



**WHAT DOES OUR  
AUTONOMOUS FUTURE  
LOOK LIKE?**

The US Military sponsored 3 challenges to see if unmanned vehicles could navigate difficult off-road terrain

(“Iraq type” war effort?)

- In 2004, DARPA (Defense Advanced Research Projects Agency) offered \$1 million to any autonomous car team capable of finishing a 150-mile desert course. No one finished.
- In 2005, the 2nd Challenge was again held in the desert. Five vehicles completed the course.
- In 2007, DARPA sponsored a 3rd Challenge designed for an urban environment. Carnegie Mellon University won.
- DARPA’s Challenges started the “driverless movement” in earnest.

# ***The promise of autonomous driving***

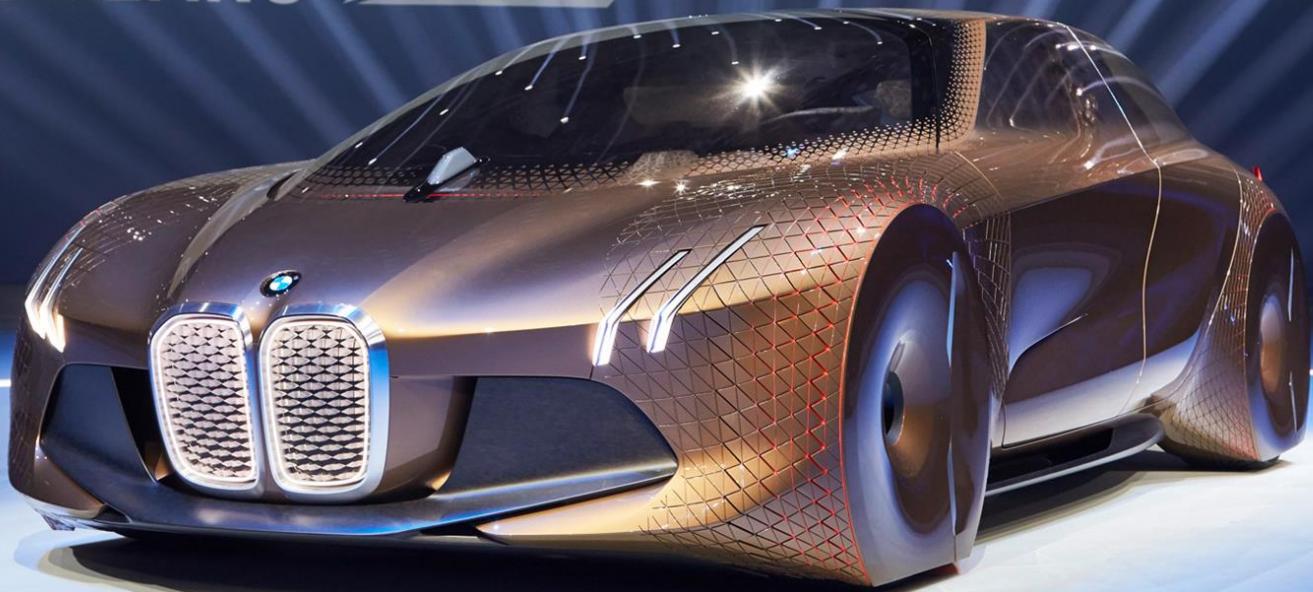
The connected car is more than a new package of automotive technology features. It's a disruptive technology that will upend traditional auto industry structures, usher in new business models, and change the nature of the business. The automobile is rapidly becoming a "thing" in the Internet of Things: the interconnection of computers, smartphones, sensors, actuators, and many other intelligent devices. By 2020, an estimated 50 billion devices are expected to be connected to the Internet, 10 times the installed base of personal computers.



“It’s almost like asking people before they even really knew what an iPhone was, how the iPhone might change their lives,” said Johanna Zmud, senior research scientist at the Texas A&M Transportation Institute.

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THE NEXT  
100 YEARS



**J**ust a few years ago, the idea of self-driving cars felt like a sci-fi fantasy, especially to auto executives in Detroit. But thanks to increasingly cheap sensors, the rise of powerful machine-learning technology, and a kick in the butt from the likes of Google **GOOG** and Tesla Motors **TSLA**, driverless vehicles are creeping closer and closer to reality.





Richard Branson: 'In 15 years, I suspect every car on the road will be electric'

Tom Sweetman, CNN

7:10 AM EDT July 8, 2016

#NEWS



# DRIVERLESS CAR REACHES 120MPH



# BUS

CITY PILOT  
CP

MA IN 2016



# TRUCKS

# AUTONOMOUS DRONES



# EHANG184

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## Specification





Electric  
re-charging  
lane

# WIRELESS CHARGING LANES?

# DAYS OF CAR OWNERSHIP OVER?



A black and white photograph of an empty parking garage. The perspective is looking down a row of parking spaces. The floor is marked with white lines for parking bays. The walls are made of rough, textured concrete. A single horizontal fluorescent light fixture hangs from the ceiling in the background.

