

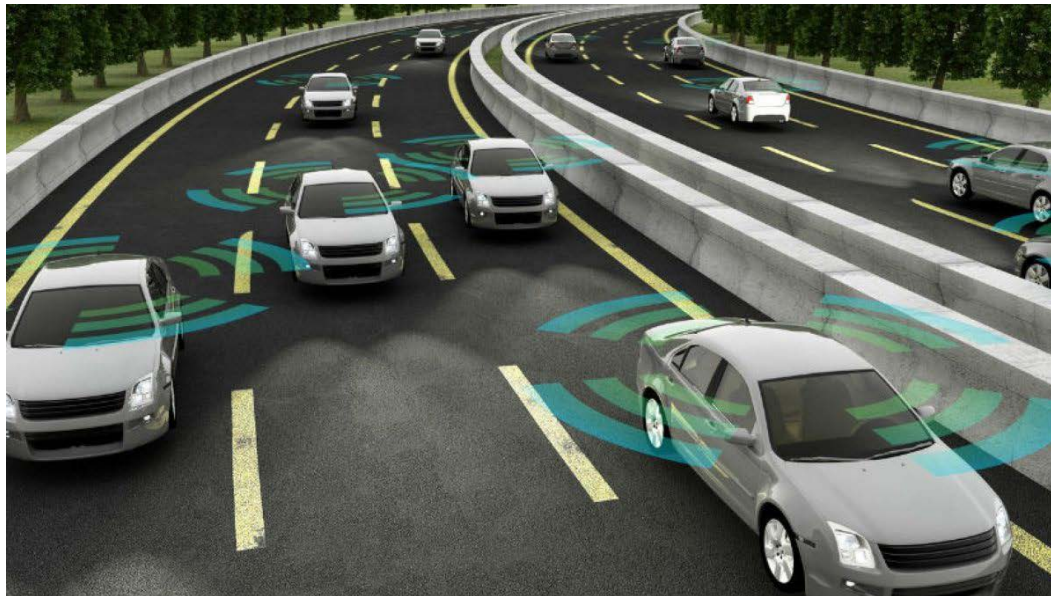
Who's driving the car?



November 14, 2018

What are autonomous vehicles?

- A vehicle capable of sensing the movement and environment around itself with little to no human interaction
- As known as robotic cars, self-driving cars, and driverless cars
- Cars, shuttles, and delivery trucks
- Gas or electric vehicles



