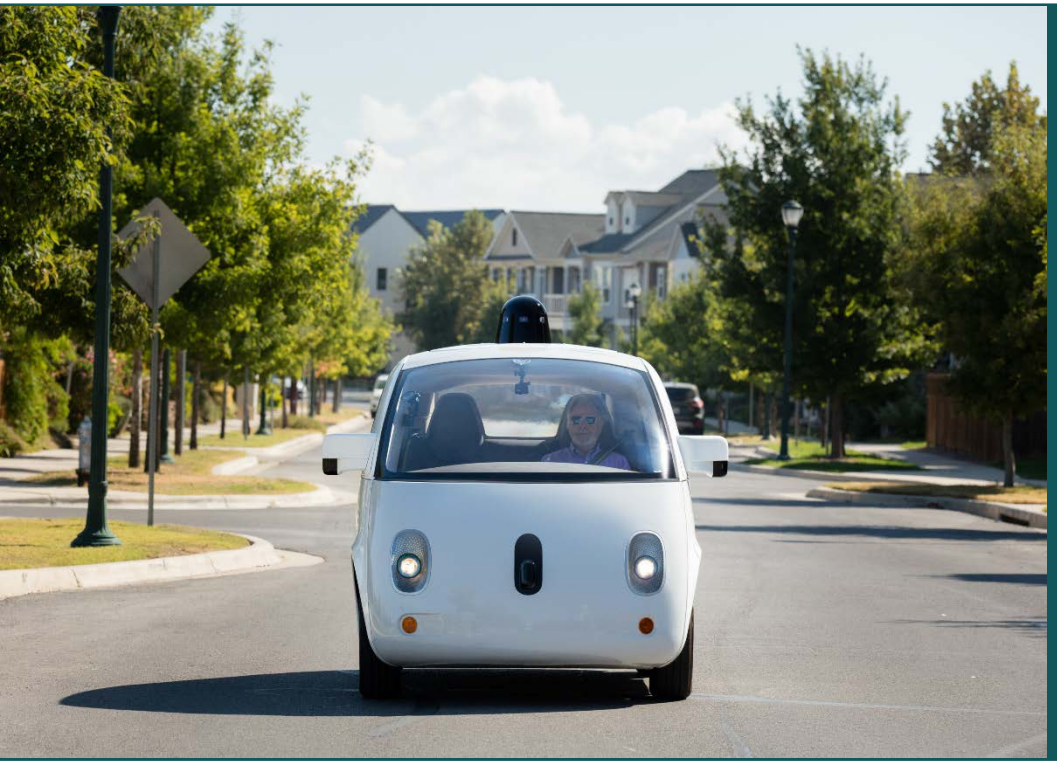


Automated Vehicles 101

Background Information for

HB 4063 AV Task Force

ODOT Office of Innovation

4/11/2018

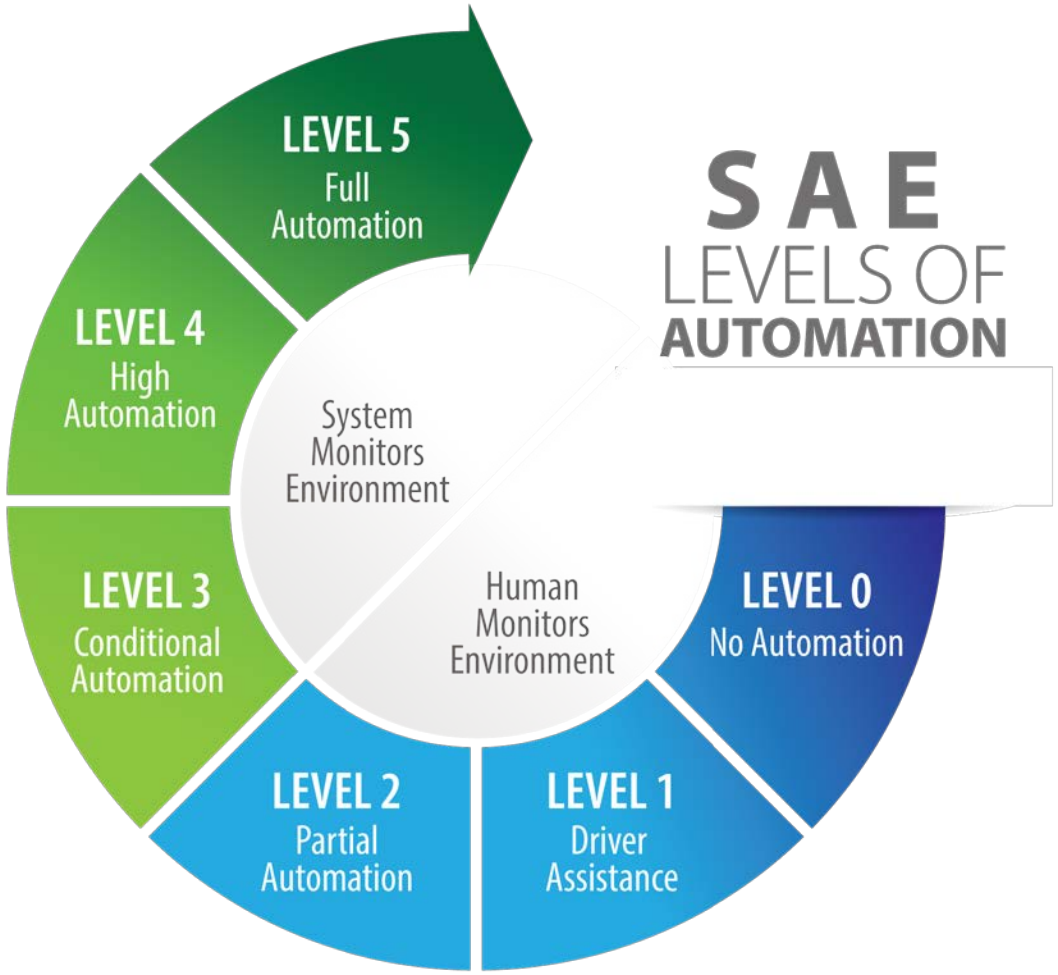
Defining ‘Automated Vehicles’

What is an automated vehicle?