PARKING LOTS?

A photograph of a winding road through a valley. The sky is a warm orange and yellow, suggesting either sunrise or sunset. The road curves through the landscape, leading towards distant mountains. The overall atmosphere is serene and suggests a journey or path forward.

UNPRECEDENTED LEVELS  
OF INVESTMENT

# Who Will Build the Next Great Car Company?

**Silicon Valley and Detroit are in a race to create our driverless future. And for the first time ever, the car may take a backseat.**

# Market Cap of Auto vs Tech Driverless Players

Toyota	\$180B	Apple	\$600B
VW	\$68B	Google	\$530B
BMW	\$57B	Microsoft	\$460B
Honda	\$55B	Intel	\$170B
Ford	\$50B	Uber	\$60B
GM	\$50B	Tesla	\$33B
Mercedes	\$50B	Lyft	\$20B
Nissen	\$40B	Mobileye	\$10B

*Google and Tesla might be the biggest names chasing self-driving cars, but a host of auto brands and other tech heavyweights are also investing heavily in driverless R&D.*

# WHO'S ENTERING THIS MARKET?



Baidu 百度



**BOSCH**

**DAF**

**DAIMLER**

**DELPHI**

**FCA**



**Google**



HONDA



HYUNDAI



**IVECO**



Mercedes-Benz



**PSA**  
GROUPE

**SCANIA**

**TATA ELXSI**  
engineering creativity

**TESLA**



**Volkswagen**

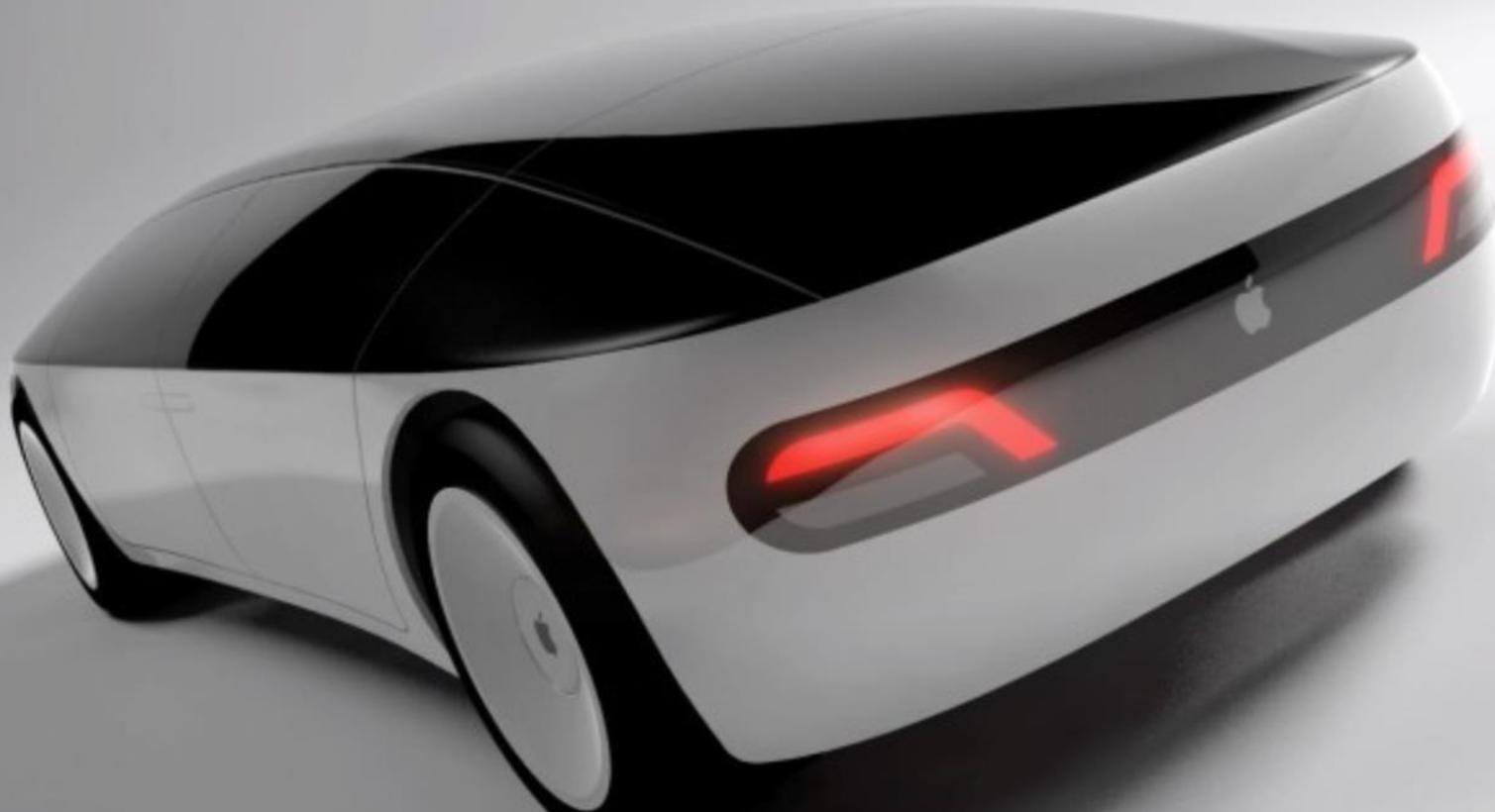


**YUTONG**

A close-up photograph of a person's hand holding a smartphone. The screen of the phone displays a map with several yellow location markers. The person is wearing a dark-colored shirt. The background is dark and out of focus.

