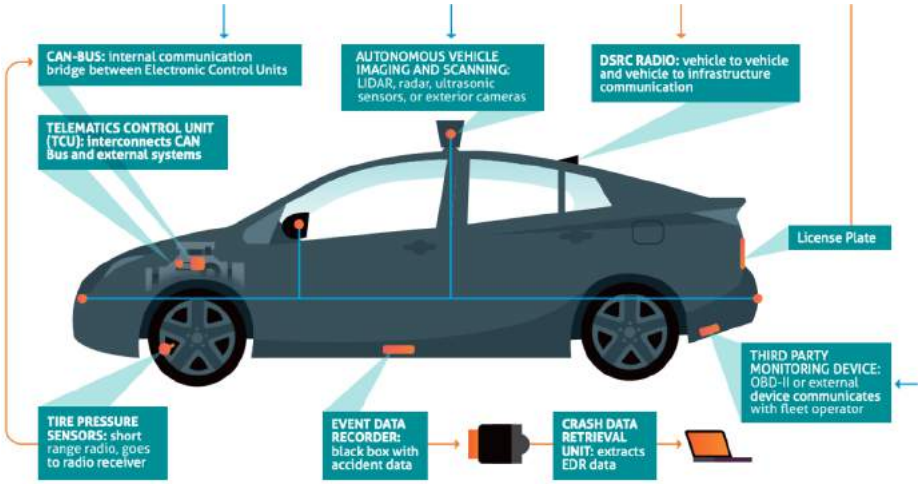
Digital Data Flows Masterclass #7:

Connected and Autonomous Vehicles

June 25, 2020



FUTURE OF PRIVACY FORUM

VUB BRUSSELS PRIVACY HUB

Future of Privacy Forum

Our Mission

Bridging the policymaker-industry-academic gap in privacy policy

Developing privacy protections, ethical norms, & responsible business practices.

Our Workstreams

Mobility & Data
Youth Privacy
AI & Machine Learning

Location & Ad Tech
Internet of Things
Biometrics

De-identification
Smart Communities

Our Supporters

150+ Companies

25+ Leading Academics

15+ Advocates and Civil Society

5 Foundations

FUTURE OF PRIVACY FORUM

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Digital Data Flows Masterclass Series:

1. Artificial Intelligence & Machine Learning
2. Location Data: GPS, Wi-Fi, Spatial Analytics
3. De-Identification, Differential Privacy, and Homomorphic Encryption
4. Online Advertising Technologies
5. Mobile Apps
6. Facial Recognition

Archived videos and slides available at www.fpf.org/classes.

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Guest Experts for Class 7: Connected and Autonomous Vehicles (CAVs)

Chelsey Colbert

Policy Counsel, Mobility & Location Data,
Future of Privacy Forum

Bryant Walker Smith

Associate Professor of Law and Engineering at the University of South Carolina and Co-Director of the Project on Law and Mobility at the University of Michigan

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Primer on Automated Driving and Connected Driving

Bryant Walker Smith

Associate Professor
University of South Carolina School of Law
and (by courtesy) School of Engineering

Affiliate Scholar
Center for Internet and Society at Stanford Law School

Codirector
Program on Law and Mobility at University of Michigan Law School

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newlypossible.org

“~~Driverless remote-controlled cars~~”?

- Driver assistance
- Automated driving
- Remote driving
- Connected driving

Increasing automation and connectivity

- **Driver assistance**
- Automated driving
- Remote driving
- Connected driving

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This is not your father's Oldsmobile.

Don't go looking for this Oldsmobile in any family album. Road & Track would be a lot more likely.

Because this Oldsmobile is the totally new Cutlass Supreme. So new, its past is just beginning.

Its most noticeable change you've probably already noticed. The way your neighbors will when they see its new aerodynamic shape.

But this sleek new styling standard is much, much more than merely a pretty face.

The inclusion of four-wheel independent suspension, front-wheel drive, four-wheel disc brakes, and a 2.8-liter multiport fuel-injected V6 is rare outside the world's most technologically advanced automobiles.

For more information on this remarkable vehicle, send for a free catalog. Write: Oldsmobile Cutlass Supreme Catalog, P.O. Box 14238, Lansing, Michigan 48901.

OLDSMOBILE QUALITY
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"Let's get it

MyCarDoesWhat.org

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Adaptive Cruise Control


Adaptive Headlights

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Automatic Emergency Braking

Automatic Parallel Parking


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Blind Spot Warning


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Drowsiness Alert


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Forward Collision Warning


High Speed Alert


Hill Descent Assist


Hill Start Assist


Lane Departure Warning


Lane Keeping Assist


Left Turn Crash Avoidance


Obstacle Detection

Parking Sensors


Pedestrian Detection

Push Button Start


Rear Cross Traffic Alert

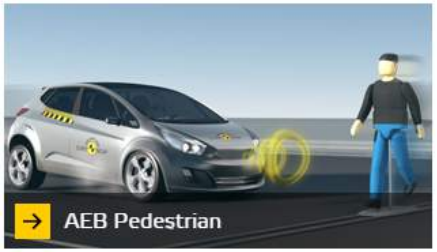

Sideview Camera


Temperature Warning


Tire Pressure Monitoring System

Traction Control

EURO NCAP FOR SAFER CARS



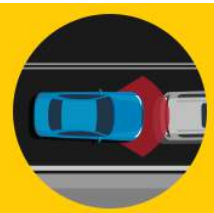
NHTSA
NATIONAL HIGHWAY TRAFFIC SAFETY ADMINISTRATION

Recommended Driver Assistance Technologies


Forward Collision Warning


Lane Departure Warning


Rearview Video System


Automatic Emergency Braking

euroncamp.com; nhtsa.gov/ratings

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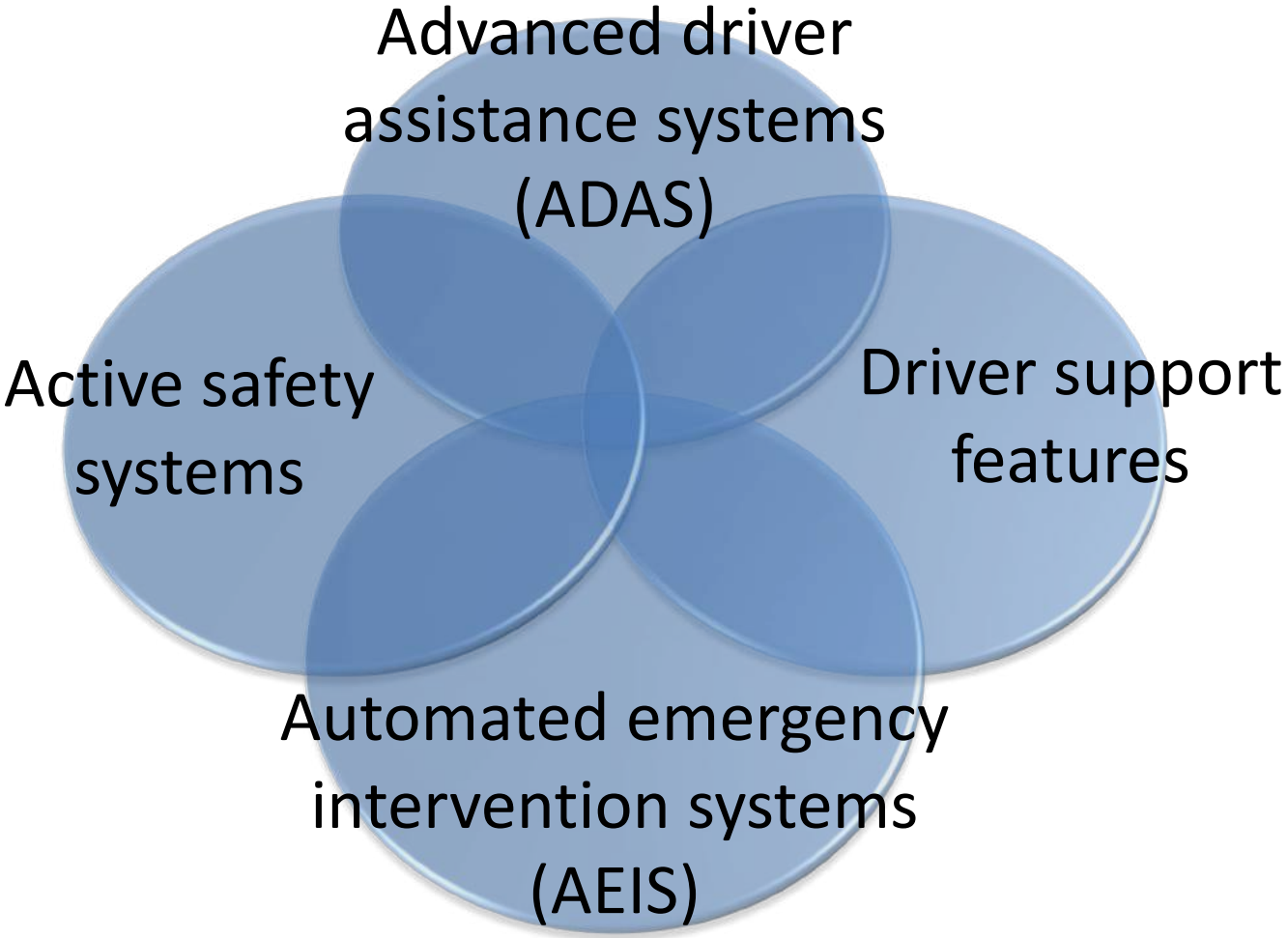
What do we call all these?



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Driving

*("performing the dynamic driving task")**

- **Driving** involves paying attention to the vehicle, the road, and the environment so you can steer, brake, accelerate, and communicate as needed

- If you're expected to pay attention, **you're still driving** — even when a feature is assisting you with steering, braking, accelerating, and/or communicating

- Driving may have an even broader legal meaning

*SAE J3016

newlypossible.org/wiki/index.php?title=Automated_Driving_Definitions

futurist.law.umich.edu/how-reporters-can-evaluate-automated-driving-announcements

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SAE J3016

(and soon-to-be ISO PAS 22736)

- Widely adopted industry document
- Key definitions for driving automation
- Levels of driving automation (L0 - L5)
  - Driver assistance / driver support (L0 - L2)
  - Automated driving (L3 - L5)

Assisted driving features

L0: You're driving

L1: You're driving, but you're assisted with **either** steering or speed

L2: You're driving, but you're assisted with **both** steering and speed

newlypossible.org/wiki/index.php?title=Automated_Driving_Definitions

futurist.law.umich.edu/how-reporters-can-evaluate-automated-driving-announcements

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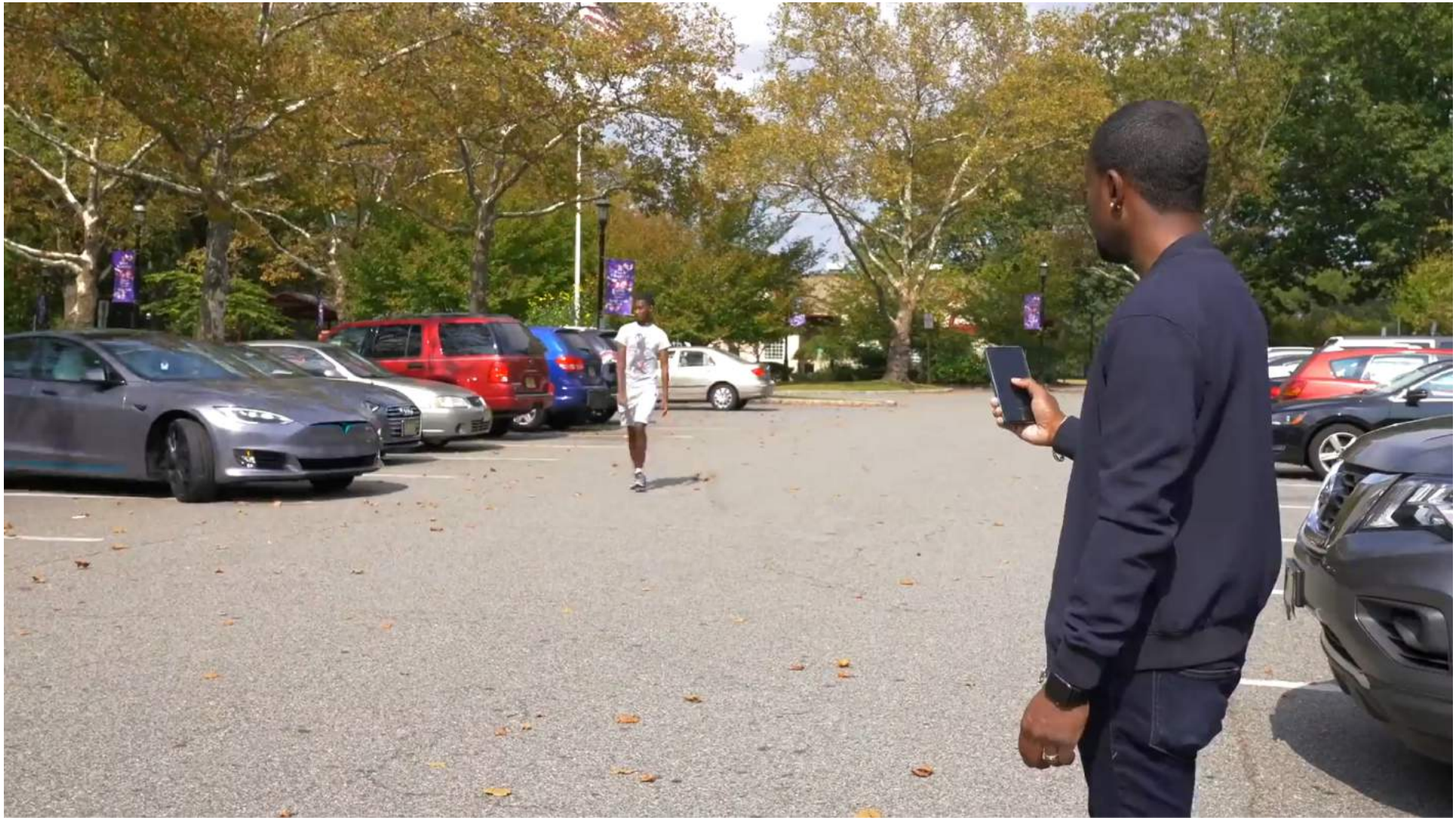
L2: You're driving, but you're assisted with **both** steering and speed

- Adaptive cruise control *plus* lane-keeping assist
- Automatic parking (speed and steering)
- GM's "Super Cruise"
- Tesla's """"Autopilot and Full Self-Driving Capability""""

cadillac.com/world-of-cadillac/innovation/super-cruise

Tesla’s “Smart Summon”



youtu.be/enkRALcdPb0?t=364

Why is this still level 2?

