Smart Communities Tech
Italian Technology Cluster for Smart Communities

Assemblea Nazionale 29.11.2018

LE PERSONE - I DATI - LE TECNOLOGIE

Mobility - Security, Government - Inclusion:
quali sono le sfide e gli scenari che ci attendono?

MOBILITY

Alberto SANGIOVANNI VINCENTELLI
University of California

Il Cluster SmartCommunitiesTech (SCT) è parte del sistema italiano Cluster Tecnologici Nazionali

The Emerging Technology Scene: IoT, Mobile Devices, Cloud

Computers and mobiles to disappear?

7 trillions devices for **7** billions persons **1,000** Devices per person by 2025

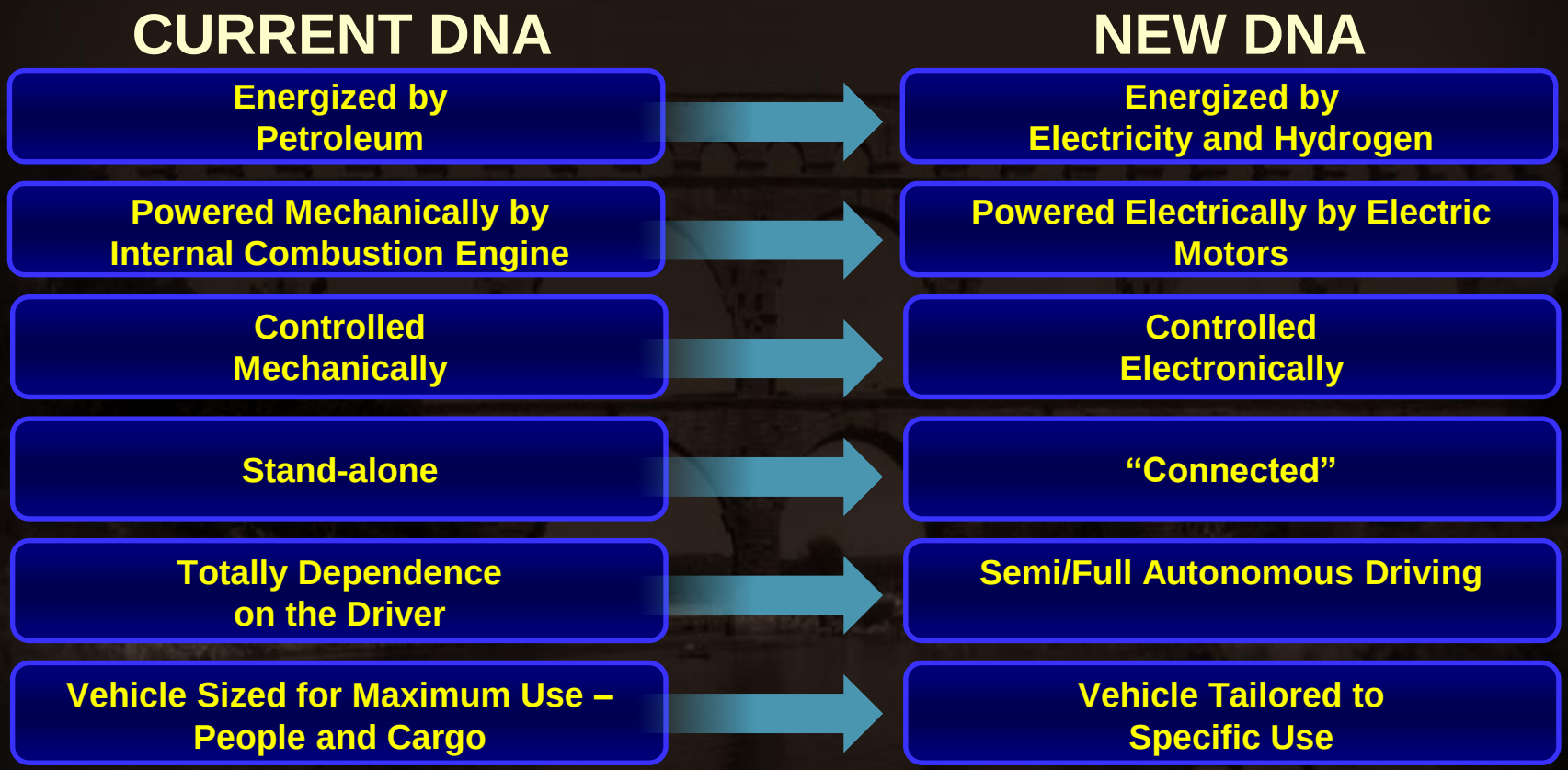
The Immersed Human

Real-life interaction between humans and cyberspace, enabled by enriched input and output devices on and in the body and in the surrounding environment

