Automation

Cross-cutting Activities

# USDOT Recent Automation Activities

- *Preparing for the Future of Transportation: Automated Vehicles 3.0*
- Public Engagement
  - FHWA National Dialogue on Highway Automation Series
  - Requests for Comment
  - Automation and the Workforce
- Automated Driving System Demonstration Grants
- Non-traditional and Emerging Transportation Technology Council









# Preparing for the Future of Transportation: *Automated Vehicles 3.0*



<https://www.transportation.gov/av/3>

# ***Automated Vehicles 3.0: Principles***

**U.S. DOT has established a clear and consistent Federal approach to shaping policy for automated vehicles, based on the following six principles.**

-  1. We will prioritize safety.
-  2. We will remain technology neutral.
-  3. We will modernize regulations.
-  4. We will encourage a consistent regulatory and operational environment.
-  5. We will prepare proactively for automation.
-  6. We will protect and enhance the freedoms enjoyed by Americans.

# Research Highlights

Exploring how to ensure safe, accessible, and efficient integration of automation



# COOPERATIVE AUTOMATION

## Research Program



Safely improve the operational efficiency and maximize capacity of our Nation's urban and rural roadways.

**RESEARCH FOCUSED ON ARTERIALS AND FREEWAYS**



Source: FHWA.

Reduce fuel consumption at intersections  
by 20 percent.



Source: FHWA.

Fuel savings of 10 percent.



Source: FHWA.

Double capacity of existing lanes.



U.S. Department of Transportation  
**Federal Highway Administration**



# USDOT MULTI-MODAL PARTNERSHIP

U.S. Department  
of Transportation

# Federal Highway Administration

Office of Operations  
Office of Operations R&D  
Office of Safety R&D

# Federal Motor Carrier Safety Administration

Technology Division  
Research Division

## Intelligent Transportation Systems Joint Program Office

# Vehicle Safety and Automation Data Program

## Volpe National Transportation Systems Center

Advanced Vehicle Technology Division



Source: FHWA.





## Existing CARMA2 Fleet



## New CARMA3 Fleet



UPGRADE



UPGRADE



# Overview of USDOT Truck Automation Research

- Cooperative Automation Research Mobility Applications (CARMA)
- Driver Assistive Truck Platooning Truck Platooning
- Feasibility Study: Low-Speed Automated Truck Queue at Ports and Warehouses
- Truck Platooning Human Factors Study
- Truck Platooning Impacts on Bridges
- Truck Platooning Early Deployment Assessment
- Various FMCSA research activities
- *Emerging Urban Freight Delivery Concepts*

# Phase 1 Truck Platooning Early Deployment Assessment

- Three awards from the 2018 Broad Agency Announcement
- Each will be a 9 month project to develop detailed plans, partnerships, and a Phase 2 proposal.
  - Battelle Team includes CAR, Penn. State, SAE, Saia LTL Freight, Volvo Group, and UMTRI. Proposed platooning location of IN – OH – PA.
  - California PATH Team includes Caltrans, CHP, Cambridge Systematics, I-10 Corridor Coalition, Volvo Group, Westat. Proposed platooning location of CA – AZ.
  - CDM Smith Team includes Anheuser-Busch, BGM Consulting, Columbus Region Logistics Council, Ohio DOT/Drive Ohio, Ohio State, Ohio Turnpike Commission, Robert Bosch, Sutra Research & Analytics. Proposed platooning location of IN – OH.



