Training and Grants

TEAMSTERS
SAFETY & HEALTH

NIEHS Fall 2023 Workshop

Implications of Evolving Technologies

Autonomous Vehicles

TRAINING AND GRANTS

SAE Levels of Driving Automation

> ### Level 3 Partial Autonomy adoption is when the market "tips" into autonomy

Autonomous Vehicles "Tipping Point"
Transition from human drivers to vehicles driving

Our World Today

Near to Distant Future

0	1	2	3	4	5
HUMAN ONLY	**MODERN VEHICLE**	**MODERN PLUS**	**PARTIAL AUTONOMY**	**FULL AUTONOMY (+ HUMAN)**	**FULL AUTONOMY (NO HUMAN)**
The driver (human) controls everything: steering, brakes, throttle, power	Most functions are still controlled by a driver, but some (like braking) can be done automatically by the car	At least 2 functions are automated (like cruise control & lane-centering), but the driver must be ready to take control of the vehicle	Drivers are still necessary, but are not required to monitor the situation as with previous levels	Vehicles perform all safety-critical driving functions and monitor roadway conditions for an entire trip, with _option for human driving_	_No option for human driving - no steering wheel or controls_

4 Pillars of Autonomous Vehicles

The key autonomous driving technologies can be divided into four parts:

- Environmental perception
- Localization - Behavioral decision-making
- Path planning
- Motion control
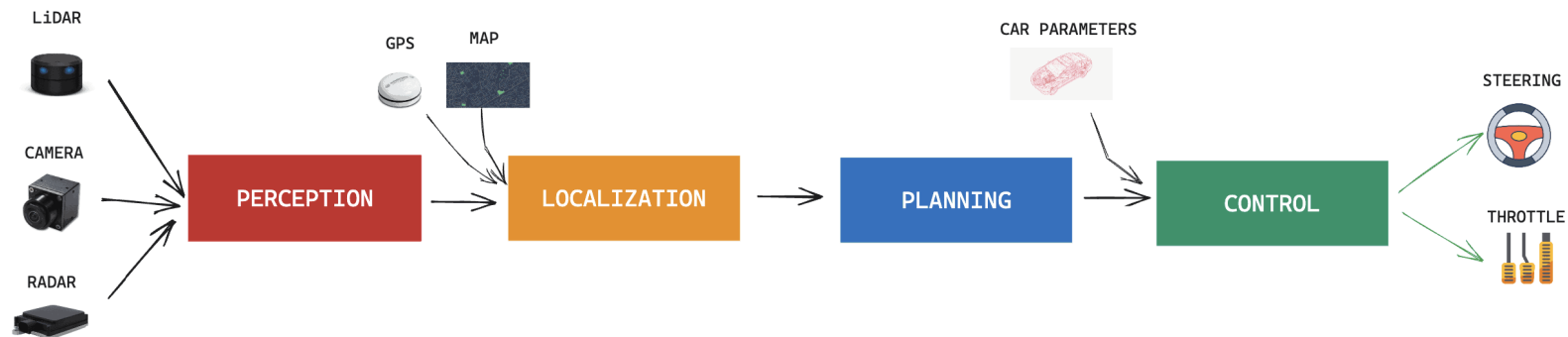
Level 5 fully Autonomous Vehicles

"Autonomous" or "self-driving" vehicles are:

- Capable of sensing its environment

- Operating without human involvement

- Human passenger is not required to take control of the vehicle at any time

- Human passenger is not required to be present in the vehicle at all

Level 5 Autonomous Vehicles

The self-driving car relies on cooperation of:

- Artificial intelligence
- Visual computing
- Radar
- Monitoring device
- GPS (global positioning system)

RADAR SENSORS
Radar sensors monitor the position of nearby vehicles.

LIDAR SENSORS
These sensors read lights to determine distances, detect the edges of roads, and identify lane markings.

VIDEO CAMERAS
Cameras identify traffic lights, road signs, and hazards.

ULTRASONIC SENSORS
Ultrasonic sensors detect curbs and other vehicles when parking.

AUTONOMOUS CARS MAP THEIR SURROUNDINGS

Autonomous vehicles use the sensors and other technologies to create a map of their surroundings. As they receive more information, they fill in more information on the map.

The Evolution of Automated Safety Technologies

Advanced Driver Assistance Systems (ADAS)

1950-2000

- Safety/Convenience Features

- Cruise Control

- Seat Belts

- Antilock Brakes

2000 – 2010

- Advanced Safety Features

- Electronic Stability Control

- Blind Spot Detection

- Forward Collision Warning

- Lane Departure Warning
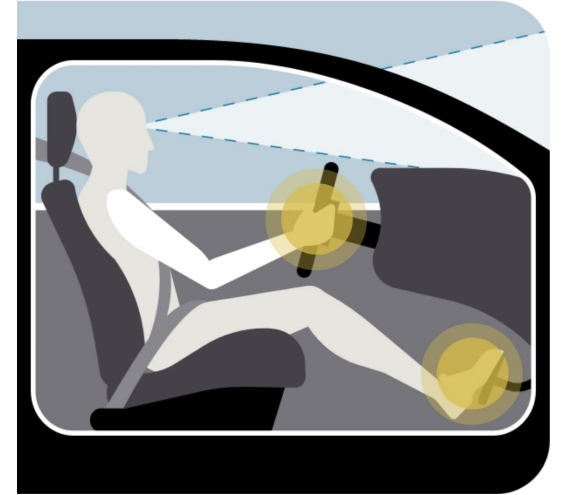
The Evolution of Automated Safety Technologies

