AUTOMATED VEHICLES AND THE CONNECTED ENVIRONMENT

A CRASH COURSE

AGENDA

- Overview of Automated Vehicles
- Health and Safety Considerations
- Government Actions
- Industry Adoption
- Teamster Response

Automated vehicles are those in which at least some aspect of a safety-critical control function (e.g., steering, shifting, or braking) occurs without direct driver input.

- Also Know As:
  - **Autonomous Vehicles, Self-Driving Car, Driverless Vehicles, Intelligent Transport Systems**


FREIGHTLINER

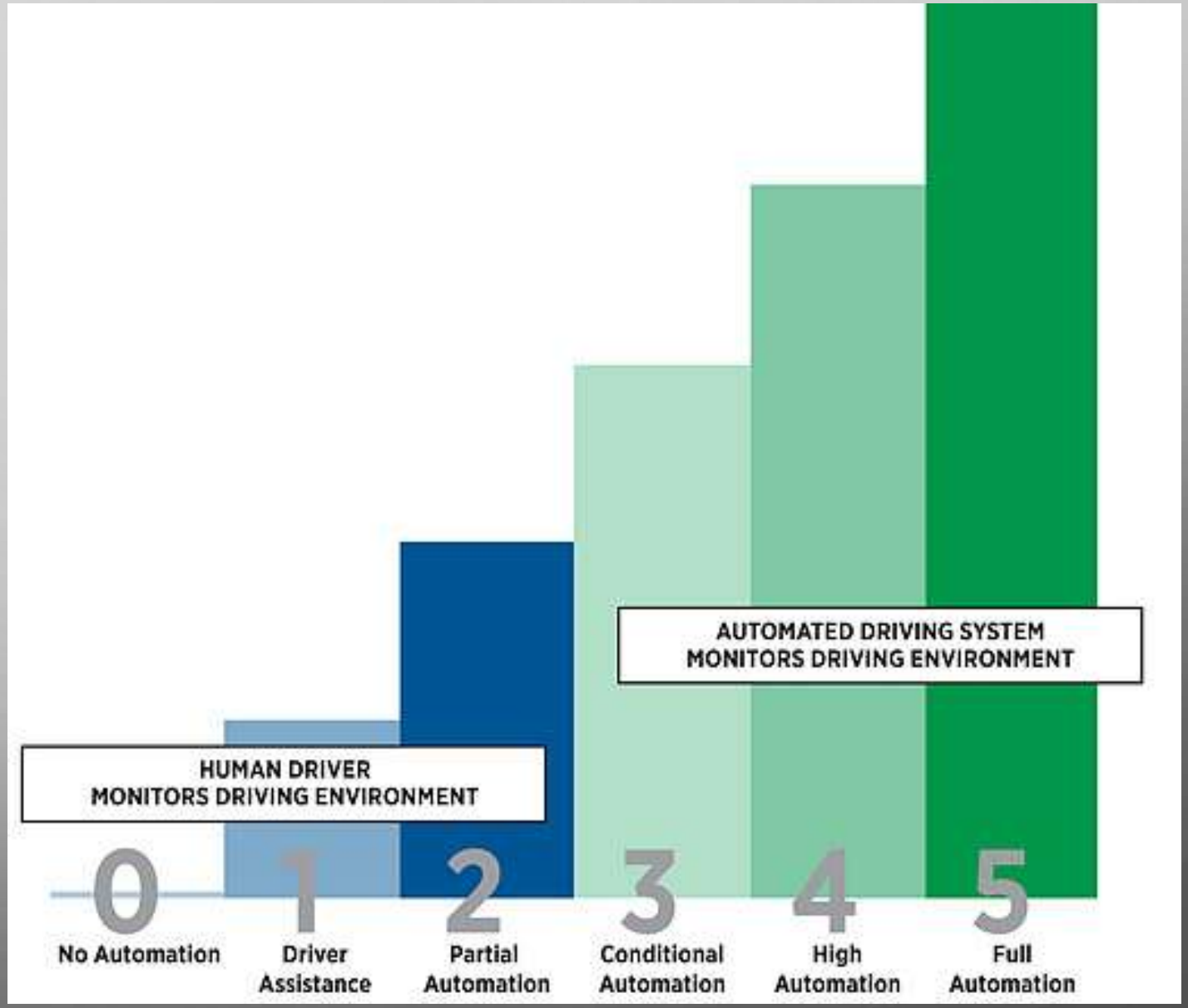

OTTO
PROUDLY BREWED.
SELF-DRIVEN.
Budweiser
OTTO


REDEFINING
PRODUCTIVITY IN
FUTURE MINING


Mercedes-Benz Safety Truck


CATERPILLAR
CAT

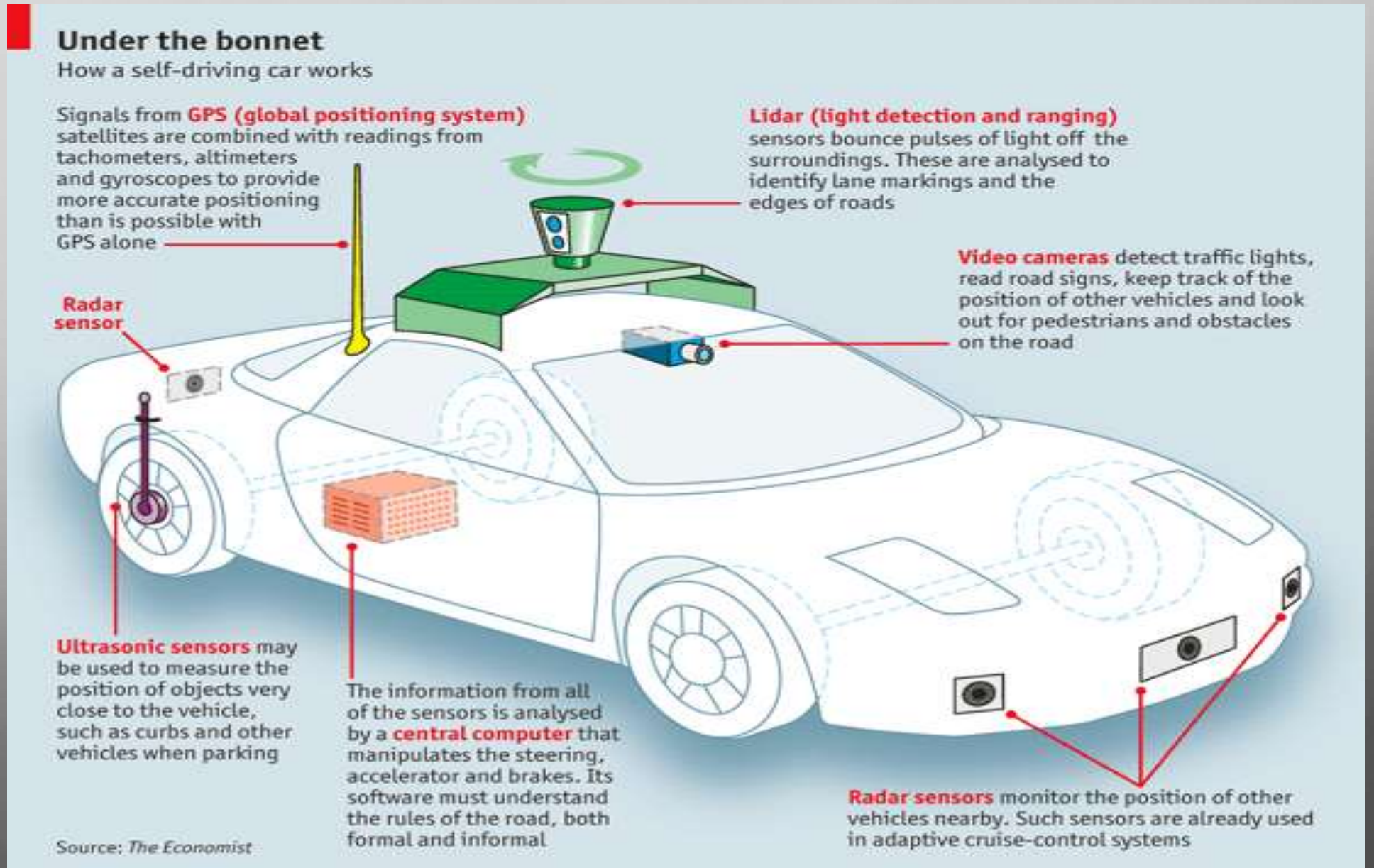
SOCIETY OF AUTOMOTIVE ENGINEERS (SAE) DEFINES SIX (6) LEVELS OF AUTOMATION



EXAMPLES OF TECHNOLOGY AT EACH AUTOMATION LEVEL

SAE Level	Example Systems	Driver Roles
1	Adaptive Cruise Control OR Lane Keeping Assistance	Must drive other functions and monitor driving environment
2	Adaptive Cruise Control AND Lane Keeping Assistance Traffic Jam Assist	Must monitor driving environment (system nags driver to try to ensure it)
3	Traffic Jam Pilot Automated parking Highway Autopilot Vehicle Platooning Technology	May read a book, text, or web surf, but be prepared to intervene when needed
4	Closed campus driverless shuttle Valet parking in garage Automated Tractor Trailers 'Fully automated' in certain conditions	May sleep, and system can revert to minimum risk condition if needed
5	Automated taxi Car-share repositioning system	No driver needed

HOW DO AUTOMATED VEHICLES WORK?