# AV Communication and Intent with Shared Road Users

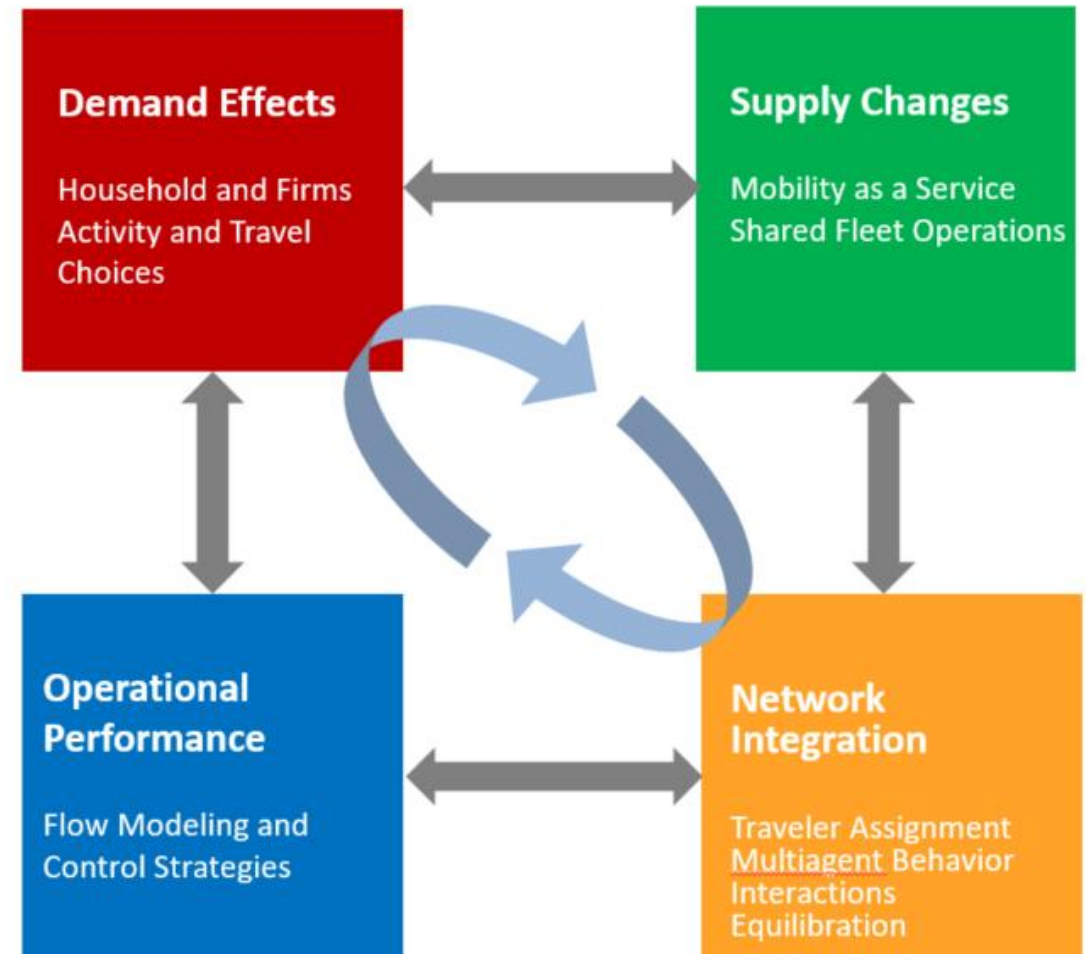
- Study 1: Structured Interviews of Driver Evaluation Experts
- Study 2: On-Road Study of Shared Road Users' Determination of Intent of Other Vehicles
- Study 3: Evaluate Concepts for Communication of Intent (Experiment)



# Analysis, Modeling and Simulation (AMS)

- Developing AMS Tools for CAV Applications
  - Freeway applications
    - I-66 in northern Virginia
    - SR-99 in Sacramento, California
  - Arterial applications
    - Ann Arbor, MI
    - Conroe, TX
- Systems Dynamics

## Four Key Modeling Components





# U.S. DOT/SAE Cooperative Automation Standards

- Develop a taxonomy for cooperative ADS
- Define factors suitable for standardization for integration of ADS with infrastructure
- Define engagement activities with other parties (SDOs, DOT FHWA, etc.)
- Develop new and augment existing standards to support ADS integration
- Foster the development of ITS standards including: V2V, V2I, V2P, V2other

