

Autonomous Vehicles Robots on Wheels

10 JANUARY, 2019



SANJAY GUPTA

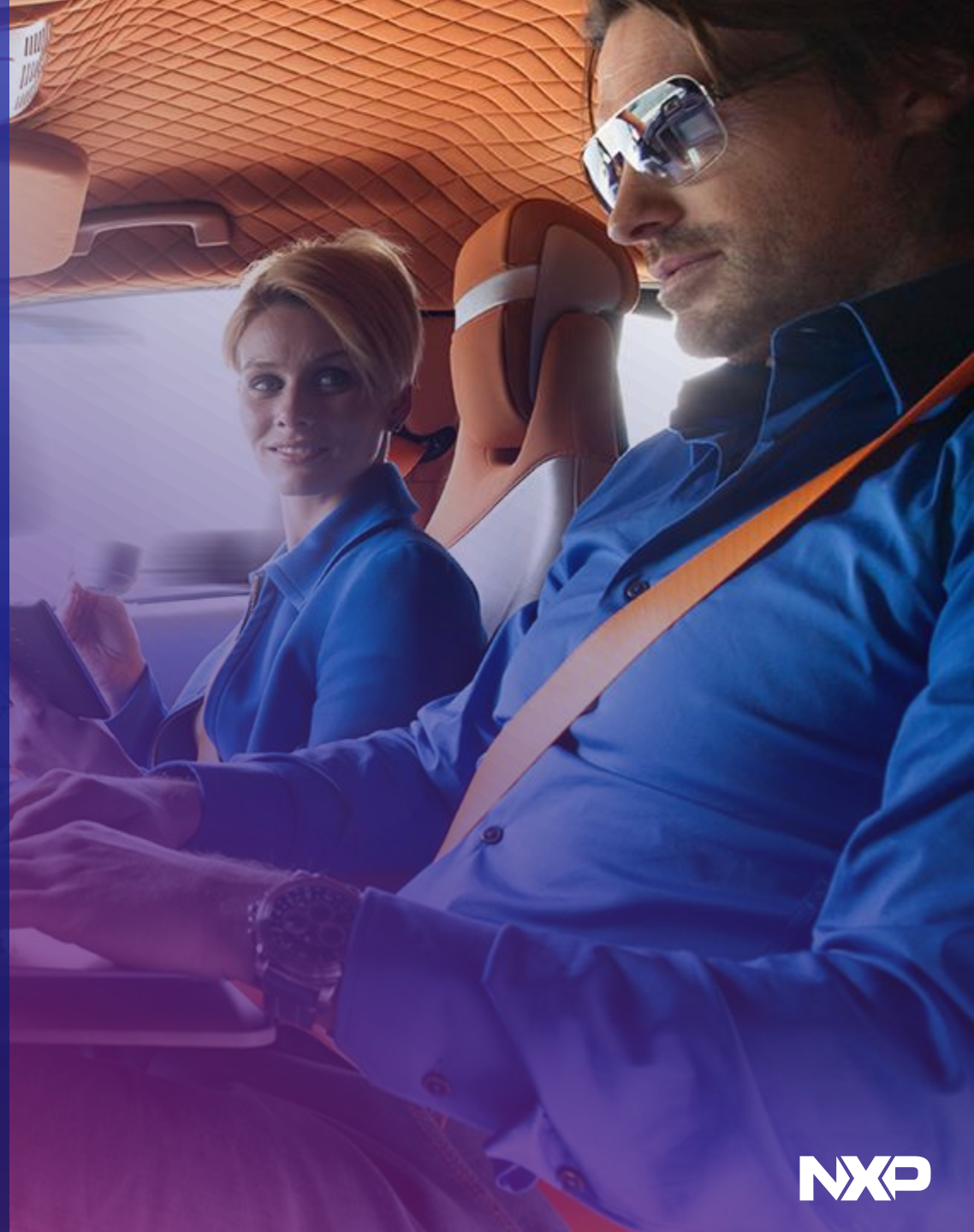
Vice President & India Country Manager
NXP Semiconductors

NXP



01.