- An automated vehicle is a vehicle where some aspects of the driving task may be performed by an automated system

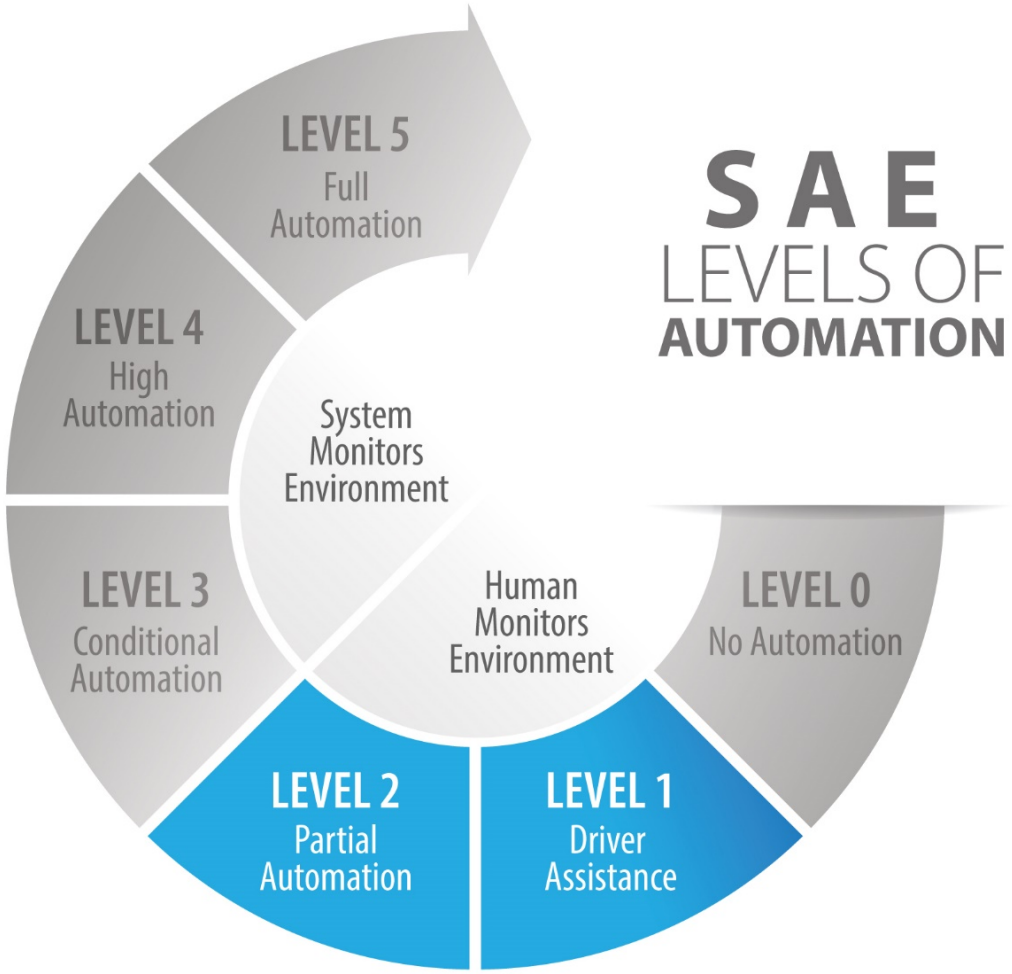
- The Society of Automotive Engineers (SAE) has designated six levels of vehicle automation, depending on system capabilities