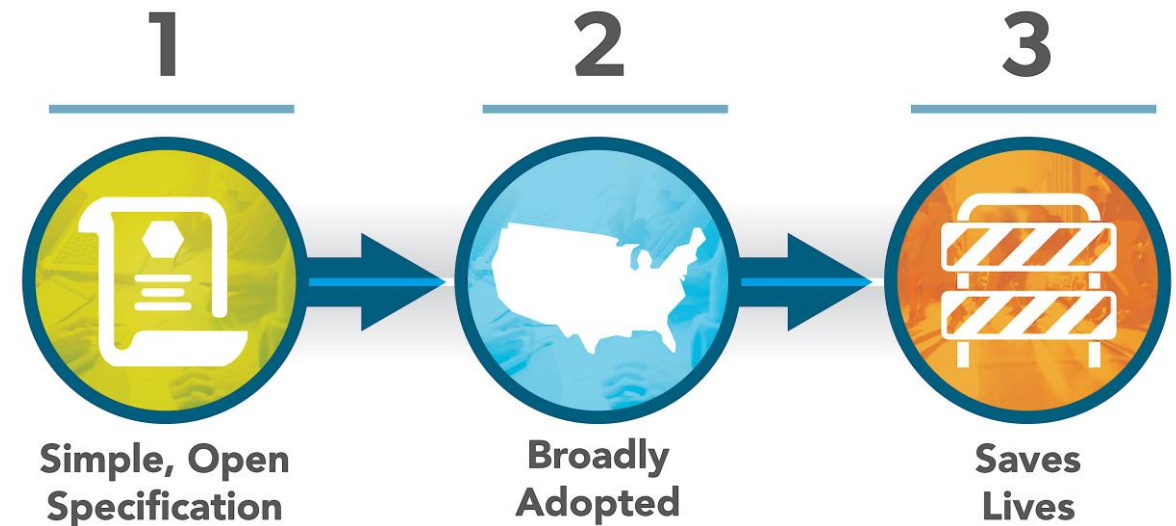
# Cooperative Automation Classification

		SAE Automated Vehicle Levels					
		No Automation <i>Human does all the Driving</i>	Driving Automation System <i>Human Driver monitors driving environment</i>		Automated Driving System (ADS) <i>Automated Driving Systems monitors driving environment</i>		
		Level 0  <i>No Driving Automation</i>	Level 1  <i>Driver Assistance</i>	Level 2  <i>Partial Driving Automation</i>	Level 3  <i>Conditional Driving Automation</i>	Level 4  <i>High Driving Automation</i>	Level 5  <i>Full Driving Automation</i>
Cooperation Classification	Class 0: No Data	(e.g. Signage, TCD)	Relies on onboard sensors and human monitoring to support limited maneuvers		Relies only on onboard sensors for perception to support maneuvers		
	Class 1: State <i>Here I am and what I see</i>	(e.g. Brake Lights, Traffic Signal)					
	Class 2: Intention <i>This is what I plan to do</i>	(e.g. Turn Signal, Merge)	Cooperative Automation				
	Class 3: Negotiation <i>Lets do this together</i>	(e.g. Hand Signals, Lane Assignment)					

Cooperative Automation

# Work Zone Data Exchange (WZDX) Project

- Launched after USDOT's December 2017 "Roundtable on Data for AV Safety"
- Goal is to get data on work zones into vehicles to help ADS and human drivers navigate safely and efficiently
- Approach is modeled off the success of open transit data, which is ubiquitously available across the nation
- Ultimately, this could be a repeatable way to accelerate harmonization of – and access to – local data sources



[transportation.gov/av/data](https://transportation.gov/av/data)

# Transit Automation Research Activity

- Transit Bus Automation Research Strategic Partnerships solicitation
  - Leverage existing automated vehicle pilots of public organizations and disseminate their research findings to the broader transit community
  - Solicitation closed March 1, 2019
- Integrated Mobility Innovation NOFO
  - Demonstrate innovative public transportation applications to increase transit efficiency and quality, promote safety, and improve the traveler's experience.
  - Will include Advanced Driver Assistance Systems (L1-2) and Automated Shuttle demonstrations
  - Release April 2019 (estimated)



**[transportation.gov/av](https://transportation.gov/av)**