Improving Vehicle Safety Through Advanced Technologies

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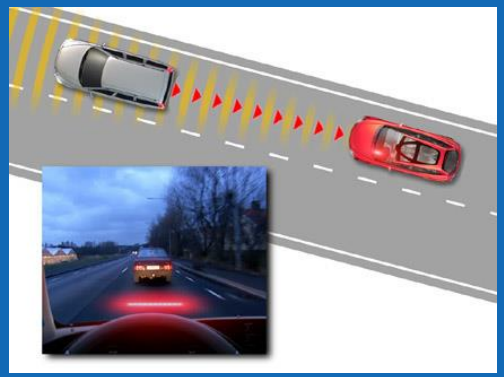
NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

New Technologies and The Crash Timeline

PREVENTION | SEVERITY REDUCTION | INJURY MITIGATION | MEDICAL ATTENTION

HUMAN / PRE - EVENT



← "Driver Assist" Technologies

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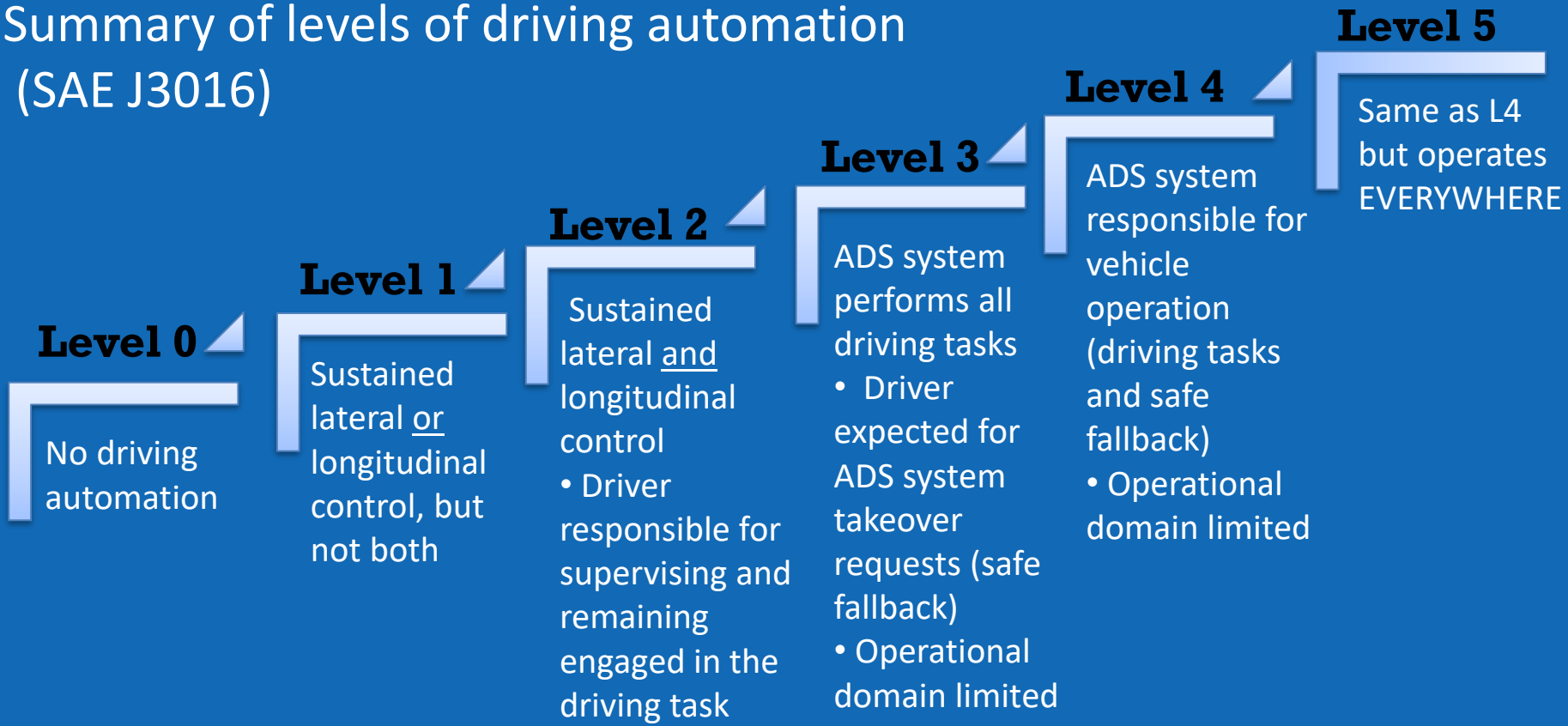
Levels of Driving Automation Systems

Summary of levels of driving automation (SAE J3016)