If you're expected to pay attention, **you're still driving** — even when a feature is assisting you with steering, braking, accelerating, and/or communicating

youtu.be/enkRALcdPb0?t=364
newlypossible.org/wiki/index.php?title=Automated_Driving_Definitions
futurist.law.umich.edu/how-reporters-can-evaluate-automated-driving-announcements

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Driver assistance features work *unless and until they don't*

Culver City Firefighters Local 1927 (via Associated Press)
NTSB Accident ID: HWY18FH004

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Complemented by interior sensors

- Occupancy/weight/seatbelt use: Many kinds (in all cars)
- Inattention: Camera (GM Super Cruise)
- Hands-on-wheel: Presence and torque (many cars)
- Drowsiness: Steering angle and torque (many cars)
- Intoxication: Alcohol detectors (aftermarket)
- Break-ins: Camera (Tesla?)
- Gestures: Camera (Bosch)
- Crash assessment: Microphone (OnStar)
- And more!

Increasing automation and connectivity

- **Driver assistance**
- Automated driving
- Remote driving
- Connected driving

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Increasing automation and connectivity

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Automated driving (SAE L3 - L5)

- ~~Autonomous~~
- ~~Driverless~~
- ~~Self-driving~~
- A shibboleth in the technical world
- A (mostly) neutral and inclusive term

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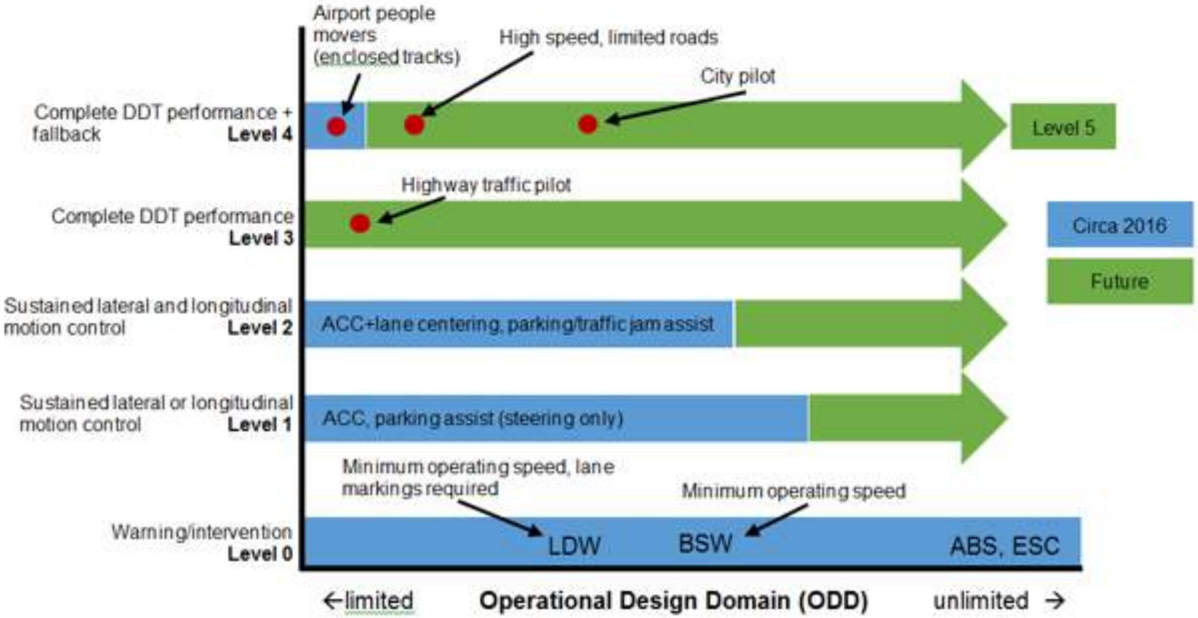
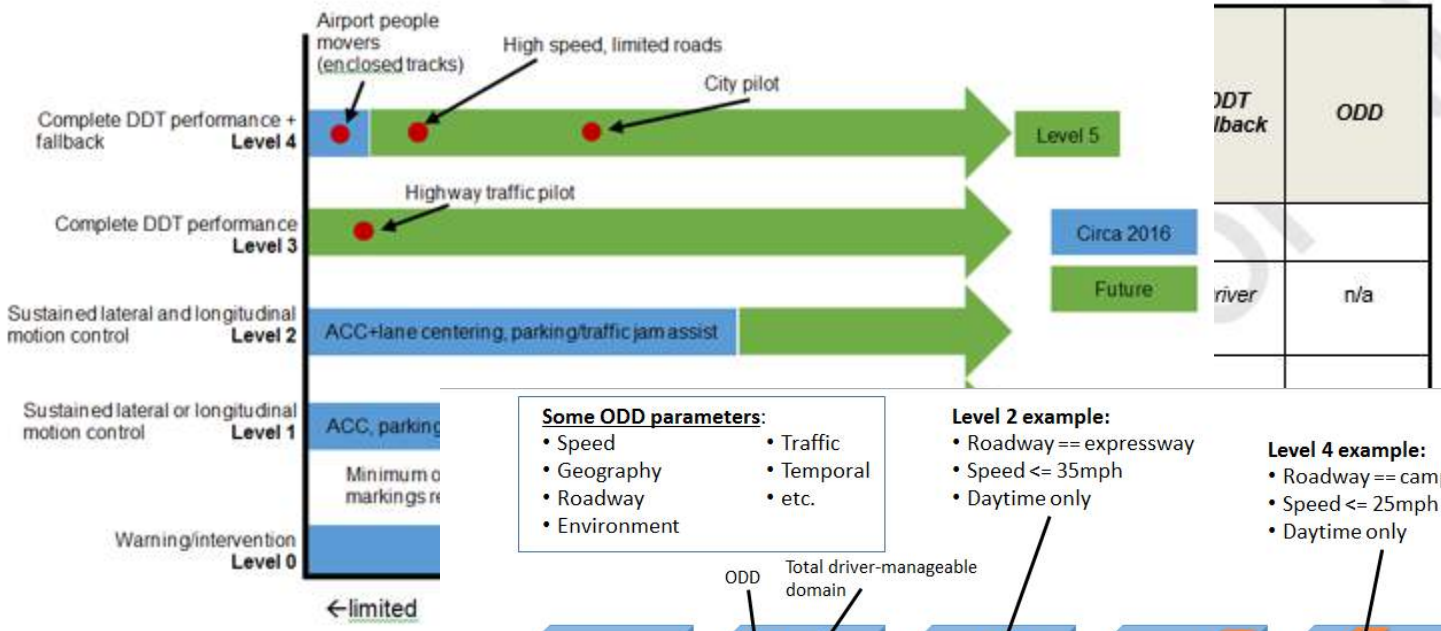
Level	Name	Narrative definition	DDT		DDT fallback	ODD
			Sustained lateral and longitudinal vehicle motion control	*OEDR*		
Driver* performs part or all of the *DDT						
0	**No Driving Automation**	The performance by the *driver* of the entire *DDT*, even when enhanced by *active safety systems*.	*Driver*	*Driver*	*Driver*	n/a
1	**Driver Assistance**	The *sustained* and *ODD*-specific execution by a *driving automation system* of either the *lateral* or the *longitudinal vehicle motion control* subtask of the DDT (but not both simultaneously) with the expectation that the *driver* performs the remainder of the *DDT*.	*Driver* and *System*	*Driver*	*Driver*	Limited
2	**Partial Driving Automation**	The *sustained* and *ODD*-specific execution by a *driving automation system* of both the *lateral* and *longitudinal vehicle motion control* subtasks of the *DDT* with the expectation that the *driver* completes the *OEDR* subtask and *supervises* the *driving automation system*.	***System***	*Driver*	*Driver*	Limited
***ADS* ("*System*") performs the entire *DDT* (while engaged)**			*System*	***System***	*Fallback-ready user (becomes the driver during fallback)*	Limited
3	**Conditional Driving Automation**	The *sustained* and *ODD*-specific performance by an *ADS* of the entire DDT with the expectation that the *DDT fallback-ready user* is *receptive* to *ADS*-issued *requests to intervene*, as well as to *DDT performance-relevant system failures* in other *vehicle* systems, and will respond appropriately.				
4	**High Driving Automation**	The *sustained* and *ODD*-specific performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*.	*System*	*System*	***System***	Limited
5	**Full Driving Automation**	The *sustained* and unconditional (i.e., not *ODD*-specific) performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*.	*System*	*System*	*System*	**Unlimited**



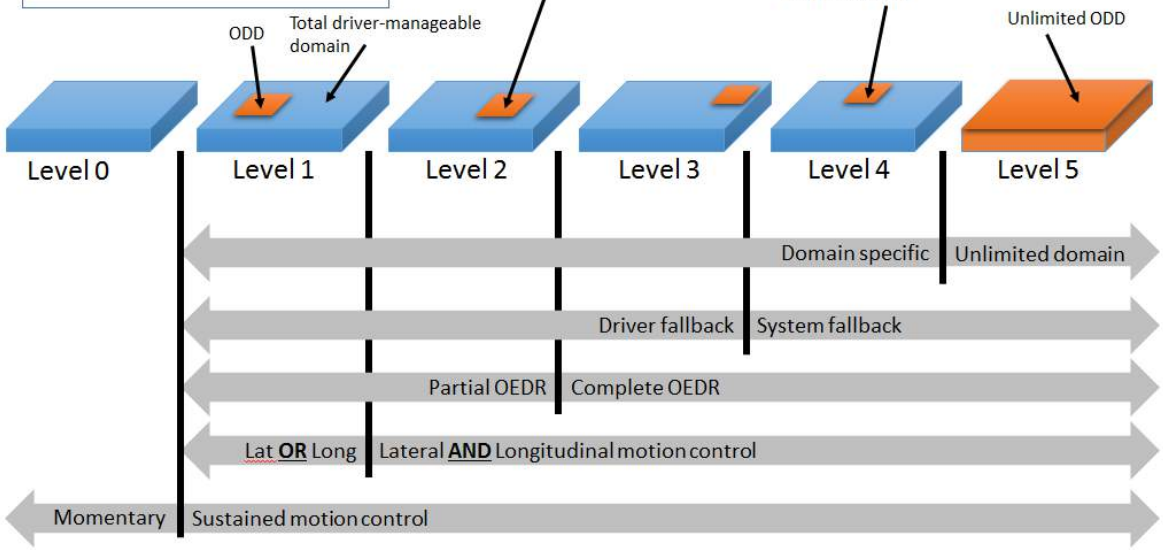
					DT lback	ODD
					river	n/a
					river	Limited
					river	Limited
ADS **("*System*") performs the entire *DDT* (while engaged)**						
3	**Conditional Driving Automation**	The *sustained* and *ODD*-specific performance by an *ADS* of the entire DDT with the expectation that the *DDT fallback-ready user* is *receptive* to *ADS*-issued *requests to intervene*, as well as to *DDT performance-relevant system failures* in other *vehicle* systems, and will respond appropriately.	*System*	***System***	*Fallback-ready user (becomes the driver during fallback)*	Limited
4	**High Driving Automation**	The *sustained* and *ODD*-specific performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*.	*System*	*System*	***System***	Limited
5	**Full Driving Automation**	The *sustained* and unconditional (i.e., not *ODD*-specific) performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*.	*System*	*System*	*System*	**Unlimited**



Some ODD parameters:
- Speed
- Geography
- Roadway
- Environment
- Traffic
- Temporal
- etc.

Level 2 example:
- Roadway == expressway
- Speed <= 35mph
- Daytime only

Level 4 example:
- Roadway == campus roads
- Speed <= 25mph
- Daytime only



		ADS ("*System*") performs t				
3	**Conditional Driving Automation**	The *su* *ADS* o *DDT fa* *request* *relevant*				
4	**High Driving Automation**	The *su* *ADS* of expect				
5	**Full Driving Automation**	The *s* specific) performance by an *ADS* of the entire *DDT* and *DDT fallback* without any expectation that a *user* will respond to a *request to intervene*.	*System*	*System*	*System*	**Unlimited**

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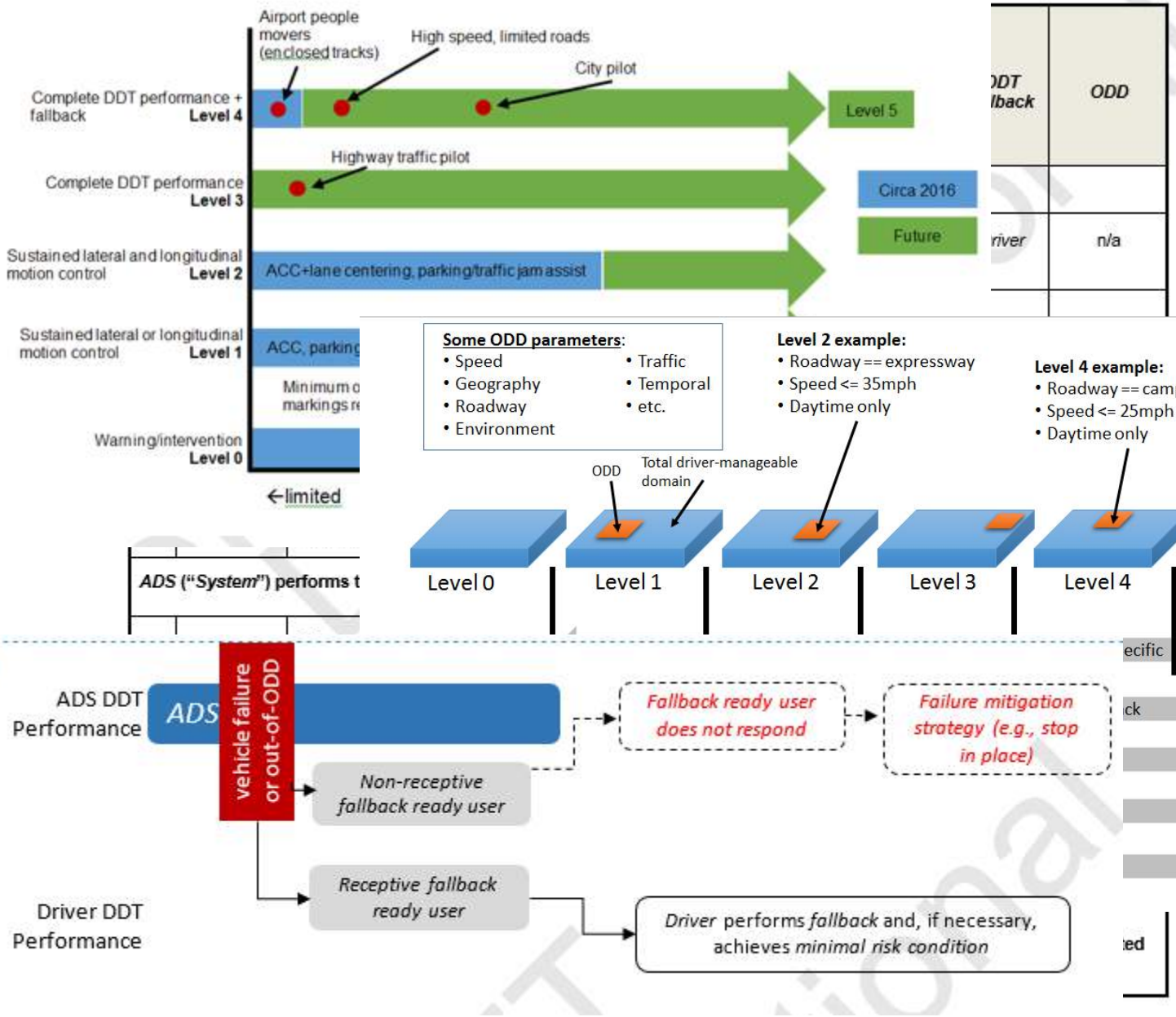