2010 – 2016

- Advanced Driver Assistance Features

- Rearview Video Systems

- Automatic Emergency Braking

- Pedestrian Automatic Emergency Braking

- Rear Automatic Emergency Braking

- Rear Cross Traffic Alert

- Lane Centering Assist

The Evolution of Automated Safety Technologies

2016 – 2025

- Partially Automated Safety Features
- Lane Keeping Assist
- Adaptive Cruise Control
- Traffic Jam Assist

2025+

- Fully Automated Safety Features

Driver Assistance Technologies

COLLISION WARNING

- Forward Collision Warning

- Lane Departure Warning

- Rear Cross Traffic Warning

- Blind Spot Warning
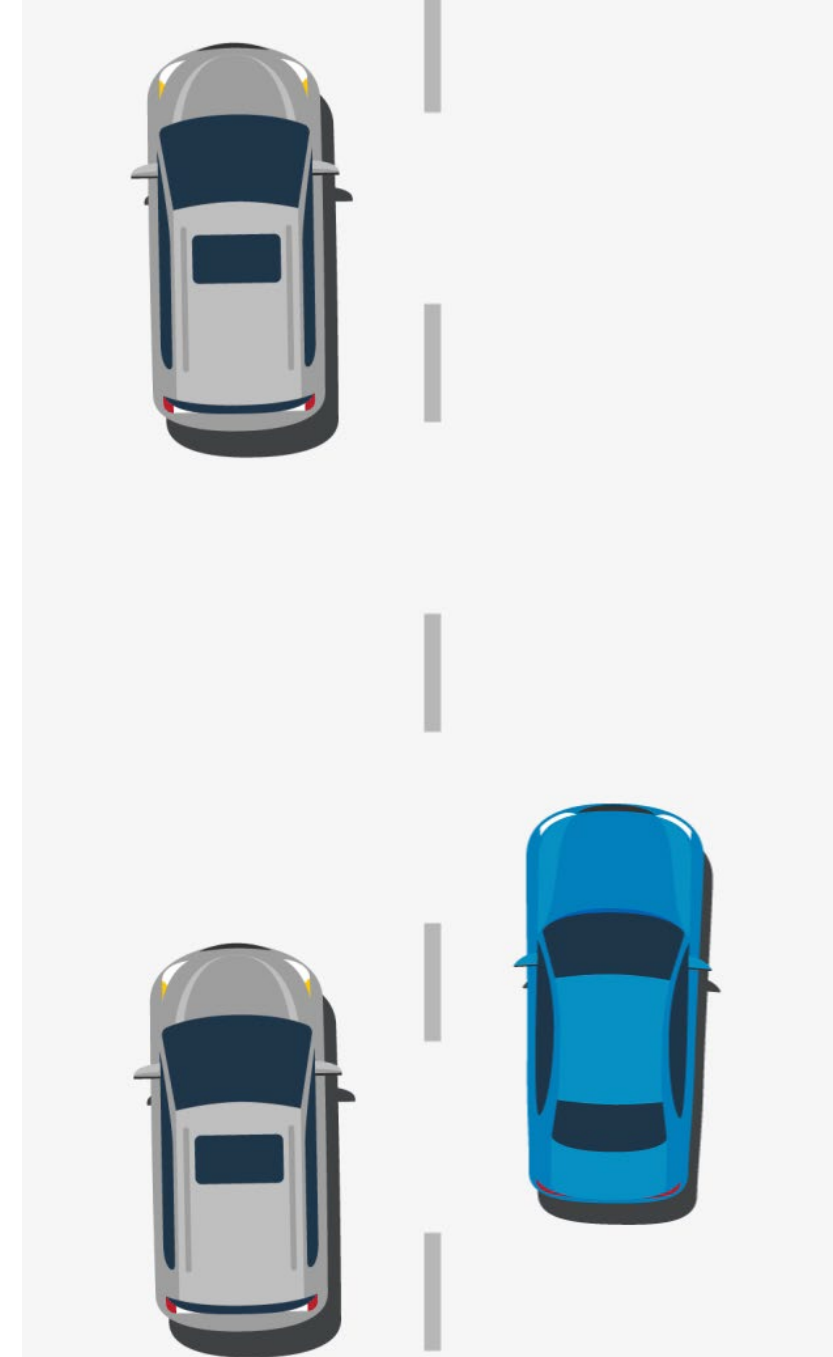
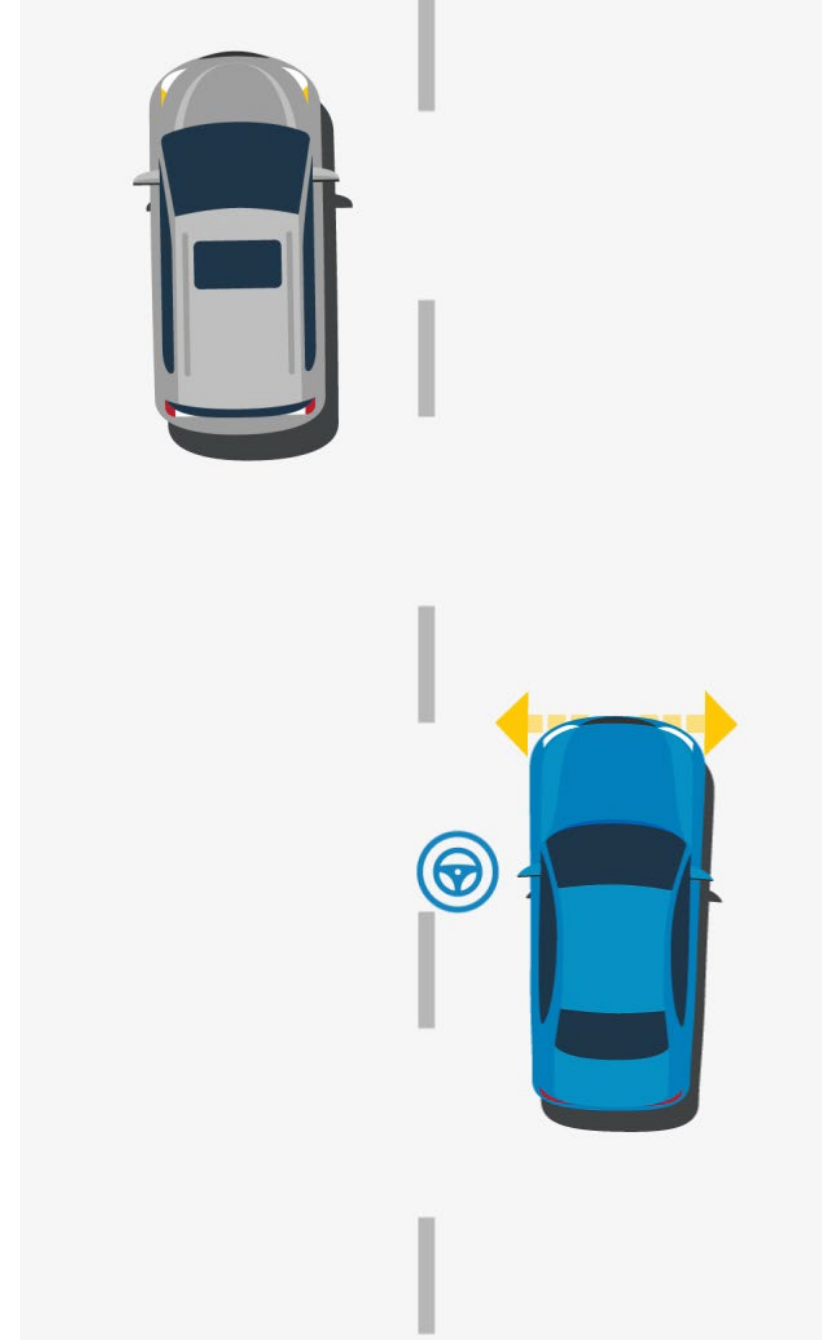# Driver Assistance Technologies