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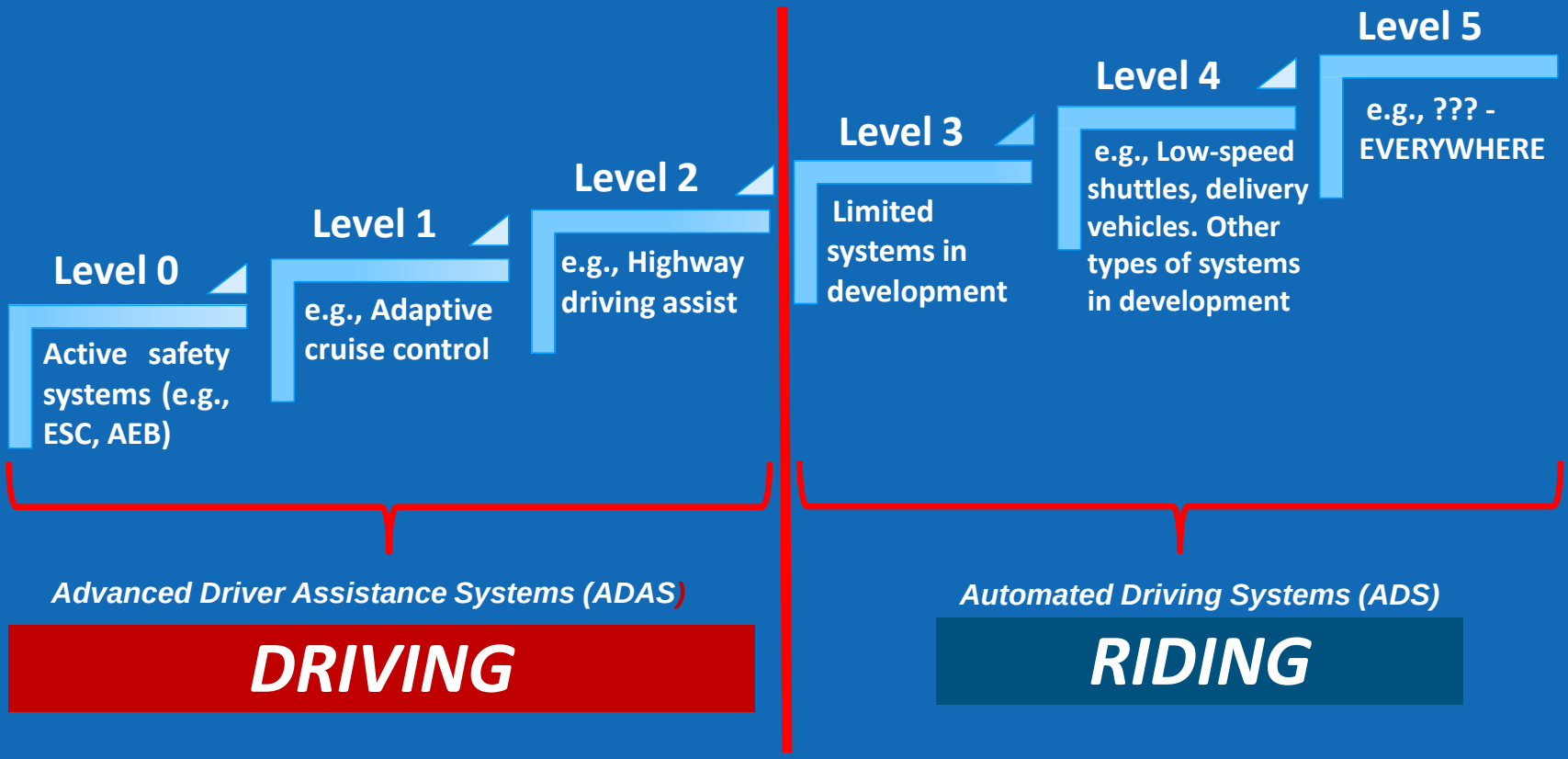
Let's Simplify!



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Active Safety Systems

Also commonly referred to as Advanced Driver Assistance Systems (ADAS)

Level 0

No sustained lateral or longitudinal control

Examples:

- Electronic Stability Control (ESC)
- Forward Crash Warning (FCW)
- Lane Departure Warning (LDW) / Lane Keeping Support (LKS)
- Automatic Emergency Braking (AEB)
- Pedestrian AEB (PAEB)
- Intersection AEB
- Cross Traffic Alert
- Rear Auto Braking (RAB)
- Blind Spot Detection (BSD) / Blind Spot Intervention (BSI)
- Head on Collision Alert / Oncoming Traffic Safety Assist (OTSA)

Other important crash avoidance features include

- Adaptive Driving Beam Headlights
- Impairment Monitoring/Detection
- Rear Visibility

Electronic Stability Control (ESC)

- Steering wheel angle, yaw rate, and lateral acceleration sensor data used to indicate loss of control
- Loss of control can result in:
  - Spinouts
  - On- and off-road rollovers
  - Jack knife events
- Light Vehicle:
  - Prevent crashes due to loss of control
  - Mandated via FMVSS* 126
- Heavy Vehicle
  - Mandated via FMVSS 136 for tractor semi trailers and motorcoaches