**DELPHI + MOBILEYE**  
**UBER + VOLVO + OTTO**  
**GM + LYFT**  
**GOOGLE + FIAT CHRYSLER**  
**VW + GET**  
**BMW + INTEL + MOBILEYE**  
**FORD + VELODYNE + SAIPS + CIVIL MAPS**





 CAR CONCEPT

©2015 Arystonics (Shen) Taiwan

Back 3/4

In race to get  
driverless cars on the  
road, Ford speeds  
ahead



Ford and Baidu are each investing \$75 million in Velodyne  
LiDAR Inc. (Keith Srakocic / Associated Press)

“This is a transformational moment in our industry and it is a transformational moment for our company,” Fields said outside Ford’s Palo Alto research center in Silicon Valley. “The next decade will be defined by the automation of the automobile, and we see autonomous vehicles as having as significant an impact on society as Ford’s moving assembly line did 100 years ago.”

**\$10Bn+ Private Sector  
Just This Year**



But a big shift came in March, when General MotorsGM surprised the world by spending \$1 billion to acquire a tiny, 40-person self-driving startup called Cruise Automation. That deal opened the floodgates.

In May, Toyota struck a partnership with Uber, Volkswagen invested \$300 million in ride-hailing company Gett, [AppleAAPL](#), which is widely expected to be working on its own car, poured \$1 billion into China's Didi Chuxing, and Google partnered with Fiat-Chrysler to outfit 100 Pacifica minivans with self-driving technology. And those are just the deals from May. Automakers and tech companies are starting to see the benefits of working together.

