





## DRIVERLESS



pull

**GREA** 



Futurama 1939 New York World's Fair *"To New Horizons"* - General Motors

#### Future vision for 1960

- High speed travel
- Distance between vehicles controlled by radio waves
- Lane control with concrete dividers



I HAVE SEEN

THE FUTURE

GENERAL MOTORS tutu

Bel Geddes designed the General Motors Pavilion, known as Futurama, for the 1939 New York World's Fair.

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- Car has control by using microwave radar
- Automatically adjusts speeds and prevents collisions
- Better use of the road surface
- Fewer delays
- Faster travel times http://www.businessinsider.com/how-adaptive-cruise-control-will-change-driving-in-america-2012-8

# 1978 – Anti-lock brakes (ABS) from Mercedes-Benz and Bosch 1991 – Adaptive Cruise Control 1995 - Electronic Stability Control

- Detecting and reducing loss of traction
- Automatic braking and engine control

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- 1991 Adaptive Cruise Control
- 1995 Electronic Stability Control
- 1995 Production GPS (2007 Map on Demand)
- Computer controlled navigation

#### 1978 – Anti-lock brakes (ABS) from Mercedes-Benz and Bosch

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- 1995 Production GPS (2007 Map on Demand)
- 2007 Blind Spot Sensors
- Visible alert when a car entered the blind spot while a driver was switching lanes
- Uses two door mounted lenses to check the blind spot area for an impending collision



## "Hands Free" Driving

## **Traffic Jam Driving**

#### Hyundai Genesis

#### Mercedes S 500

Auf dem Weg zum unfallfreien Fahren S 500 INTELLIGENT DRIVE



### **Defense Advanced Research Projects Agency** (DARPA) THE MODERN ERA OF AUTONOMOUS AUTOMOBILES

#### 2004 DARPA Challenge





"Sandstorm" vehicle by Carnegie Mellon, Intel, Boeing and others.

It went 7.4 miles on a 150 mile course.

#### In the 2005 DARPA Challenge FIVE vehicles completed a 132 mile course.

#### The race was on to bring autonomous vehicles to market!

First Place – Stanford University's racing team worked alongside Volkswagen Electronics Research Laboratory to create the vehicle.

#### Features:

- five LIDAR units
- a video camera
- GPS system





#### Over 1 million successful miles logged



#### Google launched its self-driving car project in 2009

Technology reduced in size and cost

#### Vehicle-to-Vehicle Communication (V2V)

#### National Highway Traffic Safety Administration (NHTSA)

- Constant communication between vehicles
- Crash avoidance
- Reduces traffic congestion
- Cars to trucks and buses to trains
- Vehicle to Infrastructure



**2017 Cadillac CTS** First to V2V



#### Essential technology required for autonomous driving:

- Stereo cameras Can see lane markings, combine with data to avoid obstacles
- **GPS** mapping
- Lidar Assembles 360-degree picture around vehicle
- Radar Maintain fixed distance from other cars and help maintain position
- Millimeter-wave radar High frequency radar to detect pedestrians and other obstacles



#### Cars learning to drive ...

#### Artificial intelligence

#### "Deep learning"



## LEVELS OF AUTONOMY

#### LEVEL ZERO – Driver is in control

**LEVEL ONE** – Driver is "assisted" by technology (examples: cruise control, lane assist and automatic braking)

**LEVEL TWO** – Driver is "supported" by technology (active cruise control where car takes over low speed driving)

**LEVEL THREE** – Car is driving and driver, at the controls, takes over in an emergency

**LEVEL FOUR** – Car is driving with autonomy with destination inputs from the driver

DEBATE: Evolution vs Revolution (skipping Level Three)

#### Pinewood Studios

#### Film/Television \$6 Billion

## **Georgia** Tech









#### SB 113 (2016)

- Creates a new class of motor vehicles to be known as autonomous vehicles.
- Defines autonomous technology and autonomous vehicle. Specifies requirements to operate an autonomous vehicle.
- Allows the operation of autonomous vehicles on public highways for testing purposes.
- Provides for indemnity to vehicle manufacturers in certain instances.
- Allows the regulation of autonomous vehicles.

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## So what happened?

- Nearly all of the legislators had NEVER seen an autonomous car in person
- Nearly all of the legislators do not have a technology background
- Fear of the liability issue
- Fear of hacking
- State officials do not understand the industry
- The vehicle industry message was fragmented



- Federal Government taking leadership
- Consolidated industry messaging



- Increased tech exposure for state and local officials
- Security and liability issues are being addressed
- Public acceptance is growing

#### Local government questions ...

- How will autonomous vehicles affect mass transit decisions?
- How will autonomous vehicles affect local revenue streams? Traffic fines? Less vehicles to collect tax on? Infrastructure (road quality) cost?
- Could states and counties lose authority over traffic law? No traffic signals scenario?
- Can civil liberties be protected?



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