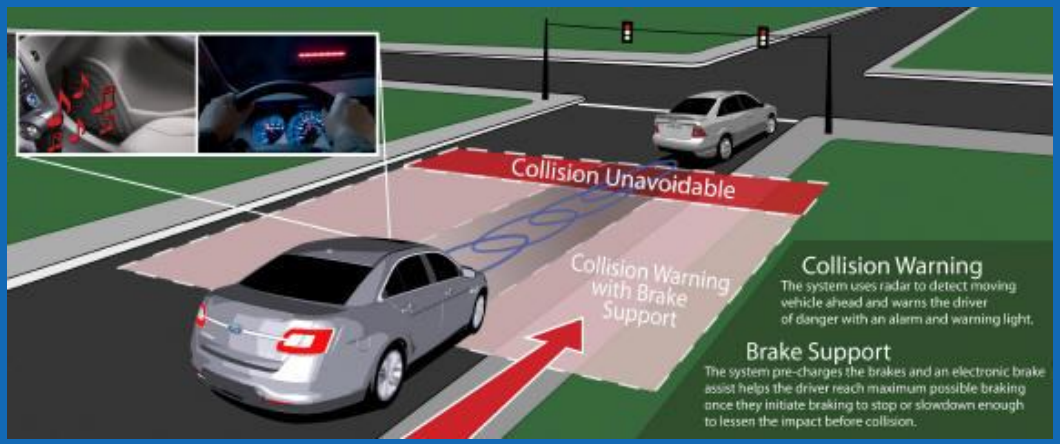
Continental Automotive Systems USA

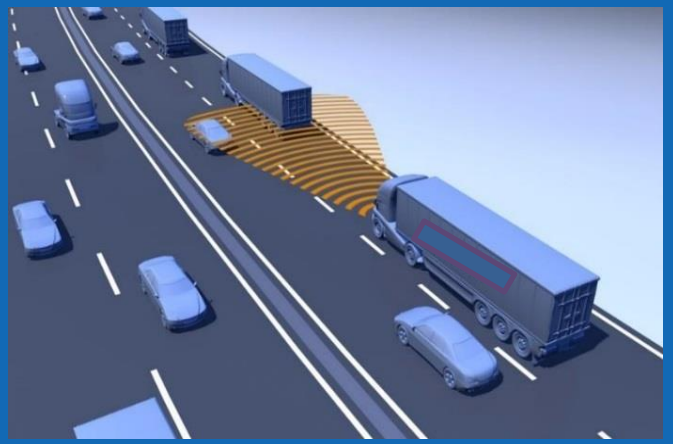
*FMVSS = Federal Motor Vehicle Safety Standard

Forward Crash Warning (FCW)

- Radar and Camera Sensors
- Provides warnings to the driver based on closure rates between vehicles
- Audio, visual, and/or haptic warnings
- FCW is included in the agency's NCAP*

*NCAP = New Car Assessment Program





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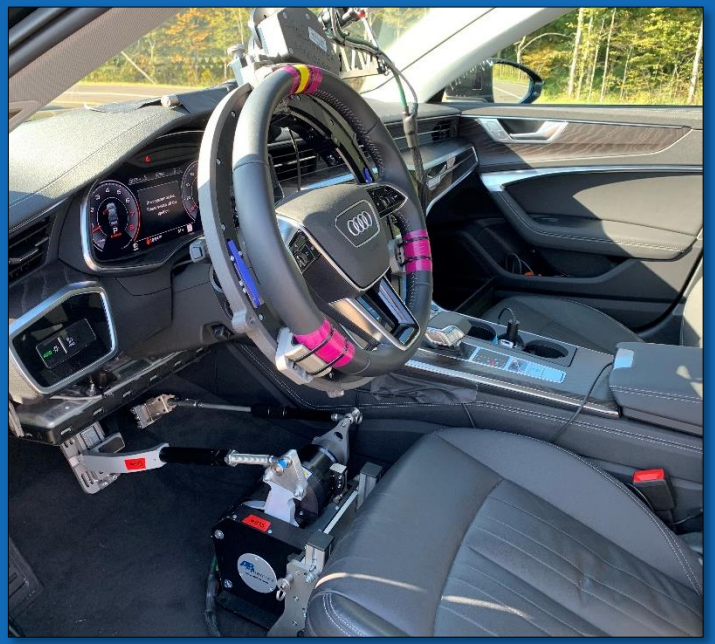
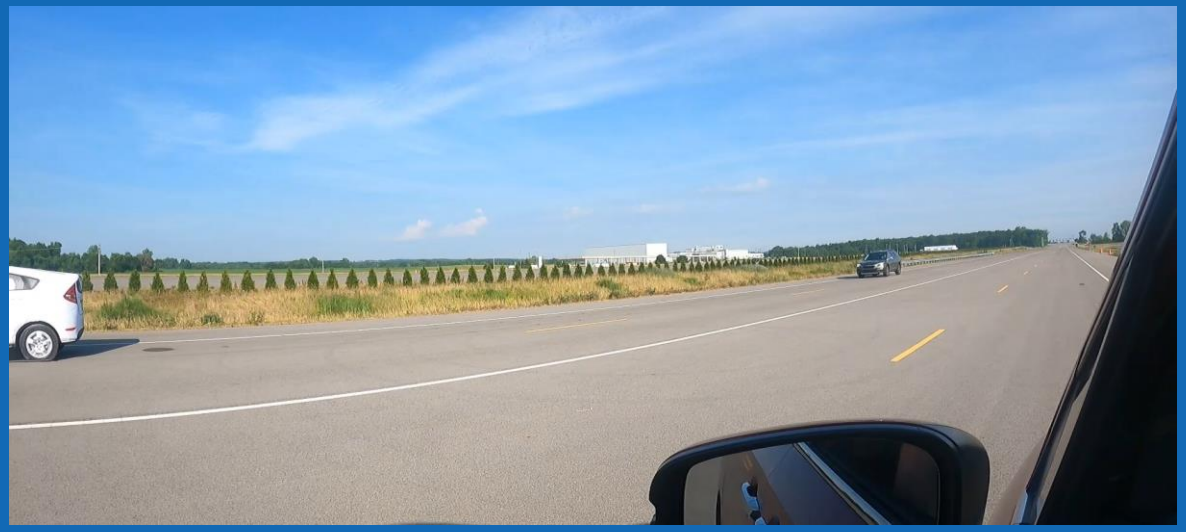
Automatic Emergency Braking (AEB)