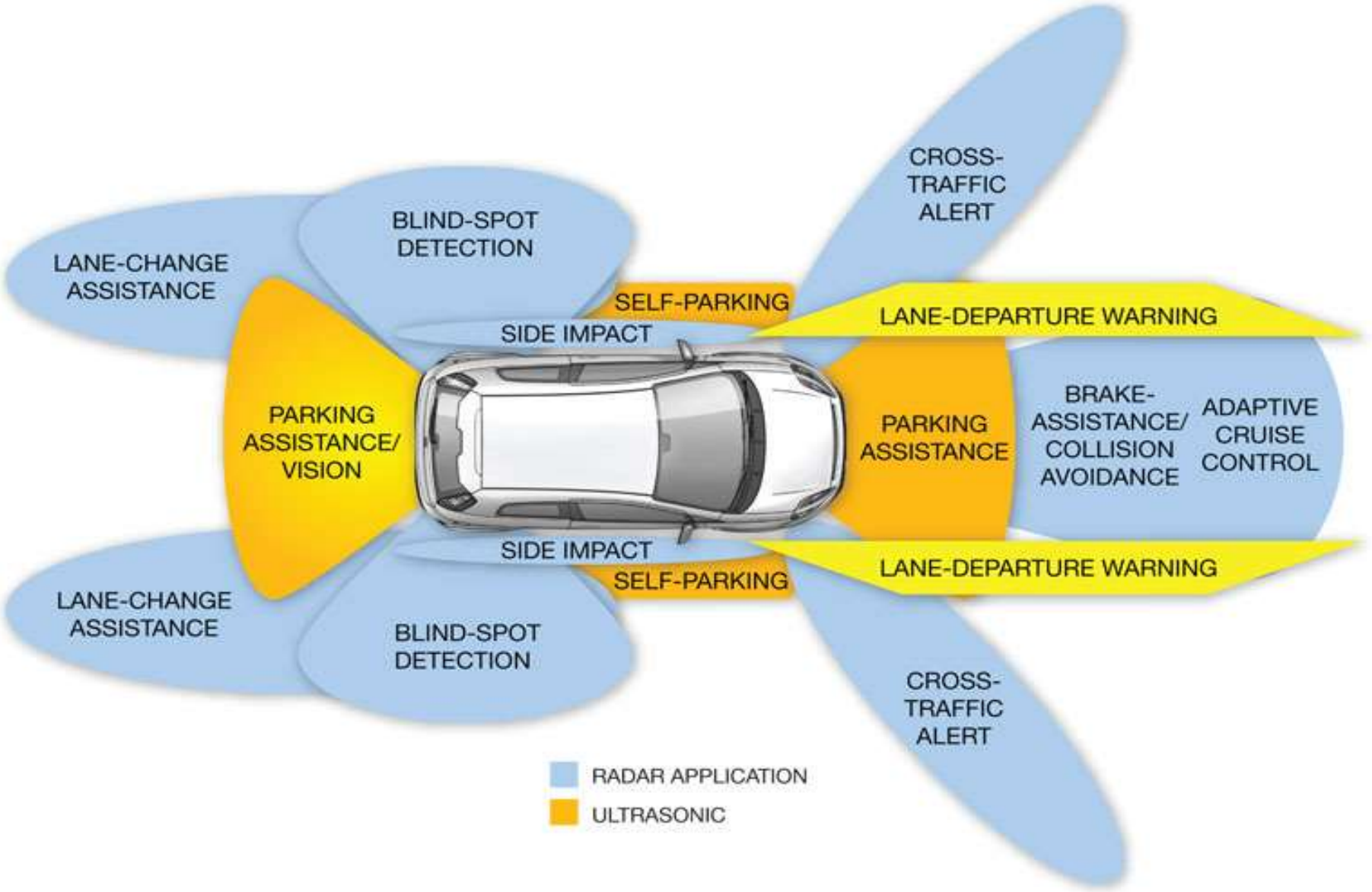
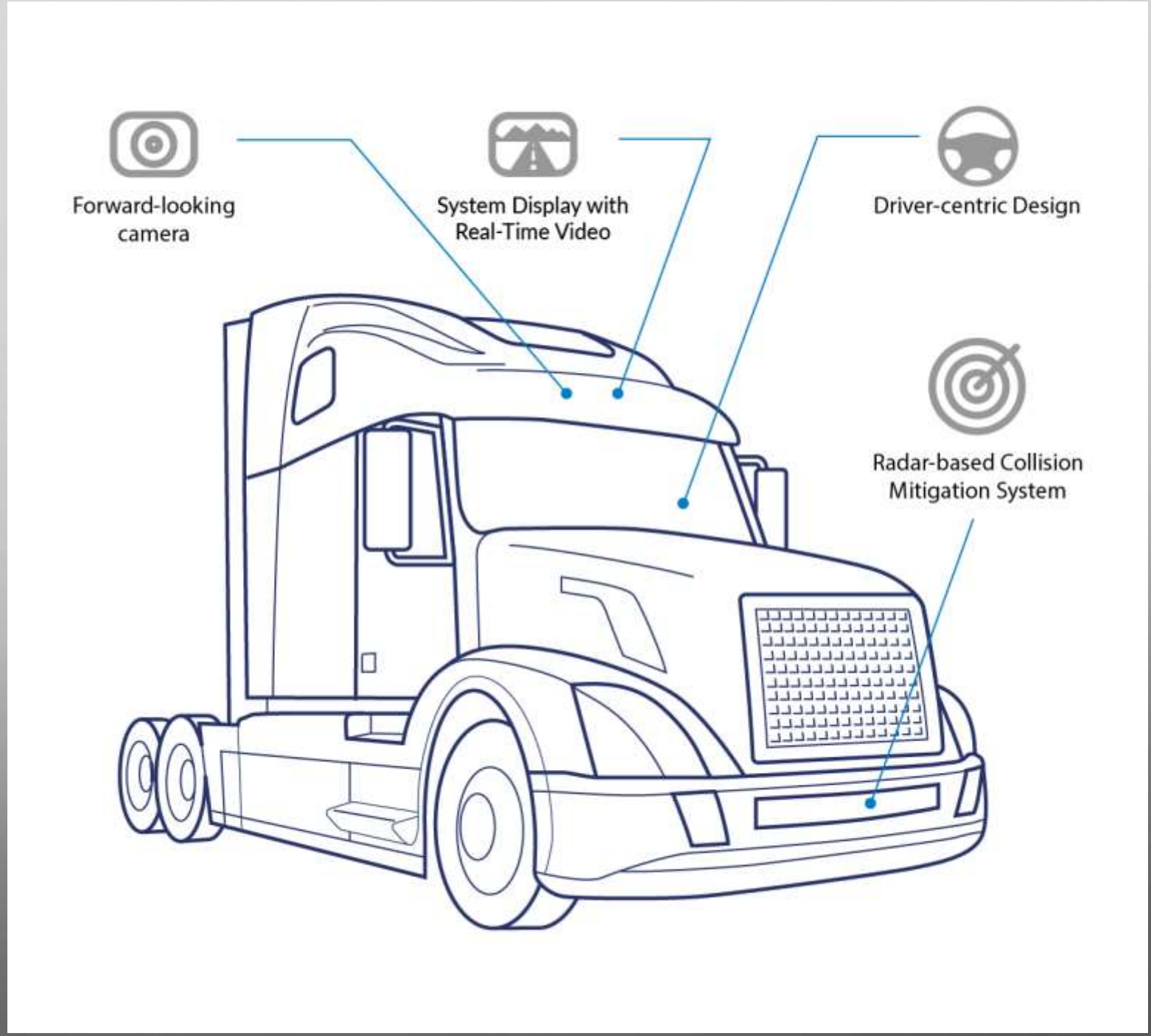
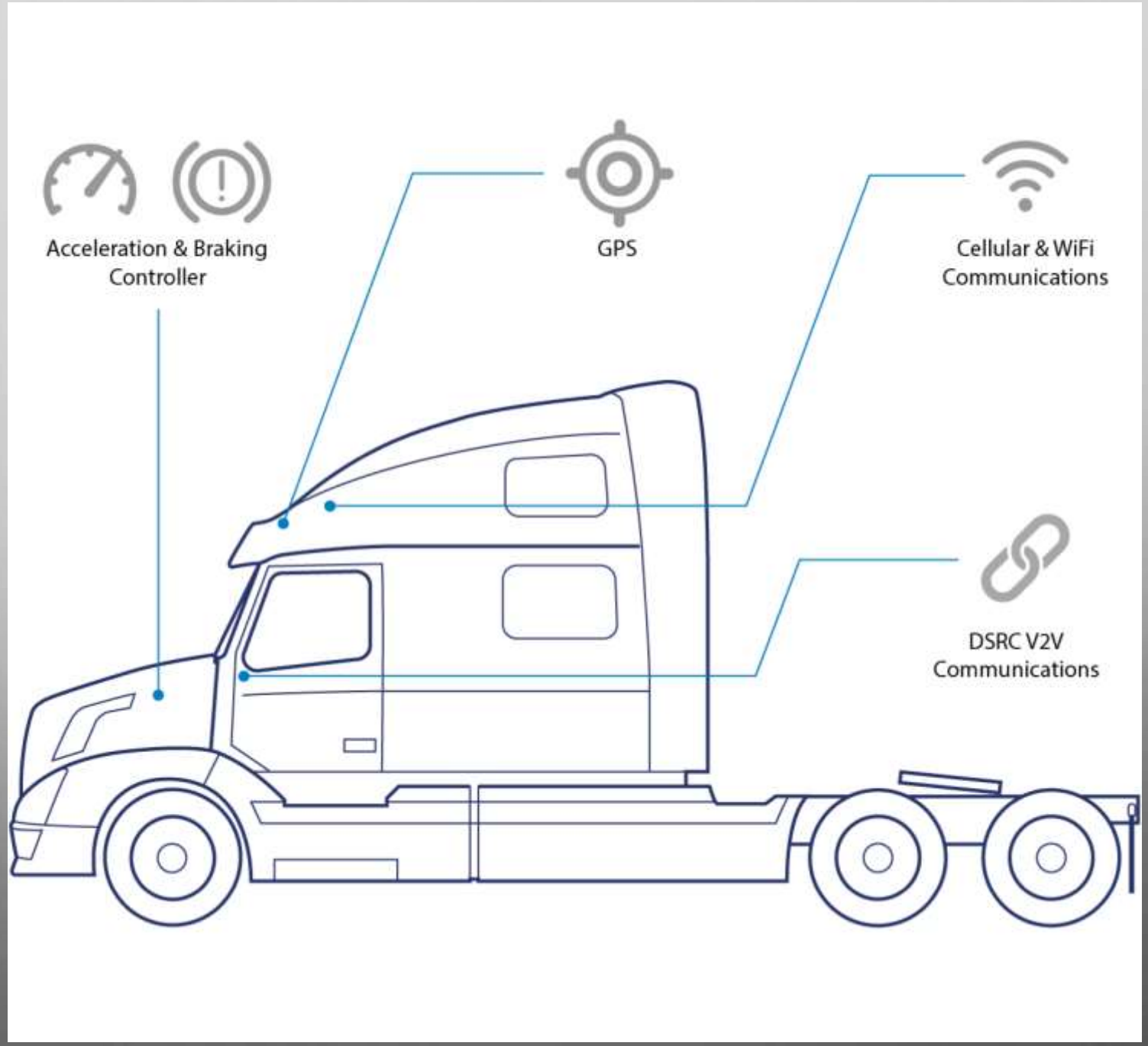


Figure 2 Several driver-assistance systems are currently using radar technology to provide blind-spot detection, parking assistance, collision avoidance, and other driver aids (courtesy Analog Devices).