AUGUST 11, 2016

# 33 Corporations Working On Autonomous Vehicles



**Baidu testing on roads now**

**Tesla on roads now**

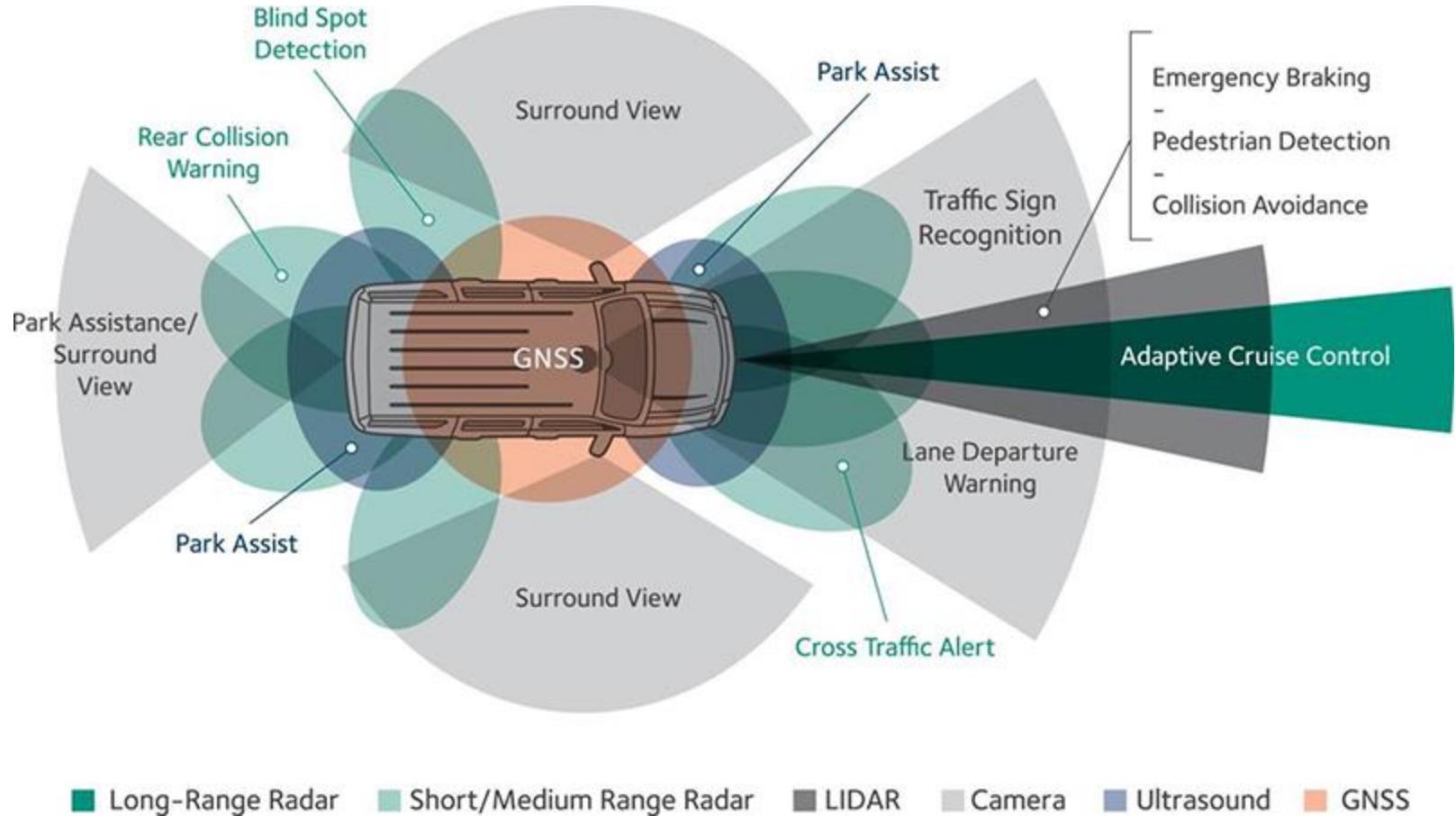
**Uber on roads next month**

"IHS Automotive estimates that by 2035, there will be 76 million vehicles on the road with some level of self-driving technology. By that same year, about 10% of the vehicles sold will be fully autonomous." -Chris Neiger

Published August 12, 2016



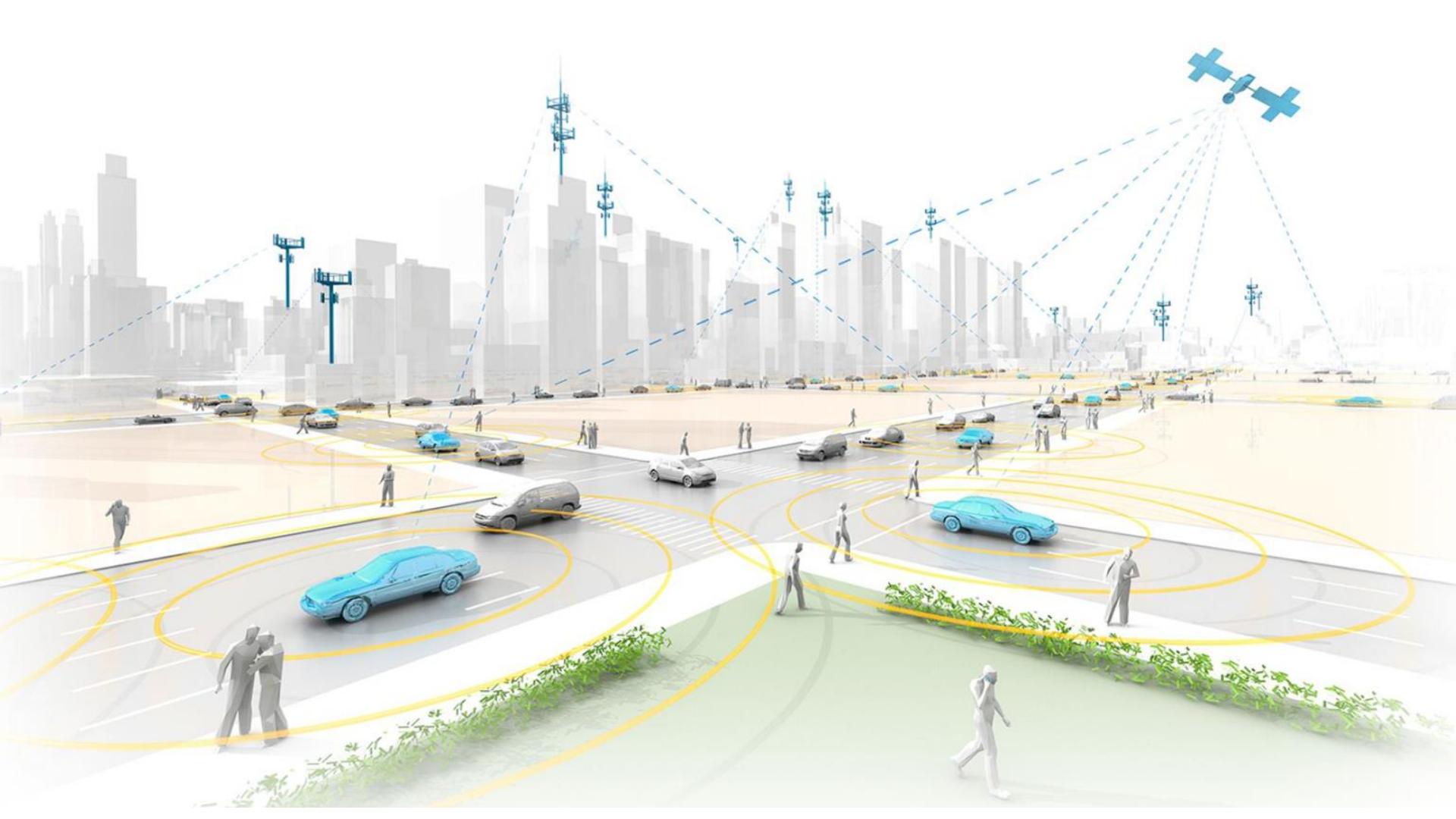
# TECHNOLOGY



Radar sensors dotted around the car monitor the position of vehicles nearby.