Major Innovations in Land Mobility

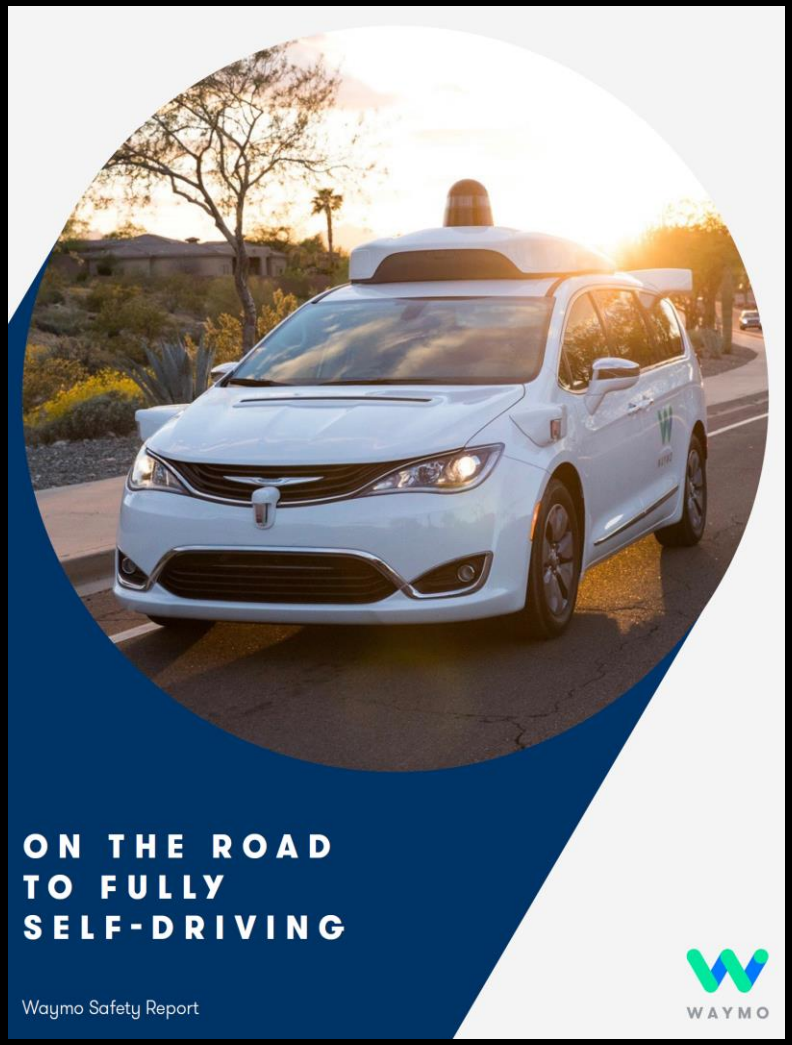
- Platform Companies (Uber, Lyft)
- Electrical Vehicles (Tesla)
- ADAS, semi-autonomous/autonomous cars
- Connected vehicles
- Car, Bicycle and electric scooters sharing

The Evolution of the Automotive DNA



U.S. Department of Transportation (DOT) federal policy framework for autonomous vehicles: *Automated Driving Systems 2.0: A Vision for Safety*.

October 13, 2017



Every year, **1.2 million lives** are lost to traffic crashes around the world, and in the U.S. the number of tragedies is growing. A common element of these crashes is that **94% involve human error**.

Driving is not as safe or as easy as it should be, while distracted driving is on the rise. We believe our technology could save thousands of lives now lost to traffic crashes every year.

Economic Potential

Autonomous/ Semi Autonomous vehicles 	**7** Miles driven by top-performing driverless car in 2004 DARPA Grand Challenge along a 150-mile route **1,540** Miles cumulatively driven by cars competing in 2005 Grand Challenge **6,000,000+** Miles driven by Google's autonomous cars with only 1 accident (which was human-caused)	**1 billion** Cars and trucks globally **450,000** Civilian, military, and general aviation aircraft in the world	**$4 trillion** Automobile industry revenue **$155 billion** Revenue from sales of civilian, military, and general aviation aircraft

Source: McKinsey Global Institute

MARCH 21, 2017

21 Industries Other Than Auto That Driverless Cars Could Turn Upside Down

The Intel $7trillion 'passenger economy'

The $7trillion 'passenger economy' predicted by Intel is not based on the future sales of self-driving cars but on services and emerging applications that will be generated from autonomous cars.

Intel Corp. is forecasting that by 2050, the future of fully automated vehicles will become a $7 trillion "Passenger Economy".

Waymo (Google)

First Google's robotic cars had about $150,000 in equipment including a $70,000 LIDAR (laser radar) system.

The range finder mounted on the top is a Velodyne 64-beam laser. This laser allows the vehicle to generate a detailed 3D map of its environment.

The car then takes these generated maps and combines them with high-resolution maps of the world, producing different types of data models that allow it to drive itself.