Forward-looking camera
System Display with Real-Time Video
Driver-centric Design
Radar-based Collision Mitigation System


Acceleration & Braking Controller
GPS
Cellular & WiFi Communications
DSRC V2V Communications

2 redundant Steering Motor

GPS Antenna +IMU

V2V Communication Antenna

Millimeter wave radar

Laser Radar

HMI

Lane detection sensor

AUTOMATED VEHICLES VS. CONNECTED VEHICLES

Autonomous Vehicle

Operates in isolation from other vehicles using internal sensors

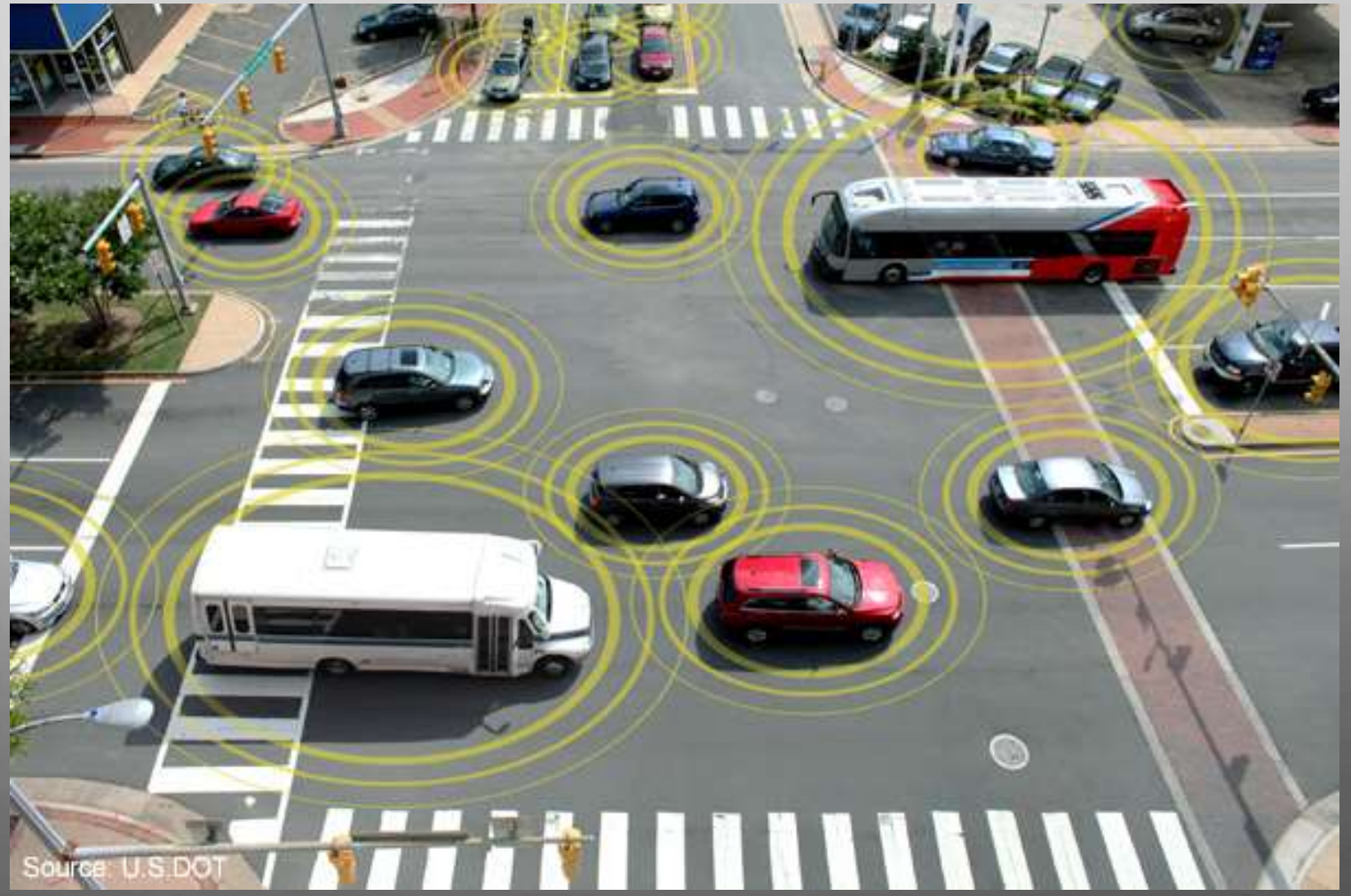
Connected Automated Vehicle

Leverages autonomous and connected vehicle capabilities

Connected Vehicle

Communicates with nearby vehicles and infrastructure

AUTOMATED VEHICLES AND THE CONNECTED ENVIRONMENT



SPECIFIC ISSUES FOR DRIVERS

- **Health and Safety Considerations**
  - Ethical Dilemma
  - Liability
  - Regulations Impacting Drivers

RADARS AND ELECTROMAGNETIC ENERGY

- Electromagnetic Energy
  - Radio waves
    - Radiofrequency RF Waves/ RF Energy/ RF radiation (nonionizing)
- Biological Effects of RF Radiation?
    - Thermal effects- tissue damage to eyes and testes- high power RF source (cell tower)
    - Non-Thermal Effects- inconclusive animal models showed tumor formation
- Will radars in automated cars produce enough energy to cause cancer?
  - Will a cumulative exposure (infrared, radar, laser-lidar, coupled with increased cell phone use and environmental EF energy pollution) make a difference ???

THE HUMAN MACHINE INTERFACE: ERGONOMICS AND COGNITIVE STRESS

- What will the dashboard look like?
- Will drivers be expected to be familiar with the different makes and models of automated CMVs?
- How will carriers handle technology
- updates for fleet vehicles?

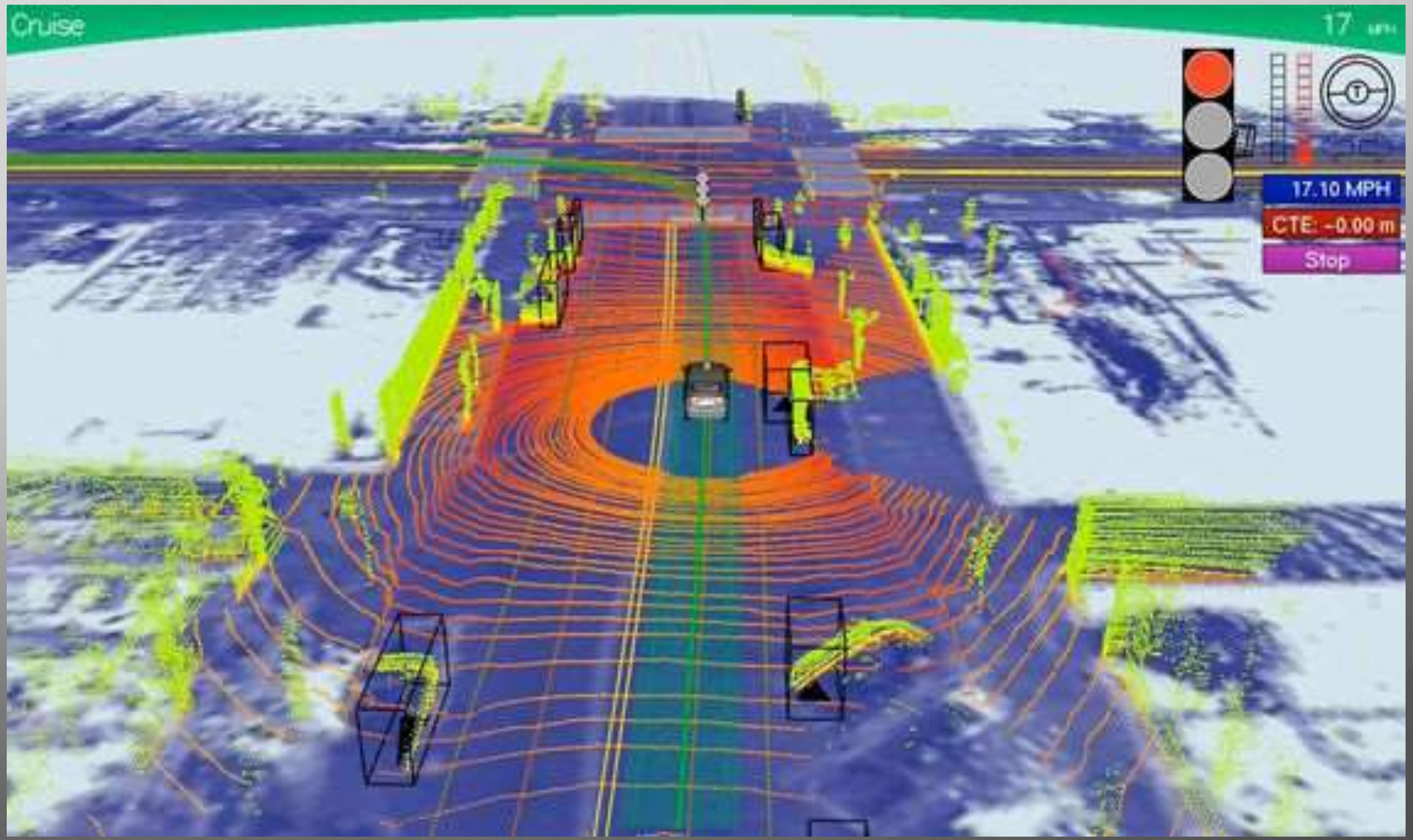
Is this HMI dashboard overwhelming?