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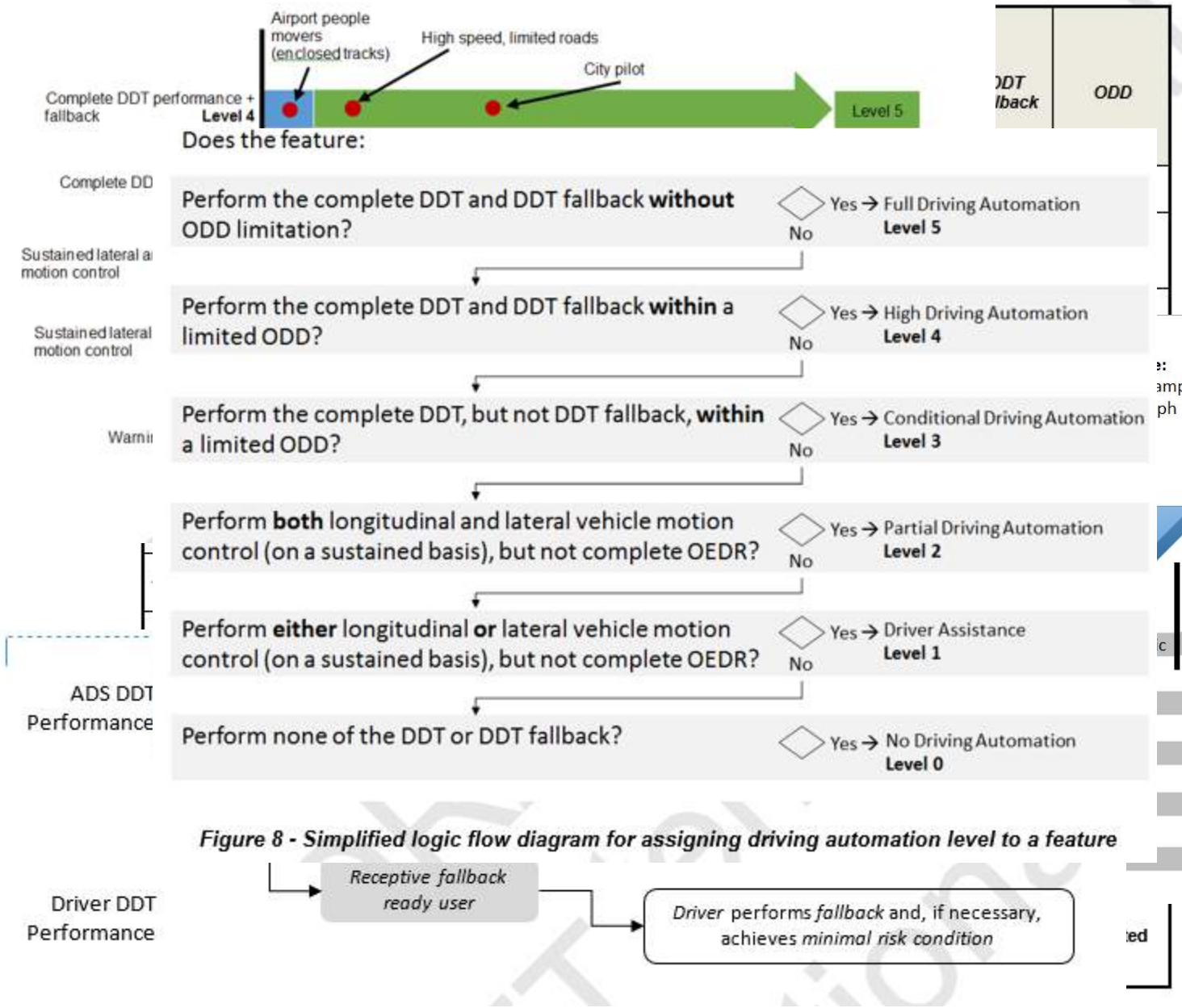

Figure 8 - Simplified logic flow diagram for assigning driving automation level to a feature

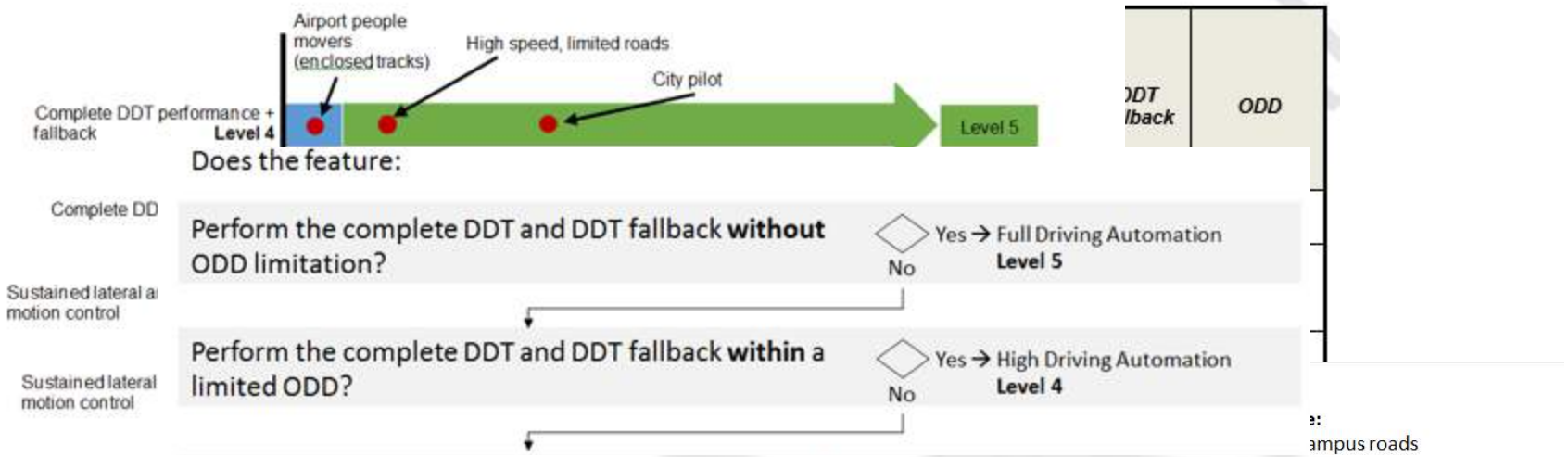

Figure 8 - Simplified logic flow diagram

Figure 8 - Simplified logic flow diagram for assigning driving automation level to a feature

SAE J3016™ LEVELS OF DRIVING AUTOMATION

sae.org/standards/content/j3016_201806/

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- "Drive means to drive, operate, move, or be in actual physical control of a vehicle…"
- "Operate … means to drive…"
- "Operating … is generally given a broader meaning [than driving]"

Maryland Transp Code § 11-114, 141 (2016)
McDuell v. State, 231 A.2d 265, 267 (Del. 1967)
Bryant Walker Smith, Automated Driving Is Probably Legal in the United States (newlypossible.org)

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Assisted driving features

L0: You're driving

L1: You're driving, but you're assisted with **either** steering or speed

L2: You're driving, but you're assisted with **both** steering and speed

newlypossible.org/wiki/index.php?title=Automated_Driving_Definitions

futurist.law.umich.edu/how-reporters-can-evaluate-automated-driving-announcements

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Automated driving features

L3: You're not driving, but you will need to drive if prompted in order to maintain safety

L4: You're not driving, but *either*

a) you will need to drive if prompted in order to reach your destination (in a vehicle you can drive) *or*

b) you will not be able to reach every destination (in a vehicle you can't drive)

L5: You're not driving, and you can reach any destination

newlypossible.org/wiki/index.php?title=Automated_Driving_Definitions

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ADS

- Automated Driving System
- "vehicle equipped with an (*engaged*) automated driving system"
- Automated Vehicle (AV)

L3: You're not driving, but you will need to drive if prompted in order to maintain safety

Audi MediaCenter

Automated driving at a new level: the Audi AI traffic jam pilot

April 28, 2020 01:05 AM

Audi quits bid to give A8 Level 3 autonomy

By B137, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=48998674

Audi press release (August 2017); europe.autonews.com/automakers/audi-quits-bid-give-a8-level-3-autonomy

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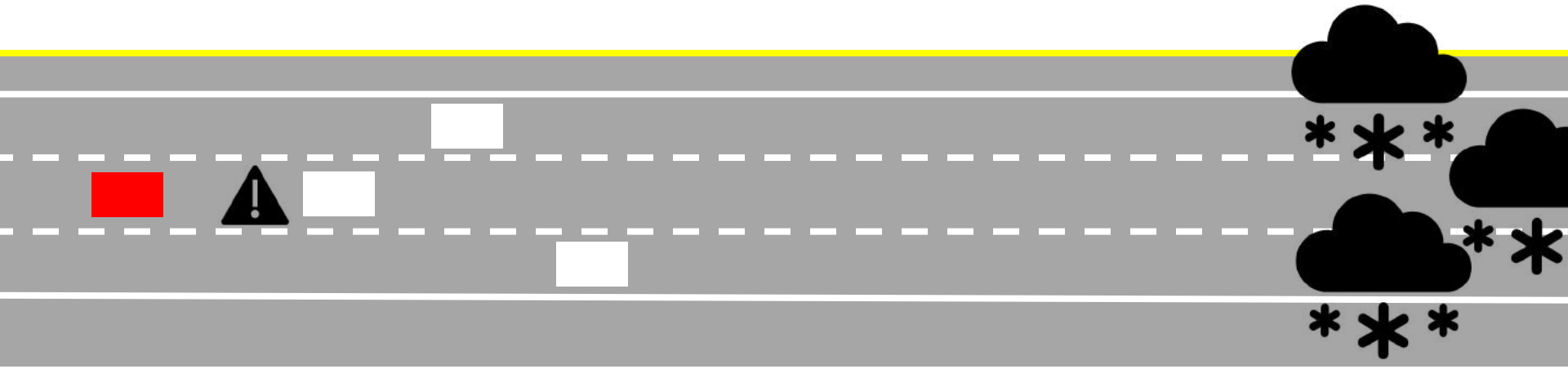
L3: You're not driving, but you will need to drive if prompted in order to maintain safety



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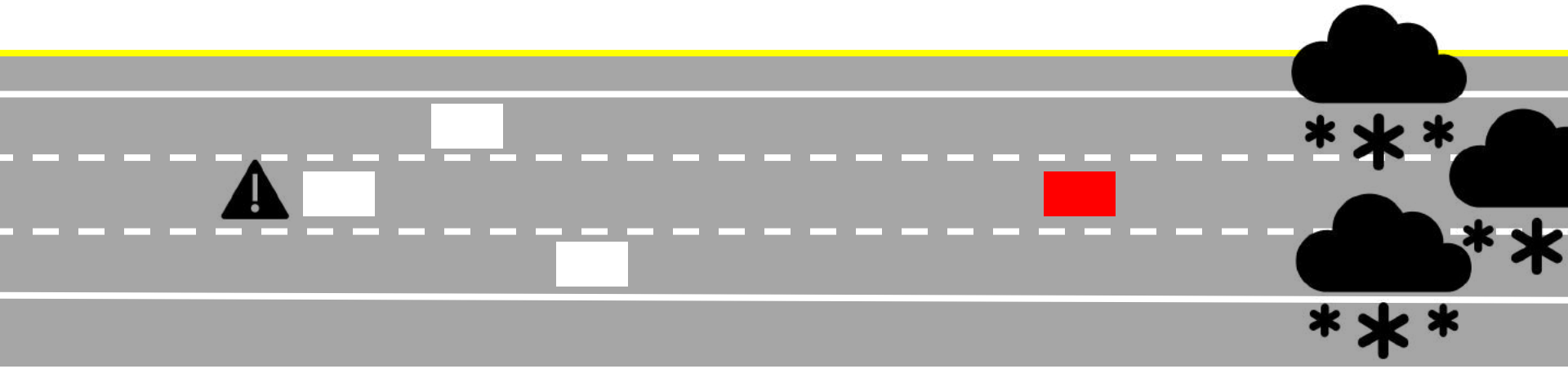
L4: You're not driving, but *either*:

a) you will need to drive if prompted in order to reach your destination (in a vehicle you can drive)….