NXP
SEMICONDUCTORS



SECURE CONNECTIONS FOR A SMARTER WORLD

NXP is the global leader in Semiconductor Solutions for Security and Automotive Connectivity

- e-Identity: 97 of 124 countries using NXP
- Contactless Banking: >30% share (> 1B security controllers shipped)
- #1 Car Infotainment; #1 In-Vehicle Networks; #1 wireless Car Access



NXP

Secure Connections for the Smarter World

Everything Smart



Processing

40B+ devices with intelligence shipped in 2020

Everything Connected



Connectivity

1B+ additional consumers online, 30B+ connected devices

Everything Secure



Security

Potential economy savings up to half a trillion dollars

Automotive | Industrial | Connected Devices | Internet of Things



A Position of Strength to Better Serve Our Customers

7TH largest semiconductor company²

Operations in 32 countries

Headquarters:
Eindhoven, Netherlands

30,000+ employees

11,000 engineers

9,000 patent families

60+ year history

\$9.26B annual revenue³

#1 Automotive

#1 Broad-based MCUs¹

#1 Secure Identification

#1 Communications Processors

#1 RF Power Transistors

Sources: HIS, ABI Research, Strategy Analytics, The Linley Group

1) MCU market excluding Automotive


2) Excludes memory

3) Posted revenue for 2017

Developing Solutions Close to Where Our Customers and Partners Operate

A company with 30,000+ employees with operations in 32 countries and posted revenue of \$9.26 billion¹



 Corporate Office
Eindhoven, Netherlands

 NXP Locations

¹ Posted 2017 revenue



02.