HOW SENSOR TECHNOLOGY INTERPRETS THE ENVIRONMENT

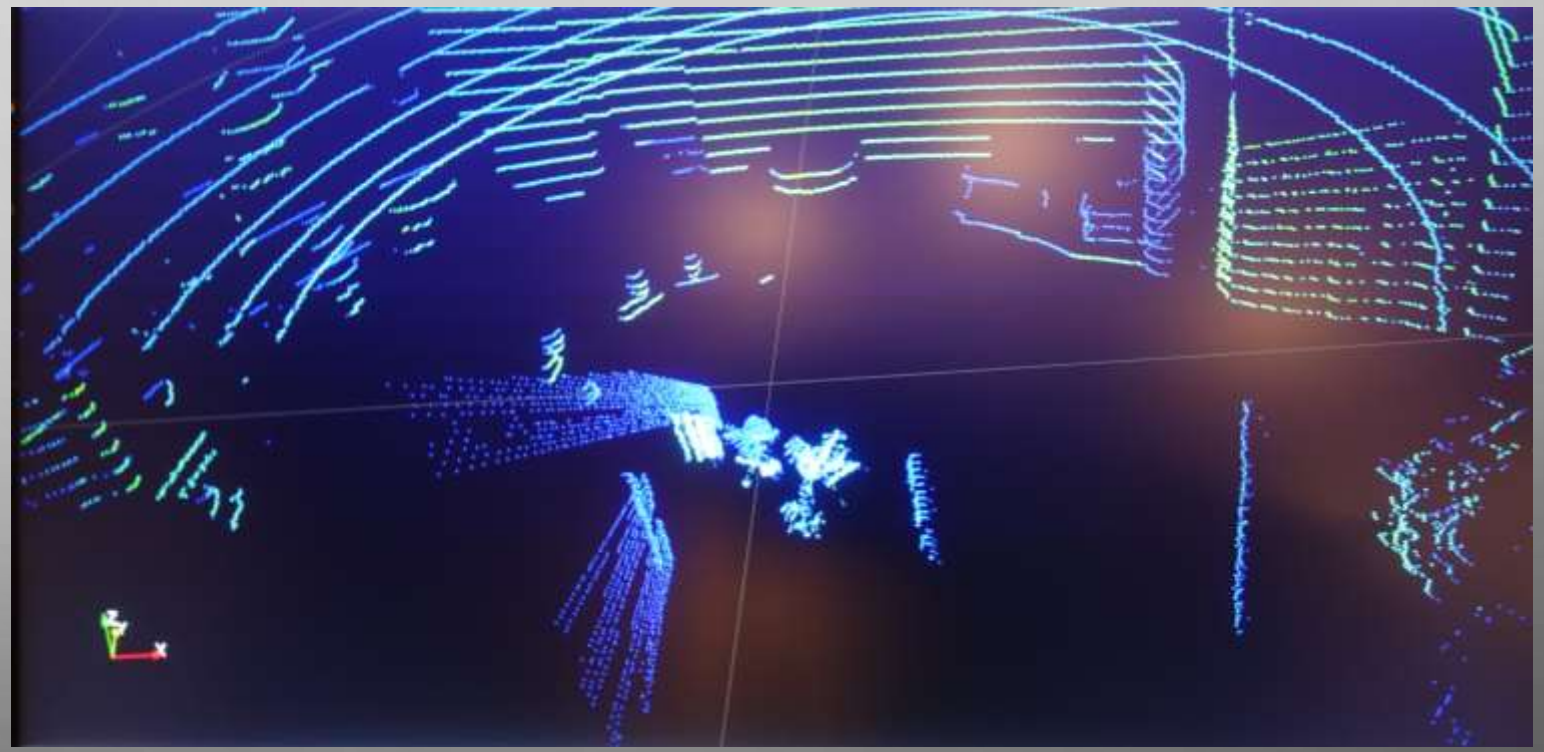
Yellow box = pedestrian
Red box = cyclists
Pink box – vehicle

Red fences – location where the car will make itself stop
Green fences- location where the car thinks it will need to slow down