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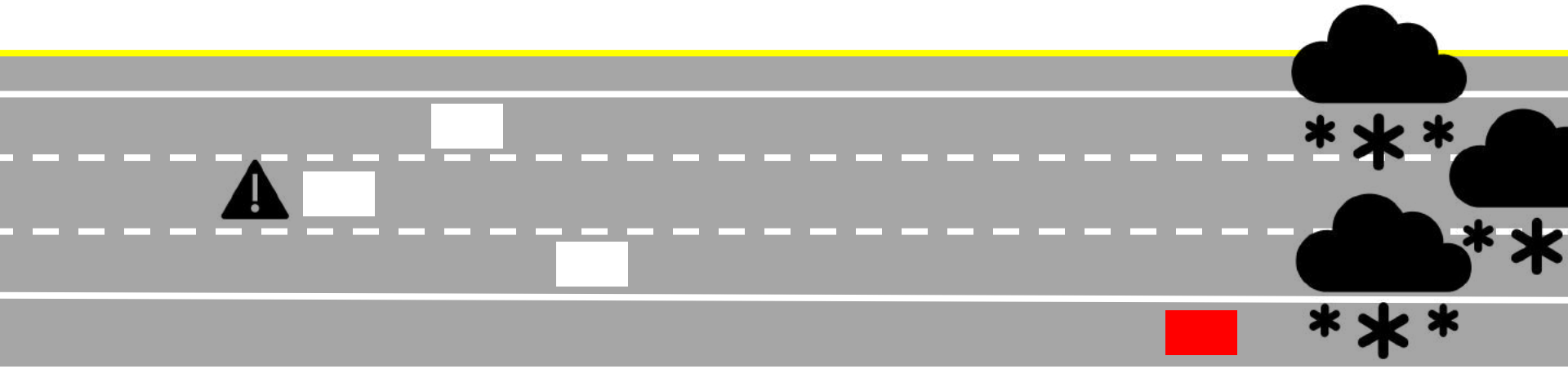
L4: You're not driving, but *either*:

a) you will need to drive if prompted in order to reach your destination (in a vehicle you can drive)….



Pulling over on shoulder = minimal risk condition (…)

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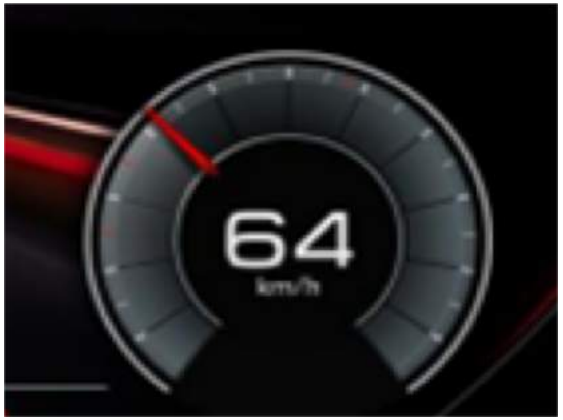
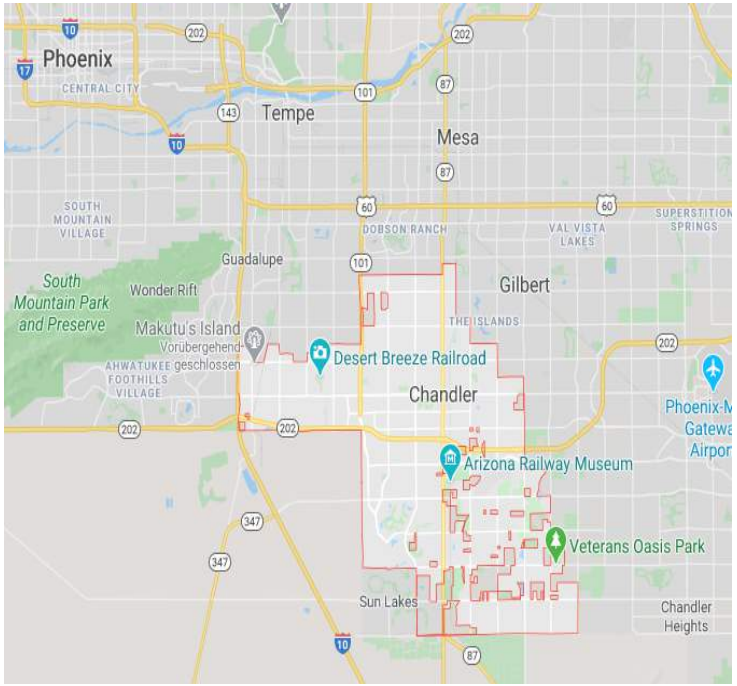
L4: … *or* you will not be able to reach every destination (in a vehicle you can't drive)

navya.tech/wp-content/uploads/2019/01/NAVYA-Safety-Report-01.09.2019-1.pdf

Operational design domain (ODD)

When and where a feature is specifically designed to function





Google Maps; Straßenverkehrsordnung, commons.wikimedia.org/w/index.php?curid=49947; miro.medium.com/max/1400/0*9MQQpiBhfRaPZhra

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L5: You're not driving, and you can reach any destination *(an "unlimited" ODD…)*

By Dante Gabriel Rossetti, Public Domain, https://commons.wikimedia.org/w/index.php?curid=44841386

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Vehicle types

- Vehicles you can drive:

- Vehicles you can't drive:

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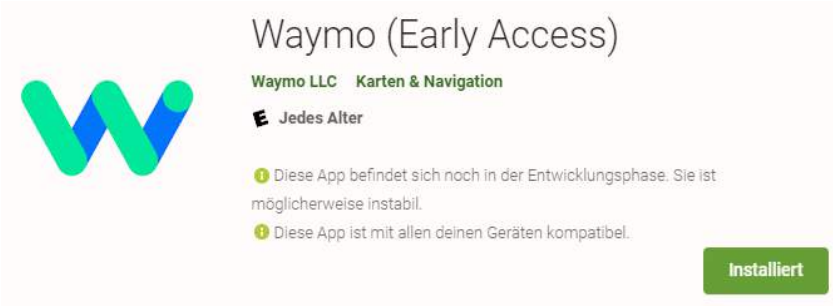
Trip types

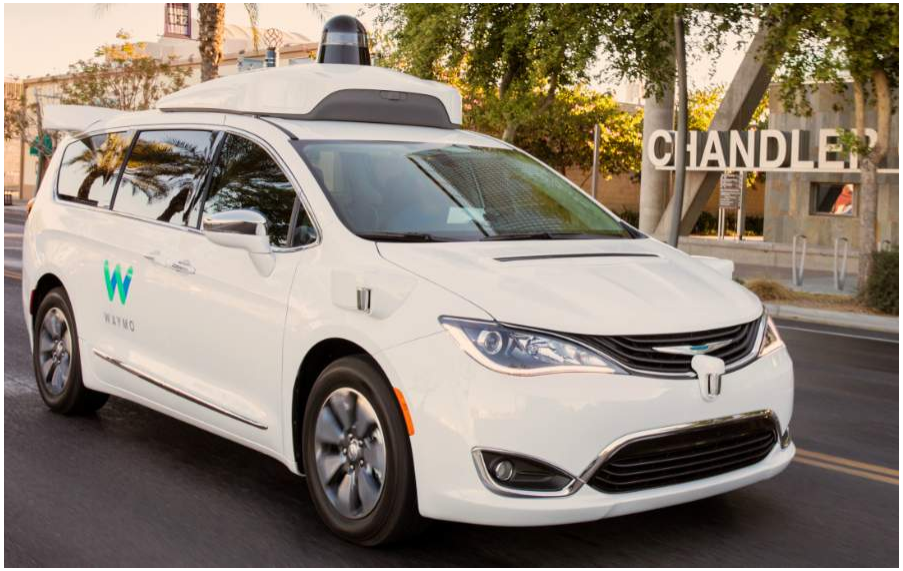
- You must drive for the entire trip (L0 - L2)
- You will need to drive if prompted in order to *maintain safety* (L3)
- You will need to drive if prompted in order to *reach your destination* (L4)
- You will not need to drive for any reason, but you may drive *if you want* (L4 - L5)
- You will not need to drive for any reason, and *you may not drive* (L4 - L5)

What's driving today?

- You cannot buy an AV
- You *might* be able to ride in an *aspirational* AV
- You *might* be able to use a delivery robot
- But they will almost certainly be *supervised*

Lt. Jeanine Menze by PO2 Jennifer Johnson,
alaska.coastguard.dodlive.mil/2014/03/breaking-barriers-and-becoming-the-change-for-women-in-coast-guard-aviation/





starship.xyz; waymo.com

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Looking ahead

Some combination of:

- **S**low speeds
- **S**imple environments
- **S**upervised operations

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Increasing automation and connectivity

- Driver assistance
- **Automated driving**
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Tesla’s “Smart Summon”

youtu.be/enkRALcdPb0?t=364

Platooning

www.fhwa.dot.gov/publications/research/ear/12033/004.cfm

Really remote driving

STARSKY ROBOTICS

We're working to make trucks autonomous on the highway and remote controlled by drivers for the first and last mile. Our trucks will make roads safer while giving drivers meaningful work close to their homes and families.

LEARN MORE | DRIVE WITH STARSKY

The End of Starsky Robotics

Stefan Seltz-Axmacher Follow
Mar 19 · 9 min read

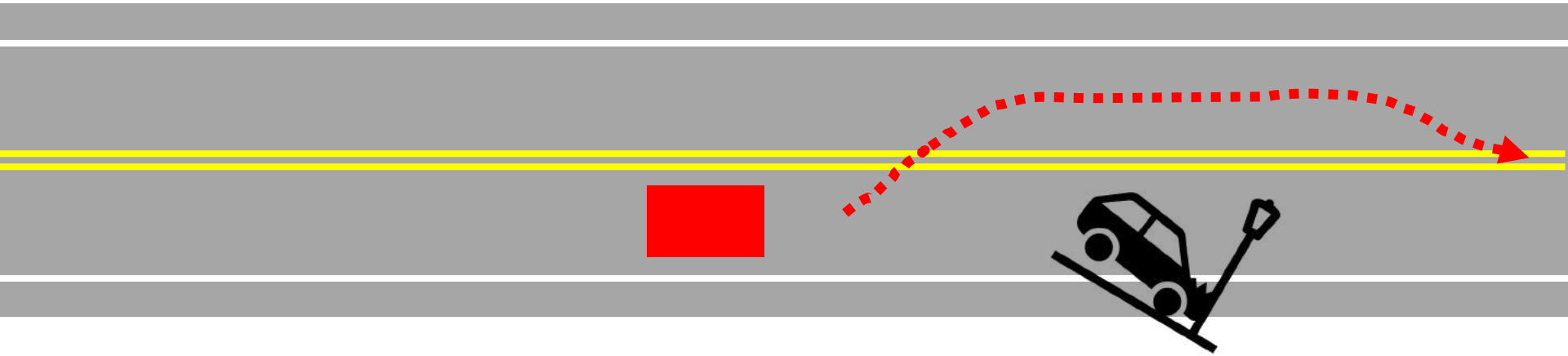
In 2015, I got obsessed with the idea of driverless trucks and started Starsky Robotics. In 2016, we became the first street-legal vehicle to be paid to do real work without a person behind the wheel. In 2018, we became the first street-legal truck to do a fully unmanned run, albeit on a closed road. In 2019, our truck became the first fully-unmanned truck to drive on a live highway.

And in 2020, we're shutting down.

www.starsky.io; medium.com/starsky-robotics-blog/the-end-of-starsky-robotics-acb8a6a8a5f5

Pop quiz!

On reaching a crash site, an automated vehicle stops in its lane until someone at a faraway monitoring center sketches a travel path. Using its sensors, the vehicle then follows this path.



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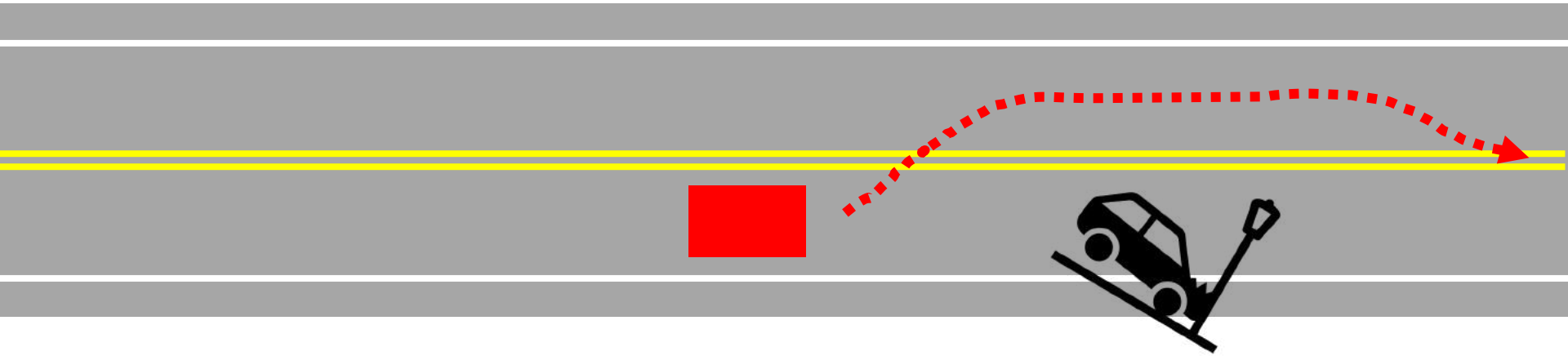

1) Is this L3 or L4 automated driving?

2) Is there a remote driver?

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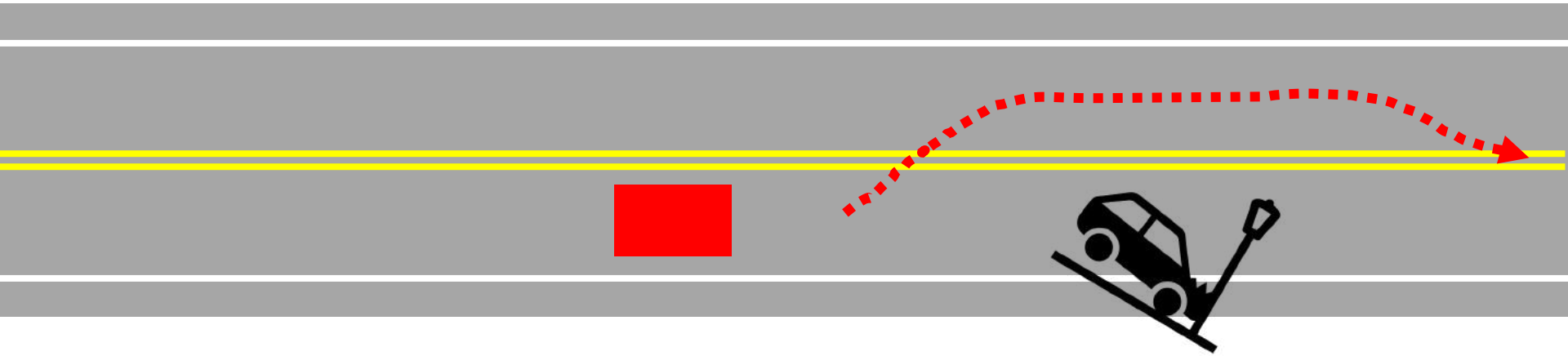
Pop quiz!