COLLISION INTERVENTION

- Automatic Emergency Braking

- Pedestrian Automatic Emergency Braking

- Rear Automatic Braking

- Blind Spot Intervention
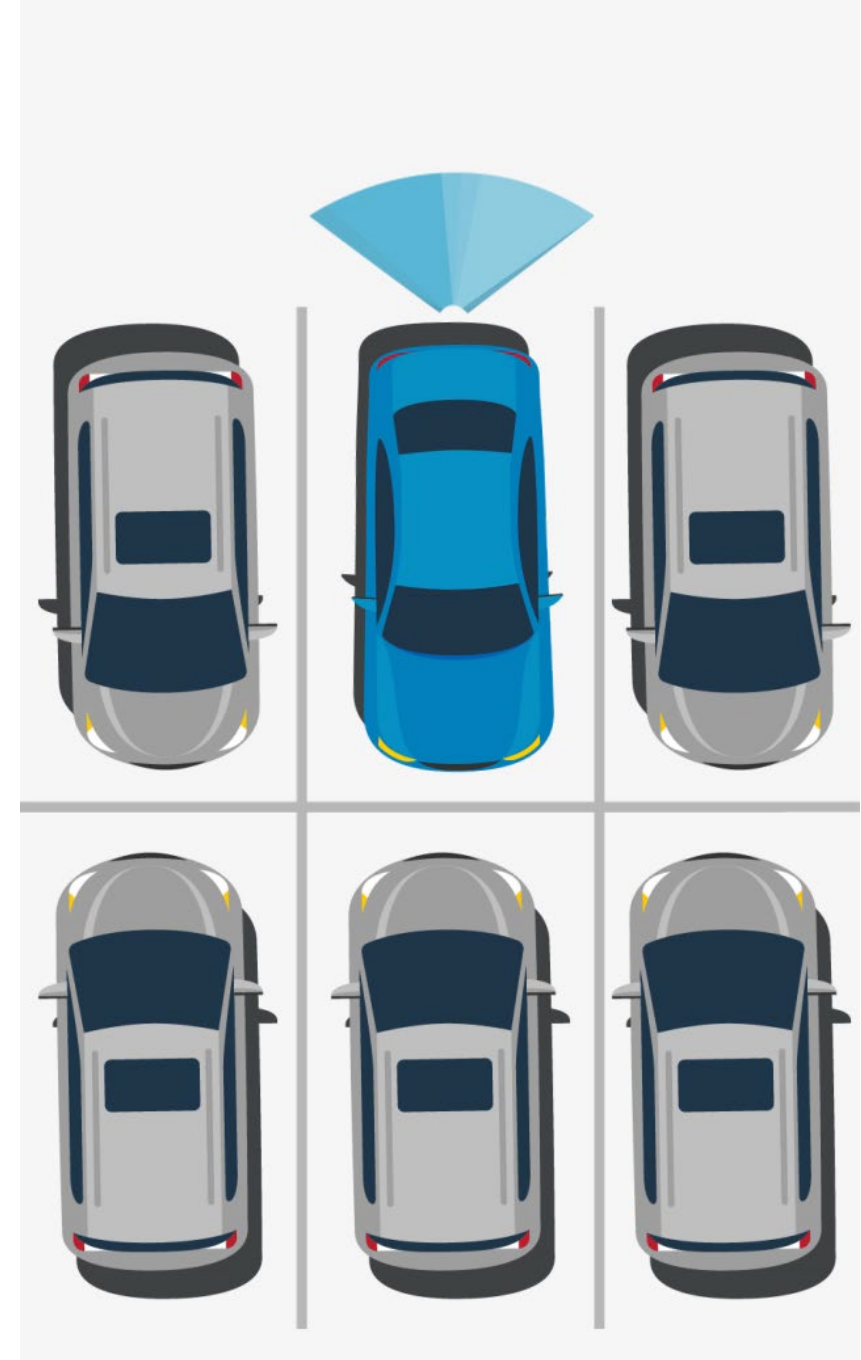
Driver Assistance Technologies

DRIVING CONTROL ASSISTANCE

- Adaptive Cruise Control

- Lane Centering Assistance

- Lane Keeping Assistance

Driver Assistance Technologies

OTHER SYSTEMS

- Automatic High Beams

- Backup Camera

- Automatic Crash Notification

Full Automation Offers more Personal Freedom

- Access to the disabled and people with reduced mobility

- Enhance independence for seniors

- Ride-sharing of **HIGHLY AUTOMATED VEHICLE** (HAVs) could reduce costs of personal transportation, providing more affordable mobility
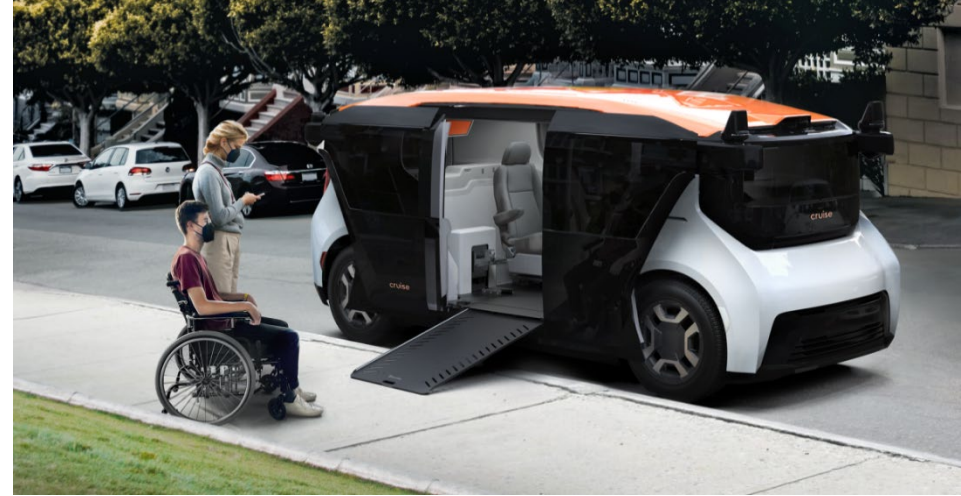
Benefits of Autonomous Vehicles