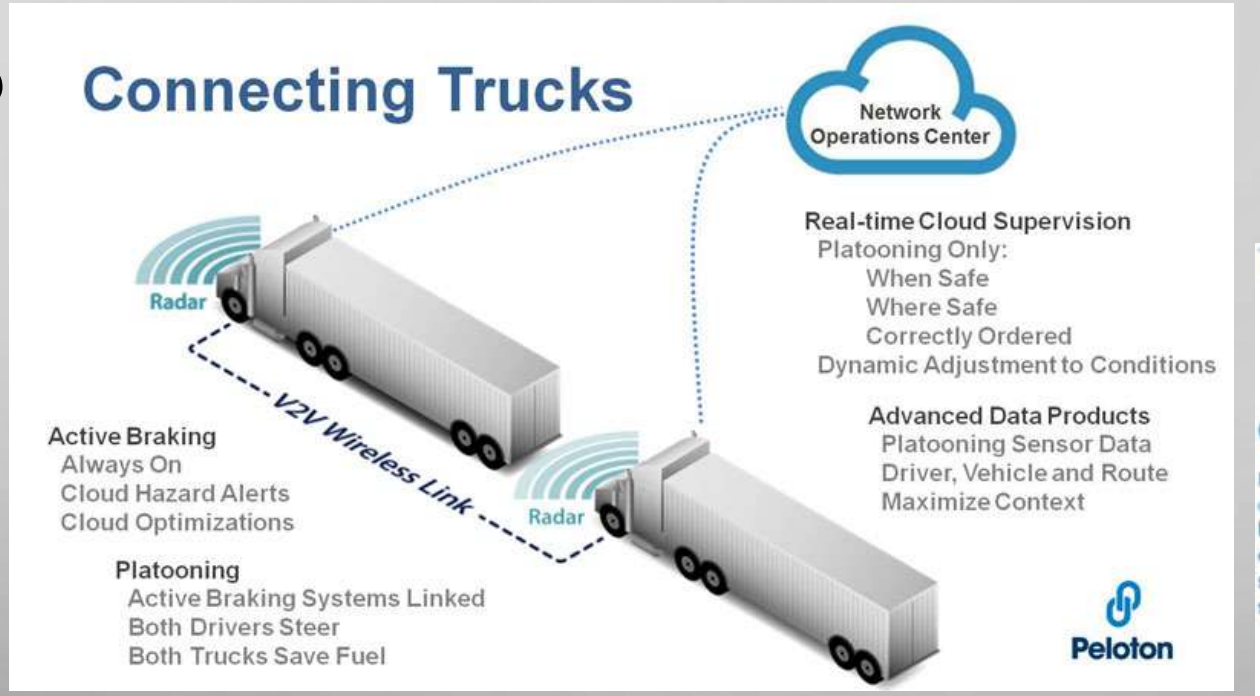
LIDAR: GOOGLE CAR

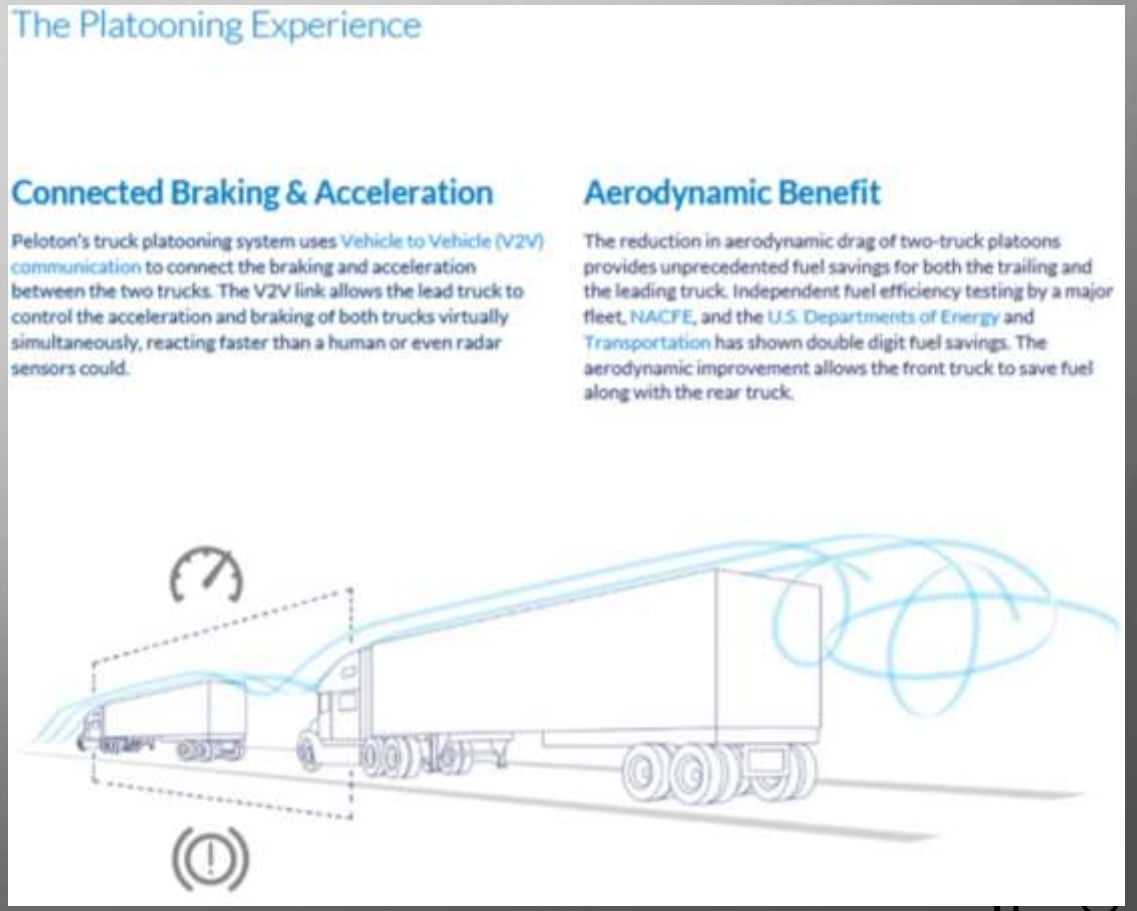


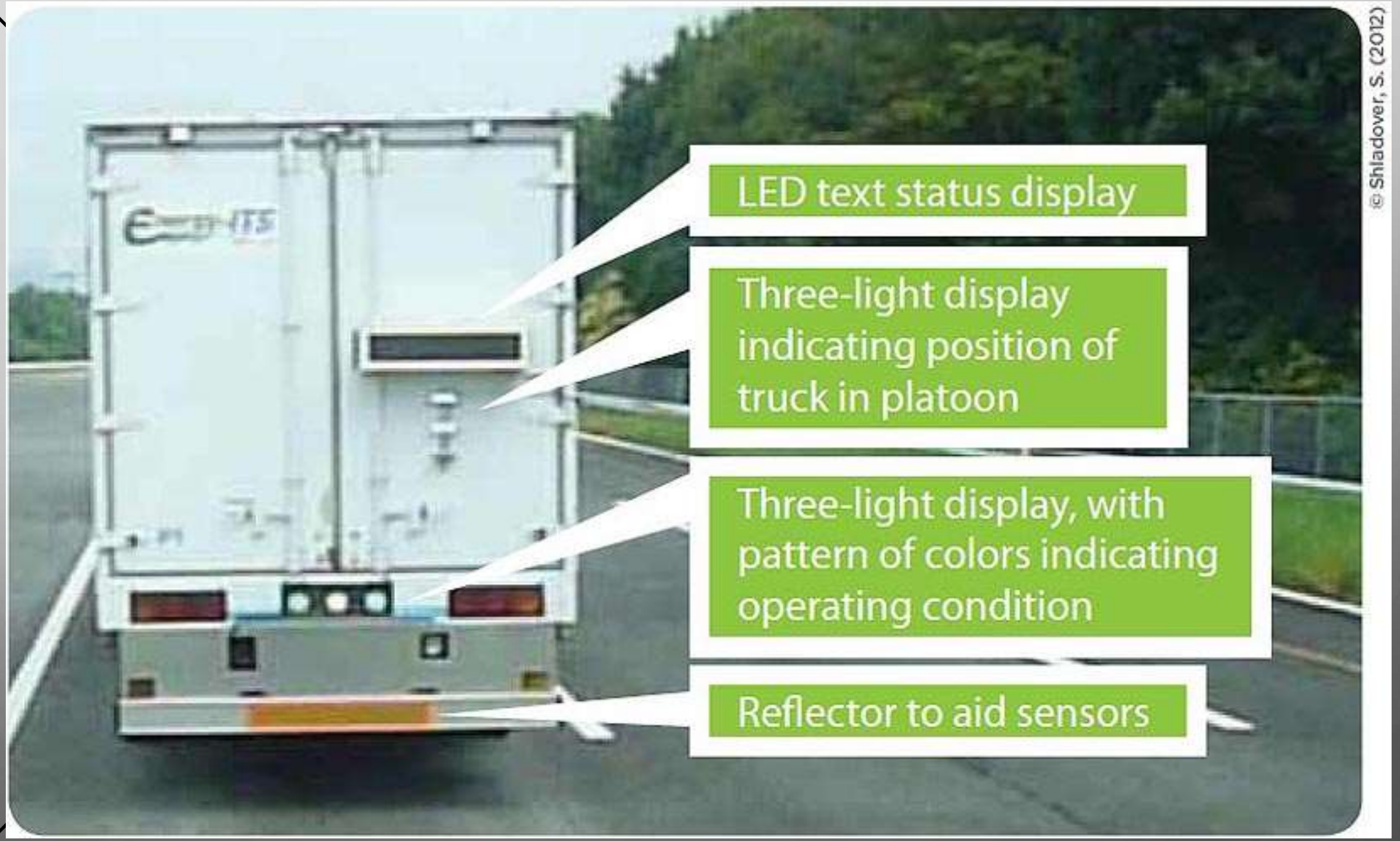
LIDAR: VELODYNE
IS THERE A DIFFERENCE IN THE QUALITY OF TECHNOLOGY?



DRIVER ASSISTED TRUCK PLATOONING






LED text status display
Three-light display indicating position of truck in platoon
Three-light display, with pattern of colors indicating operating condition
Reflector to aid sensors
© Shladover, S. (2012)

2ND VEHICLE MONITOR DISPLAY (PLATOON)

FATIGUE MONITORING DEVICES AND MISUSE

WHOOP STRAP 2.0

WORN ON THE WRIST AND USED FOR FITNESS APPLICATIONS.

WHOOP is a scientifically-grounded wearable which tracks and reports on strain, sleep, recovery analysis and more. It has been endorsed by...

MAVEN CO-PILOT

WORN ON THE HEAD AND USED FOR INDUSTRIAL APPLICATIONS.

The Maven Co-Pilot is a wearable device designed to address truck driver fatigue and distraction. The device is able to detect the...

SMART CAP

WORN ON THE HEAD AND USED FOR INDUSTRIAL APPLICATIONS.

The Smart Cap is a fatigue monitoring system designed for industrial purposes. This wearable device is excellent for keeping truck drivers...

EASYWAKEME

WORN ON THE WRIST & ANKLE AND USED FOR FITNESS APPLICATIONS.

EasyWakeMe is a high-tech device developed by Dreamtrap Commercials to capture sleep patterns. This wearable device detects optimal wake-up...

VIGO FATIGUE MONITOR

WORN ON THE HEAD AND USED FOR LIFESTYLE & INDUSTRIAL APPLICATIONS.

The Vigo Fatigue Monitor is a wearable device that tracks alertness over time. It has the capability to alert the user when they are drowsy...

FATIGUE SCIENCE READIBAND

WORN ON THE WRIST AND USED FOR MEDICAL, INDUSTRIAL & FITNESS APPLICATIONS.

The ReadiBand is a wearable device worn on the wrist and designed to collect wrist movement data. From this data, Fatigue Science is able...

OPTALERT EAGLE

WORN ON THE HEAD AND USED FOR LIFESTYLE & INDUSTRIAL APPLICATIONS.

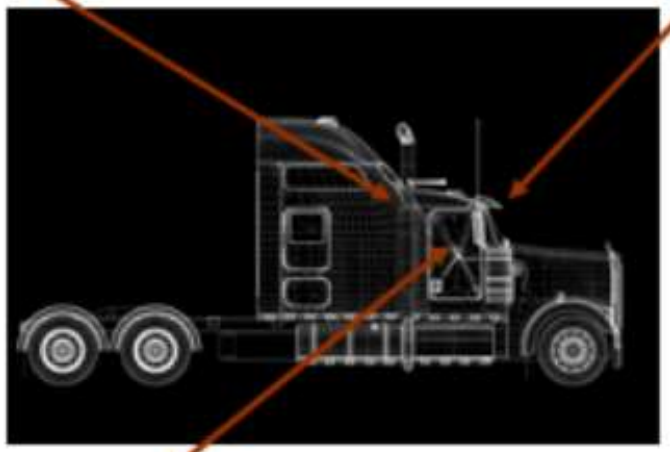
The Optalert Eagle is a fatigue management system that detects the physiological warning signs of early onset drowsiness. The Eagle's...

OTHER HEALTH AND SAFETY CONSIDERATIONS OF CMV PLATOONING

- Alarm Fatigue (DSRC Passive Alerts)
- Intellectual Overload (fatigue)
- Ergonomics
- Technological Malfunction
- Workplace Stress/ Workplace Violence

HIGH TECH SECURITY CHALLENGES (HACKING)

Cyber Security Attack Points



Critical Vehicle Data

- Engine control unit
- Transmission control unit
- Body controllers (locks/lights)
- Air bag control unit
- Steering, suspension, and stability

External Interfaces

- Keyless entry
- Tire pressure monitoring system
- V2x communication/DSRC
- Satellite data
- Sensor and camera data

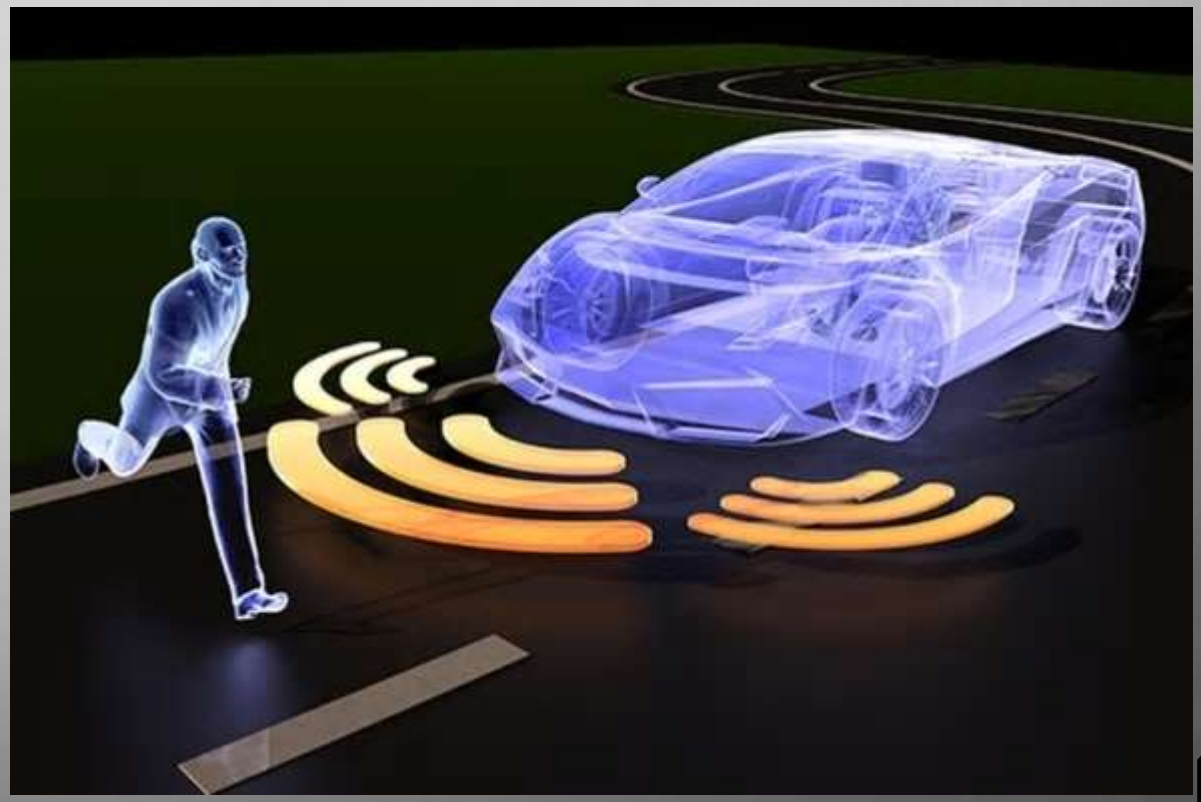
Infotainment & Telematics

- Vehicle data from OBD II, GPS co-ordinates, driving patterns, diagnostics
- Internet, smartphone interfacing, Bluetooth, Wi-Fi, app store
- Radio and media streaming