2015 View of Silicon Valley Entry in Robotic Cars

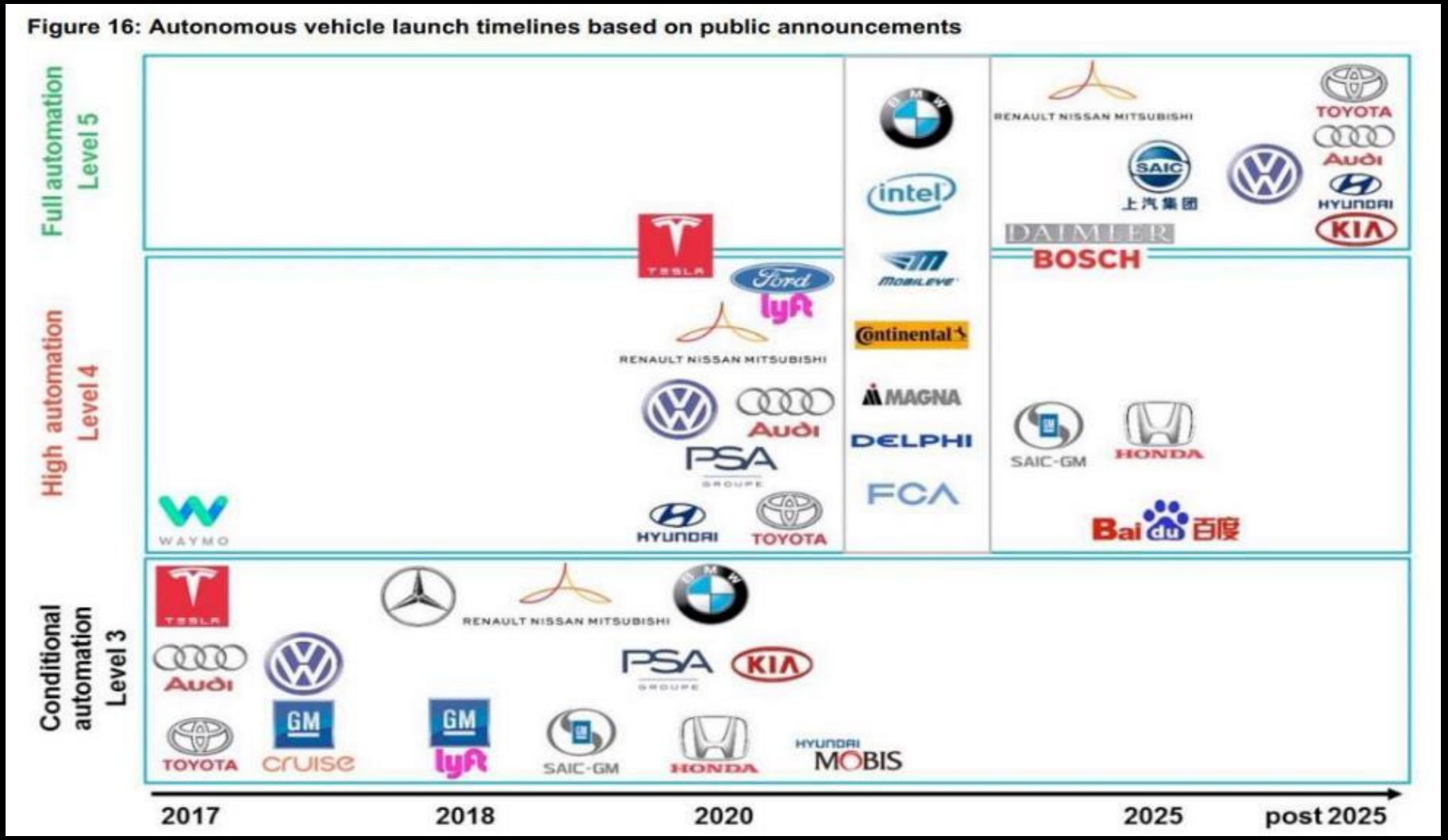
In an interview with Motoring.com.au, Dr. Zetsche , Chairman of Daimler AG and chief executive of Mercedes-Benz Cars, said:

If there were a rumor that Mercedes or Daimler planned to start building smartphones then they (Apple) would not be sleepless at night. And the same applies to me. And this is full of respect for Apple. "