- Vehicle safety promises to be one of automation's biggest benefits???
- Remove the human driver from the chain of events that can lead to a crash
- Higher traffic efficiency
- 360° vision
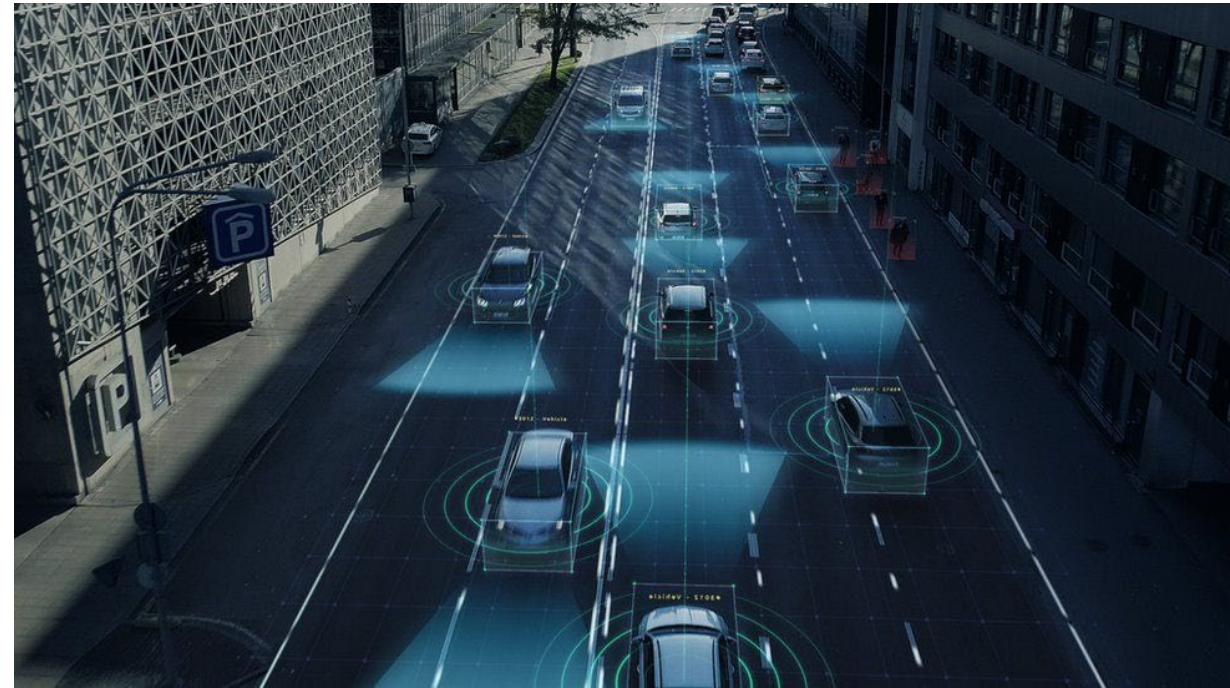
Benefits of Autonomous Vehicles

HAVs could offer the convenience of dropping vehicle occupants at their destination

• Vehicle parks itself

Benefits of Autonomous Trucking

- Don't have to follow Federal Motor Carrier Safety Administration (FMCSA) at this time

- Trucks don't need to take breaks

Autonomous trucks could more easily travel:

- During off-peak hours

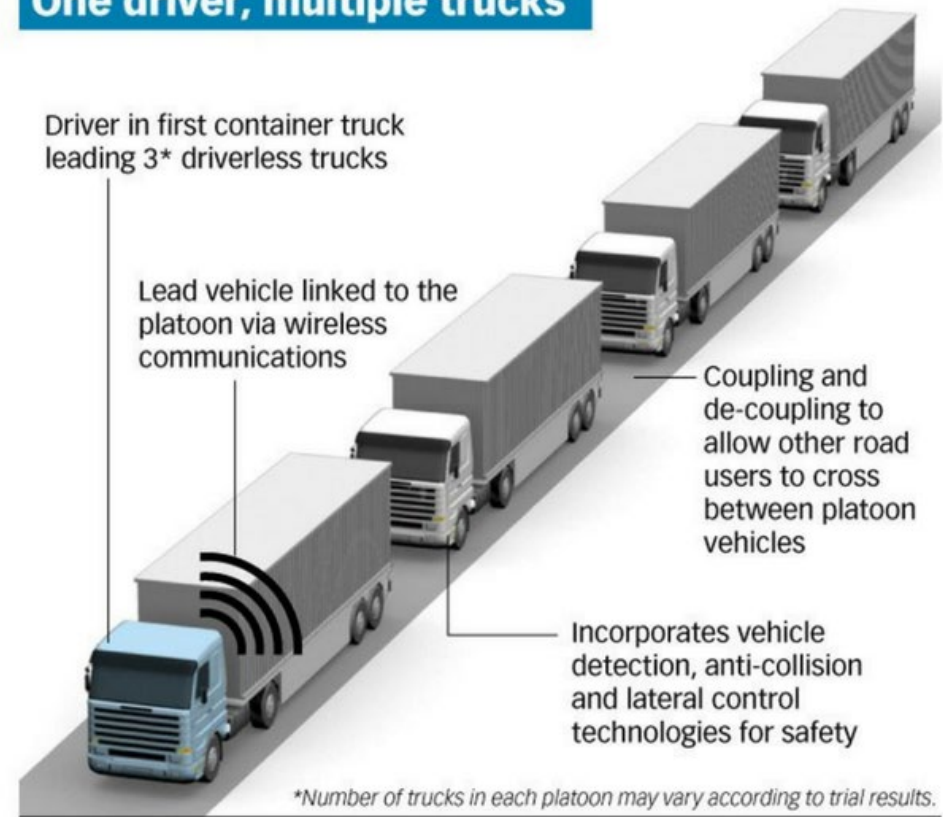- Helping to reduce traffic congestion during the busiest times of the day