Levels of automation



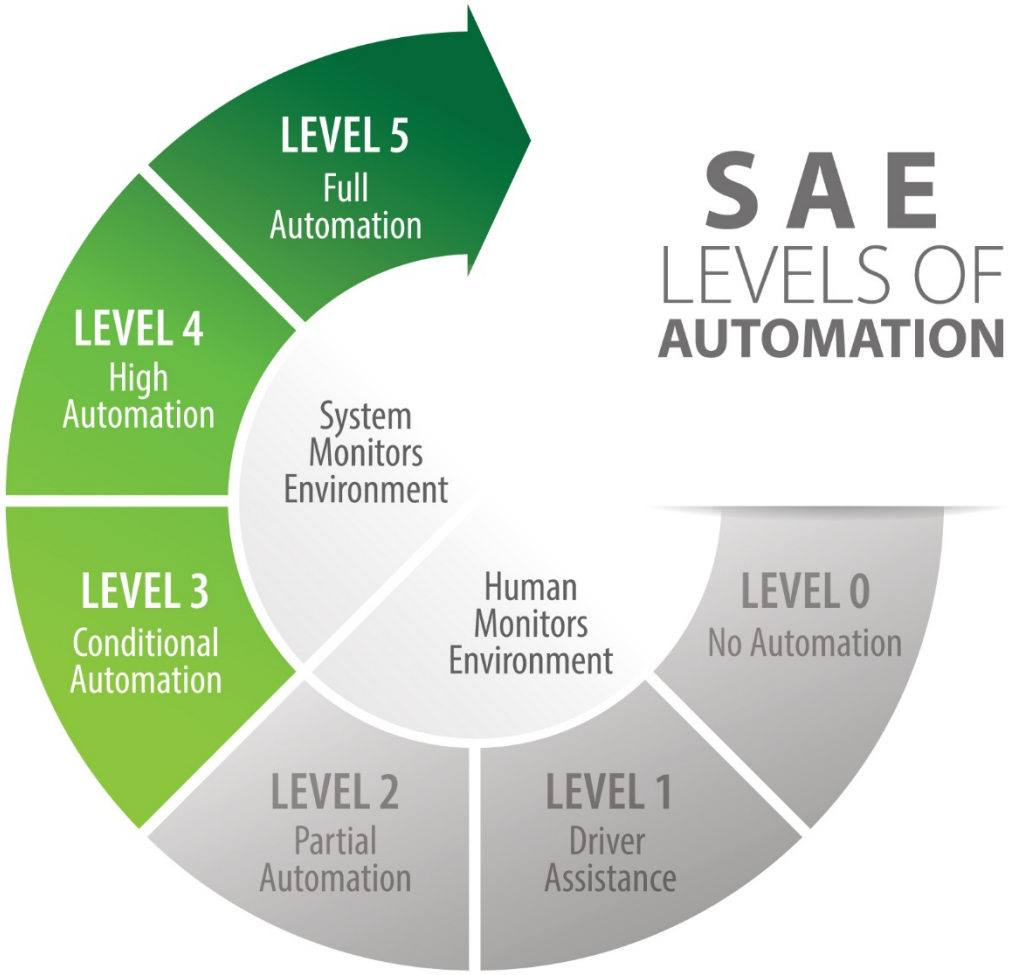
- Lower levels of automation may be called "advanced driver-assistance systems" (ADAS) where a human is always required to monitor the driving environment.
- Higher levels of automation may be called "automated driving systems," which are capable of monitoring the driving environment. Vehicles with this capability may be called *autonomous*, not just automated, vehicles.
- More information can be found here.