THE AUTOMOTIVE INDUSTRY



New York City, April 15, 1900

**1900:
Where is THE CAR?**

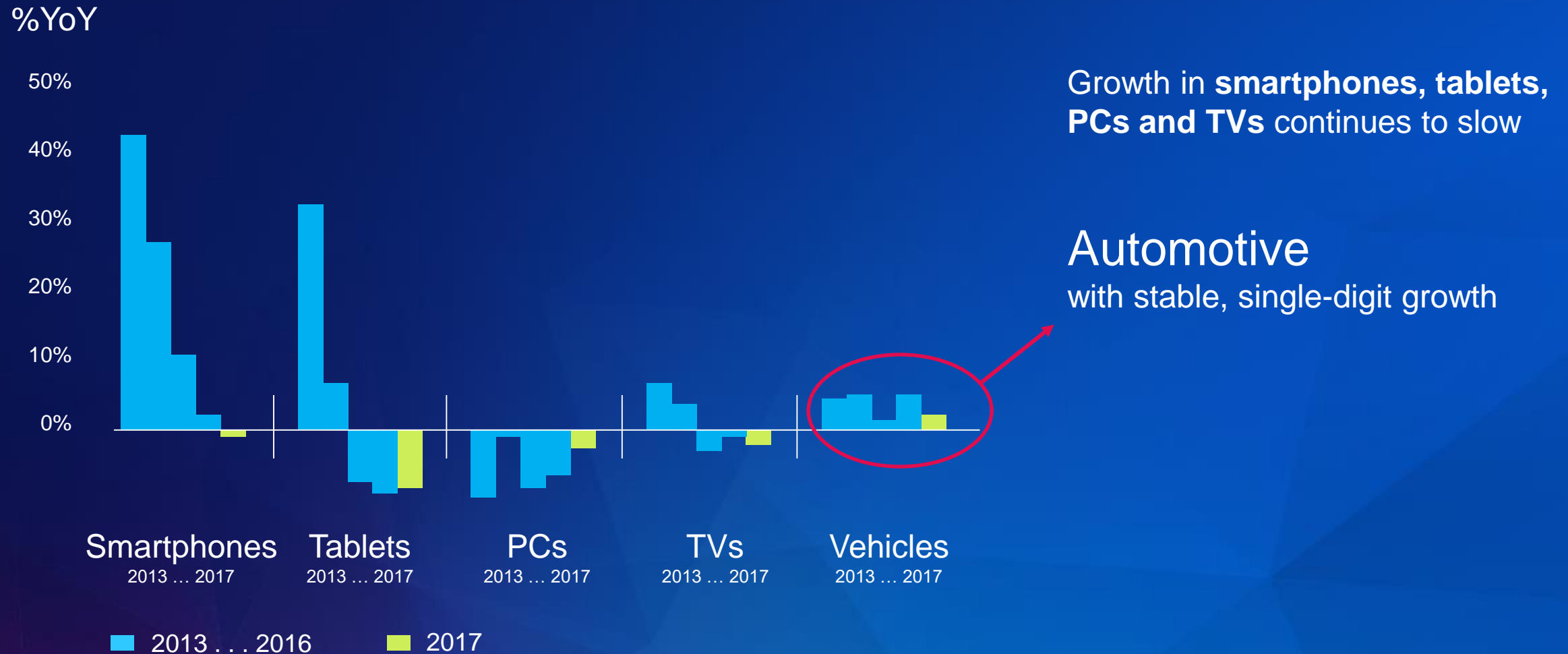


New York City, March 23, 1913



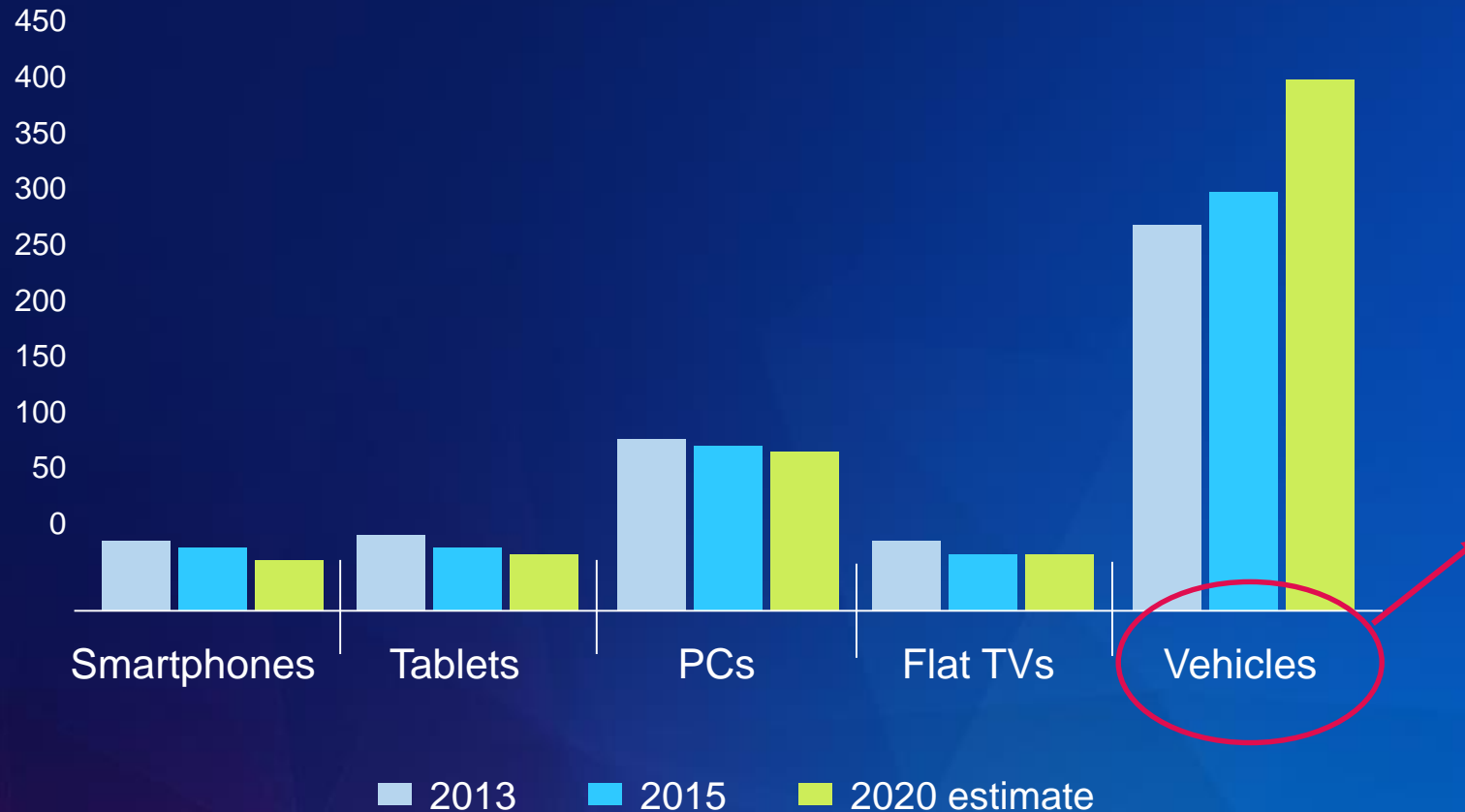
1913:
Where is THE HORSE?