1) Is this L3 or L4 automated driving?

Is standing in this lane a minimal risk condition?



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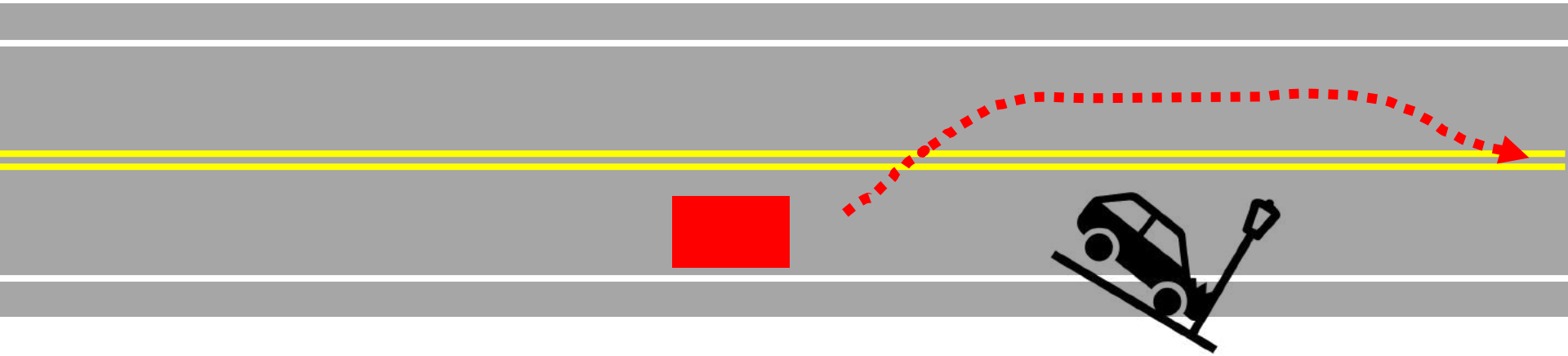
Pop quiz!

2) Is there a remote driver?

Is the remote agent (a) "performing the dynamic driving task" or (b) merely providing additional information for the automated driving system?



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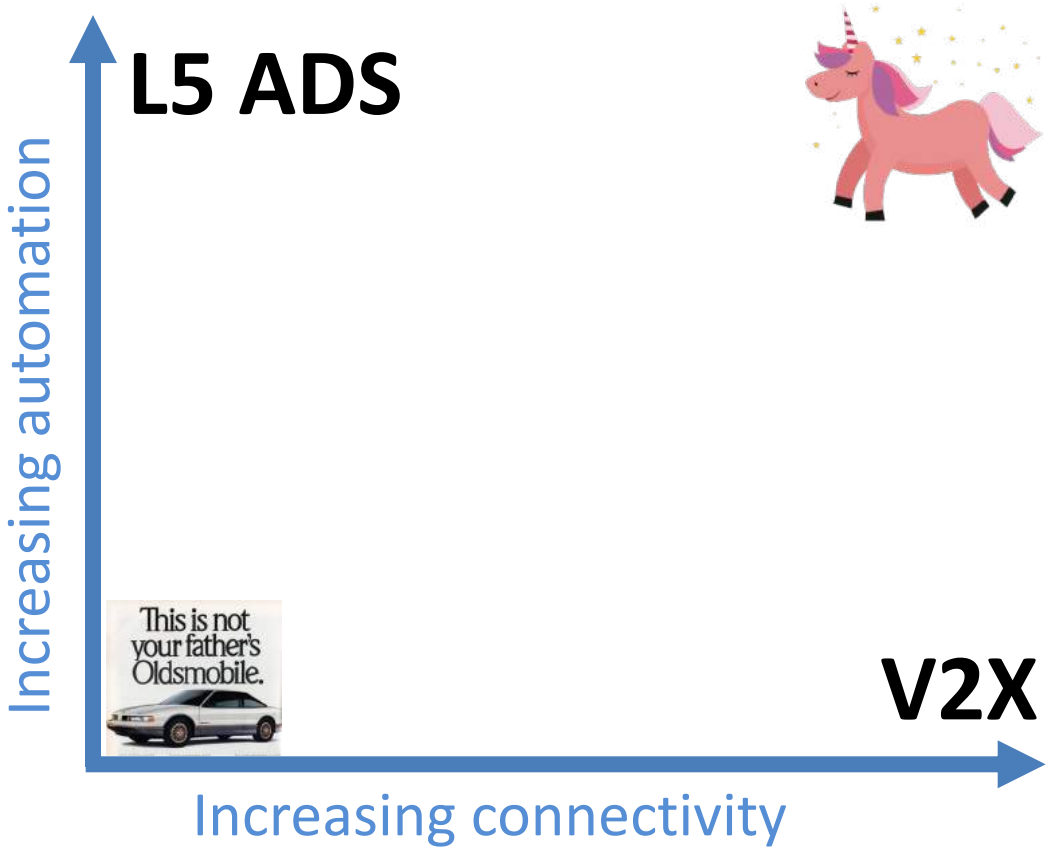
Increasing automation and connectivity

- Driver assistance
- Automated driving
- **Remote driving**
- Connected driving

Increasing automation and connectivity

- Driver assistance
- Automated driving
- Remote driving
- **Connected driving**

Automation versus connectivity



clickamericana.com/topics/culture-and-lifestyle/cars-trucks/1989-oldsmobile-cutlass-supreme-cutlass-Calais

freesvg.org/unicorn-vector-clipart-pdv

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Communications

V2V: Vehicle-to-Vehicle

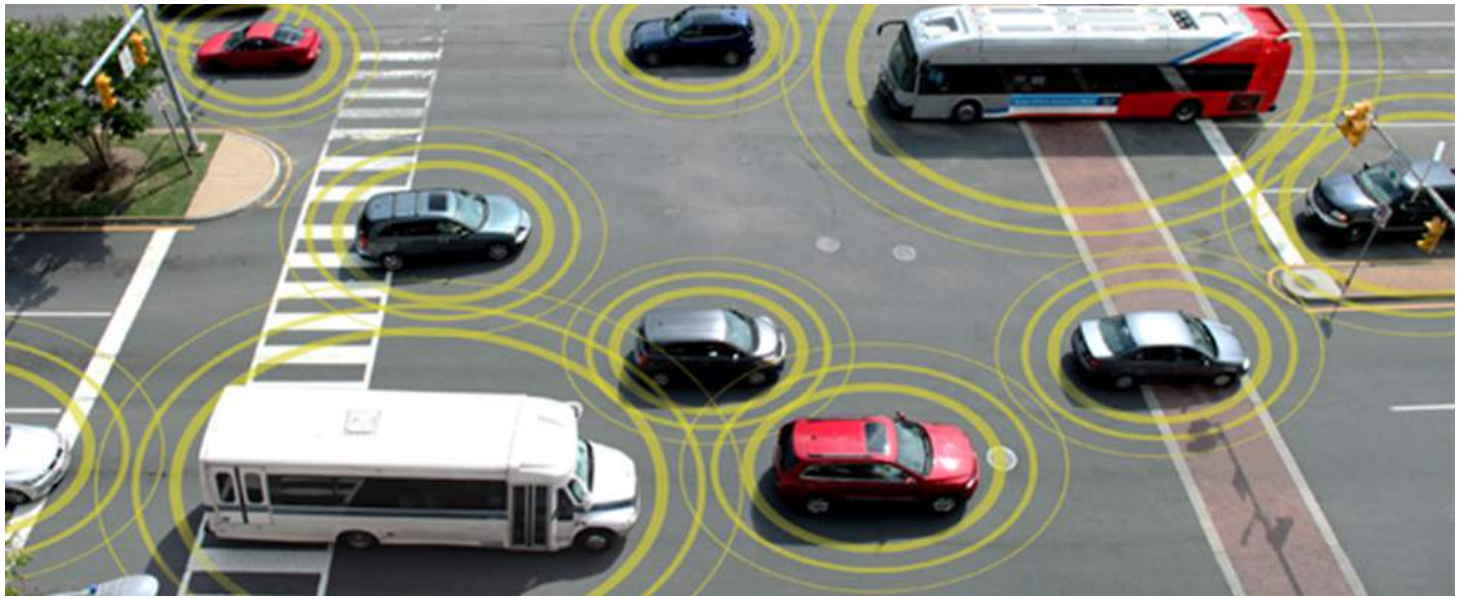
V2P: Vehicle-to-Pedestrian

V2I: Vehicle-to-Infrastructure

V2C: Vehicle-to-Cloud

V2D: Vehicle-to-Device

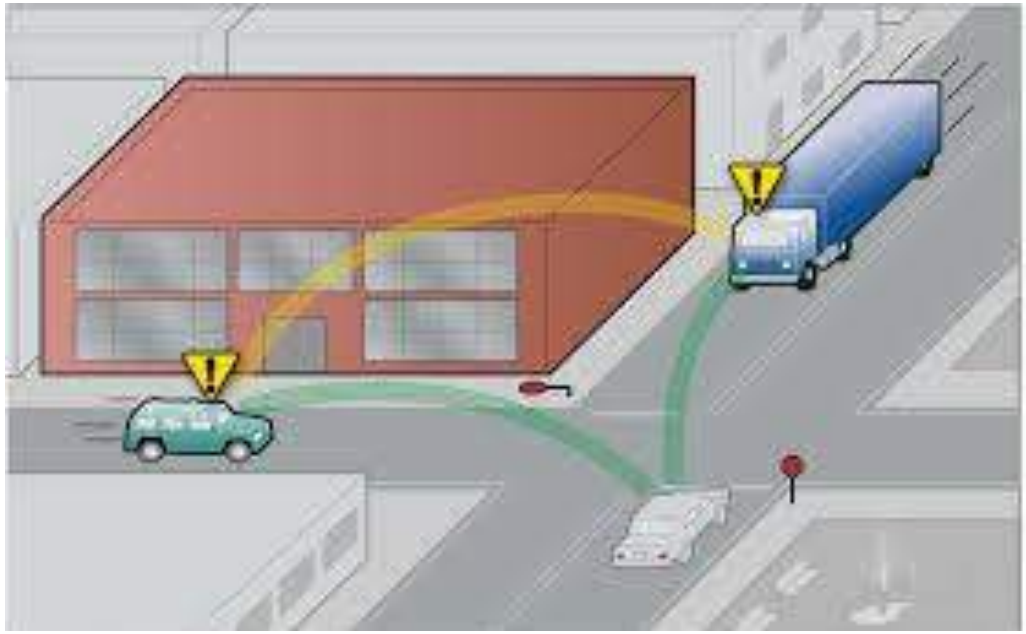
V2X: Vehicle-to-Everything



transportation.gov/content/us-dot-advances-deployment-connected-vehicle-technology-prevent-hundreds-thousands-crashes-0. But really: This image is everywhere. *Everywhere*. Back in the day, no briefing on V2V was complete without it. I think people started expecting that cars of the future would shoot golden halos. So does anybody actually know where this image originally came from? Or does it have a kind of transcendent always-has-and-always-will-be permanence, much like those mysterious golden halos?

A narrow version of vehicle connectivity

- Direct communication to/from vehicles
- Really fast ("low latency") and super reliable
- Supports safety-critical applications



nhtsa.gov/staticfiles/rulemaking/pdf/V2V/Readiness-of-V2V-Technology-for-Application-812014.pdf

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Basic safety message (BSM) in US*

Ten times a second: "Hey there vehicle neighbors! My temporary pseudonym is BigSister389. I'm a 15-ft-long vehicle at 34°/81°/300ft moving NW at 30mph but slowing at 15fps with my steering wheel at 15° and my brakes engaged…."

Every few seconds: "And by the way, it's 32° outside, I think it's raining, my lights and wipers are on, I weigh 3000lbs, and here's some other fun trivia that you might find safety-relevant… oh, but first, *watch out for the black ice!*"

**The EU's cooperative awareness message is vaguely similar….*

SAE J2735 (but supremely stylized)

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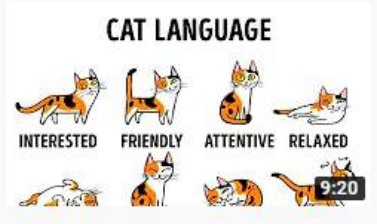
Devil in the details

- Competing technologies
  - DSRC/ITS G5/802.11p (Wi-Fi)
  - C-V2X LTE & 5G (Cellular)
- Spectrum (re)allocation and spectrum sharing
- Slooooow adoption
- Regional differences and incompatibilities



youtube.com, but please don't go there now; the cat videos will still be there when this is done

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Few and (literally) far between

DSRC/ITS G5	C-V2X
Some Cadillacs since 2017	All Fords from 2022?
Some VW Golfs from 2020	
~~All US Toyotas from 2021?~~	
Some cars in Japan since 2016	
~~To be mandated in US (2018)~~	Preferred in China
~~Preferred in EU (2019)~~	
EU to be “technology neutral” (2019)	