- AEB builds on FCW to add active braking capability
- Crash Imminent Braking (LV and HV)
  - Applies the vehicle's brakes when the driver makes no avoidance attempt
- Dynamic Brake Support (LV only)
  - Supplements the vehicle's brake output when the system believes that the driver has not applied enough brake pedal force
- Agency Activities
  - LV AEB included in the agency's NCAP program, a recent RFC asked for feedback on potential upgrades
  - Agency developing regulatory proposals for light and heavy vehicles

*RFC = Request for comment



AEB Test Example: Stopped Lead Vehicle



Crash Avoidance

Impact

(and why strikable test devices are important)

Heavy Vehicle AEB Test Example: Stopped Lead Vehicle

Pedestrian Detection Systems

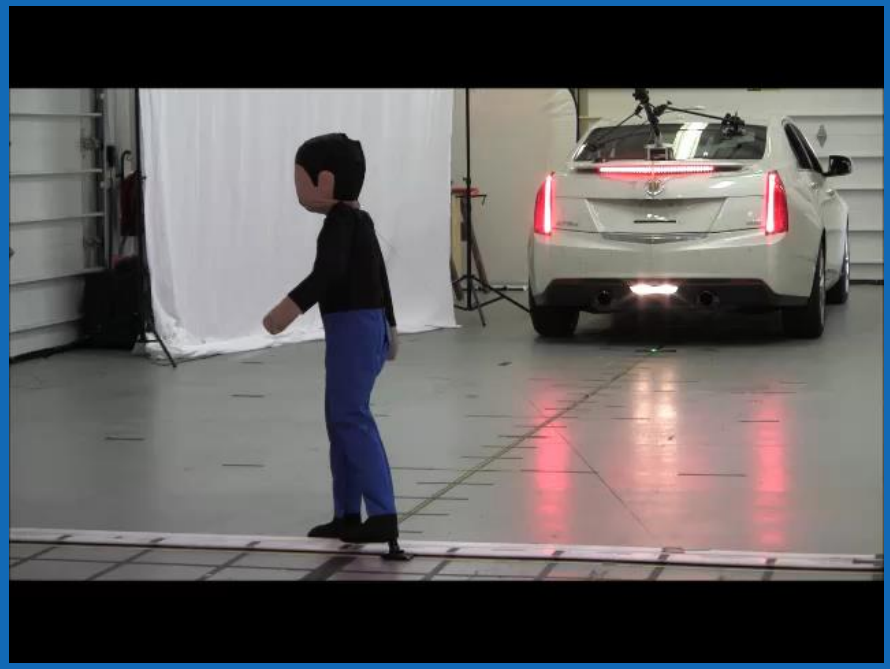
- Pedestrian Automatic Emergency Braking (PAEB)
  - Radar and Camera Sensors
  - Systems sense a potential pedestrian collision; present an alert and automatically apply emergency braking
- NHTSA activities:
  - A recent RFC asked for feedback on potential NCAP inclusion
  - Developing a regulatory proposal

Adult test mannequin

Obstructed child scenario

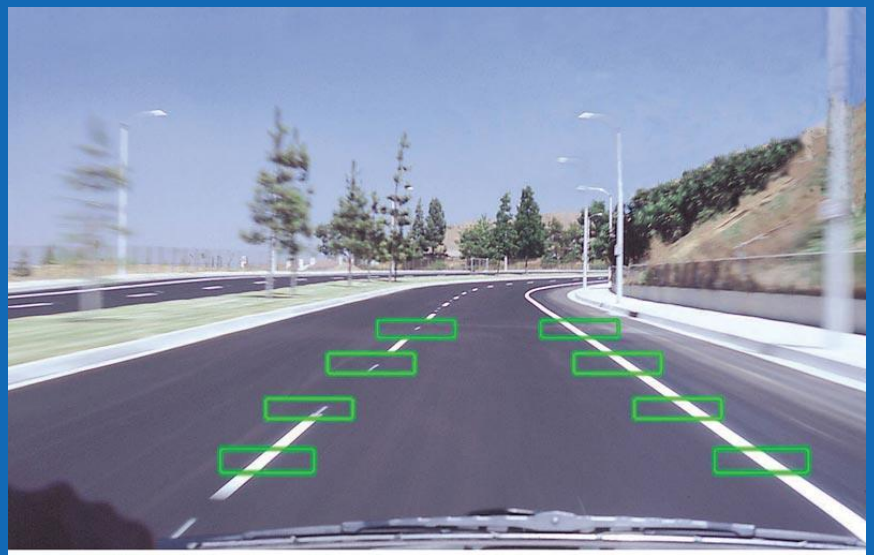
Rear Visibility and Backing Crash Avoidance

- Rear Visibility Systems:
  - Camera Sensors
  - Final regulation issued for LVs (all LV by 2018)
- Rear Automatic Braking Technology
  - Camera/radar sensors
  - NHTSA activities:
    - Research test procedure development
    - Proposed as possible future technology for NCAP