SEMICONDUCTOR TARGET APPLICATIONS UNIT GROWTH SLOWING DOWN



ELECTRONICS CONTENT THE VARIED TREND

Semiconductor Content in \$



By 2020, semiconductor content is expected to start decreasing in **smartphones, tablets, PCs, TVs**

Automotive
Further growth expected

\$450+
total average semiconductor value per car by 2020

SAFE & SECURE MOBILITY

90% INNOVATION THROUGH ELECTRONICS

CONNECTIVITY

Seamlessly Connected
Mobility Experience



One hour per
day in the vehicle

Enjoying Life

AUTONOMY

ADAS Towards
Self-Driving



1.3M global road fatalities
every year

Saving Lives

ELECTRIFICATION

Energy
Efficiency



US mandates 163 grams / mile
and 54.5 MPG by 2025

Reducing CO₂

1.3 MILLION

Road traffic deaths occur every year



HIT BY A VEHICLE TRAVELING AT:



9 OUT OF 10 PEDESTRIANS SURVIVE*

HIT BY A VEHICLE TRAVELING AT:



5 OUT OF 10 PEDESTRIANS SURVIVE

HIT BY A VEHICLE TRAVELING AT:

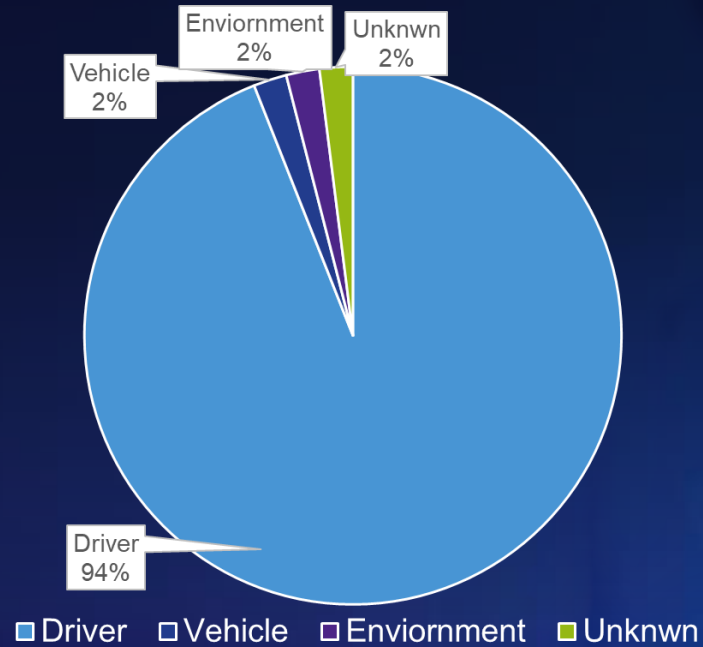


ONLY 1 OUT OF 10 PEDESTRIANS SURVIVES

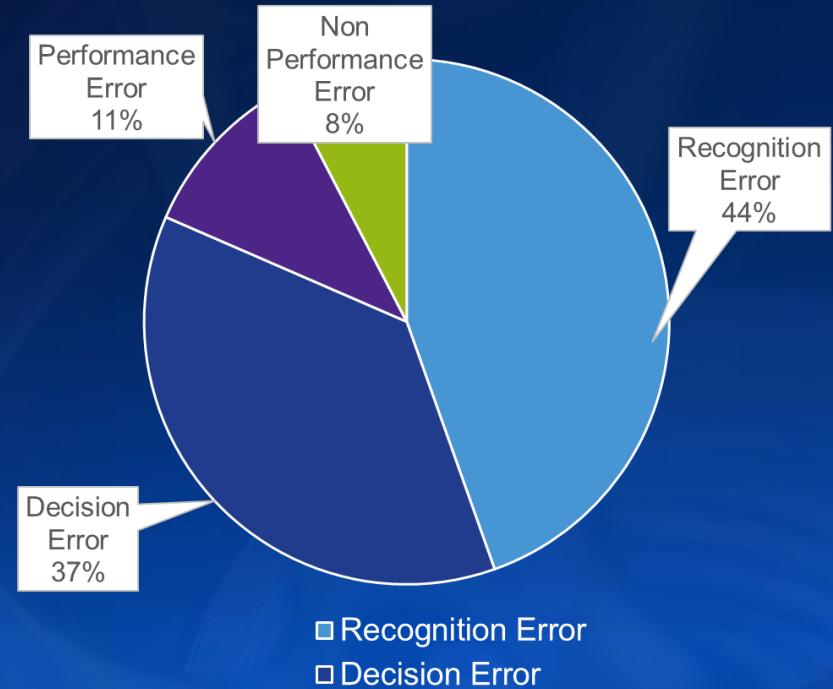


OUT OF ALL ACCIDENTS GLOBALLY, 90% are caused by **HUMAN ERROR**

AUTOMOBILE ACCIDENTS THE CAUSES



Drivers are the leading causes of critical pre-crash events



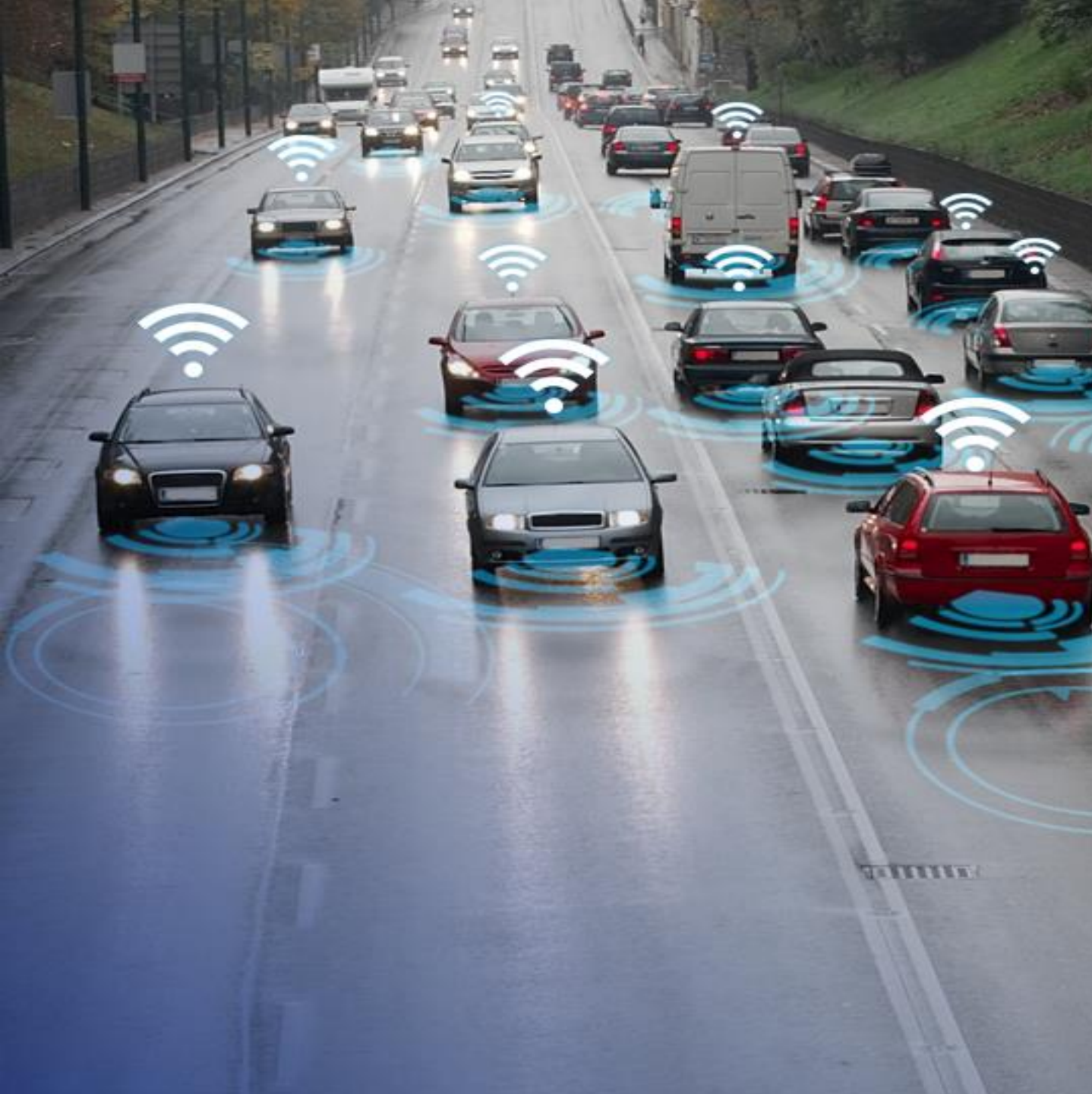
Recognition Errors & **Decision** Errors are leading causes