Levels of automation



- A Level 1 vehicle might be equipped with adaptive cruise control or lane keeping assist.
- A Level 2 Vehicle might combine these types of driver-assistance systems to accelerate, brake, and steer the vehicle in certain traffic situations.
- However, these are *driver assistance systems*. The driver must always remain attentive and in control of the vehicle.

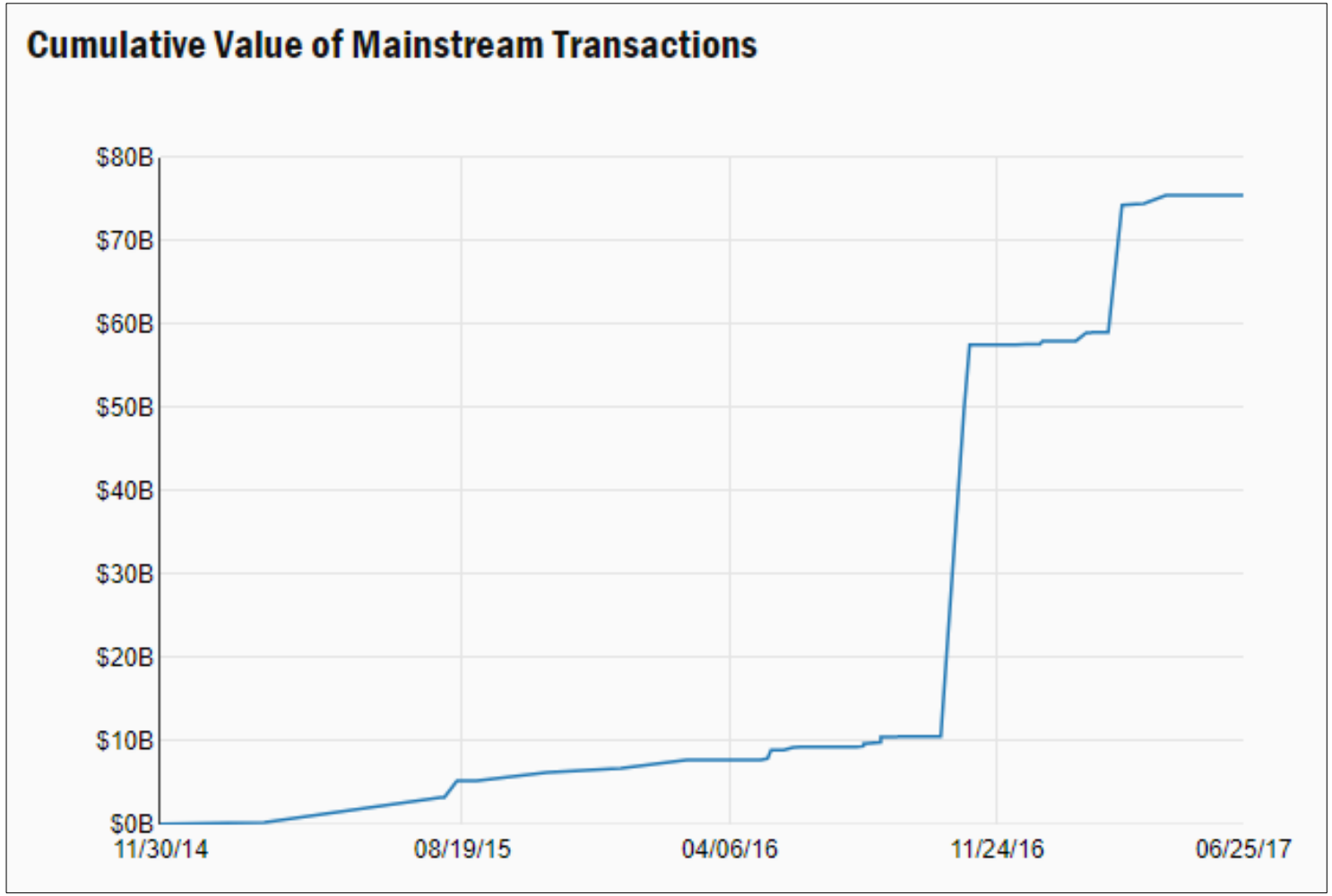
Levels of automation



- A Level 3 vehicle might allow a vehicle to travel without human oversight under