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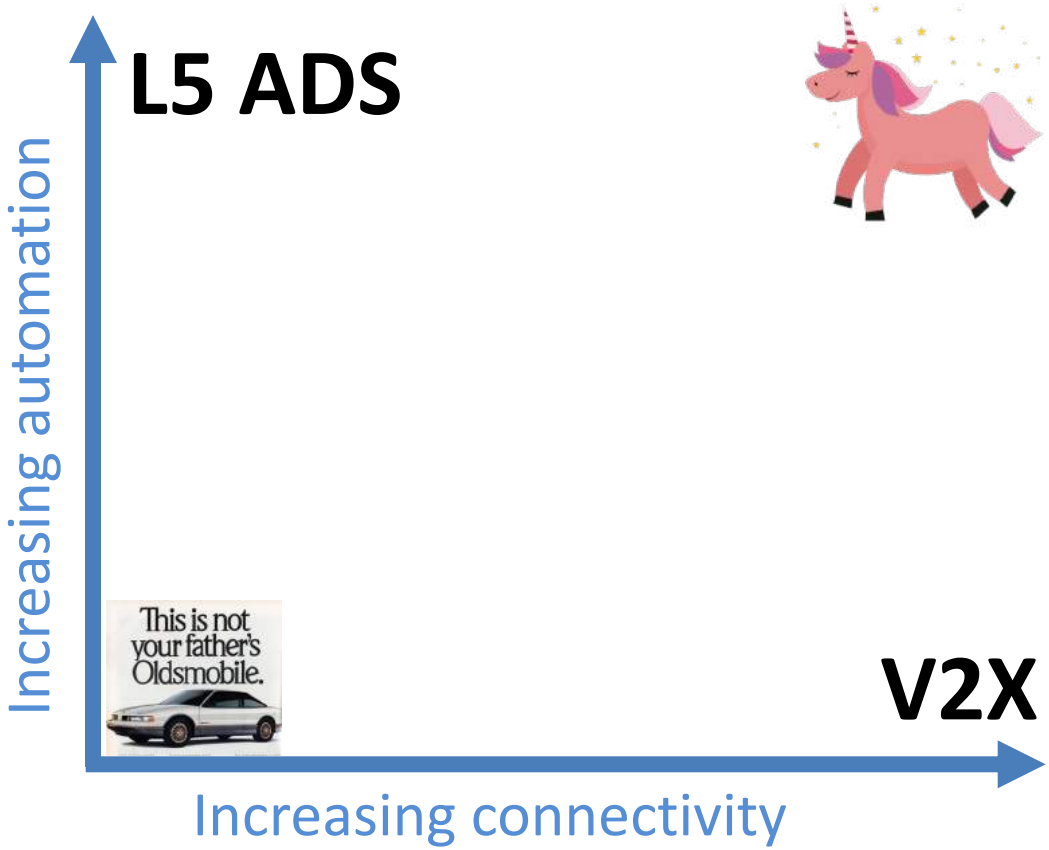
Automation versus connectivity



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freesvg.org/unicorn-vector-clipart-pdv

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A broad version of vehicle connectivity

- Telematics
- Infotainment
- OBD II dongles
- In-vehicle Wi-Fi
- In-vehicle Bluetooth
- Mobile vehicle apps
- Over-the-air updates
- OnStar (and its competitors)

A broad version of vehicle connectivity

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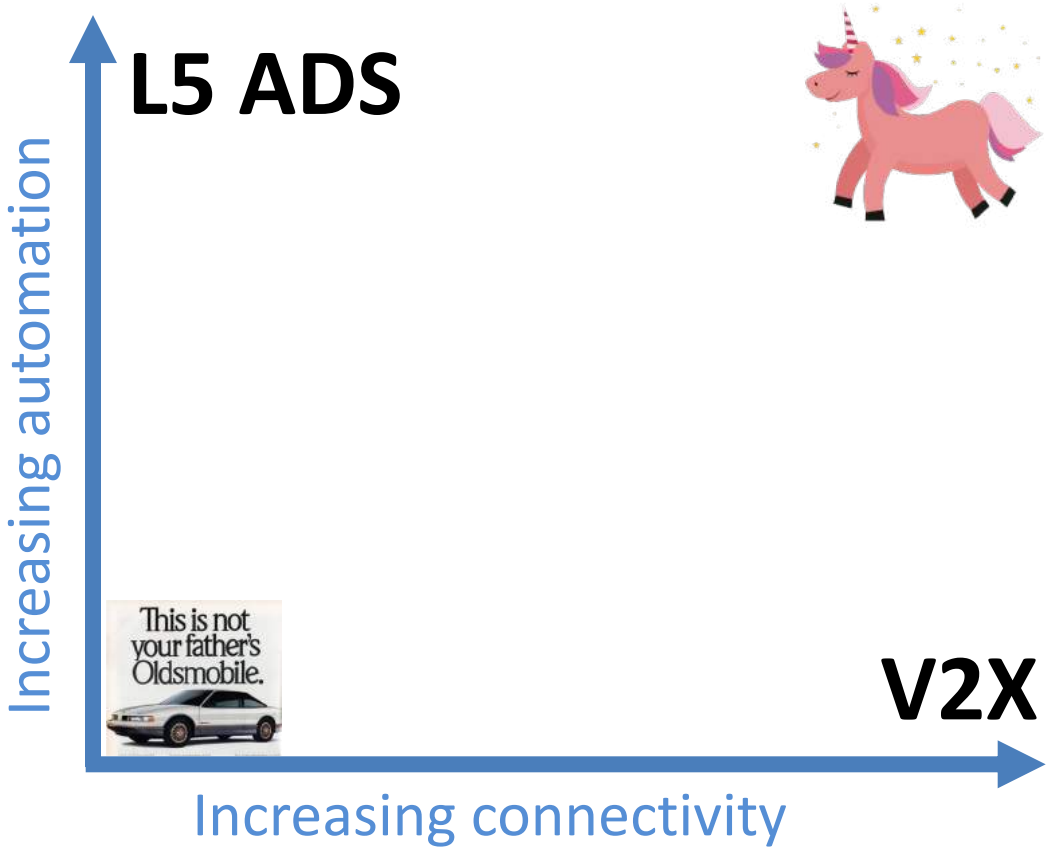

clickamericana.com/topics/culture-and-lifestyle/cars-trucks/1989-oldsmobile-cutlass-supreme-cutlass-Calais

freesvg.org/unicorn-vector-clipart-pdv

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Key questions for a data discussion

- (How) are mobile phones and other connected devices different than motor vehicles?
- (How) are V2V-capable motor vehicles different than conventional motor vehicles?
- (How) are automated vehicles different than conventional motor vehicles?

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Increasing automation and connectivity

- Driver assistance
- Automated driving
- Remote driving
- **Connected driving**

Increasing automation and connectivity

- Driver assistance
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- Connected driving

END PART ONE

BEGIN PART TWO

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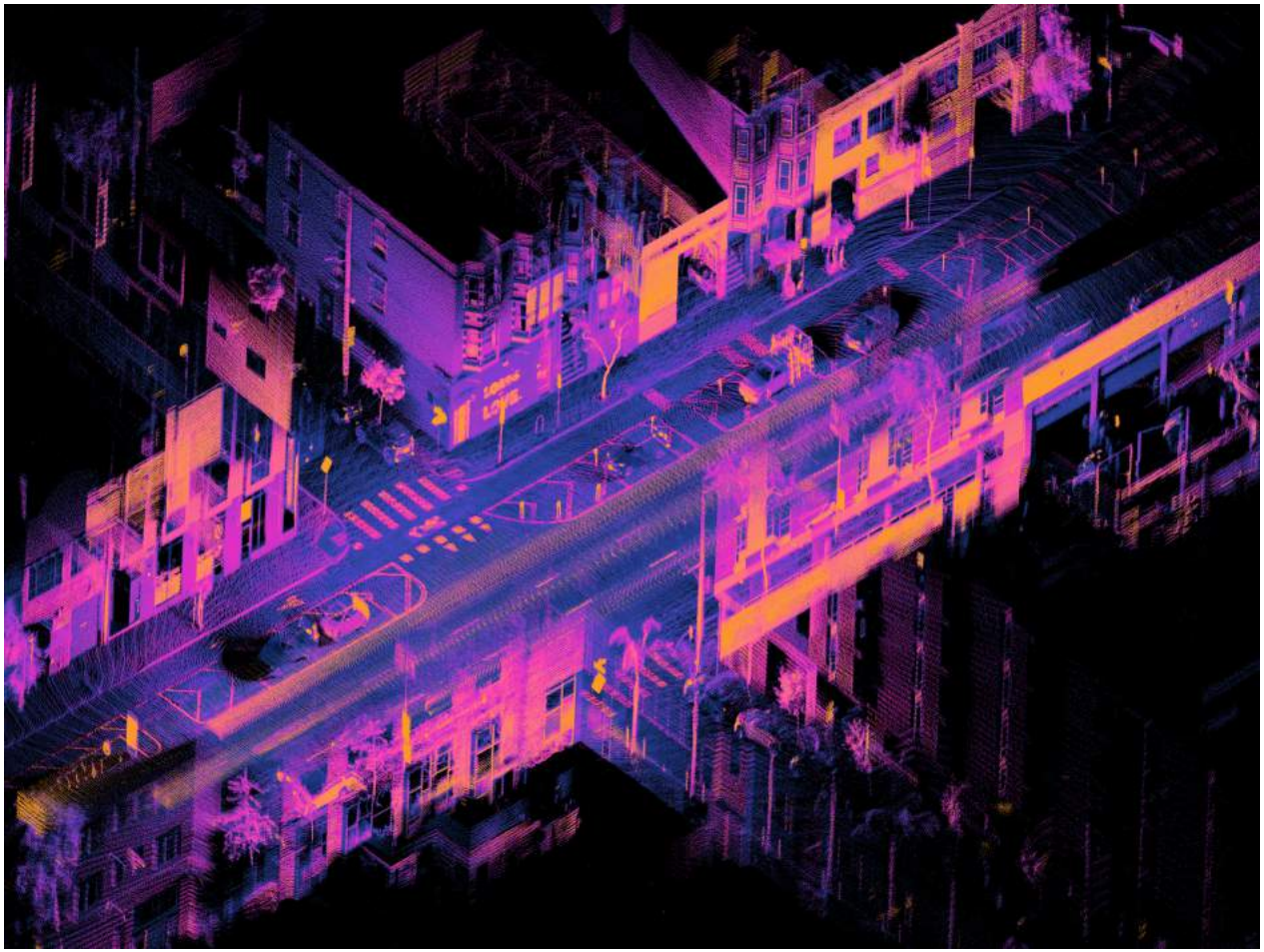
tenor.com/view/adam-workaholics-way-to-work-cat-driving-gif-16820165. As promised

Automated Driving Technologies and Data



Increasing automation and connectivity

- Driver assistance
- Automated driving
- Remote driving
- Connected driving

How the technologies work

- Driver assistance
- **Automated driving**
- Remote driving
- Connected driving

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Automated driving is a wide range of

- Underlying technologies
- Applications of those technologies
- Business cases for those applications
- Participants in those business cases

Driving

*("performing the dynamic driving task")**

- **Driving** involves paying attention to the vehicle, the road, and the environment so you can steer, brake, accelerate, and communicate as needed

- If you're expected to pay attention, **you're still driving** — even when a feature is assisting you with steering, braking, accelerating, and/or communicating

- Driving may have an even broader legal meaning

*SAE J3016

newlypossible.org/wiki/index.php?title=Automated_Driving_Definitions

futurist.law.umich.edu/how-reporters-can-evaluate-automated-driving-announcements

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Driving

- What's around me?
- What should I do?
- I'm doing it!
- …

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Driving

- What's around me? **Perception**
- What should I do? **[Path] Planning**
- I'm doing it! **Actuation**
- …

Driving

- What's around me? **Perception**
- What should I do? **[Path] Planning**
- I'm doing it! **Actuation**
- …

Some of Waymo's external sensors

Plus microphones, ultrasonic sensors,
inertial sensors, and GPS receivers (but not DSRC receivers)

As well as numerous internal sensors

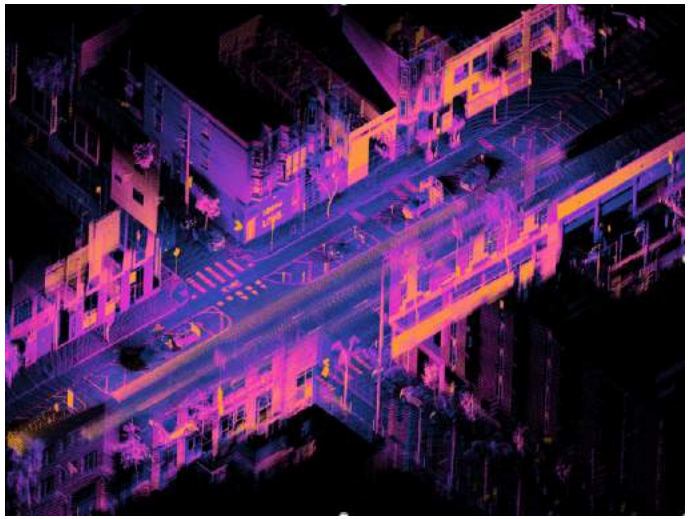
waymo.com

Why so many?

- Inches away to hundreds of feet away
- Day and night, sunrise and sunset….
- Snow, rain, fog, glare....
- Distance, size, color, detail….
- Accuracy, reliability, and confidence

Sensors and mapping: What do I expect?

- Beforehand: Build a highly detailed 3D map
- During: Compare the map to the real world
  - Where am I?
  - What's different?
    - What has changed?
    - What is there to see?
- Afterward: Update the map



(unless you're Tesla)

Sensors and “objects”: What do I see?