In the automated scenario, there is a high possibility of vehicle being compromised. **Drivers of the vehicle must be provided with a failsafe switch to shut down ADAS systems to regain full control over the vehicle.**

Heavy dependence remains on an Internet network, and the exchange of data is to be managed properly. **Encryption of data exchange will bring third-party security solution providers into the value chain.**

LOW-TECH SECURITY CHALLENGES

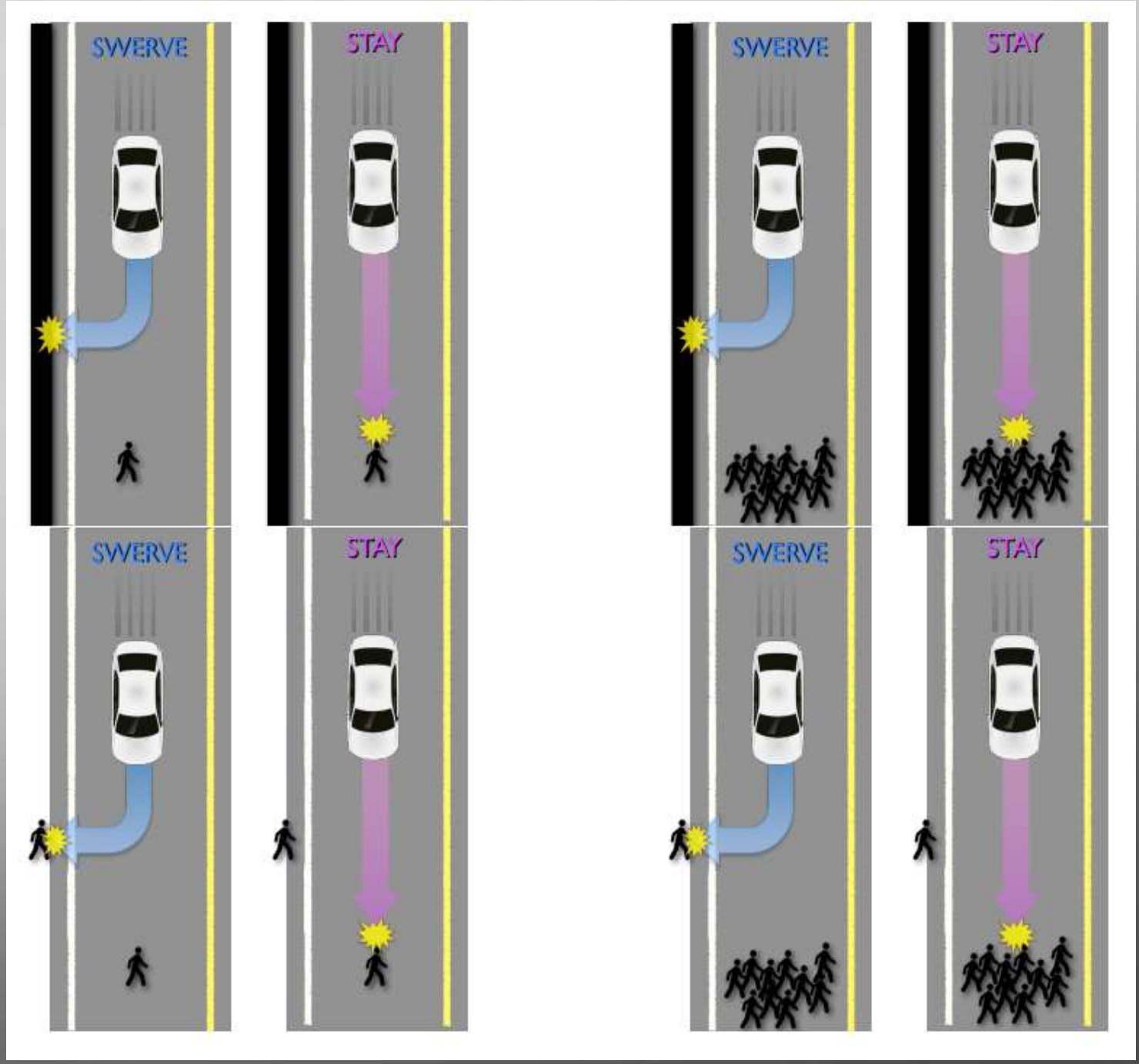


SPECIFIC ISSUES FOR DRIVERS

- Health and Safety Considerations
- Ethical Dilemma
- Liability
- Regulations Impacting Drivers

ETHICAL DILEMMA:

HOW WILL AUTONOMOUS VEHICLE BE PROGRAMMED?



LIABILITY CONCERNS

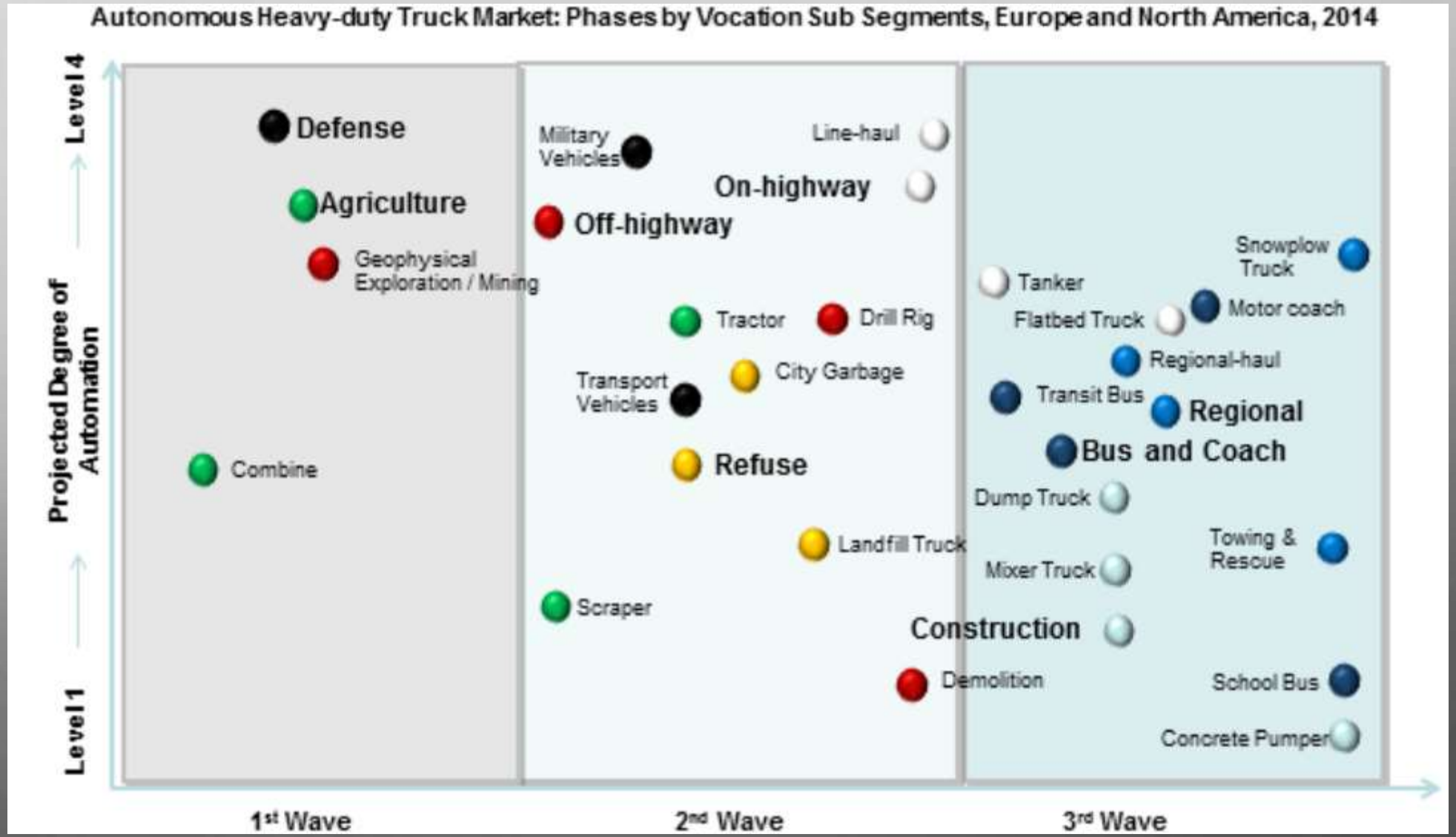
- **Who's liable when an autonomous car crashes? The driver? The manufacturer? The programmer? The Carrier?**
  Liability is a major ethical issue surrounding autonomous vehicles. Complex systems inherently have errors and bugs. An issue that will arise surrounding liability is assigning fault when an autonomous vehicle crashes. However as autonomous vehicles become more prevalent a system of responsibility must be established. If the software misinterprets a worn down sign does the blame fall on the department of transportation for poorly maintained signage or the company who produced the self-driving software? It is unclear where the future of liability will rest in the realm of self-driving cars however it is known that the United States is fast to place blame on car manufacturers. The precedent set over the next few years will have a significant impact on how willing car companies will be in pursuing autonomous vehicle technology.
- **Google, Volvo, Mercedes have all accepted liability for crashes due to AV technology failure**