certain circumstances, but requires a human backup driver to take over in conditions it cannot handle.
- A Level 4 vehicle may be able to travel without human oversight at all times, only limited by geographic or other conditions. They may not have manual controls.
- A Level 5 vehicle can navigate any circumstances that a human driver can, and may or may not have manual controls.

Development of Automated Vehicles

Development of Automated Vehicles



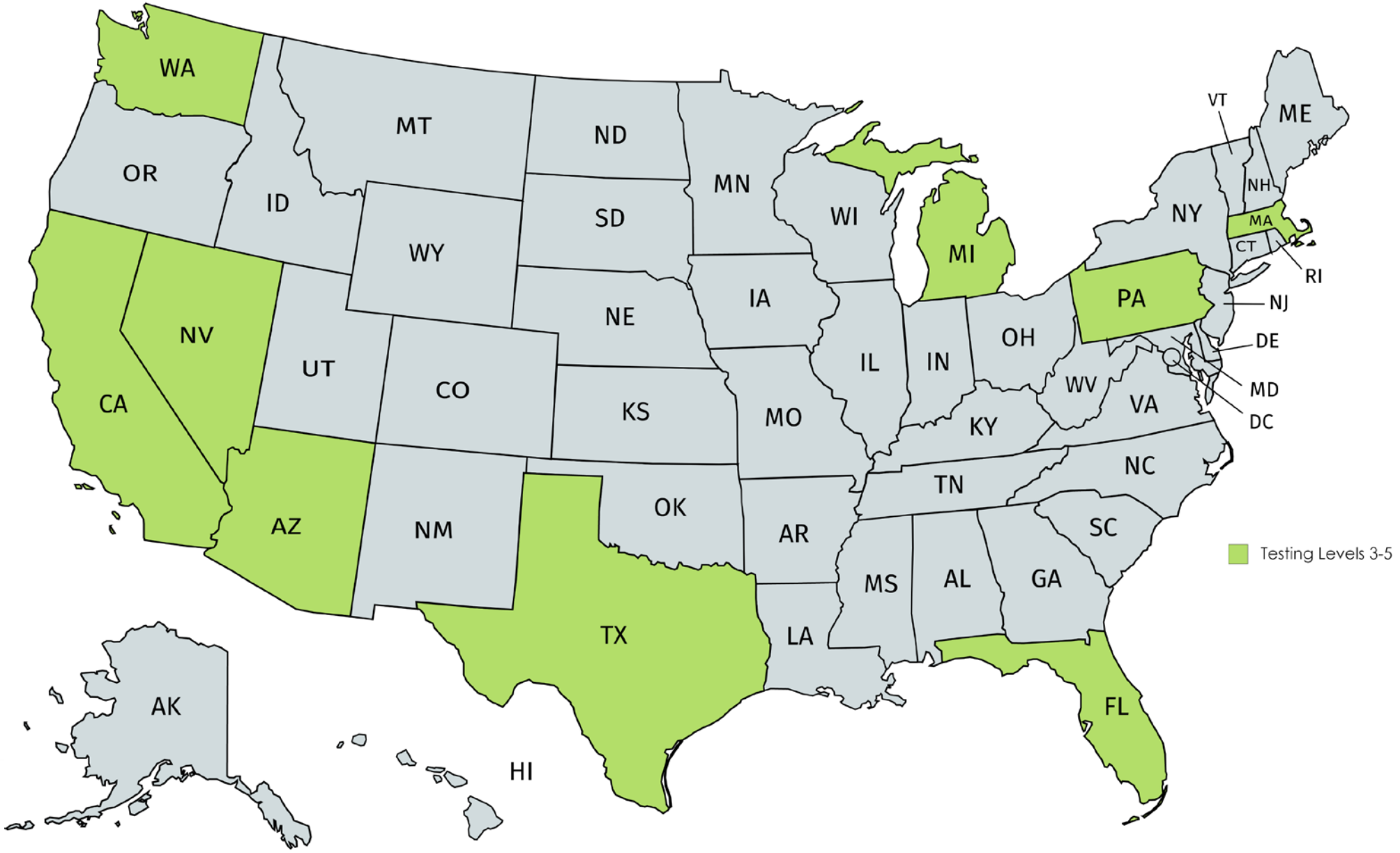
(Source: Brookings Institution)