Benefits of Autonomous Trucking

- Can move freight from West to East coast in 2 days
- Fully automated driving systems may be able to travel more closely together, reducing air drag and thereby reducing fuel use
- Increase in lane capacity

One driver, multiple trucks

Driver in first container truck leading 3* driverless trucks

Lead vehicle linked to the platoon via wireless communications

Coupling and de-coupling to allow other road users to cross between platoon vehicles

Incorporates vehicle detection, anti-collision and lateral control technologies for safety

*Number of trucks in each platoon may vary according to trial results.

Source: PSA and Ministry of Transport

Autonomous Bus Vehicles

- Intermodal shuttle buses

- Schools

- Shopping center

Automated Vehicles in the Warehouse

- In 2023, approximately 1.32M people employed in the Warehousing and Storage industry

- Automated stackers

- Autonomous tuggers

- Robotic Forklifts

- Pallet jacks

- Pallet trucks

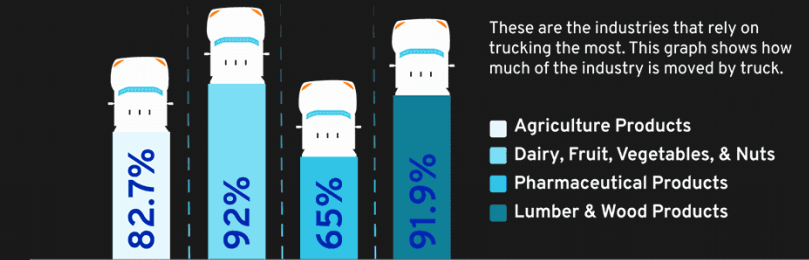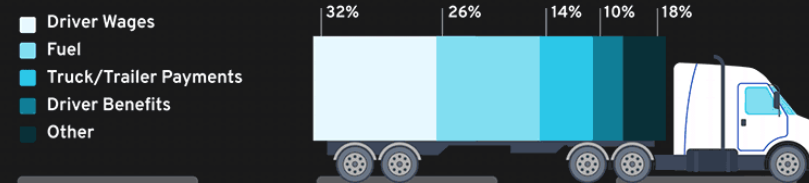- Automated Guided Vehicles (AGVs) - in use in port industry for several years now.
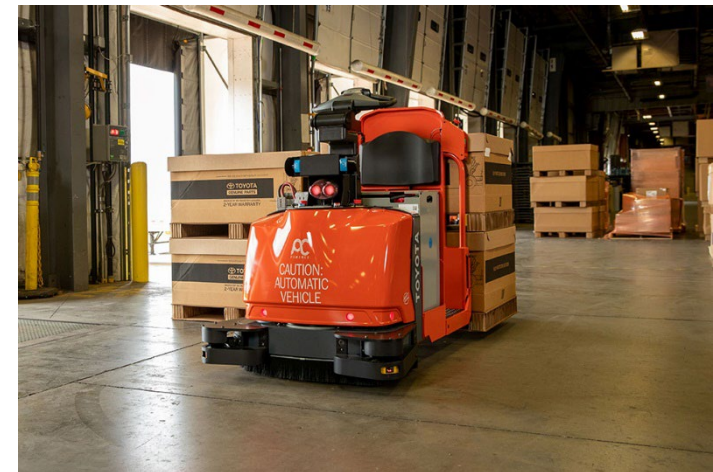
Trucking Industry

- In 2023, an estimated **3.5 million truck drivers** are employed in the US alone

- Drivers operate over **4 million trucks**, moving an incredible **10.5 billion tons of freight each year**

- Most truck drivers are between the ages of **45 to 54**

- (BLS) states that more than 2 million drive heavy trucks and tractor-trailers

- More than 1.5 million are delivery drivers or driver/sales workers

Industries With Highest Trucking Reliance

These are the industries that rely on trucking the most. This graph shows how much of the industry is moved by truck.

82.7% | 92% | 65% | 91.9%

- Agriculture Products
- Dairy, Fruit, Vegetables, & Nuts
- Pharmaceutical Products
- Lumber & Wood Products

Trucking Related Costs

- Driver Wages
- Fuel
- Truck/Trailer Payments
- Driver Benefits
- Other

32% | 26% | 14% | 10% | 18%

Teamsters

- Teamsters represents approximately 1.3 million workers in the United States, Canada, and Puerto Rico

- Approximately Five hundred (500) thousand drivers who would be directly impacted by highly automated commercial vehicle (HACVs) design, development, testing and deployment.