Video cameras detect traffic lights, read road signs and keep track of other vehicles, while also looking out for pedestrians and other obstacles.

Lidar sensors help to detect the edges of roads and identify lane markings by bouncing pulses of light off the car's surroundings.



# Levels of Autonomy

**Level 0:** The human driver is in complete control of all functions of the car.

**Level 1:** One function is automated.

**Level 2:** More than one function is automated at the same time (e.g., steering and acceleration), but the driver must remain constantly attentive.

**Level 3:** The driving functions are sufficiently automated that the driver can safely engage in other activities.

**Level 4:** The car can drive itself without a human driver.



That said, the level of development needed to go from Level 3 to Level 4 is immense. I'd say a good expectation is that by 2020 we might get our first taste of a proven effective Level 4 car people can trust.

# **Communications Infrastructure**

**The federal government has supported the development of Dedicated Short-Range Communications (DSRC) applications that would allow V2V and V2I communications and has reserved electromagnetic spectrum for this use.**

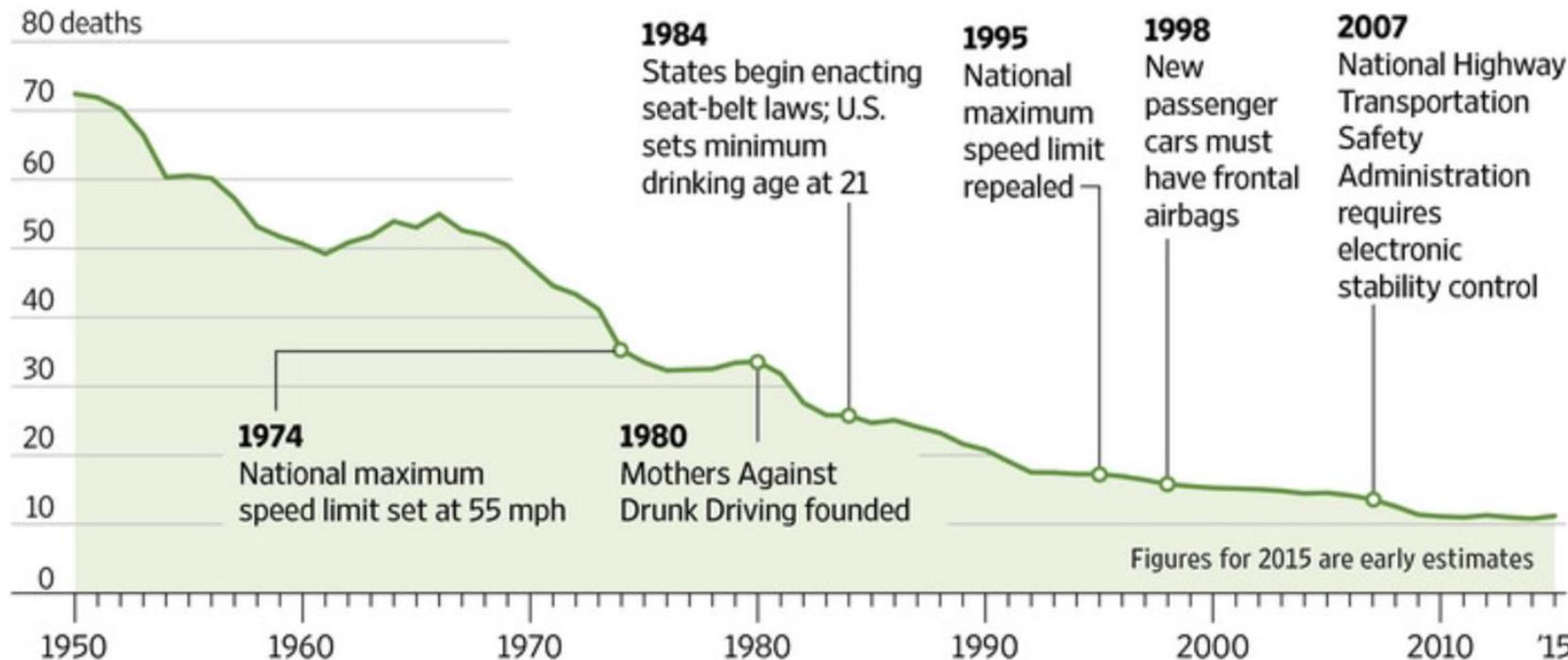
A nighttime photograph of a multi-lane highway. The image shows several sets of light trails from cars, creating long, streaky lines of light against the dark night sky. The highway curves gently to the right. The text "SAFETY BENEFITS" is overlaid in large, white, sans-serif capital letters.