- Nearly all major auto manufacturers and many tech companies are investing in vehicle automation
- The Brookings Institution estimates that companies had invested $80 billion in vehicle automation as of October 2017

Development of Automated Vehicles

- 20 companies submitted year-end reports on AV testing to the state of California in 2017
- Waymo, the sibling company of Google, has conducted more than 4 million miles of AV testing on public roads
- Autonomous passenger vehicles have been tested on public roads in at least eight states

Automated vehicle testing on public roads



Use Cases for Automated Vehicles

A Range of Use Cases for Automated Vehicles

Automated Regional Public Transit

Passenger Vehicle with Full Automation

Automated Freight Truck

Use Cases for Automated Vehicles

- Many visible automated vehicles are targeted for taxi or ride-hailing applications
- But automated vehicles have a range of use cases across transportation applications
- ODOT has developed informational materials on AV use cases (link to come)

A Range of Use Cases for Automated Vehicles

- Personal vehicles with conditional automation
- Personal vehicles with full automation
- On-demand fleets of driverless vehicles
- Automated regional public transit
- Automated interregional public transit
- Automated local delivery vehicles
- Automated medium- and long-haul freight trucks
- Automated heavy equipment vehicles

Public Transit: Automated low-speed shuttles

- Automated low-speed shuttles are already deployed in dozens of pilot projects worldwide
- In deployment, these vehicles may provide last-mile service that links to existing transit services
- Automated shuttles may also provide transportation around university or corporate campuses

Automated truck mounted attenuator

- Automated attenuator trucks have been piloted in Colorado and Florida
- These vehicles travel behind maintenance crews to protect them while they work
- Removing the driver from this vehicle keeps them from harm's way if the vehicle is struck

How Automated Vehicles Navigate

How Automated Vehicles Navigate

- Automated vehicles rely on cameras, sensors, high-resolution 3D maps, and/or communications systems to determine where they are in space

- Software enables the vehicle to identify infrastructure, other road users, potential hazards, and other surroundings

- The automated driving system then responds to its surroundings based on how it can safely proceed, and sends commands to accelerator, brake, steering system, turn signals, etc.