Is replacing humans with 'Robots on Wheels' the solution?

03

Autonomous Driving

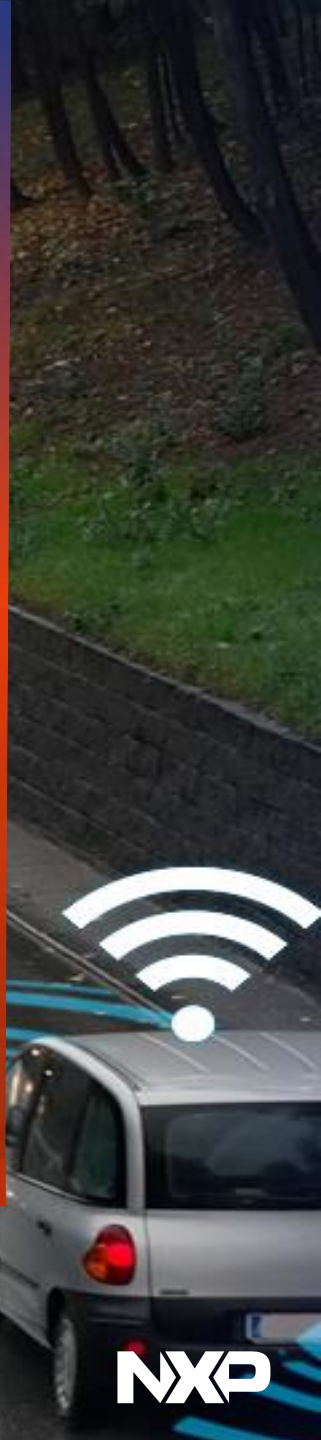




“What if...” Your car could “talk” to other cars?

Scenario: The driver on the other side of the wet, dark road is asleep and drifting dangerously. The chips inside your cars’ radar and communication systems recognize the danger and signal you and the other driver. The chips in your steering, engine and braking systems help redirect, slow or shut down each car to avoid an accident.

Your life is saved.



“What if...” Your home could “talk” to your car?