Lane Departure Warning/Lane Keeping Support

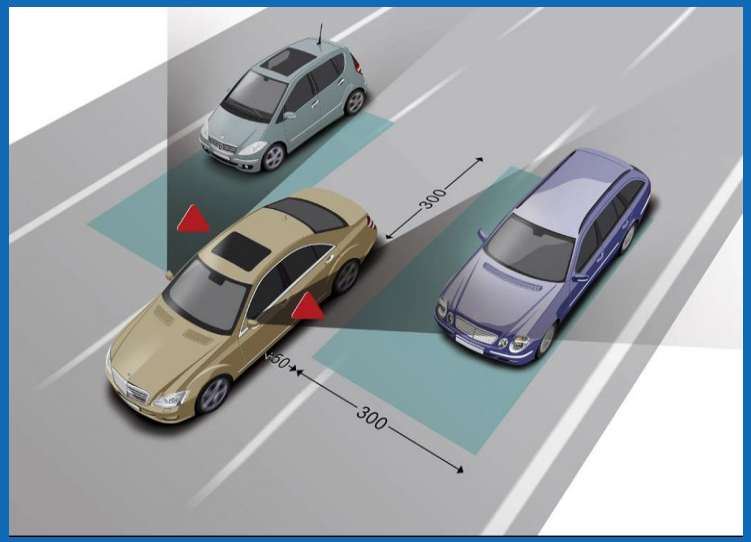
- Camera technology detects lane markings and LDW warns the driver of unintentional lane drift
- LKS adds corrective brake torque or steering assist
- Agency activities:
  - LDW included in NCAP
  - A recent RFC asked for feedback on potential LKS NCAP inclusion
  - Recent congressional mandate (Bipartisan Infrastructure Law)

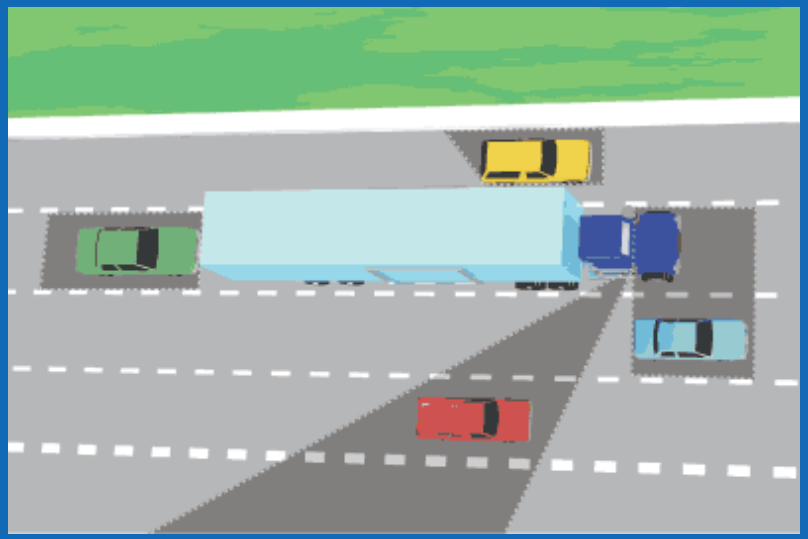


Camera's view of the road ahead as it tracks lane markings

Blind Spot Detection (BSD)

- Typically radar or camera based
- BSD alerts the driver when another vehicle is within, or approaching, the blind zone of their vehicle
- Operates continuously, regardless of whether the driver's vehicle is in, or attempting to depart, their travel lane
- Agency activity: A recent RFC asked for feedback on potential BSD NCAP inclusion





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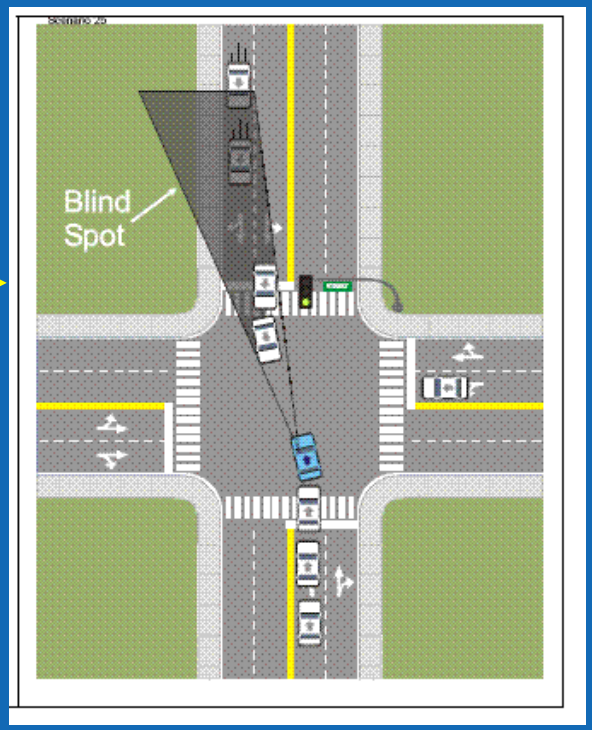
Blind Spot Intervention (BSI)

- An active version of blind spot detection
- Functions when the driver is making a lane change
- Agency activity: A recent RFC asked for feedback on potential BSI NCAP inclusion

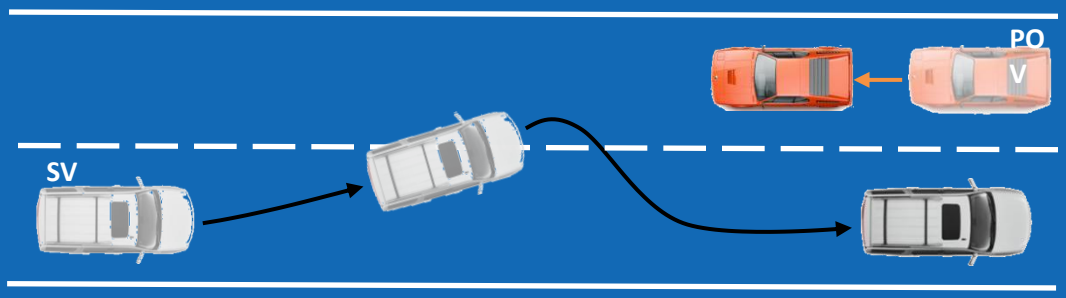
Intersection AEB and Head-On Collision Prevention