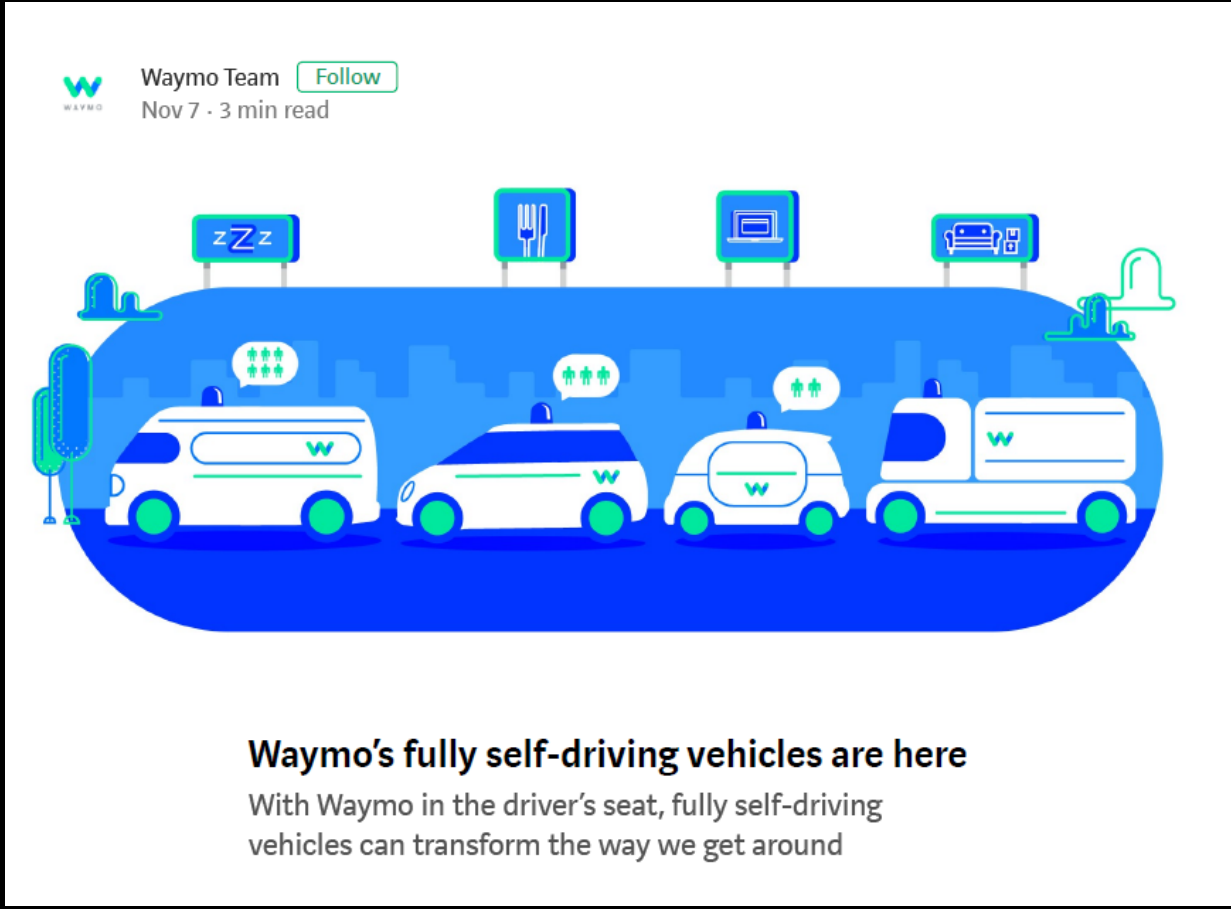
PROMISES, PROMISES

Launch timelines all over the board

Figure 16: Autonomous vehicle launch timelines based on public announcements



Waymo Early Riders Program: Phoenix

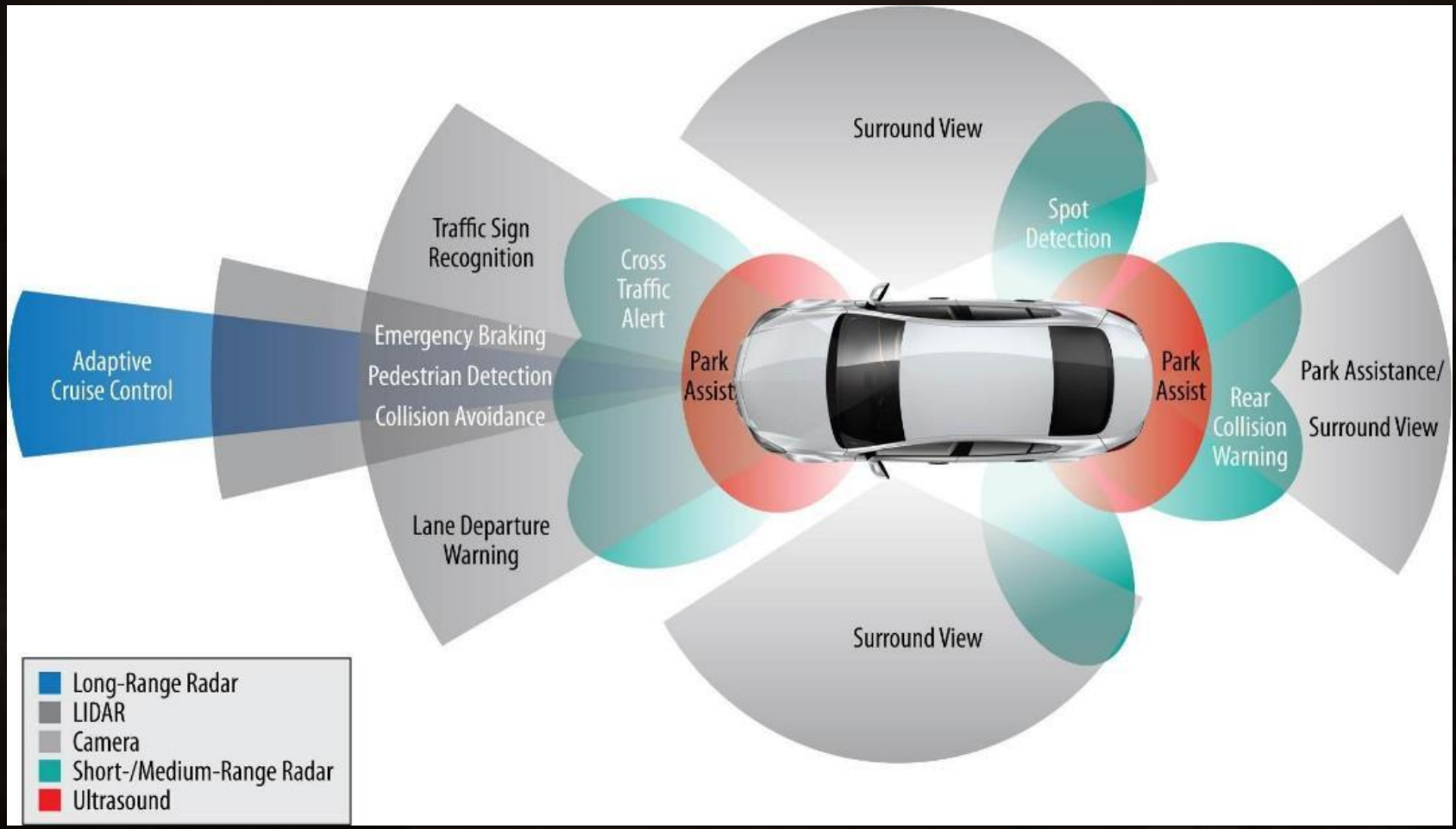


Four Fundamental Questions

1. Where Am I?
   - Sensing technology: GPS, Inertial,… (mapping technology)
2. What's Around Me?
   - «Vision» systems: Radars, Lidars, Camera systems (neural networks for image recognition)
3. What Will Happen Next?
   - Predictive systems: software and algorithms (dynamical systems)
4. What Should I Do?
   - Decision systems (neural networks for decision making, connected cars, trip planning)

SENSOR FUSION AND BIG DATA

Architecture



Sensors are key Building Blocks

for Smart Driving

Safer			Greener			More Connected	
Digital and Satellite radio receivers	Machine Vision ADAS Processors	RADAR LiDAR	32-bit Auto Grade Microcontrollers	Engine control ICs	Secure Gateway Solutions	V2X Communication	Telematics processors
Integrated VDC	HD imaging ICs	GPS/GNSS Low-noise ampl & receivers	Ignition controllers and drivers	Multiple- Phase Motor driver	Analog Audio Processors	EV/HEV Power management ICs	Multiple channel Air Bags
Auto MEMs, gyroscopes, accelerometers	Communication transceivers	Alternator regulators	Door module drivers	Class AB and D Audio Amplifiers	AM/FM tuners	Valve driver ICs	Infotainment voltage regulators
High/Low and configurable side drivers/switches	Voltage regulators	Field Effect Rectifiers	SiC Diodes	SiC MOSFETs	Integrated filter and dataline protection	Micro-batteries	DC and Stepper Motor drivers