REGULATORY CONSIDERATIONS

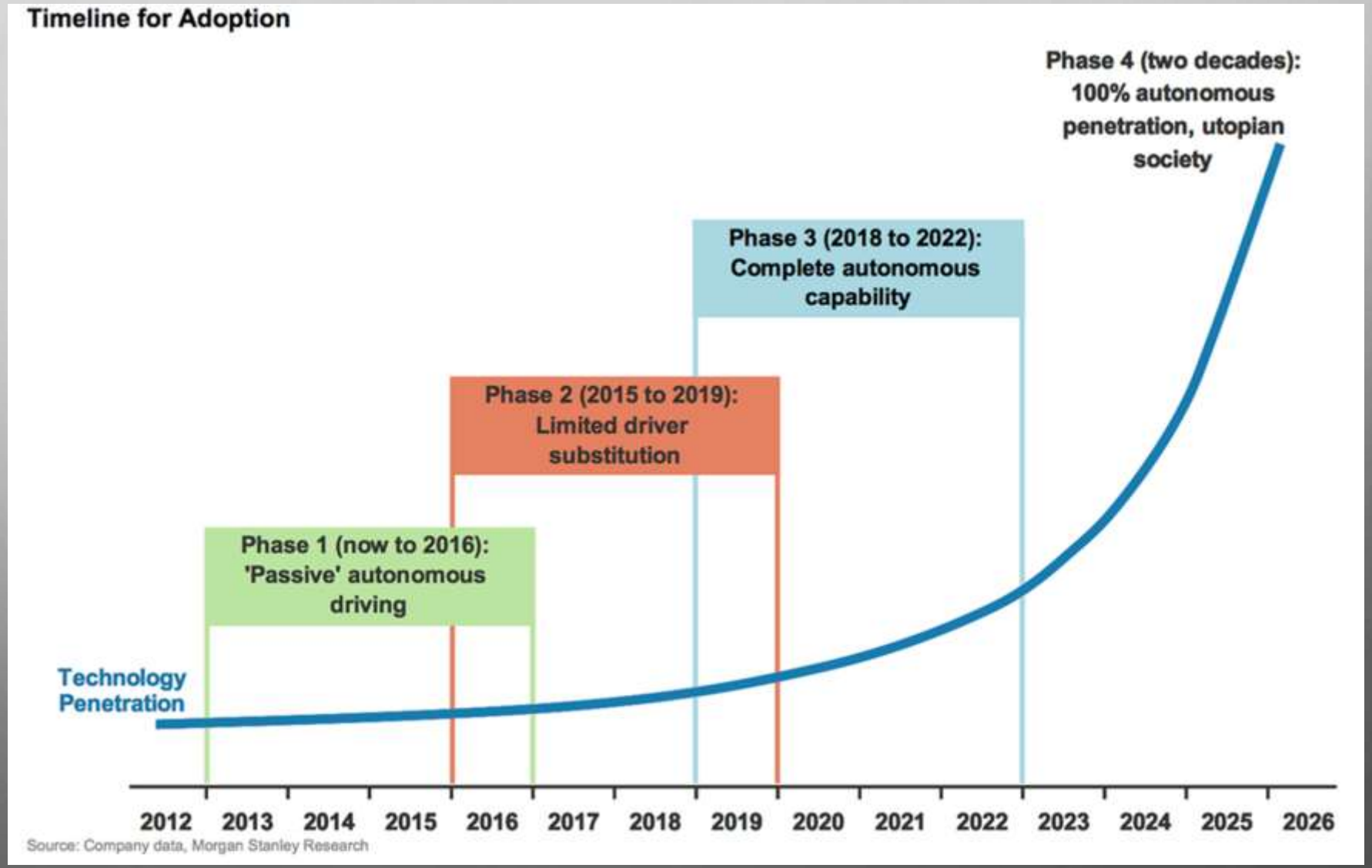
- Changes to the Federal Motor Vehicle Safety Standards (FMVSS)
- Driver Licensing
- Maintenance Standards
- Vehicle Inspections (Pre-Trip / DVIR)
- FMCSA Hours of Service changes for operators of CMVs
- Federal Automated Vehicle Policy (should this be a regulation?)
- What guidance will law enforcement have in citation or stopping an autonomous vehicles?
- How will autonomous vehicles behave at grade crossings where there is no arm limiting crossing and the “connected environment technology is not ubiquitously implemented.

WHAT WE KNOW

WHAT SECTOR IS LIKELY TO ADOPT THIS TECHNOLOGY?



IMPLEMENTATION PROJECTIONS



WHO IS PUSHING THIS?

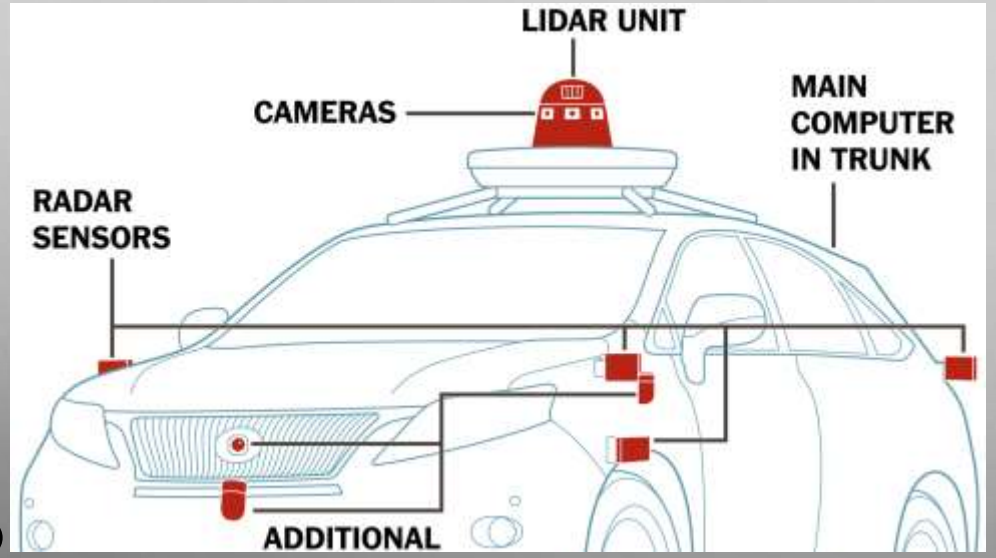
- Passenger Vehicles Auto Companies

- **Internationally**
  - Honda, Volvo

WHO ELSE IS INVOLVED? - TECH COMPANIES

- **Google (Alphabet)**
- **Apple**
- **Uber**
- **Baidu -** The Chinese internet company
- **Thousands of smaller**
- **companies**

WHO ELSE IS INVOLVED? - SUPPLIERS



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THE MOVEMENT TO TRUCKS

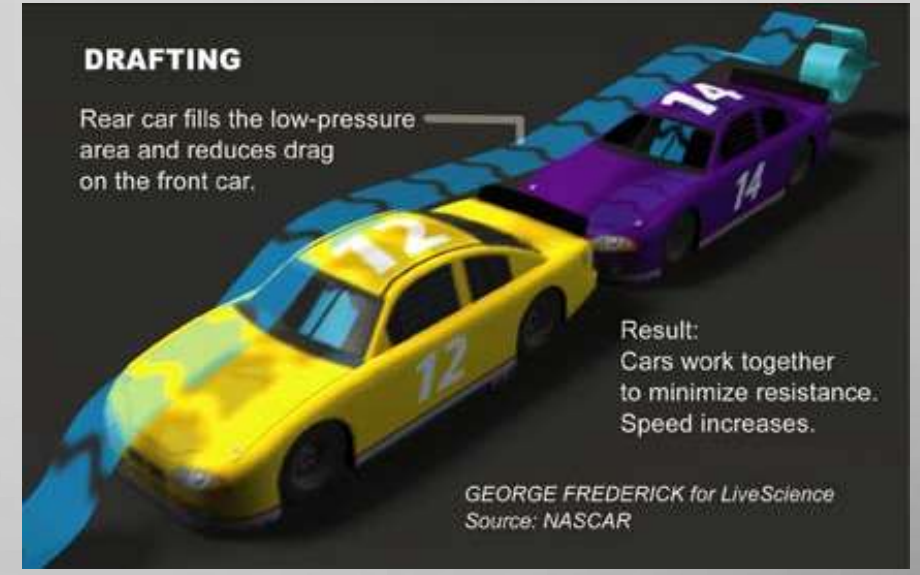
- Self driving trucks are one part of the equation
- Different dynamic in Trucking
- Each segment presents it's own challenges – we know they can't be lumped together into one group
- Issues impacting tankhaul aren't the same as LTL
- Manufacturers dictate much of what companies can buy, many trucking companies are consumers also
- For the self driving tech –same similar suppliers
- Volvo Group
- Otto
- Embark