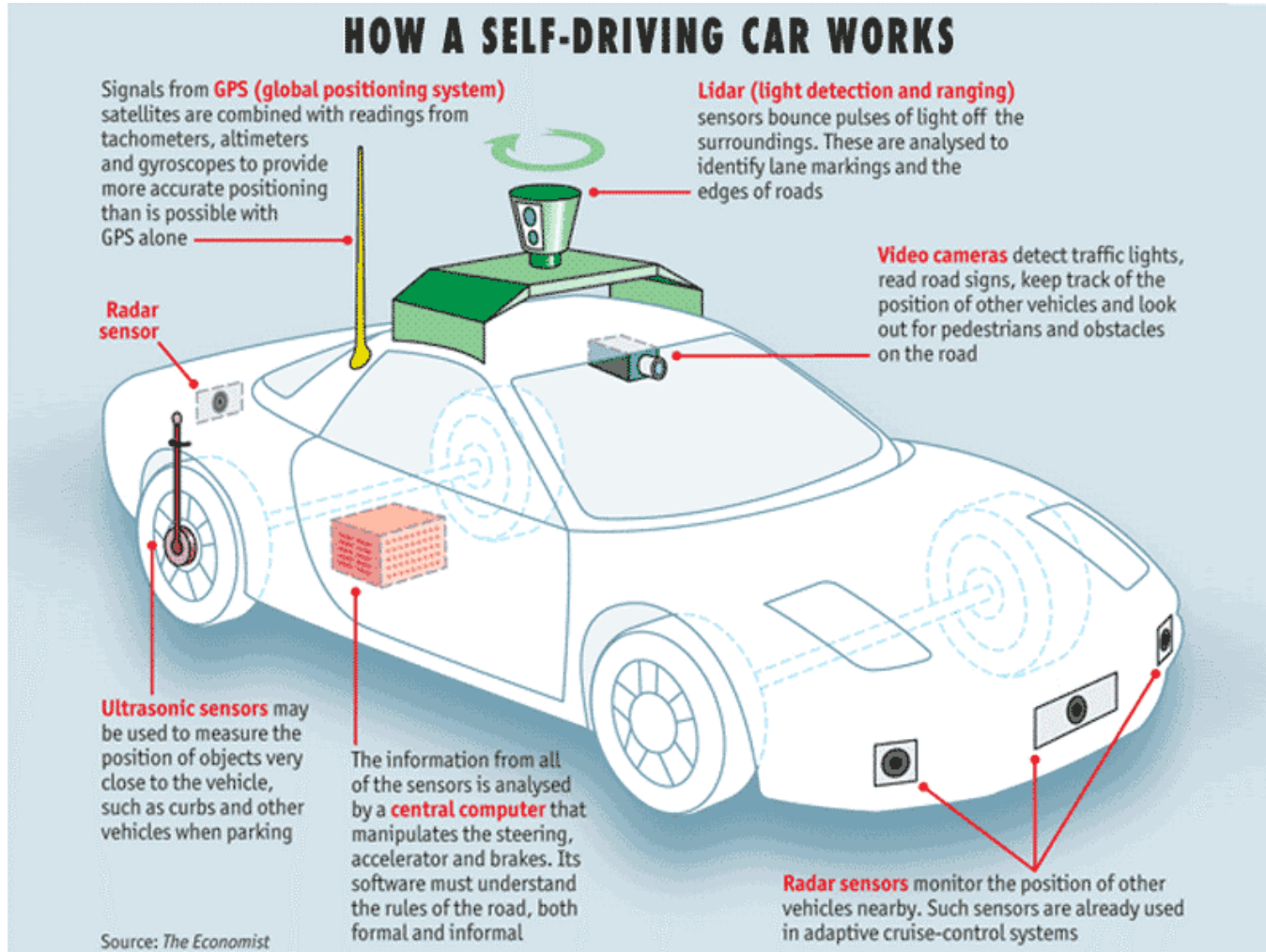
The Five Levels of Autonomy

- Automakers generally categorize autonomy across five levels
 - Level 1: limited to warning lights and screens
 - Level 2: provides independent driver operation but with accident avoidance systems
 - Level 3: offers autonomy but requires a human driver who can take over at any time
 - Level 4: capable of full autonomous operation under most circumstances, but a nominal driver remains present
 - Level 5: vehicles contain only passengers

How does the vehicle operate?

- Driverless cars use sensors, cameras, and digital maps to navigate based on road markings and rules of the road
- Human operators are either present in the vehicle or monitoring from a command center
- Using cellular connections the vehicle can communicate with satellites and human operators from a command center
 - Currently 4G, rolling out 5G by the end of 2018 in select cities
- When the vehicle doesn't recognize a situation, it will stop and defer to the human operator to make the decision
- Situations that might cause confusion
 - Gas stations
 - Car crashes

How does the vehicle operate?



Advantages

- Helps limit parking requirements for cities
- Allows developers to create more entertainment areas by taking advantage of free curb space
- Users no longer have to deal with parking
 - Easy pick up and drop off capabilities
- Has the ability to create less traffic and decrease car accidents
- Potential to be more affordable than owning vehicles
- Provides a type of “freedom”
 - Ability to work, eat, sleep instead of driving

Disadvantages

- Hard to adopt
 - Users
 - Technology
 - Current roads and infrastructure
- Zero or single occupant vehicles have the ability to cause more traffic and produce more carbon per passenger-mile
- Challenging for developers to predict future project plans, which could lead to more costs upfront and during ownership

Who is producing autonomous vehicles?

