



American Association of
Motor Vehicle Administrators

Automated Vehicles Technical Assistance for North Carolina

Agenda Item #6

February 27 – 28, 2020

OUR VISION

Safe drivers

Safe vehicles

Secure identities

Saving lives!

As adopted by SAE, International:

Level 0 – No Automation

Level 1 – Driver Assistance

Level 2 – Partial Automation

Level 3 – Conditional Automation

Level 4 – High Automation

Level 5 – Full Automation

In vehicles available today:

Level 0 – No Automation

The human driver does everything

Level 1 – Driver Assistance

An automated system on the vehicle can sometimes assist the human driver conduct some parts of the driving task.

Examples:

- Cruise control, auto high beams, blind spot monitoring,
- Lane departure warning, forward collision warning

Level 1 Example: Lane departure warning system

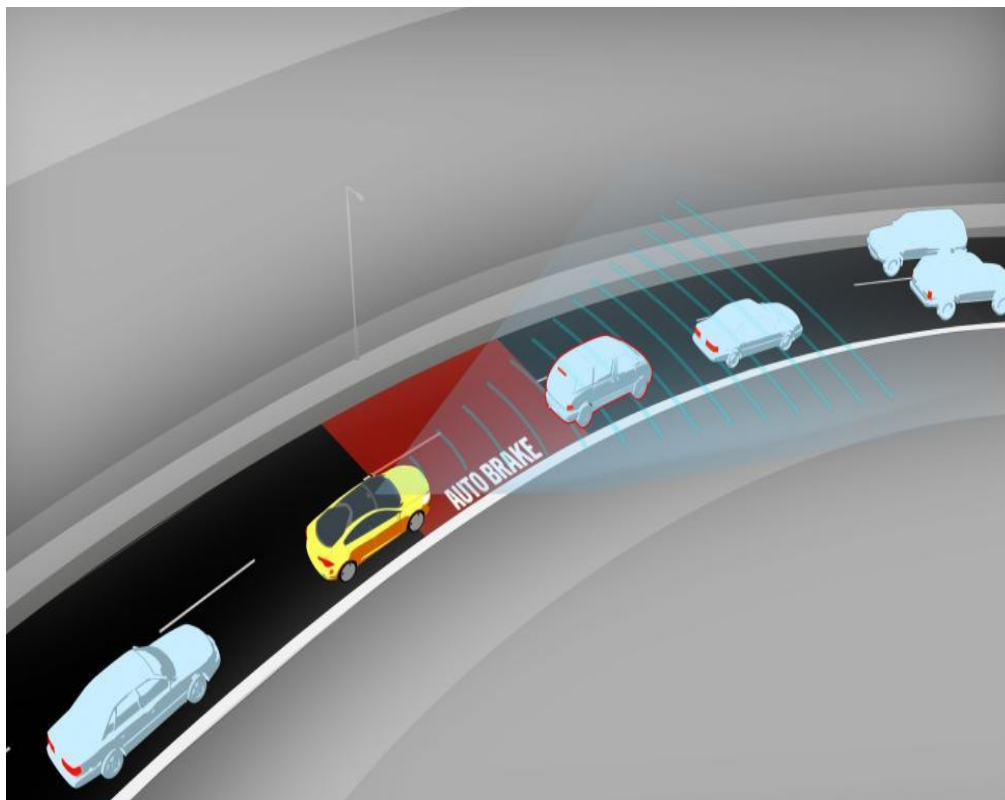


Level 2 – Partial Automation

An automated system on the vehicle can actually conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task.

- Automated braking
- Adaptive cruise control
- Lane centering

Automated Emergency Braking



Adaptive cruise control can increase or decrease the vehicle's speed to maintain a following distance that is set.

Advanced versions can even slow and stop the vehicle in traffic jams and then accelerate. May work with lane centering capabilities.



Levels 3 – 5 In testing and development today also Automated Driving Systems or ADS – equipped vehicles

Level 3 – Conditional Automation

An automated system can both actually conduct some parts of the driving task and monitor the driving environment in some instances, but the human driver must be ready to take back control when the automated system requests.



Level 4 – High Automation

An automated system can conduct the driving task and monitor the driving environment, and the human need not take back control, but the automated system can operate only in certain environments and under certain conditions.