Low/High Voltage Planar MOSFET	Planar IGBT	Low Voltage Trench MOSFET	High Voltage Superjunction MOSFET	Ultra Fast & Schottky Diodes	1200V Thyristors	Microphone	Dataline & Load dump protection

increasing complexity

Vision Processing for Autonomous Driving

Richest source of raw data about the scene – the only sensor that can reflect the true complexity of the scene.

- The lowest cost sensor for the data received
- Cameras are getting better - higher dynamic range, higher resolution

Combination of RADAR/LIDAR/Ultrasonic for redundancy, robustness

Mobileye

- Mobileye's system-on-chip (SoC) – the EyeQ® family – provides the processing power to support a comprehensive suite of ADAS functions based on a single camera sensor.
- In its fourth and fifth generations, EyeQ® will further support semi and fully autonomous driving, having the bandwidth/throughput to stream and process the full set of surround cameras, radars and LiDARs.

Sensing Challenges:

- Perception of a comprehensive Environmental Model breaks down into four main challenges:
  - **Freespace**: determining the drivable area and its delimiters
  - **Driving Paths**: the geometry of the routes within the drivable area
  - **Moving Objects**: all road users within the drivable area or path
  - **Scene Semantics**: the vast vocabulary of visual cues (explicit and implicit) such as traffic lights and their color, traffic signs, turn indicators, pedestrian gaze direction, on-road markings, etc.