# SAFETY BENEFITS

# Road Safety

The rate of U.S. auto fatalities has declined since 1950, but rose in 2015 to 11.2 deaths per billion vehicle-miles, up from 10.8 deaths the year before.

## Yearly motor-vehicle crash deaths per billion vehicle-miles traveled



Sources: Insurance Institute for Highway Safety; National Highway Transportation Safety Administration

THE WALL STREET JOURNAL.

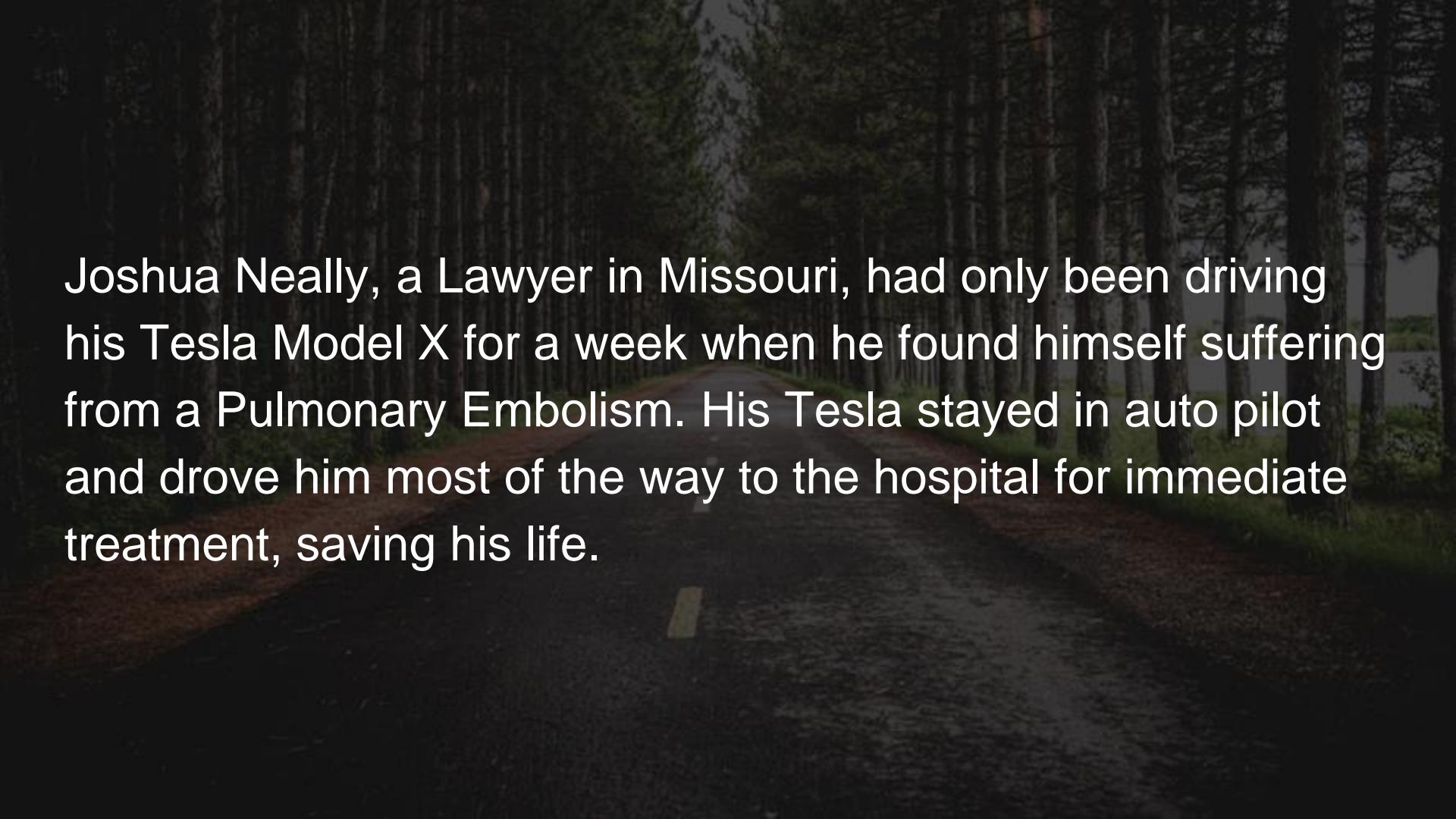
# SAFETY BENEFITS

There were more than 5.3 million automobile crashes in the United States in 2011, resulting in more than 2.2 million injuries and 32,000 fatalities

Technologies that permit the car to drive (Level 4) will likely further reduce crash statistics because driver error is responsible for most crashes

This is particularly true given that 39 PERCENT of the crash fatalities in 2011 involved alcohol use by one of the drivers

The dangers caused by drivers who become distracted or fall asleep are well established. In 2014, 3,179 people were killed and 431,000 injured in distracted-driving crashes. That same year, the National Highway Traffic Safety Administration estimated that 7 percent of all crashes and almost 17 percent of fatal crashes involved drowsy driving.