Examples:

low speed shuttles

automobiles that can only be used in a specific area (ODD)



Automated Vehicle Classification Terms





Automated Vehicle Classification Terms

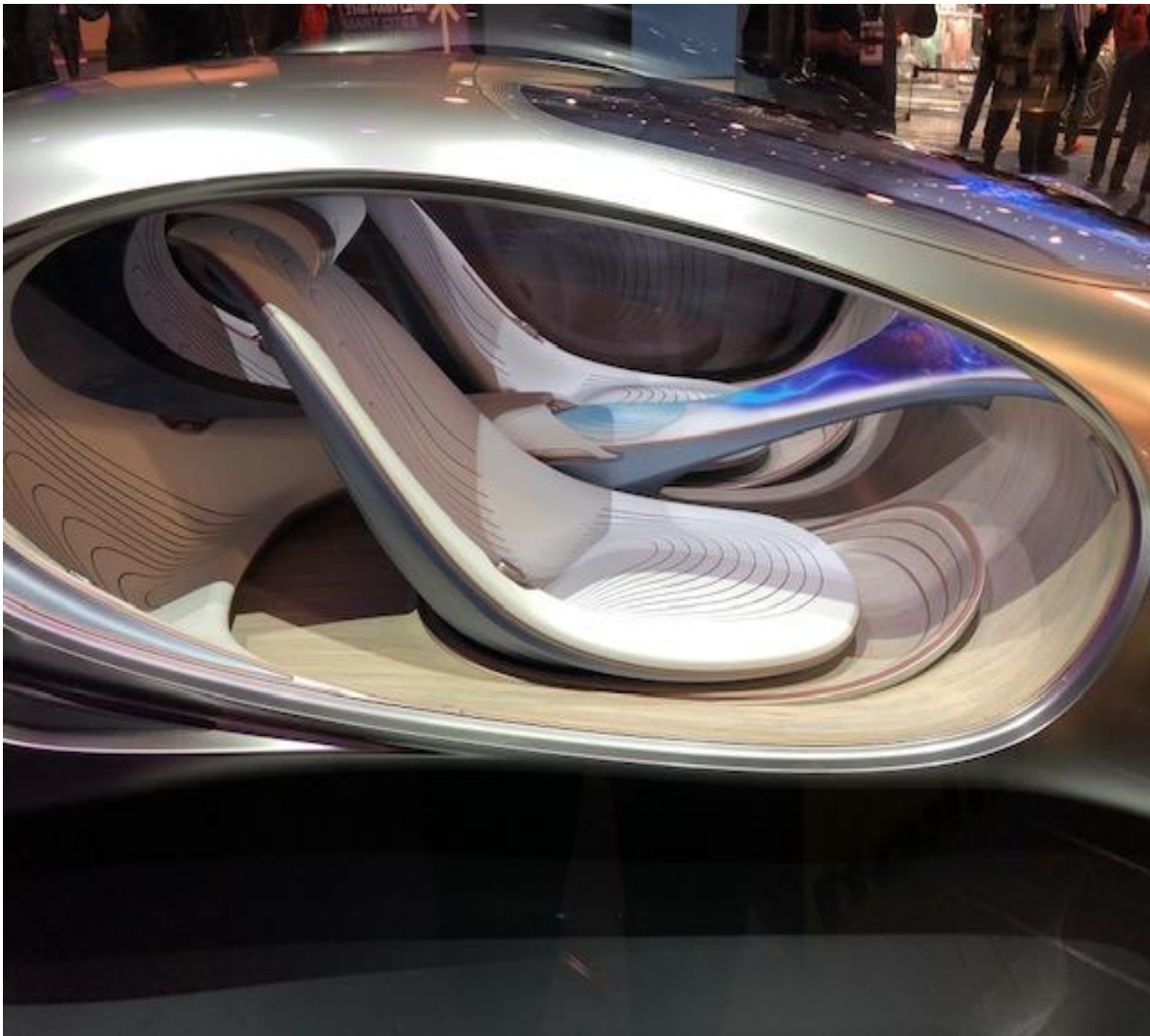


Level 5 – Full Automation

The automated system can perform all driving tasks, under all conditions that a human driver could perform them.



Level 5 Concept



Level 4 and 5 vehicles

May be completely driverless and have no driver controls such as no brake or steering wheel.