Detect, classify, and track people walking, people running, people biking, people walking bikes, people walking in crowds, people trying to cross, buses, cars, motorcycles, scooters, trucks, trucks pulling cars, cars pulling trucks, trailers, cats, dogs, birds, turtles, snakes, alligators, deer, elk, police cars, ambulances, firetrucks, garbage trucks, construction equipment, construction detours, first responders, crossing guards, temporary traffic signals, new traffic signs, potholes, mattresses, plastic bags, shredded tires, trees, tree limbs, shadows, hanging wires, low-flying planes, marathons, towtrucks, towtrucks towing other towtrucks, cars backing up, cars going the wrong way, cars upside down, millions of other things we’ve seen before and millions of things that we haven’t…

…and then predict what they’ll do next

www.publicdomainpictures.net/en/view-image.php?image=243334&picture=kangaroo-crossing-sign

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Example: Uber's fatal crash

ntsb.gov/investigations/AccidentReports/Pages/HWY18MH010-prelim.aspx

Example: Uber's fatal crash

- Volvo's emergency braking system disabled in favor of Uber's human and machine system
- 6 sec before impact: Software is unsure about classification and path (unknown object / vehicle / bicycle) *and so does nothing*
- 1.3 sec before impact: Software anticipates collision *and so does nothing*
- < 1 sec before impact: Human driver finally intervenes

ntsb.gov/investigations/AccidentReports/Pages/HWY18MH010-prelim.aspx

Example: Uber's fatal crash

- Believing the safety driver will be careful, Uber's engineers create a vehicle that behaves recklessly
- Believing the vehicle will be careful, Uber's safety driver behaves recklessly
- A woman dies

ntsb.gov/investigations/AccidentReports/Pages/HWY18MH010-prelim.aspx

This failure is unacceptable

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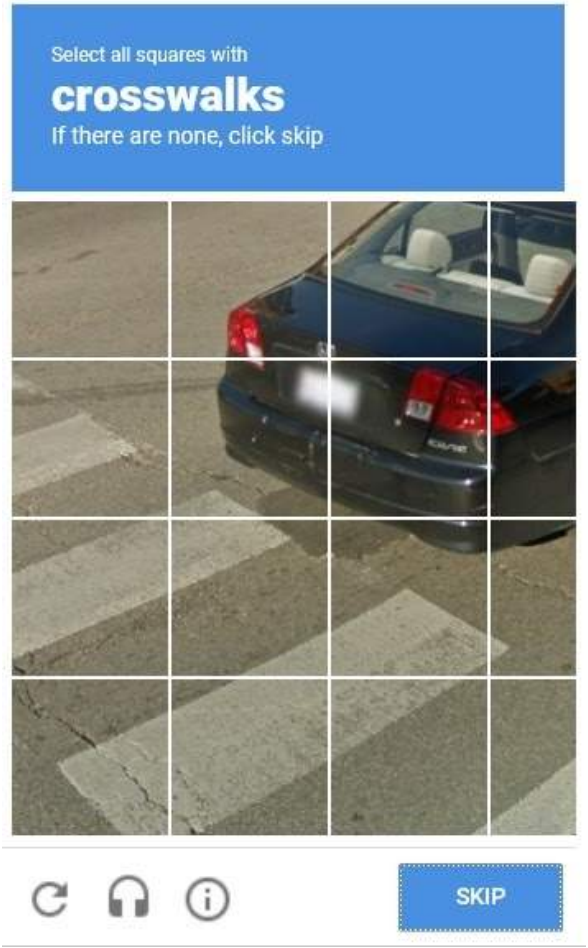
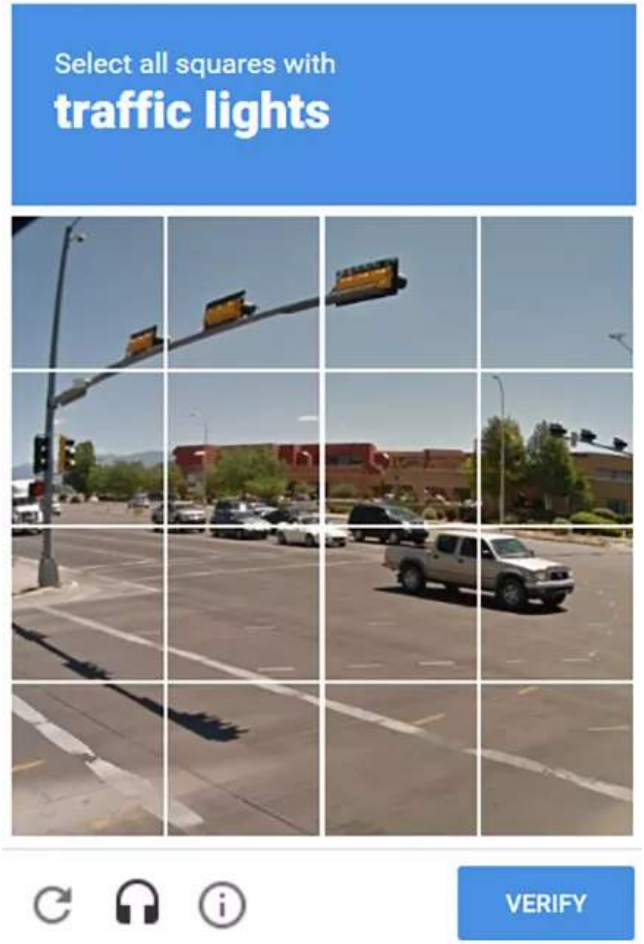
You're helping





learn.g2.com/captcha; wingarc.com.au/2019/09/is-google-using-us-to-train-self-driving-cars

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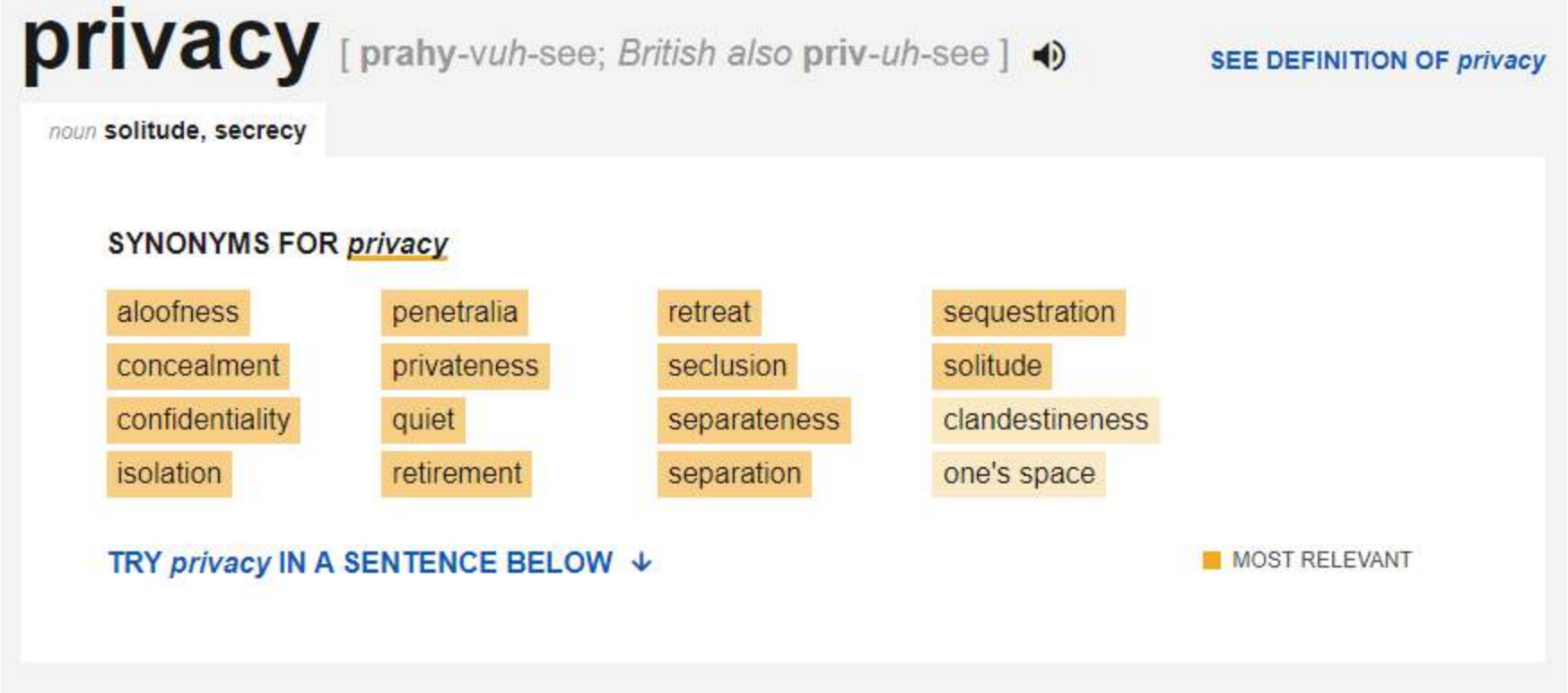
Machine learning

- Supervised

- Unsupervised

Like a thesaurus



privacy [prahy-*vuh*-see; *British also* priv-*uh*-see]

SEE DEFINITION OF *privacy*

noun **solitude, secrecy**

SYNONYMS FOR *privacy*

aloofness	penetralia	retreat	sequestration
concealment	privateness	seclusion	solitude
confidentiality	quiet	separateness	clandestineness
isolation	retirement	separation	one's space

TRY *privacy* IN A SENTENCE BELOW ↓

MOST RELEVANT

www.thesaurus.com/browse/privacy

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Increasing automation and connectivity

- **Driver assistance**

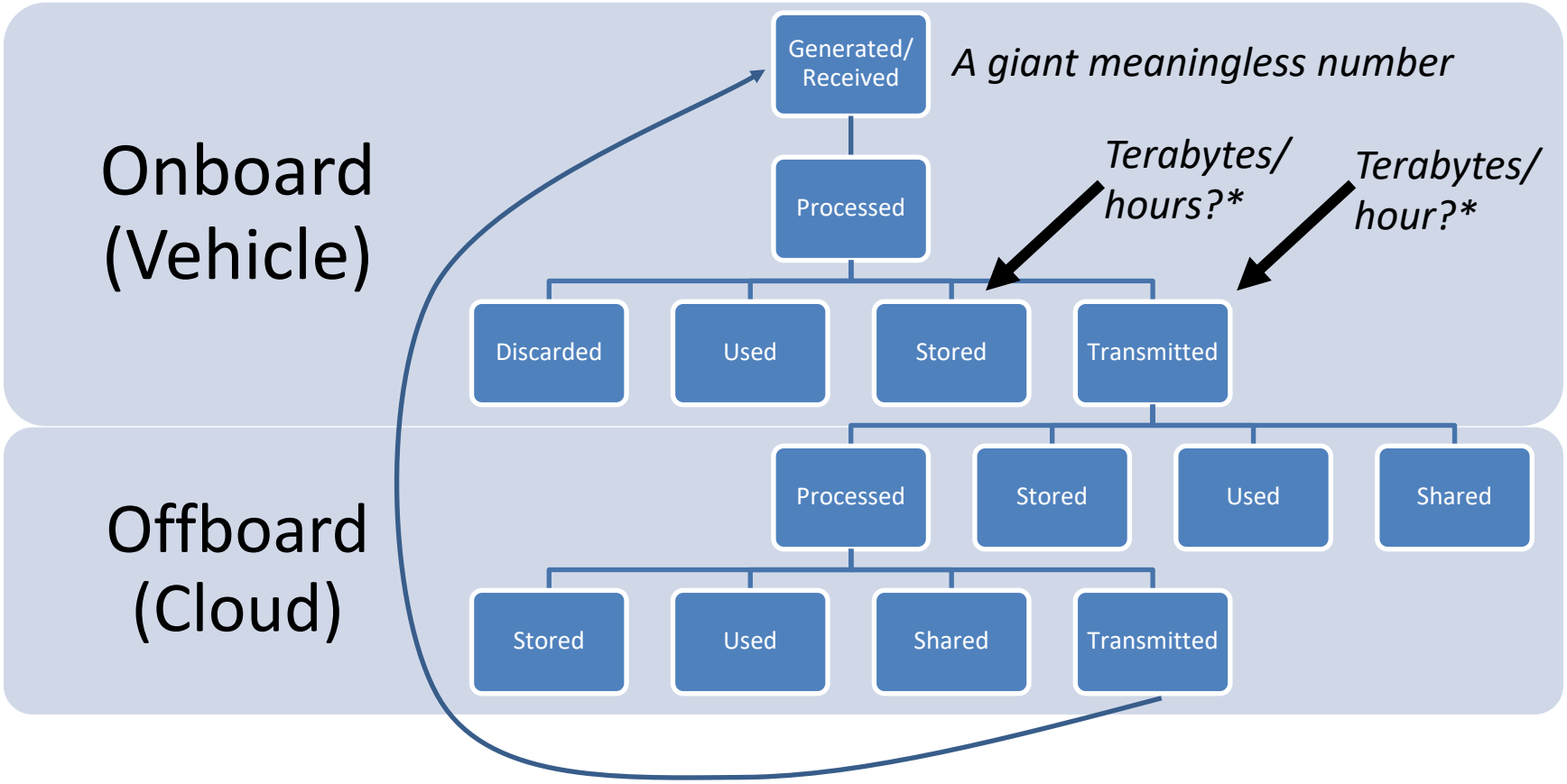
Some systems use machine learning techniques

