Agenda

- Intro to autonomous vehicles

- AMOD market and technology

- Why is it difficult to make an AV?

- Tools of the trade
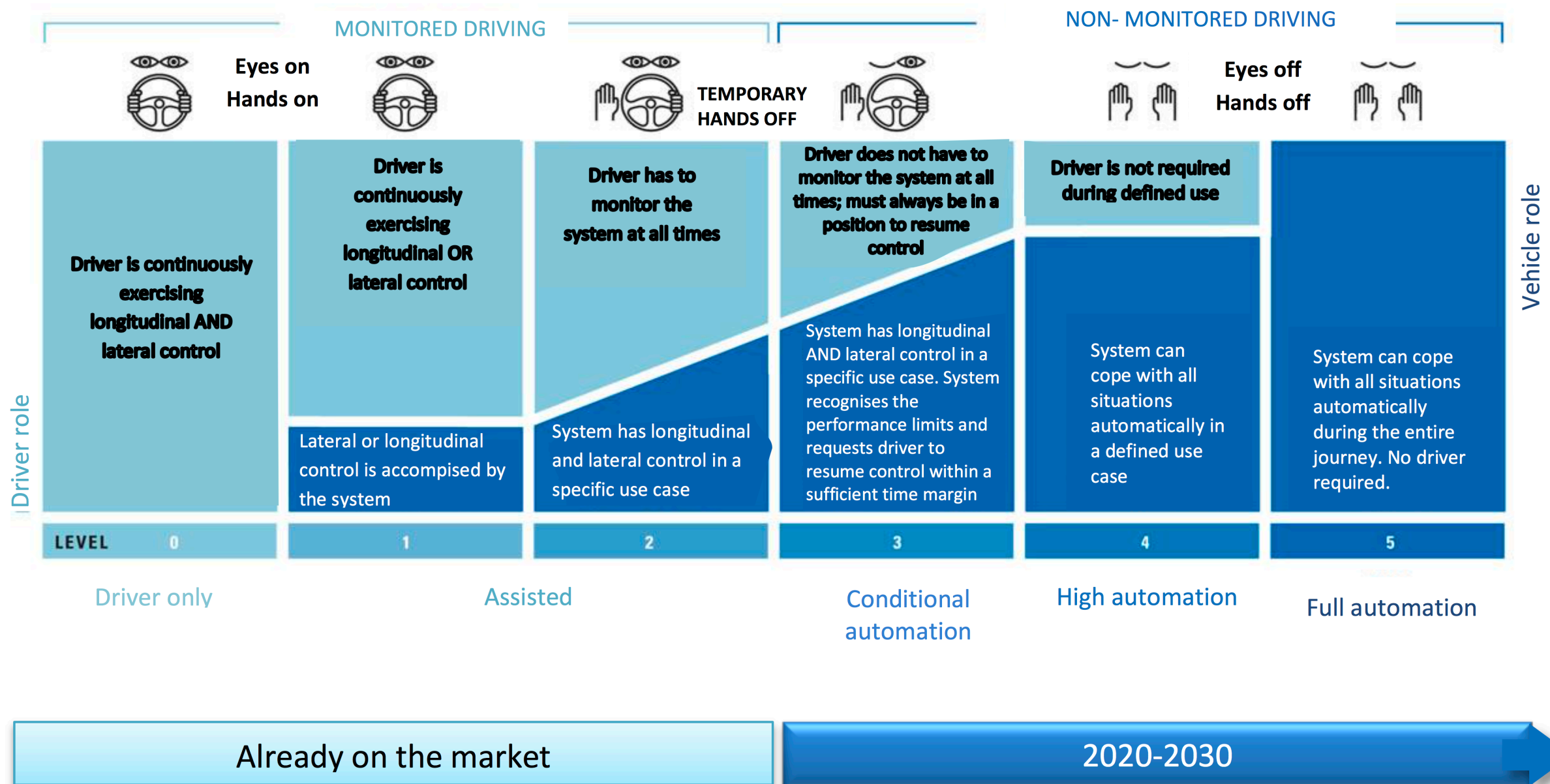
A blooming industry

- <u>Waymo</u> (Alphabet/Google group)

- <u>Cruise Automation</u> (General Motors)

- <u>nuTonomy</u> (Aptiv) + Hyundai → <u>Motional</u> *

- <u>Zoox</u> (Amazon)

- <u>Uber Advanced Technologies Group</u>

- <u>Tesla Autopilot project</u>

- <u>Toyota Research Institute</u>

- <u>Aurora Innovation</u>

- <u>Audi</u>

- <u>Nissan's autonomous car</u>

- <u>Baidu</u>

- Apple?

* Emilio Frazzoli: current Chief Scientist
Andrea Censi: former Director of Research

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The Five Levels of Autonomy

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- **Level 0**: the human driver does everything;

- **Level 1**: an automated system on the vehicle can sometimes assist the human driver conduct some parts of the driving task;

- **Level 2**: an automated system on the vehicle can conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task;

- **Level 3**: 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**: 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

- **Level 5**: the automated system can perform all driving tasks, under all conditions that a human driver could perform them.

Level 2 - Driver assistance system

- **Level 2**: an automated system on the vehicle can conduct some parts of the driving task, while the human continues to monitor the driving environment and performs the rest of the driving task.

Level 3 - the "hand over" problem

- **Level 3**: 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 3 - Example failure

- (This accident resulted in a fatality.)

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First fatality in AV testing (March 2018)

- Circulated video shows safety driver apparently distracted.

- Details about circumstantial and root causes are unclear.

First fatality in AV testing (March 2018)

- Update as of September 2020:

  - Uber was not charged.

  - Uber settled with the victim.

  - The safety driver has been indicted for negligent homicide.

Uber Backup Driver Indicted in 2018 Self-Driving Crash That Killed Woman

Tempe, AZ | Phoenix New Times | 5d

A Maricopa County grand jury has charged a former self-driving car backup driver with negligent homicide over a March 18, 2018, crash in Tempe that killed a homeless woman. As internal video of the Uber car showed, Rafaela Vasquez, a 46-year-old transgender woman still legally known as Rafael Stuart Vasquez, had been looking down below the dashboard repeatedly in the seconds before the Uber's converted Volvo SUV, in autonomous mode, struck and killed Elaine Herzberg, who was 49.

Why level 4 AVs?

improve safety

increase productivity

increase accessibility

reduce cost

reduce congestion

make Rome beautiful again

Increasing accessibility

- For some less fortunate, a self-driving car would be more than a "convenience"

The economic impact

- Might affect 2 million transportation jobs in the United States.

- What about all the jobs lost?

What about all the jobs lost?

About those trucks...

Former Google exec Anthony Levandowski sentenced to 18 months for stealing self-driving car secrets

He's now suing Uber for $4.1 billion

By Nick Statt | @nickstatt | Aug 4, 2020, 7:48pm EDT

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Photo by Angelo Merendino / AFP / Getty Images

Controversial engineer Anthony Levandowski, who worked for the Google division that would become Waymo before founding trucking company Otto and selling it to Uber, has been sentenced to 18 months in prison for trade secret theft during his various stints in the self-driving industry. His sentencing closes the book on a multi-year legal saga stemming from Levandowski's high-rising and equally fast-falling career in Silicon Valley spanning much of the past decade.

VERGE D

Sony's last-gen WH-1000X noise-canceling headphor

The Apple Watch Series 5 Walmart