Or

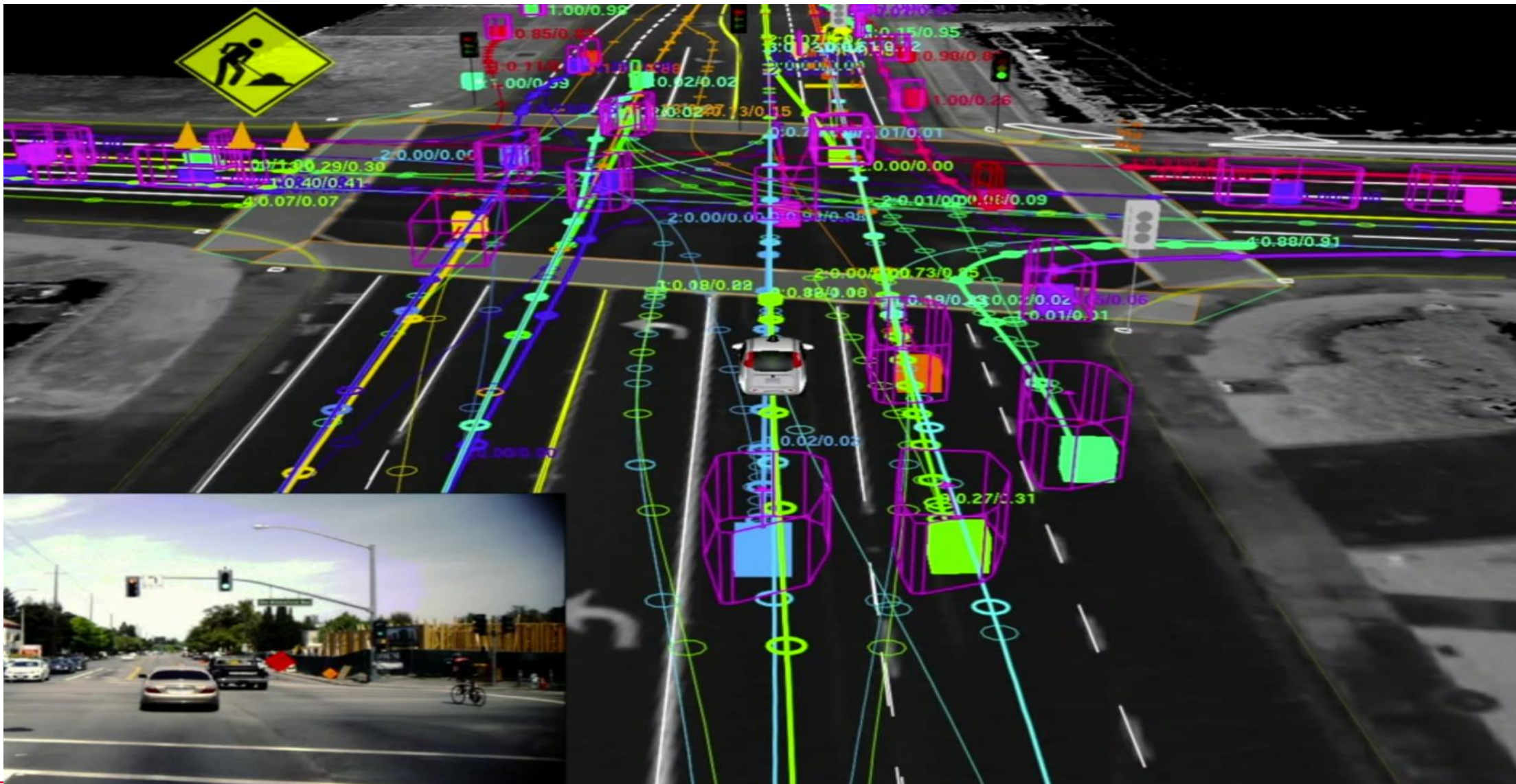
Some level 4 and 5 vehicles may be completely driverless and may also have driver controls such as a brake and steering wheel. Can operate fully either way – “Dual-mode ADS- equipped vehicle

- **LIDAR** Laser Illuminating Detection and Ranging – or LIDAR – is used to build a 3D map and allow the car to “see”.
- **Radar** units allow the car to avoid impact by sending a signal to the on-board processor to apply the brakes, or move out of the way.
- **High-Powered Cameras** mounted to the exterior with slight separation in order to give an overlapping view of the car’s surroundings.
- **Sonar** narrow field of view and its relatively short effective range (about 6 meters).
- **Positioning** GPS data, and driving speed to accurately determine the precise position of each vehicle.
- **Sophisticated Software** processes all of the data in real-time as well as modeling behavioral dynamics of other drivers, pedestrians, and objects around the vehicle. While some data is hard-coded into the car, such as stopping at red lights, other responses are learned

Layers of Information



Layers of Information



Connected Vehicles:

Networked wireless communications among vehicles, the infrastructure, and passengers' personal communications devices.



Connected Vehicles



Connected Vehicle

Vehicle to Infrastructure (V2I)