- **Automated driving**

All systems will use machine learning techniques

- Remote driving
- Connected driving

Stylized Data Pathways



** Equivalent to a large home hard drive with millions of photos or hundreds of thousands of songs*

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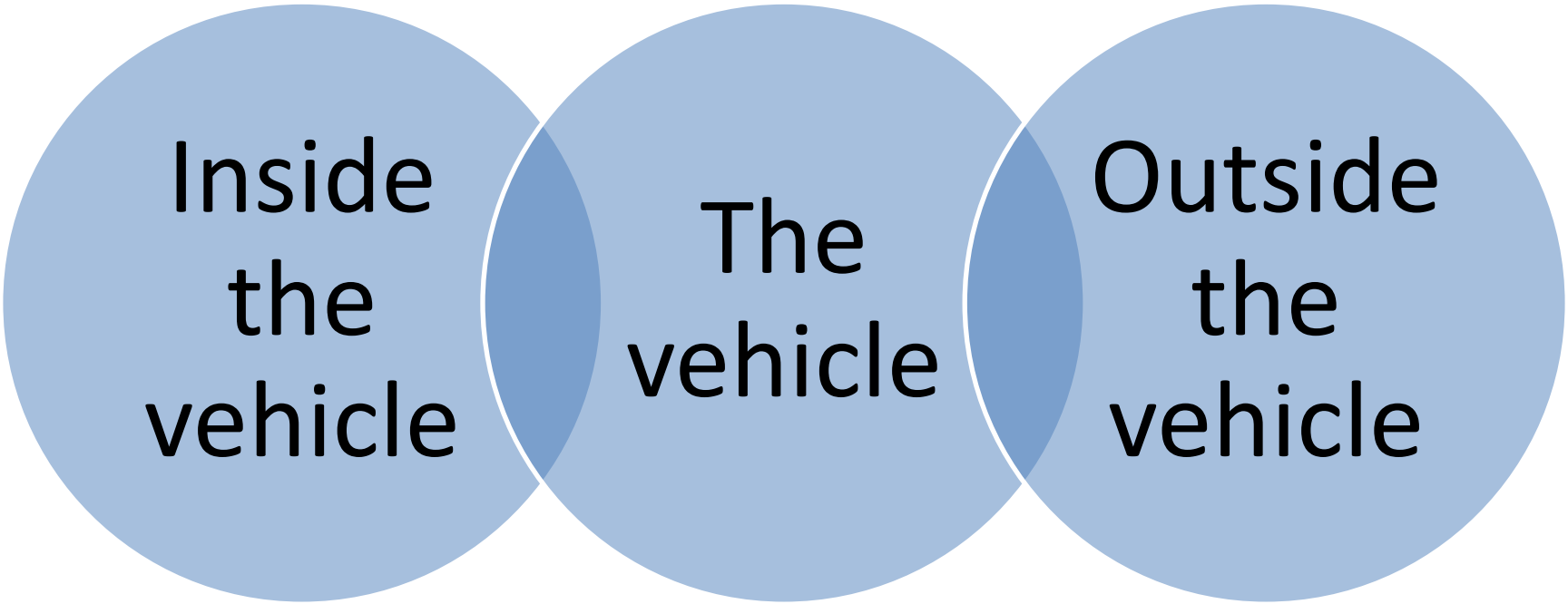
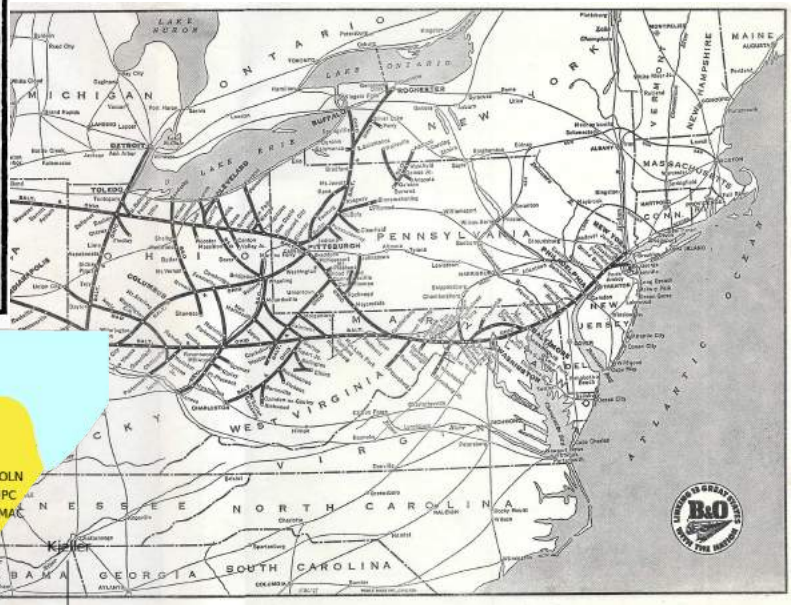
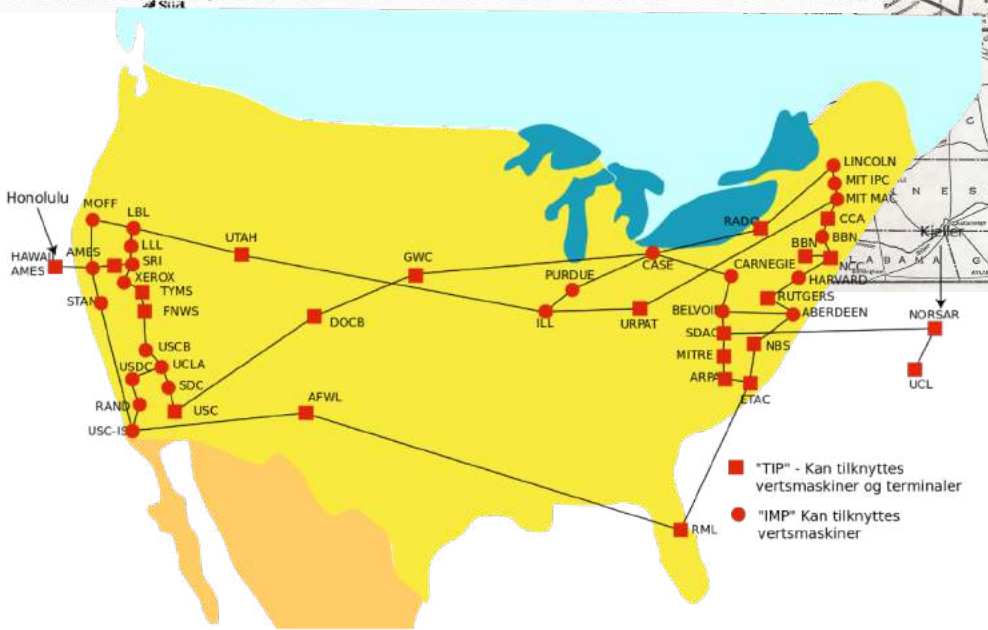
Automated driving data

- To operate the system (*implicit*)
- To develop the system (*implicit/intended*)
- To document performance (*intended*)
- During operation of the system (*incidental*)



Unimaginable possibilities?





www.american-rails.com/baltimore.html; germanyiswunderbar.com/northern-germany/germany-holidays-the-kiel-canal;
By Yngvar - Own work, based on notes and recollections from 1974, Public Domain, commons.wikimedia.org/w/index.php?curid=1555388

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Real-time Streetview?

Google Street View, cnet.com/pictures/crazy-images-caught-on-google-street-view/26/

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Automated enforcement by private networks?

Can Big Automakers Be Trusted With Big Data?

Autonomy will turn cars into rolling supercomputers. That's a problem.

BY ERIC ADAMS APRIL 13, 2018

"It's not just that automated vehicles will be supercomputers," said Bryant Walker Smith, a law professor at the University of South Carolina who studies the impact of autonomous technology on society. "They'll be mobile supercomputers powered by big batteries, fed by all kinds of capable sensors both inside and outside the vehicle, and connected back to huge companies with even greater collective computing resources."

thedrive.com/tech/20102/can-big-automakers-be-trusted-with-big-data

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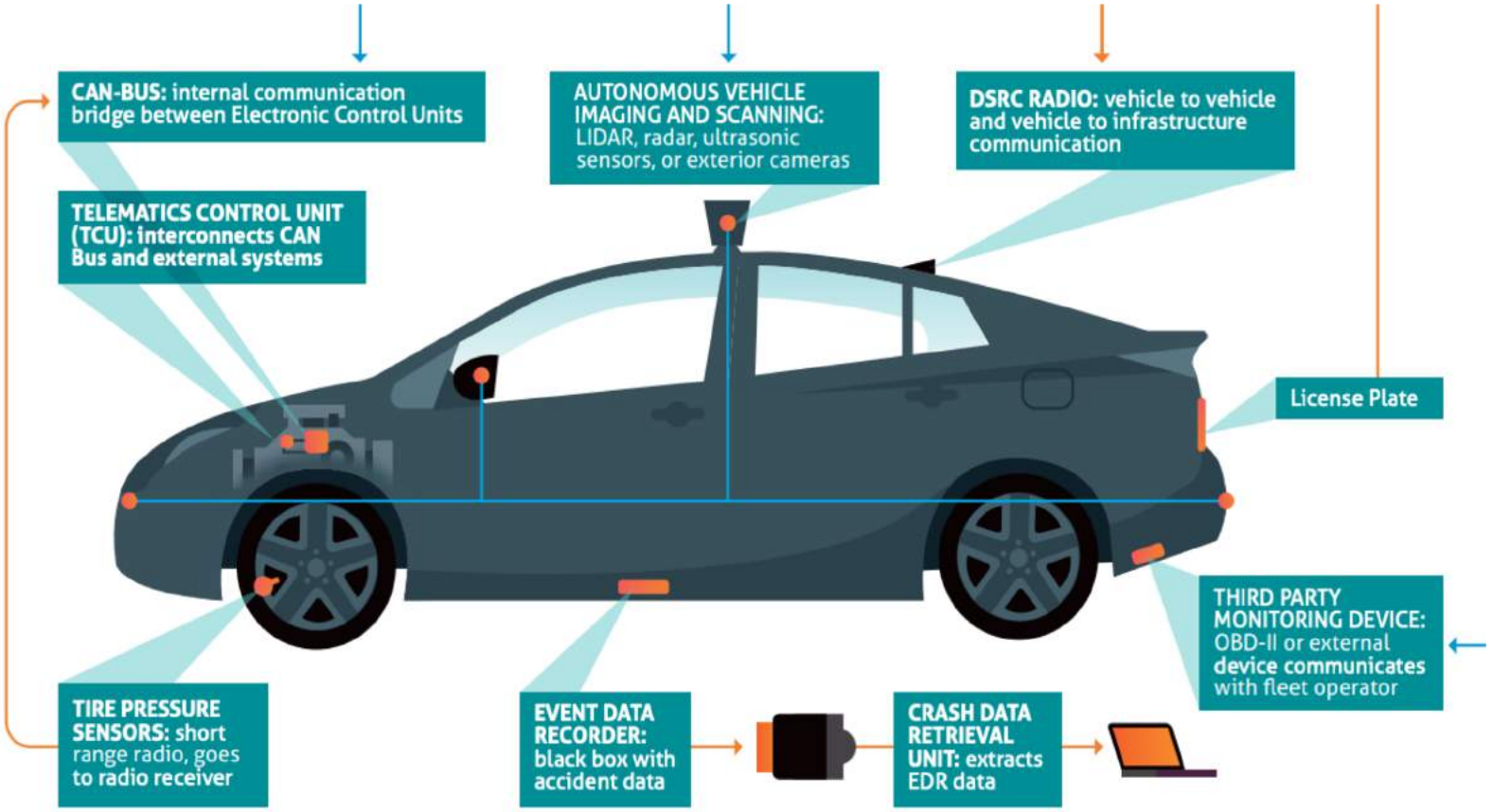
Connected Car Data Flows



Regulatory Landscape

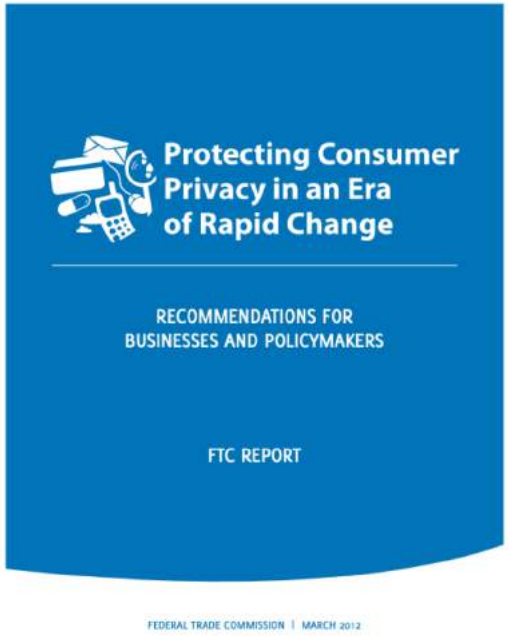
Data Protection by Design & by Default

- Legal requirements in the GDPR
  - embedded safeguards and mechanisms throughout the lifecycle of the application, service or product
  - requires the Controller to implement appropriate technical and organizational measures
  - a risk-based approach that is contextual and dynamic

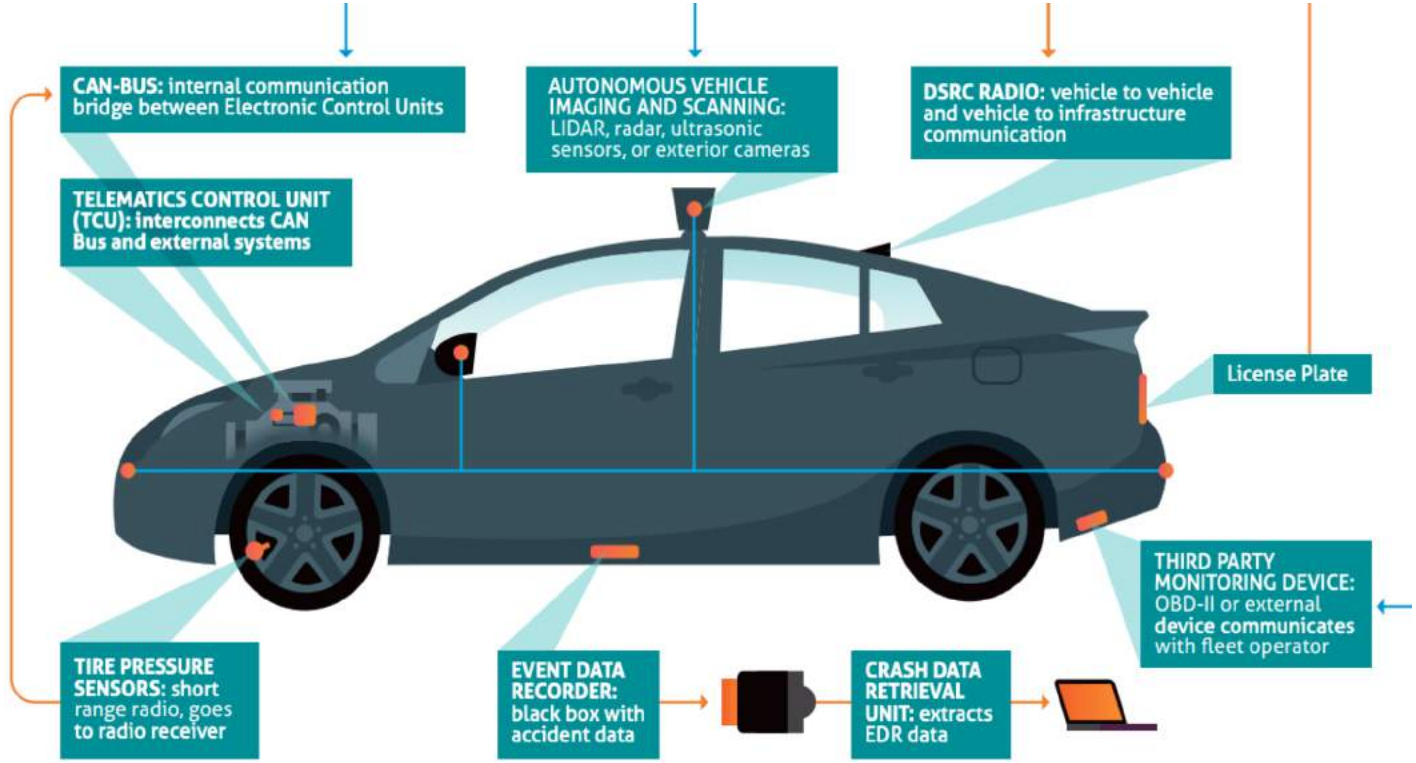
- European Data Protection Board
  - Draft guidelines Guidelines 1/2020 on processing personal data in the context of connected vehicles and mobility related applications

Privacy by Design

1. Proactive not reactive; Preventative not remedial
2. Privacy as the default setting
3. Privacy embedded into design
4. Full functionality - Positive-sum, not zero-sum
5. End to end security - full lifecycle protection
6. Visibility and transparency - keep it open
7. Respect for user privacy - keep it user-centric



Example of PbD Practices with optical sensors and computer vision



Thank-you!

Questions?

FUTURE OF PRIVACY FORUM

VUB BRUSSELS PRIVACY HUB