- These technologies are relatively new, with limited market penetration
- DRAFT research test procedures developed
- Research/testing continuing
- Both proposed as potential future NCAP technologies

Intersection



Head on Collision Prevention



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Adaptive Driving Beam (ADB) Systems

- ADB headlighting systems are an advanced type of headlamp beam switching technology
- Provides increased illumination without increasing glare
- Agency Activities
  - Final Rule in February 2022

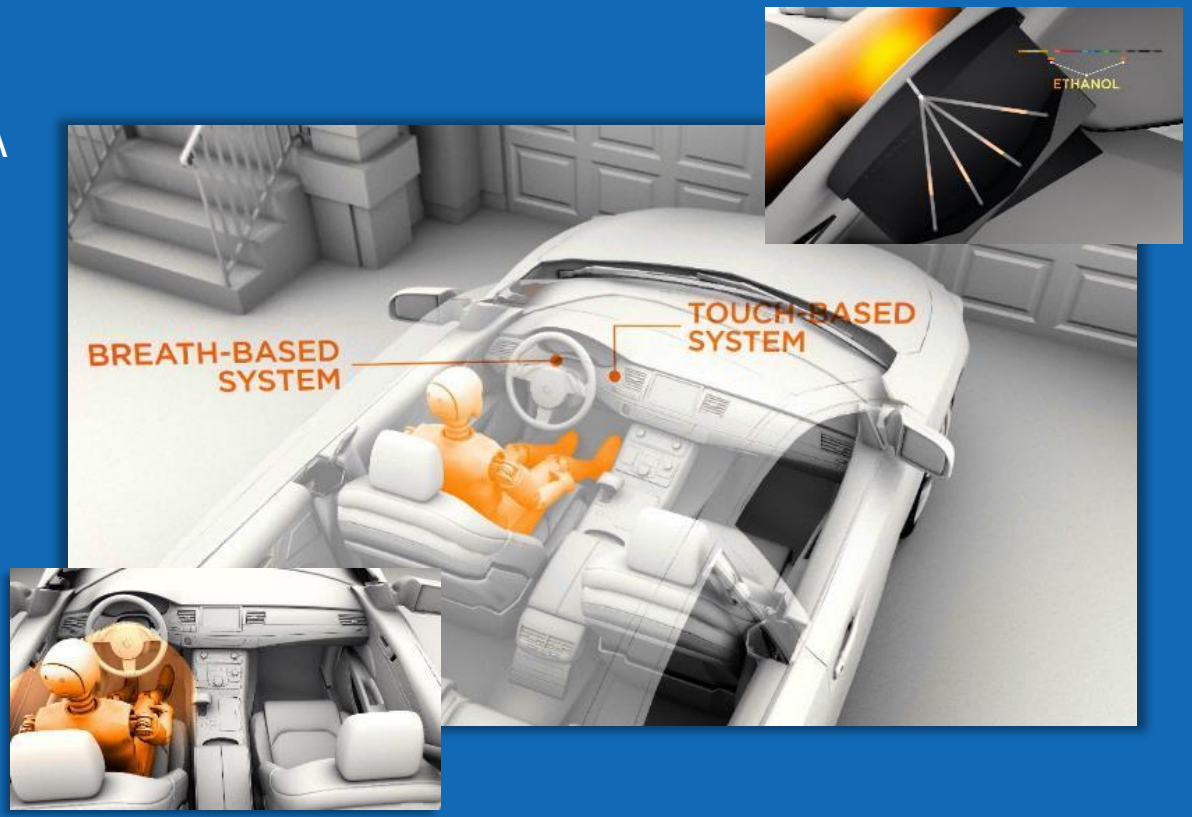
Advanced Drunk and Impaired Driving Technology

Two approaches:

- Detection
  - Non-invasive breath-based and touch-based technologies to measure driver Blood Alcohol Content (BAC)
- Driver Monitoring
  - Sensors (e.g. cameras) monitor driver behavior to detect impairment

Advanced Drunk and Impaired Driving Technology

Driver Alcohol Detection System for Safety Program (DADSS)
www.dadss.org



BREATH BASED
The breath–based system measures the alcohol in a driver's naturally exhaled breath. A small sensor compares the amount of carbon dioxide molecules with alcohol molecules in a driver's breath using infrared light (Distant Spectrometry)

TOUCH BASED
The touch–based system measures the blood alcohol concentration under the skin's surface by shining an infrared-light through the fingertip of the driver (Tissue Spectrometry)

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Advanced Drunk and Impaired Driving Technology

NHTSA Activities:

- DADSS Program - Cooperative Agreement between the Automotive Coalition for Traffic Safety (ACTS) and NHTSA
  - Naturalistic and controlled in-vehicle tests of technology prototypes are underway on cars and heavy trucks
  - Further refinement of technology and test instruments continue in laboratory and on-road settings
- Driver Monitoring Systems research
- Congressional Requirement in BIL – Advanced Drunk and Impaired Driving Technology