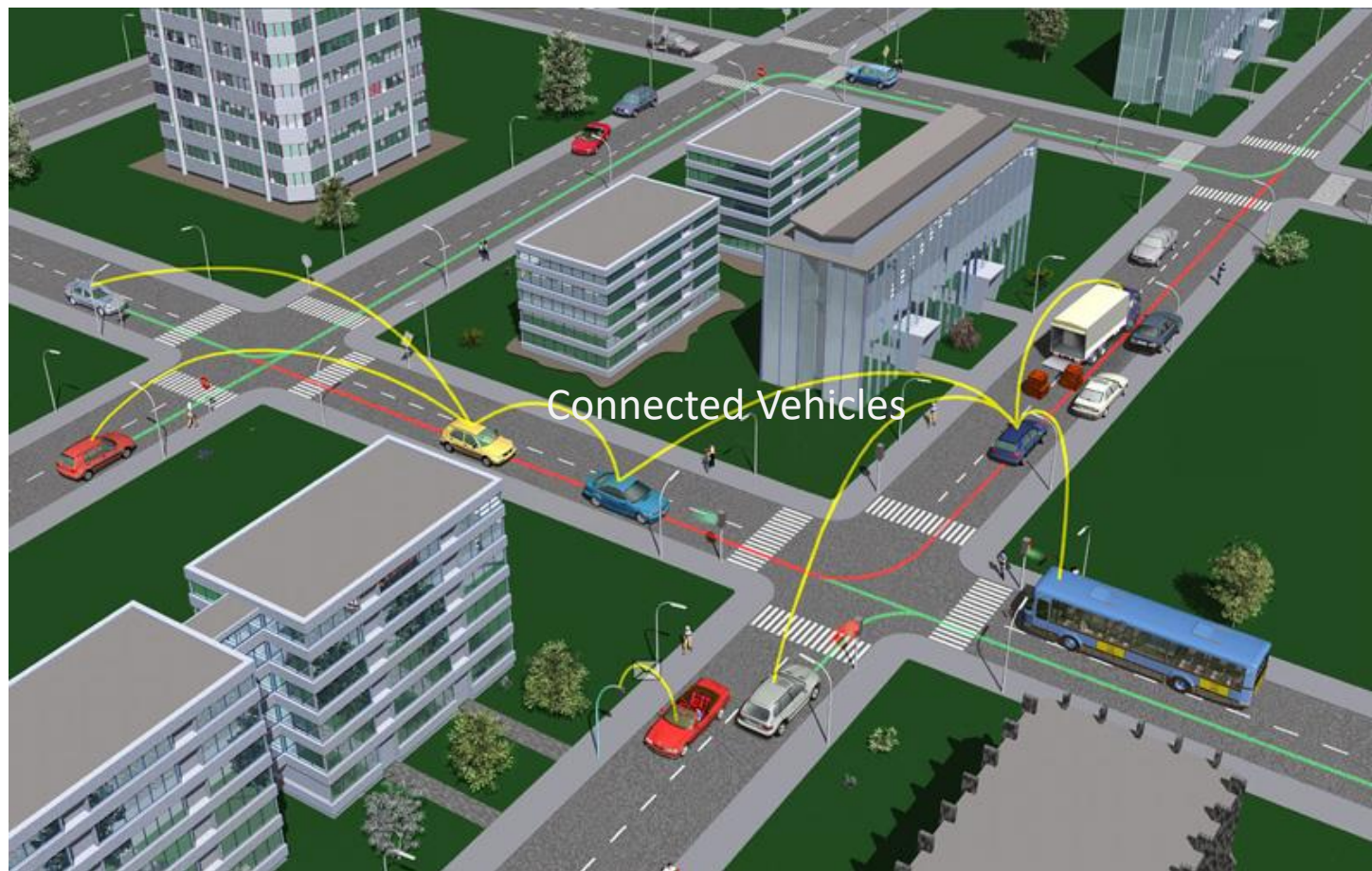


Vehicle to Vehicle (V2V)





Connected Vehicles



Connected Vehicles - Networked wireless communications among vehicles, the infrastructure, and passengers' personal communications devices.

V2V - vehicle to vehicle

V2I - vehicle to infrastructure

V2E or V2X - vehicle to everything

A vehicle can be ADS-equipped or

Can be a connected vehicle or

It can be both ADS-equipped and connected.

RECAP:

Advanced driver assistance Systems (ADAS)

Automated Driving Systems (ADS-equipped vehicles)

Connected Vehicles

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) AUTOMATION LEVELS

Full Automation



0

No Automation

Zero autonomy; the driver performs all driving tasks.

1

Driver Assistance

Vehicle is controlled by the driver, but some driving assist features may be included in the vehicle design.

2

Partial Automation

Vehicle has combined automated functions, like acceleration and steering, but the driver must remain engaged with the driving task and monitor the environment at all times.

3

Conditional Automation

Driver is a necessity, but is not required to monitor the environment. The driver must be ready to take control of the vehicle at all times with notice.

4

High Automation

The vehicle is capable of performing all driving functions under certain conditions. The driver may have the option to control the vehicle.

5

Full Automation

The vehicle is capable of performing all driving functions under all conditions. The driver may have the option to control the vehicle.

ADAS - Advanced Driver Assistance Systems

- In vehicles today
- Impact driver licensing, testing and education
- Consumer confusion
- Discuss in more detail tomorrow

ADS-equipped vehicles - Automated Driver Systems

- In research and development
- Being tested today
- Not available to the public yet



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Networked wireless communications among vehicles, the infrastructure, and passengers' personal communications devices.



Questions ??