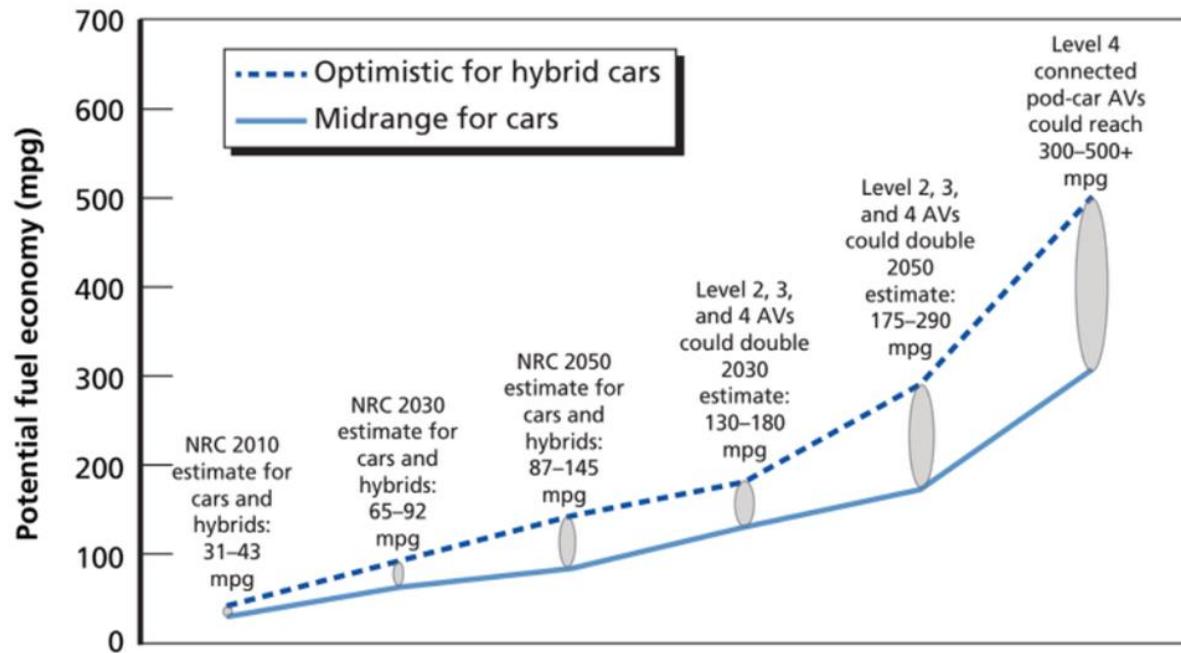
A dark, blurry background image showing a road through a dense forest. The trees are tall and dark, creating a moody atmosphere. The road itself is dark and appears to be asphalt.

Joshua Neally, a Lawyer in Missouri, had only been driving his Tesla Model X for a week when he found himself suffering from a Pulmonary Embolism. His Tesla stayed in auto pilot and drove him most of the way to the hospital for immediate treatment, saving his life.



“The National Highway Traffic Safety Administration (NHTSA) says 7% of vehicle crash costs are paid for by public taxes. Driverless cars will save U.S. taxpayers \$10 billion each year as a result of fewer accidents, according to the Brookings Institute.”