Rear Visibility - Outside Mirrors

- Fed Regs require that cars be equipped with “inside” and “outside rearview mirrors” to provide a clear rear view having certain specs
- Camera-based systems are being studied as a potential alternative to outside mirrors
- NHTSA activities:
  - Examined prototype camera-based system performance in various lighting and weather conditions
  - Examining driver acclimation issues relating to display location, focus issues

VW prototype system installed on an Audi A4

Driving Automation Systems - L1

L1: Mainly Adaptive Cruise Control (longitudinal control)

Level 1

Sustained lateral or longitudinal control, but not both

e.g.,

- Adaptive Cruise Control (ACC)
- Truck Platooning

Adaptive Cruise Control

Platooning

Driving Automation Systems - L2

- An increasing number of L2 systems are currently being offered on production vehicles
- Three main categories of L2 systems
  - Highway Pilot (highway driving assist)
  - Traffic Jam Assist (lower speed scenarios)
  - Self Parking

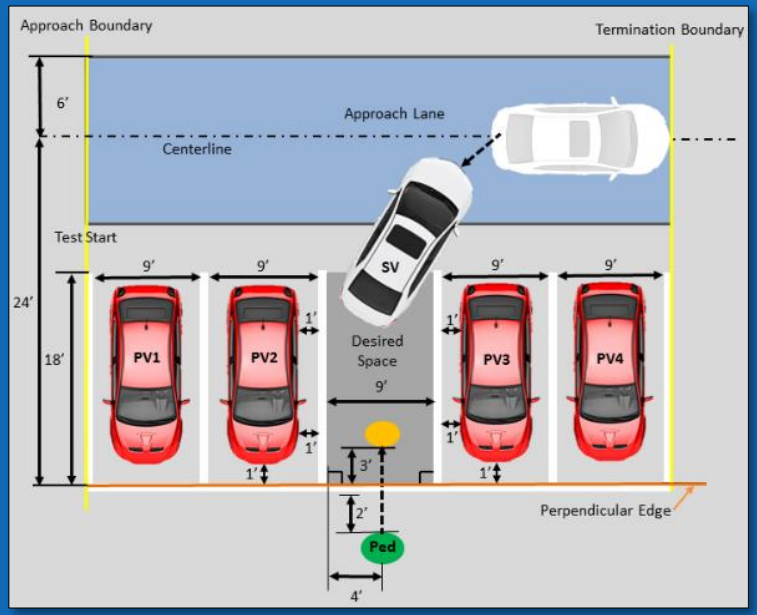
Level 2

Sustained lateral and longitudinal control

- Driver responsible for supervising and remaining engaged in the driving task

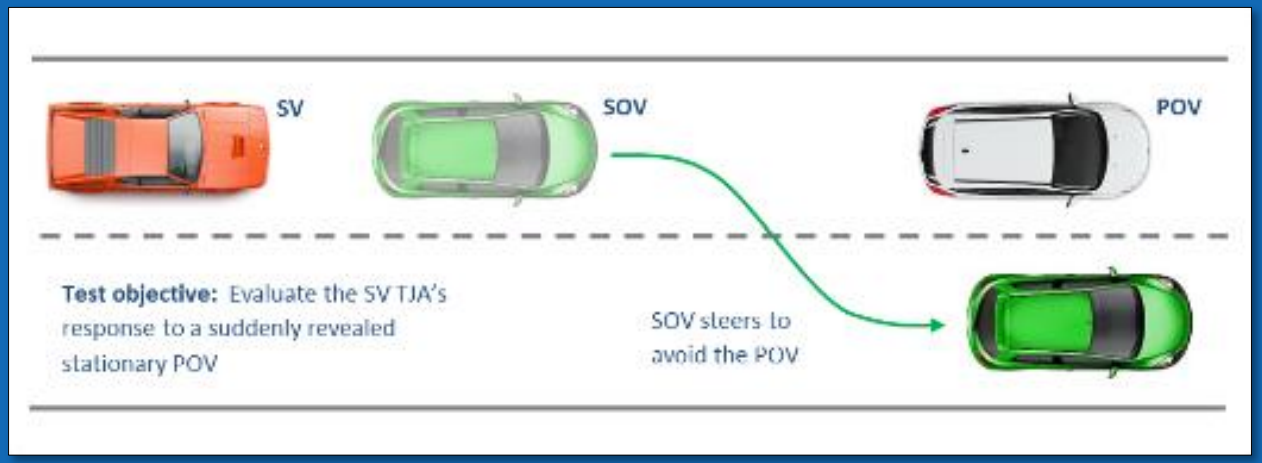
Park Assist

- Operational Design Domain (ODD)
  - Expected operating domain is low speed, object rich environments such as parking lots and residential roads
- Requirements for this type of system are based on:
  - System capability
  - Governing safety principles
- DRAFT research test procedure developed



Traffic Jam Assist

- Operational Design Domain (ODD)
  - TJA refers to low speed automation that allows the vehicle to operate in L2 at speeds of approximately 25 mph
  - Different systems have different requirements to satisfy their respective ODDs
- DRAFT research test procedure developed



Driving Automation Systems - L2

Highway Pilot
(Highway Driving Assist)

- Operational Design Domain (ODD)
  - Highway speeds/environments
  - Real world operation can differ significantly, especially curve-based operation and where the systems can be used
- Market penetration is increasing
- NHTSA Activities:
  - LV and HV research
  - Human factors and on-road testing
  - Standing General Order (SGO) – Covers Level 2 ADAS + ADS (levels 3- 5)

https://www.nhtsa.gov/laws-regulations/standing-general-order-crash-reporting

Automated Driving Systems - ADS (L3, L4, L5)