Implications of Emerging Hazards

Challenges of Autonomous Vehicles

- Blockage

- Traffic Violation

- Collisions

- Software failure

- Behavior Prediction Uncertainty

- Increased traffic congestion

- Speak in one common terminology
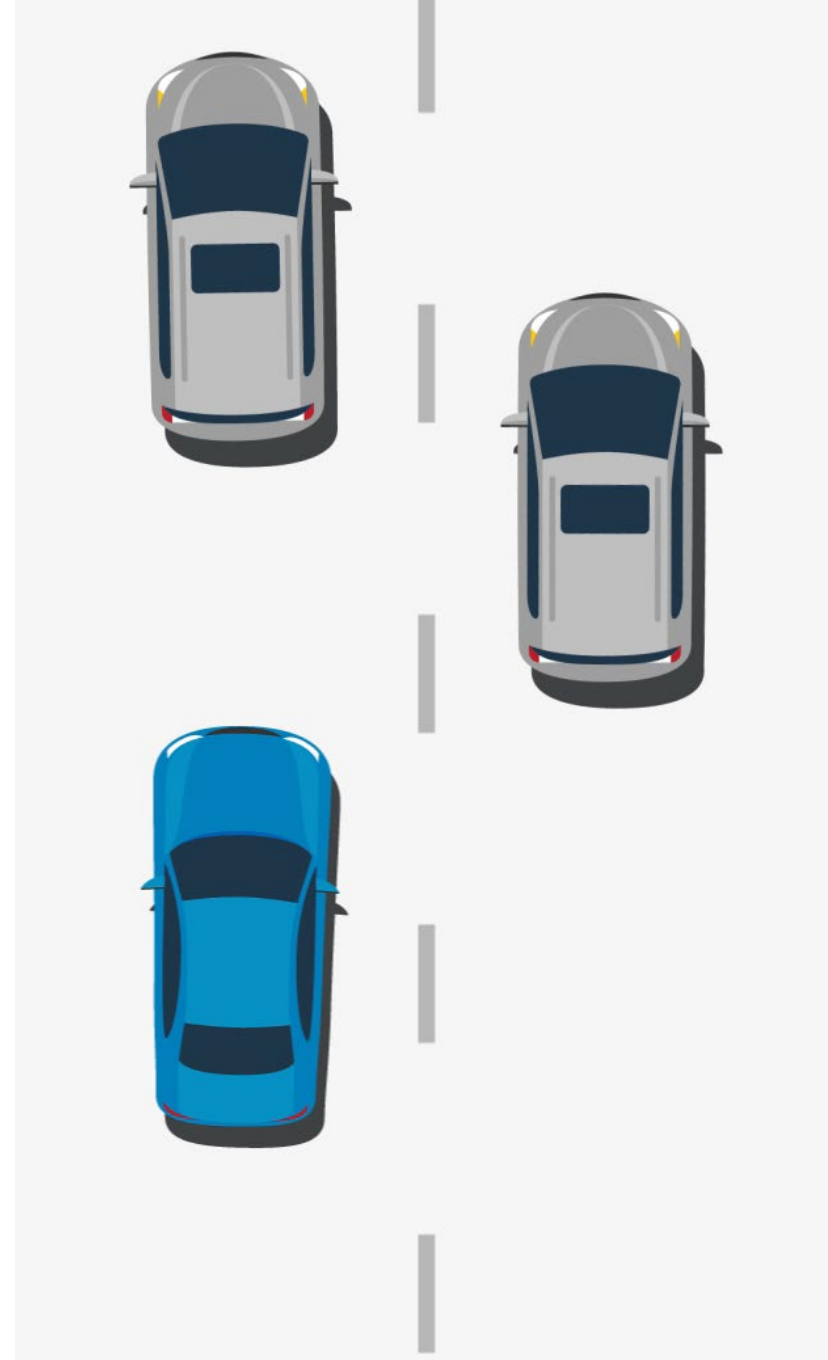
Challenges of Autonomous Vehicles