- Alphabet (Waymo), Uber, Tesla, General Motors, Ford, Nissan, Toyota, Phantom Auto (startup), Aptiv (auto-tech supplier), Nikola Motor (semi-truck startup), Nuro (partnered with Kroger to deliver groceries), Local Motors (Olli – shuttles), etc.



Who's NOT?

- Many have passed on working on autonomous vehicles
- Acura and McLaren
 - “Wow! I want to ride in that!” & “design is timeless”
 - “We sell entertainment, not transportation”



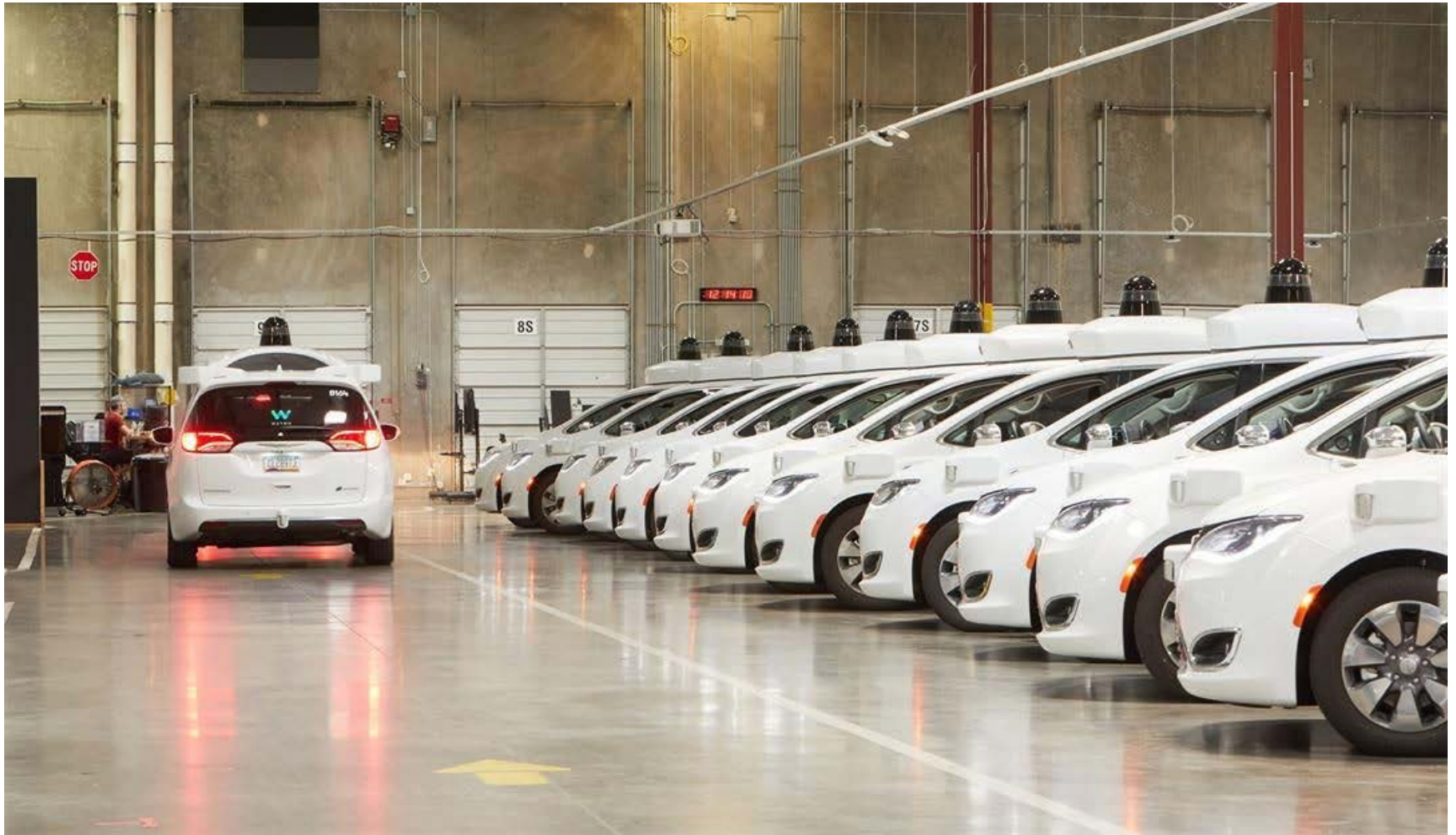
States with Autonomous Vehicles

- Arizona (multiple cities), Ohio (Cincinnati), California (multiple cities), Massachusetts (Boston), Nevada (Las Vegas), Michigan (Detroit), Georgia (Atlanta), New York (New York), Pennsylvania (Pittsburgh), and many more are adopting them in near future
- Nevada was the first state to allow driverless cars on public roads
- Arizona is the first state to charge passengers for using the vehicles (Waymo)

Autonomous Vehicles in Arizona - Waymo

- 70k SF warehouse in Chandler
- Began testing in the East Valley in April 2016
- Started offering free self-driving rides in the East Valley in April 2017 (Early Rider Program – only one in the country)
- On July 31, 2018, they announced their partnership with Valley Metro to offer rides to and from nearby light rail and bus stops or park-and-ride locations (fill the last mile gap)
- Started charging for rides in October 2018
 - First company to launch commercial services
 - Still figuring out pricing

Autonomous Vehicles in Arizona - Waymo



Autonomous Vehicles in Arizona - Uber

- Began testing in the Phoenix area in February 2017
- Fatal crash involving a pedestrian in March of 2018
 - Human operator in car
- Suspended testing in Phoenix, San Francisco and Pittsburgh following the crash, which lead to them letting their CA permit lapse in the same month of the crash
- Uber conducted an internal review
 - 16 recommend improvements
 - Included developing emergency braking features to help minimize collisions if system fails