Lidar new entry

Many startups target lidar cost, performance

QUANERGY

Total funding: $134M

Investors: Aptiv, Samsung Ventures, Motus Ventures

LeddarTech

Total funding: $117M

Investors: Aptiv, Osram, BDC Venture Capital

INNOVIZ TECHNOLOGIES

Total funding: $82M

Investors: Aptiv, Magma Venture Partners, Magna

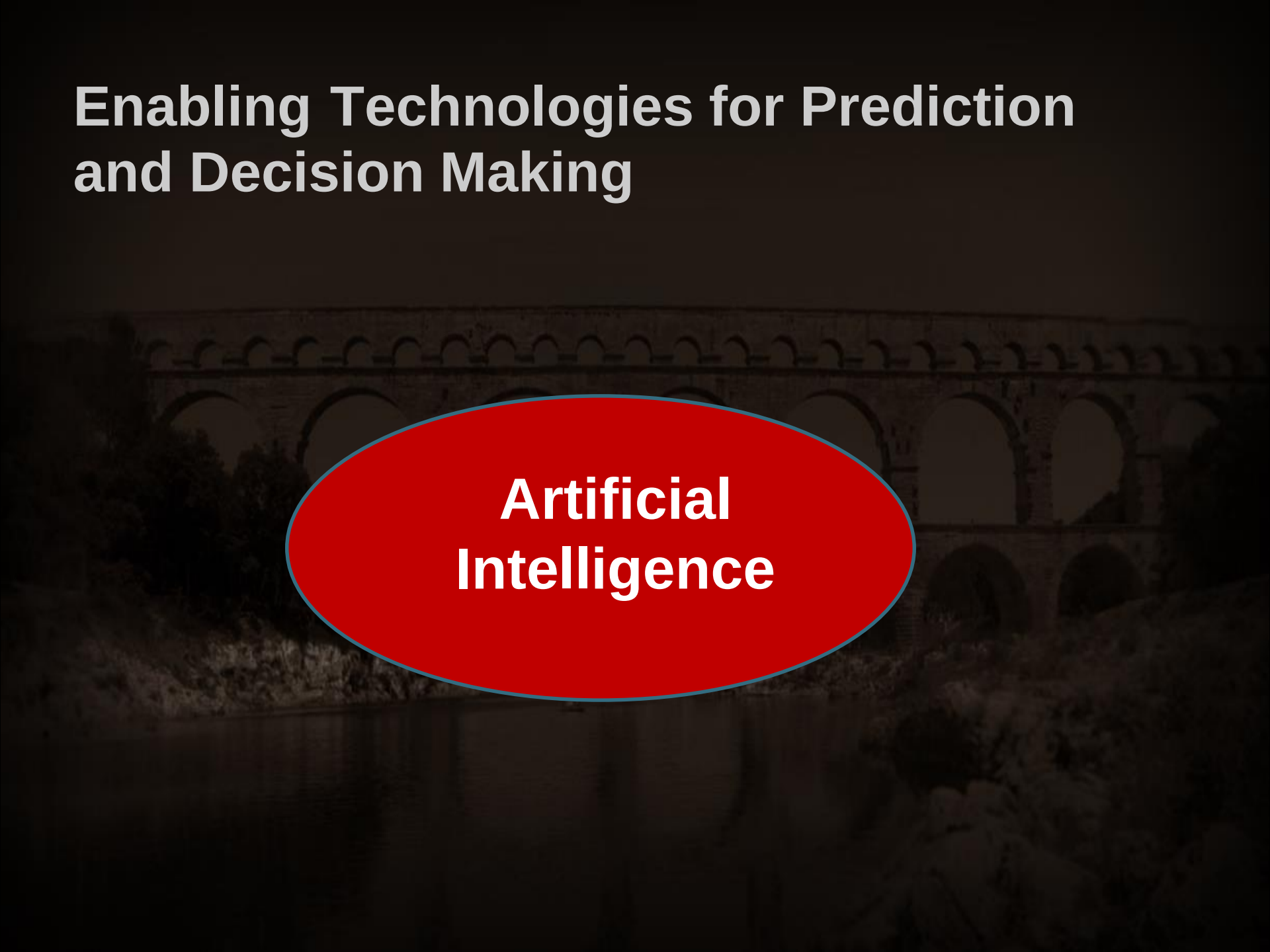
oryx

Total funding: $67M

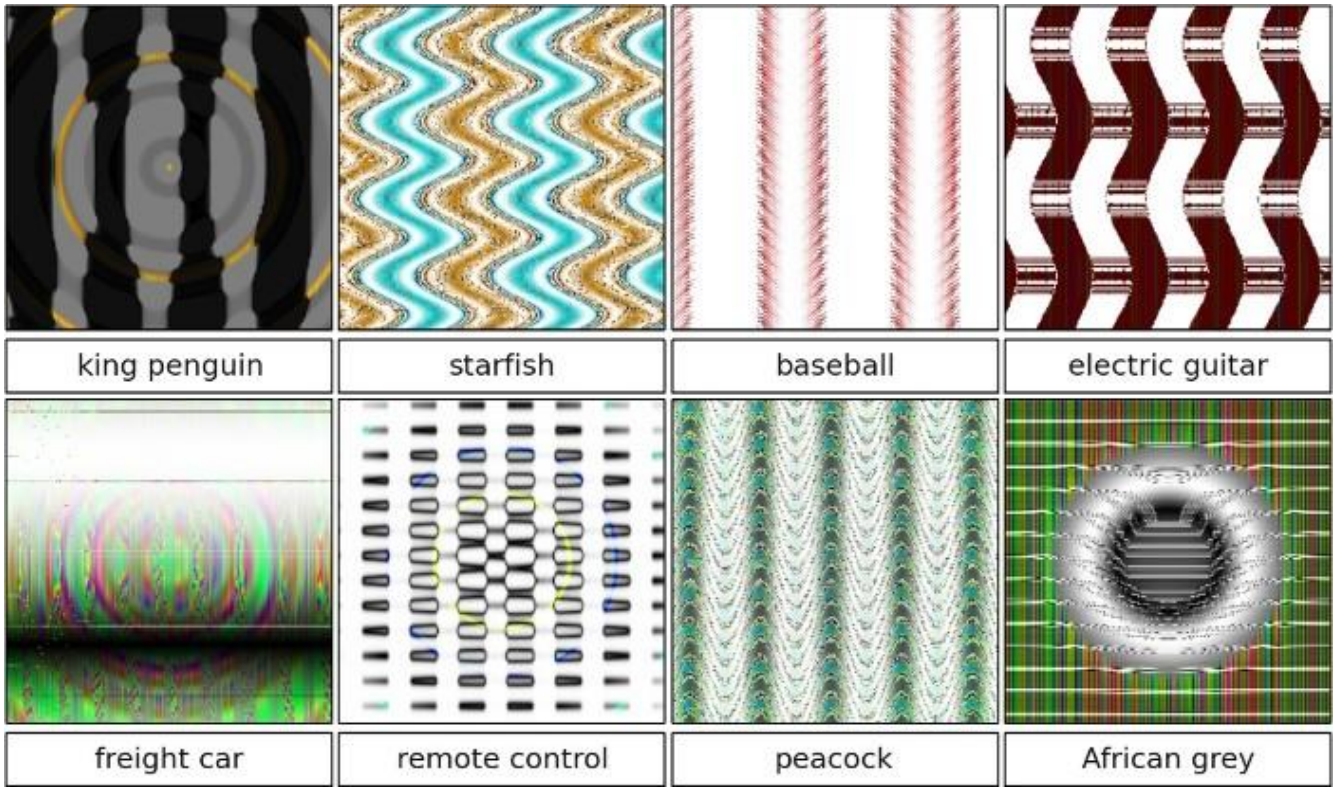
Investors: BVP, Maniv Mobility, Trucks VC

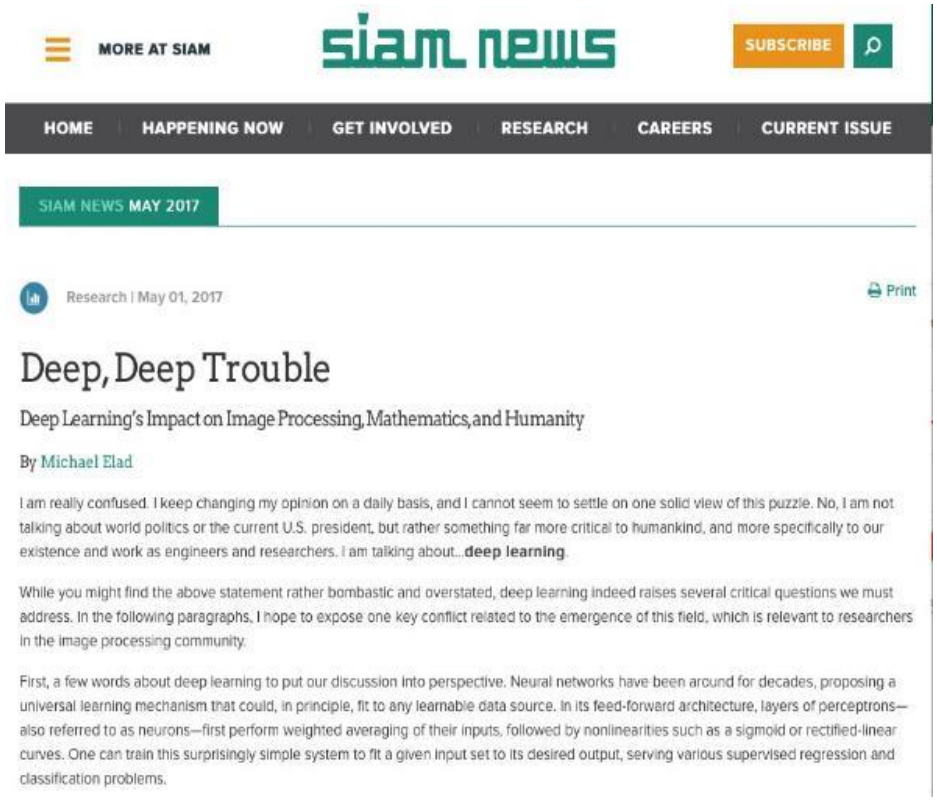
GM Investor Day Presentation

Enabling Technologies for Prediction and Decision Making



Deep neural networks are easily fooled
(Nguyen, Yosinki & Clune 2014)





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Print

Deep, Deep Trouble

Deep Learning's Impact on Image Processing, Mathematics, and Humanity

By Michael Elad

I am really confused. I keep changing my opinion on a daily basis, and I cannot seem to settle on one solid view of this puzzle. No, I am not talking about world politics or the current U.S. president, but rather something far more critical to humankind, and more specifically to our existence and work as engineers and researchers. I am talking about...**deep learning**.