PLATOONING

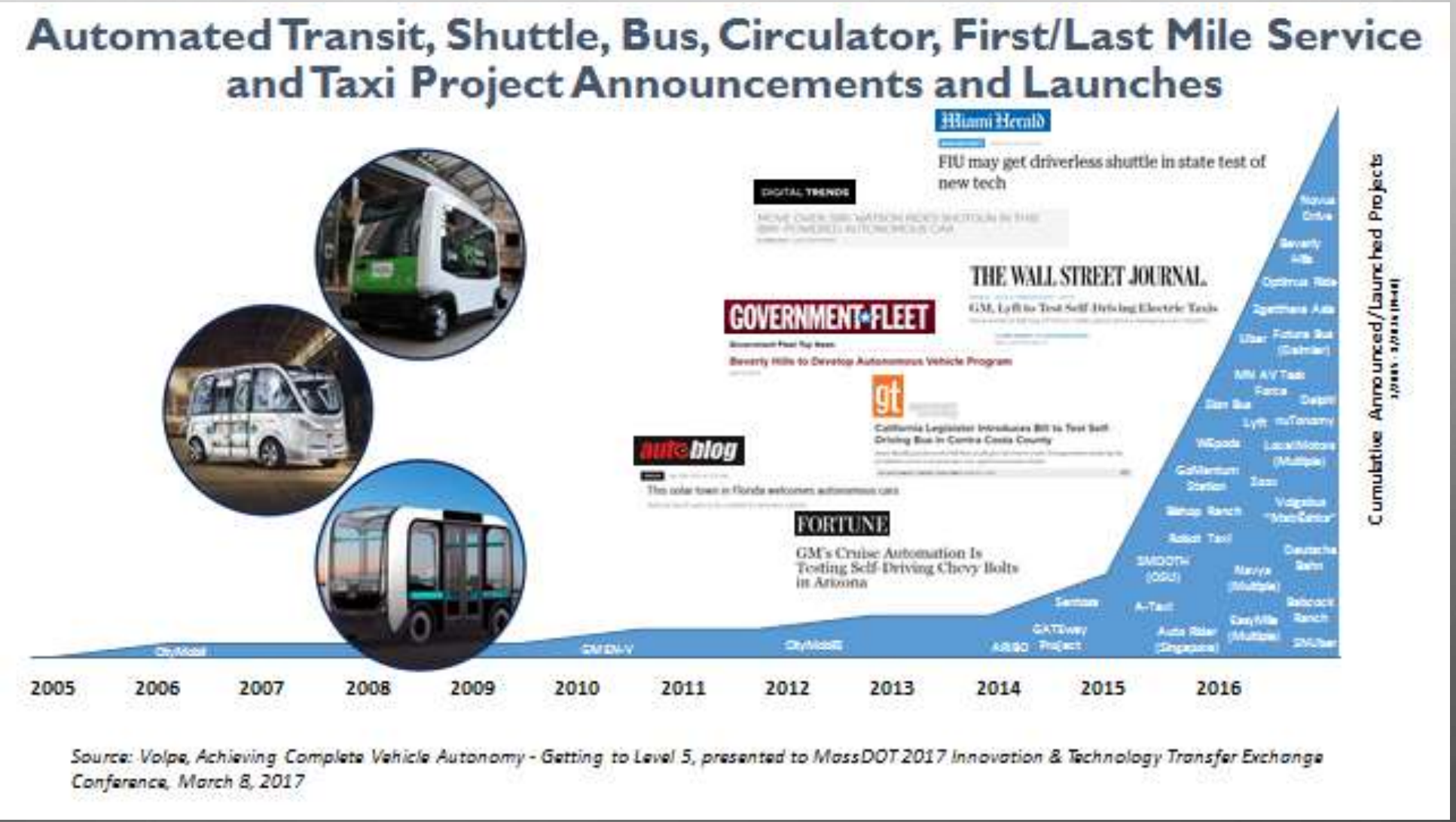
- Level 3+ automation
- Hybrid of human and computer interfaces
- Operate like trains on wheels
- UPS, FedEx, truckload OTR companies, anywhere fixed point to point operations with multiple vehicles is being examined
- Creates unique risks to commercial drivers and other motorists on the road

PLATOONING

- Why? **Fuel efficiency**
- Same concept as race cars



PASSENGER CARRYING VEHICLES



Source: Volpe, Achieving Complete Vehicle Autonomy - Getting to Level 5, presented to MassDOT 2017 Innovation & Technology Transfer Exchange Conference, March 8, 2017

US CRASH STATS

- Motor Vehicle Crashes are Costly
  - Human toll: 32, 675 people died in 2014
  - $836 billion dollars a year to society
  - A leading cause of death for 4 to 34 year olds
  - U.S. falling behind other European countries and Japan in terms of crashes

What they don’t say - 80 percent of truck crashes are caused by other cars on the road

- Need to accelerate deployment of current crash avoidance technologies (automatic braking, lane departure warning, etc) that will directly help

WHAT HAPPENS TO WORKERS

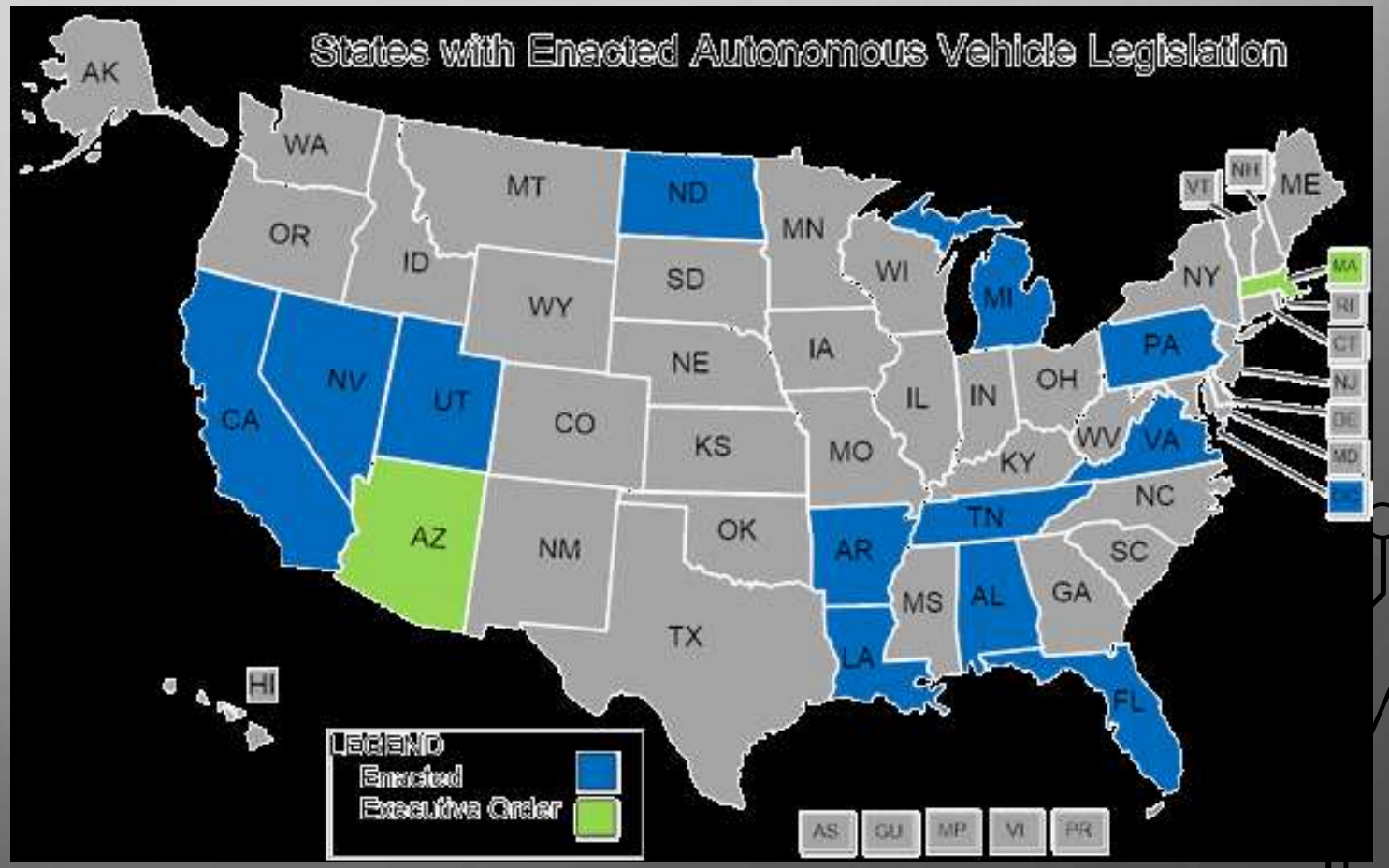
- Job loss?
- Change to what the job itself is
- Difficulties attracting drivers to field?
- Degradation of skills?
- Downward pressure on wages?
- More duties without commensurate pay?

SOCIOECONOMIC CONSIDERATIONS

- Potential broad impacts:
  - 4.5 Million Jobs lost? ~less than 400,000 jobs created?
  - Trucking, Transit, Taxi, Hotel, Food Service, Medical, Parking garage, Waste, Construction, Port, and Mining sectors, potential for various impacts
  - Related industries – hotels and truck stops
  - African America, Latino, American Indian communities exponentially impacted
  - Environmental Concerns (increased traffic)
  - Forecasted reduced injuries and fatalities as a result of vehicle crashes. Probably increased in the early stages of implementation however as non AVs and Avs coexist on roads and highways

GOVERNMENTAL ACTIONS

- Federal Department of Transportation
  - NHTSA- guidance policy
  - FMCSA- TBD?
- State Laws
- City initiatives
  (Las Vegas, LA, etc.)



WHAT ARE THE FEDS DOING?

- Obama carved out $4 billion in the 2017 budget for AV development, and the National Highway Traffic Safety Administration (NHTSA)
- FMCSA listening session in Atlanta, putting out potential guidance
- Thune-Peters Legislation tackling initial parts of regulatory side
- Senators calling on DOT to approve proving ground funding
- House Ed and Workforce and other committees examining workforce impact
- DOT Automated Working Group – limited union participation
- Tacking major infrastructure bill, with a/v component?

WHO RULES THE ROADS? STATES VS THE FEDS

- So many different issues states are filling in the gaps licensing, registration, certification, insurance, infrastructure, cybersecurity, privacy and ethical dilemmas
- Some groups want feds to take the reins, interstate operations become direct importance
- Will depend on state and federal political dynamics
- Some states want to get the upper hand in competition, even if not in citizens best interest

AVIATION

Similarities:
-Driver disengagement during long stretches (highway automation vs autopilot during flight)
-Still need drivers

Differences
-Reaction times
-Public Acceptance?
-No Patchwork of Regs
-FAA requires pilots to be hands-on for takeoffs and landings while a plane is below 500 feet

SAN PEDRO BAY, CA WHARF

AUTOMATED VEHICLE TALKING POINTS FOR MEDIA

- Communicate the message/Teamster perspective
- Raise questions and share concerns
- Clarify the industry(ies)
- Educate and have open conversations with reporters
- Work as a team to maintain a consistent message
- Give our union and our members a voice


That's all Folks!
kalilak