- July 2018 Uber began small operations in Pittsburgh

Autonomous Vehicles in Arizona – Local Motors

- Driverless, electric shuttle known as Olli
- A pair of eight-passenger shuttles will be delivered by the end of 2018



Autonomous Vehicles in Arizona – Nuro

- Partnered with Kroger Co. in June 2018 to deliver groceries to customers from Kroger Stores
- Started pilot in Scottsdale in August 2018
- Flat-fees of \$5.95



Autonomous Vehicles in Arizona – Nikola Motor

- Hydrogen-electric semi-truck startup
- 150k SF R&D facility in Goodyear
- Manufacturing and headquarters to come
- Nikola has received over 10,000 orders for its hydrogen-electric semi-trucks, including 800 from Anheuser-Busch announced in May



Real Estate - Offices

- Developers and investors will have to be proactive and adaptive as self-driving vehicles become more popular
- Must consider reuse of parking structures in development stages for long-term holds
 - Creating garages with higher floors costs 15%-20% more, but it makes it easier to convert to office later on
- Possibility to eliminate all parking garages
- Requires more expansive building drop-off and pickup zones and more elaborate entry lobbies
- Lobbies will become a social / entertainment area where vehicles pick you up inside, not at the curb

Real Estate - Offices



Real Estate - Multifamily

- Where parking is still a desirable amenity, tenants are less dependent on automobiles than they have been in past years
- Autonomous vehicles will have the biggest impact on urban areas
- Developers working to limit parking as it costs \$30k per space to create structured parking and demolishing garages can be difficult to demolish
- Developers and investors will start welcoming bike-share programs at their properties
- Shared parking agreements could be a great option for mixed-use developments (heavy traffic hours flipped)
- The unknown is making future developments tricky

QUESTIONS?