ADS = Subset of Driving Automation Systems

Level 3

ADS system performs all driving tasks

- Driver expected for ADS system takeover requests (safe fallback)
- Operational domain limited
- Some manufacturers have indicated working on systems

Level 4

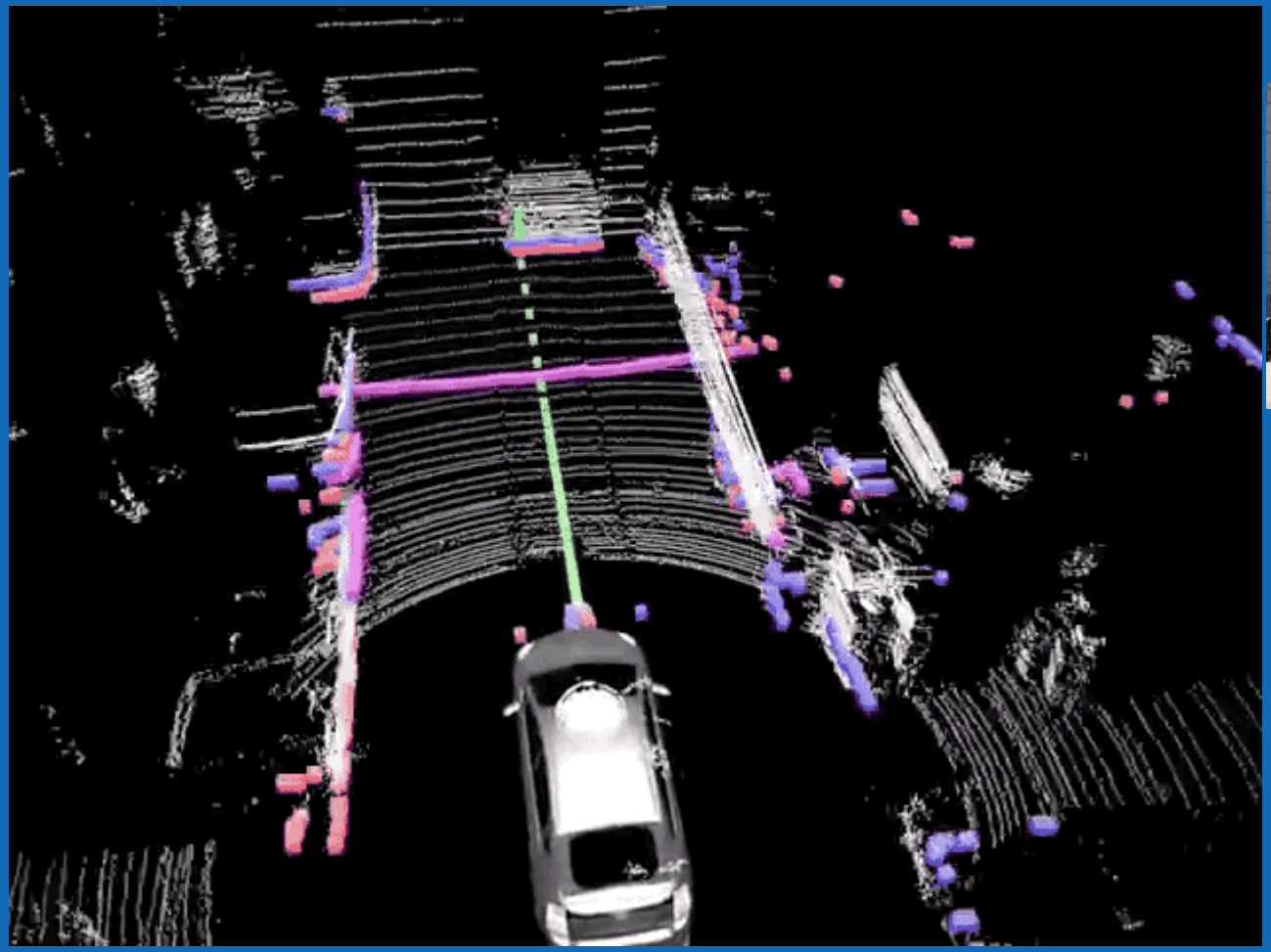
ADS system responsible for vehicle operation (driving tasks and safe fallback)

- Operational domain limited
- e.g., low speed passenger shuttles, delivery vehicles, higher speed urban/suburban systems, heavy vehicle systems in development

Level 5

Same as L4 but operates EVERYWHERE

Automated Driving Systems (ADS)



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Automated Driving Systems (ADS)

- Potential to reduce crashes due to driver related factors
- Technology
  - Combination of several sensor and data technologies likely
    - LIDAR (e.g. Velodyne)
    - Radar, Camera, Communications, Digital Maps
- NHTSA research activities include:
  - Researching new tools, methods, and metrics to test ADS systems
  - Research/test available technology (e.g. low speed shuttles)
  - Human factors research
  - Crashworthiness for alternative designs

Automated Driving Systems (ADS)

NHTSA activities include:

- Regulation - Occupant Protection Safety Standards for Vehicles Without Driving Controls (March 2022)
- Automated Vehicle Transparency and Engagement for Safe Testing Initiative (AV Test)

  https://www.nhtsa.gov/automated-vehicle-test-tracking-tool
- Standing General Order (SGO)

Thanks for your attention!

Contact Information

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