## Range of Potential Fuel Economy Improvements for Conventional, Hybrid, and Autonomous Cars

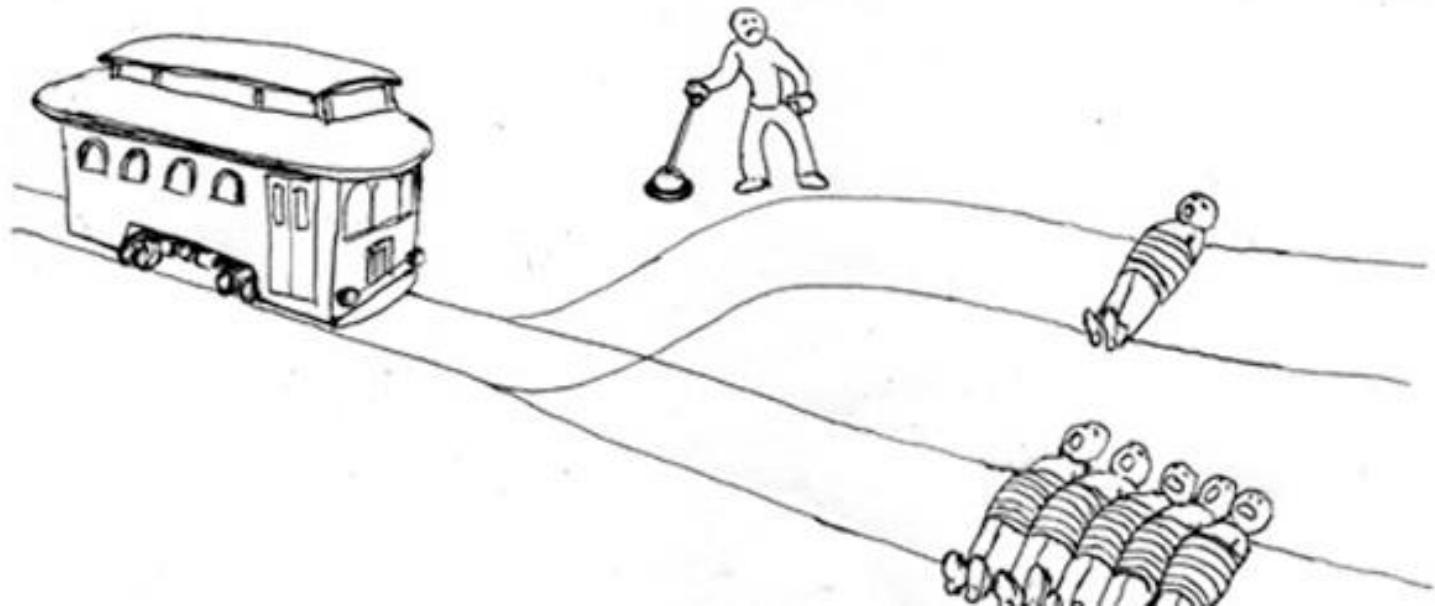




**CHALLENGES**

Crumbling roads, poor markings and uneven signage could delay the arrival of self-driving cars in the U.S., experts say.

# THE TROLLEY PROBLEM



A [recent study](#) revealed that most people prefer that self-driving cars be programmed to save the most people in the event of an accident, even if it kills the driver—unless they are the drivers. So, no martyrs to be found there.



# HACKING THREATS

But in a future of autonomous cars, actuaries may have to replace calculations about individuals with issues such as: how often cars are hacked and which parts of the country have better satellite imagery. They'll also have to identify the safety differences across driverless cars, from Google to Tesla, just as they now know that today's auto makers have safety features of varying quality.



**REGULATIONS**

**RULES**



# Can Austin still be a tech hub without Uber?

May 21 NEW YORK

Austin is still a city of innovation, despite the departure of Uber and Lyft.

# Crash Economy Disrupted

Entire “crash economy” of insurance companies, body shops, chiropractors, and others will be disrupted.

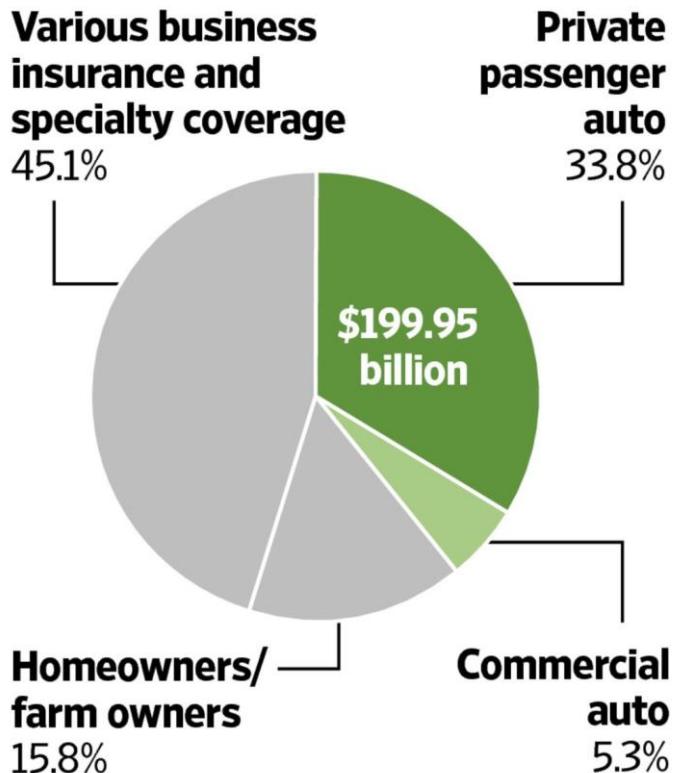
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For the actuaries who set insurance rates, it is a puzzle like no other: How do they prepare for a world of so many fewer auto accidents? In the future, will underwriters be insuring drivers or computer code?

“Change is coming and we need to get ahead of it,” said [Allstate](#) Corp. Chief Executive

# Auto Dominance

U.S. property-casualty insurance premium, 2015



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KPMG forecasts fully autonomous vehicles to be widely available by 2025, while Deloitte Consulting expects proliferation in the late 2020s.

Deloitte forecasts approximately \$200 billion in personal-car-insurance premiums to hold steady for seven or eight years, then slide to about \$40 billion by 2040. It projects about \$100 billion of this \$200 billion could migrate to product-liability insurance and coverage bought by ride-sharing businesses.

The background of the slide features the Arizona state flag. It consists of a dark blue field with a large yellow sun in the center. The sun has rays extending outwards, alternating in color between gold and maroon. The entire flag is set against a dark, textured background that looks like a chalkboard or weathered metal.

**What action do we take now?  
What unique decisions does AZ need to make?**