Sensing and Communications Technologies

Automated vehicles navigate the world using a range of sensing technologies:

- LiDAR
- Radar
- Cameras (visual, infrared, …)
- GPS
- V2V (Vehicle-to-Vehicle) Communications
- V2I (Vehicle-to-Infrastructure) Communications

Image: Velodyne

Image: Wikipedia

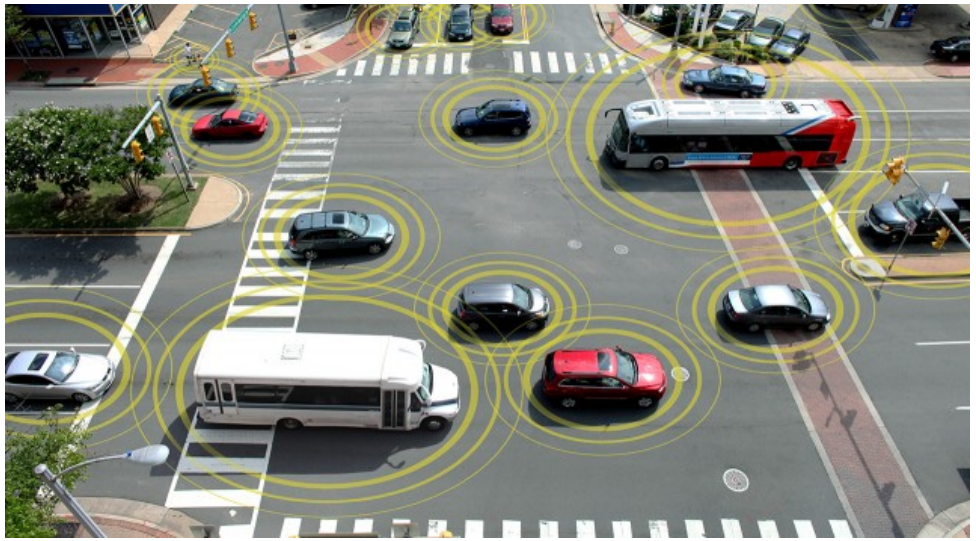


Image: US DOT

What is LiDAR?

- LiDAR is a sensor system that uses laser beams to measure the distance to a vehicle's surroundings
- The surroundings can then be represented as points in 3D space
- Computers can interpret the data to identify vehicles, pedestrians, and infrastructure

Watch a video to learn more about LiDAR here (Source: Velodyne)

Image: ODOT

Federal vs. State Roles in Safety

National Highway Traffic Safety Administration (NHTSA): Federal and State Regulatory Roles for Conventional Vehicles

Federal	State
Regulating motor vehicles and motor vehicle equipment	Regulating the human driver and most other aspects of motor vehicle operation
• Set Federal Motor Vehicle Safety Standards (FMVSS) for motor vehicles and equipment • Enforce compliance with FMVSS • Manage safety recalls • Educate public about safety	• License drivers • Register motor vehicles • Enact and enforce traffic laws • Conduct safety inspections • Regulate insurance and liability

Federal and State Safety Roles for Automated Vehicles

- The National Highway Traffic Safety Administration (NHTSA) proposes that regulation of automated driving systems (ADSs) mirror existing roles

- NHTSA has proposed new safety areas for ADSs, such as cybersecurity, data recording, and human-machine interface, that it may regulate pending the development of FMVSS

- States are encouraged to provide licensing and registration procedures for AVs, reporting and communications methods for Public Safety Officials, and to review traffic laws and regulations that conflict with AVs

Learn more in NHTSA's "Automated Driving Systems 2.0" guidance here

Additional Resources

National Highway Traffic Safety Administration:

Automated Vehicles for Safety

NHTSA's website provides an overview of AV technology, the federal government's view of how they will improve safety, and answers to many frequently asked questions about the technology.

National Conference of State Legislatures:

Autonomous Vehicles Enacted Legislation

NCSL has maps, summary information, and links to state legislation to help track the steps other states in the U.S. have taken to address AVs.

American Association of Motor Vehicle Administrators:

Autonomous Vehicle Information Library

AAMVA has a collection of reports and other information that may help states decide how to adapt to an AV future, including several addressing state-level concerns.