While you might find the above statement rather bombastic and overstated, deep learning indeed raises several critical questions we must address. In the following paragraphs, I hope to expose one key conflict related to the emergence of this field, which is relevant to researchers in the image processing community.

First, a few words about deep learning to put our discussion into perspective. Neural networks have been around for decades, proposing a universal learning mechanism that could, in principle, fit to any learnable data source. In its feed-forward architecture, layers of perceptrons—also referred to as neurons—first perform weighted averaging of their inputs, followed by nonlinearities such as a sigmoid or rectified-linear curves. One can train this surprisingly simple system to fit a given input set to its desired output, serving various supervised regression and classification problems.

Intelligent Machines

The Dark Secret at the Heart of AI

No one really knows how the most advanced algorithms do what they do. That could be a problem.

by Will Knight April 11, 2017

Last year, a strange self-driving car was released onto the quiet roads of Monmouth County, New Jersey. The experimental vehicle, developed by researchers at the chip maker Nvidia, didn't look different from other autonomous cars, but it was unlike anything demonstrated by Google, Tesla, or General Motors, and it showed the rising power of artificial intelligence. The car didn't follow a single instruction provided by an engineer or programmer. Instead, it relied entirely on an algorithm that had taught itself to drive by watching a human do it.

INDEED….

BUSINESS DAY

Self-Driving Tesla Was Involved in Fatal Crash, U.S. Says

By BILL VLASIC and NEAL E. BOUDETTE JUNE 30, 2016

Even as the companies conduct many tests on autonomous vehicles at both private facilities and on public highways, there is skepticism that the technology has progressed far enough for the government to approve cars that totally drive themselves.

Last Fatal Accidents

In the **Uber crash** of March 19th, the ride services company was testing a fully driverless system intended for commercial use when the prototype vehicle struck and killed a woman walking across an Arizona road. Video of the crash, taken from inside the vehicle, shows the driver at the wheel, who appears to be looking down and not at the road. Just before the video stops, the driver looks upwards toward the road and suddenly looks shocked.

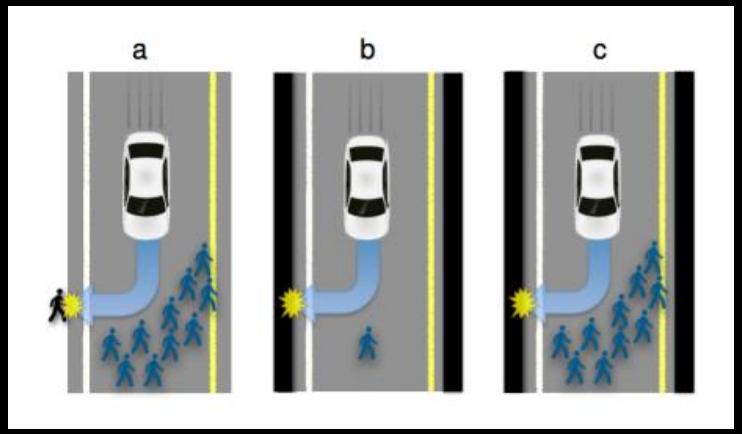
In the **Tesla incident** last month, which involved a car that any consumer can buy, a Model X vehicle was in semi-autonomous Autopilot mode when it crashed, killing its driver. The driver had received earlier warnings to put his hands on the wheel, Tesla said.

Ethical Issues

Germany Issues Ethics Report on Automated and Connected Cars

Posted on June 22, 2017

On June 20, 2017, the German Federal Ministry of Transport and Digital Infrastructure issued a report on the ethics of Automated and Connected Cars (the "Report").



Ethics

Key points from the Report's 20 ethical guidelines:

- Automated and connected transportation (driving) is ethically required when these systems cause fewer accidents than human drivers.
- Damage to property must be allowed before injury to persons: in situations of danger, the protection of human life takes highest priority.
- In the event of unavoidable accidents, all classification of people based on their personal characteristics (age, gender, physical or mental condition) is prohibited.
- In all driving situations, it must be clearly defined and recognizable who is responsible for the task of driving – the human or the computer. Who is driving must be documented and recorded (for purposes of potential questions of liability).
- The driver must fundamentally be able to determine the sharing and use of his driving data (data sovereignty).

Vehicle Cybersecurity

- Modern vehicles are complex, networked Information Technology (IT) systems that comprise an increasingly sophisticated array of sensors and control processors connected by internal communication networks
- Vehicles are networked entities that exist in cyberspace much like any other computational node, PC, tablet, or smartphone
- As more and more technology is introduced into automobiles, the threat of malicious software and hardware manipulation increases
  - Increasing connectivity and complexity is greatly expanding the attack surface of our systems
- Potential security weaknesses in vehicles

Comprehensive Experimental Analyses of Automotive Attack Surfaces, S. Checkoway et al. ,UC San Diego, K. Koscher, et al, U. of Washington *IEEE Symposium on Security and Privacy* in Oakland, CA on May 19, 2010.

Surface of attack