- Driver privacy video monitoring
- **Define the responsibility** for the accident, whether the vehicle, the driver, or the vehicle manufacturer (Insurance)
- Performance in navigating bad weather, heavy rain, snow, fog, and winter conditions have short comings because of the optical sensors loses effectiveness
- **Exposure to** electromagnetic field (**EMF**)
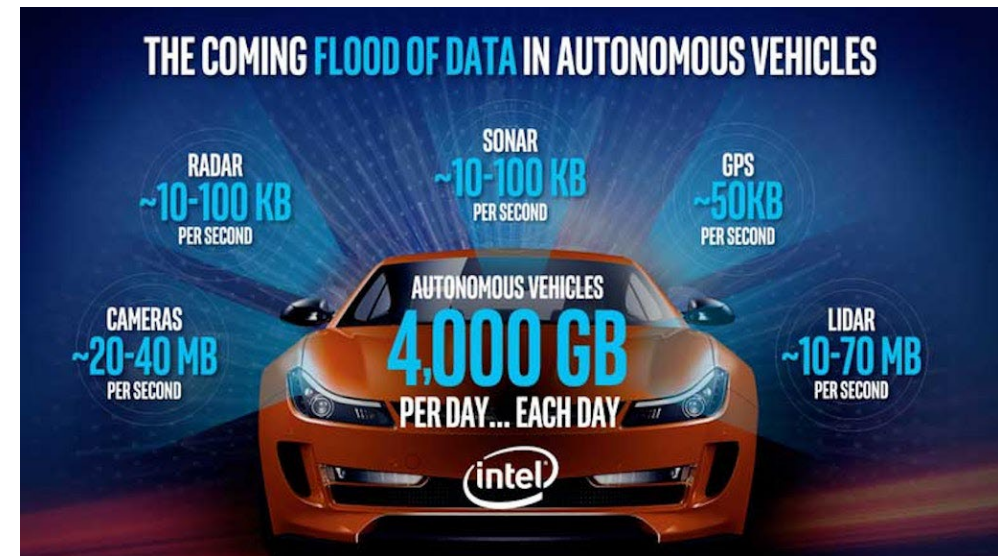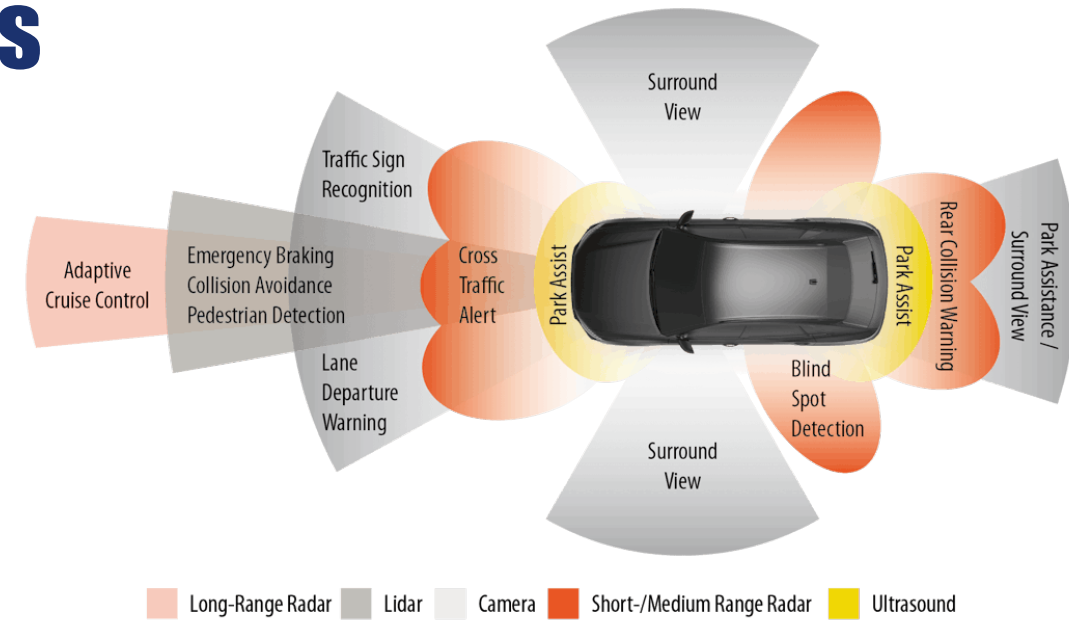
Challenges of Autonomous Vehicles

- Autonomous vehicle companies don't provide data on performance / near misses

- Data protection issues (cybersecurity)

- High cost of implementation

- High cost of vehicles

- Data Connectivity

- Need more research

- Developing AV Regulatory Policy (Federal/State/Local)

- Communication, Education and Training

Challenges of Autonomous Vehicles in a Warehouse

- Increase pace of work

- No OSHA standard for robotics industry

- Collisions between vehicles

- Collisions between vehicles and personnel

- Power outage

- Software or Sensor Failures

- Equipment malfunctions

- Mechanical failures

Challenges with the Trucking Industry

- The average trucking company has a turnover rate of roughly 95 percent, meaning that it must replace nearly all of its work force in the course of a year

- More than 10 million Americans held commercial driver's licenses in 2019

- Quality of Life

- Quality of Health

- Almost half of truck drivers work more than 40 hours per week

Issues with the Trucking Industry

- Shortage of roughly 80,000 truckers
- Aging workforce
- Many truckers are paid only for driving time
- Not compensated for overtime

Issues with the Trucking Industry

- Not compensated for time spent waiting for loading and unloading goods, adding to uncertainty for workers

- Many also pay their own fuel costs

- Lack health care benefits

- Drivers not passing drug test

Changing Careers

New Jobs in Automation Industry

- Software Developers

- Engineers

- Field Service Technician

- Vehicle Maintenance

- Safety drivers

- Vehicle operations specialists

- Increase Short-haul drivers

Thank You
Questions

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