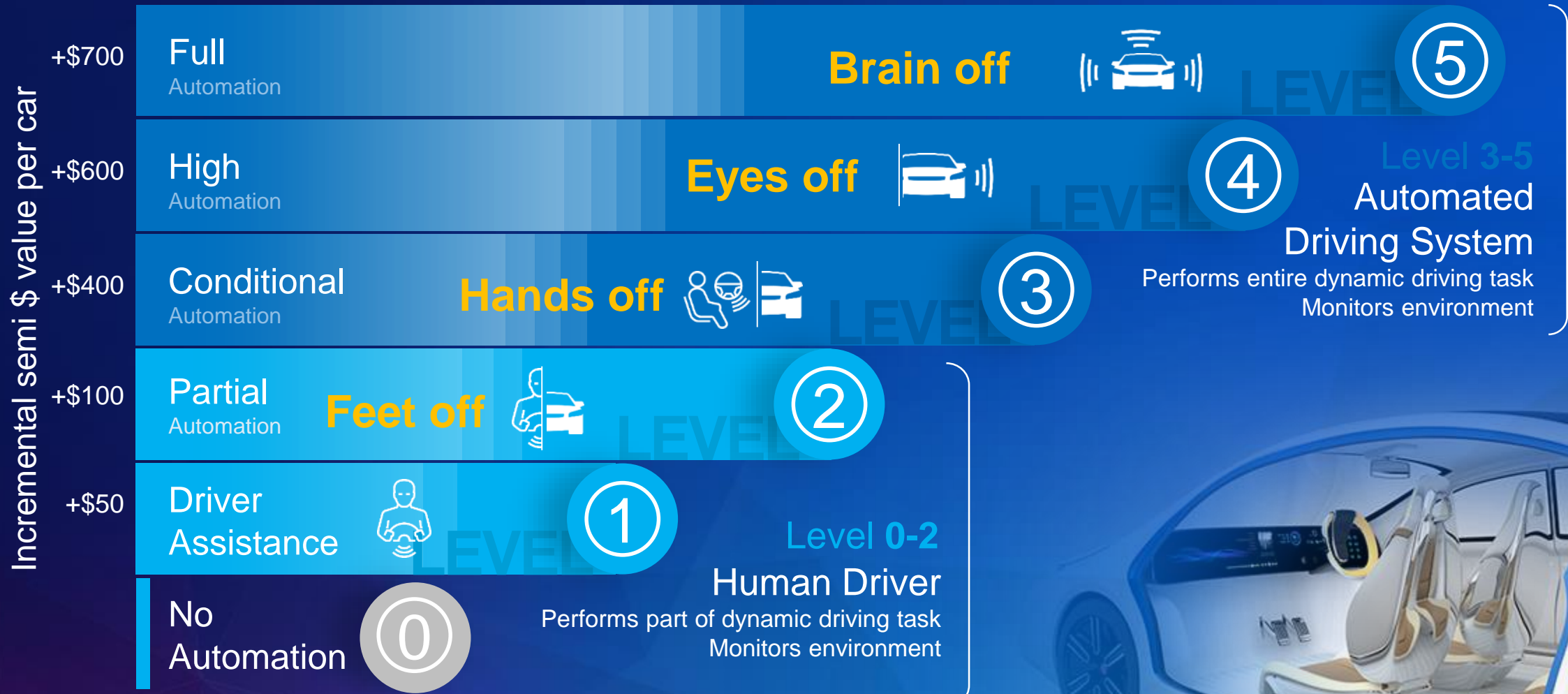
Scenario: You like to save money on your household energy costs, but living where we do means long, hot summers. Imagine the chip in your car telling the chip in your home thermostat that you’re almost home, so it adjusts your living areas to cooler temps, just as you arrive.

You save money and conserve energy for the planet.



AUTONOMY

DRIVING UP THE SEMI VALUE PER CAR



Semi Content per Car increase (TAM) vs Level 0
Source: Strategy Analytics; IHS; Evercore; ABI Research; NXP



04.

NextGen Architecture for Autonomous Driving



THE CAR OF THE FUTURE

More than a brain on four wheels.
The core of safe and secure mobility.



SENSE



THINK



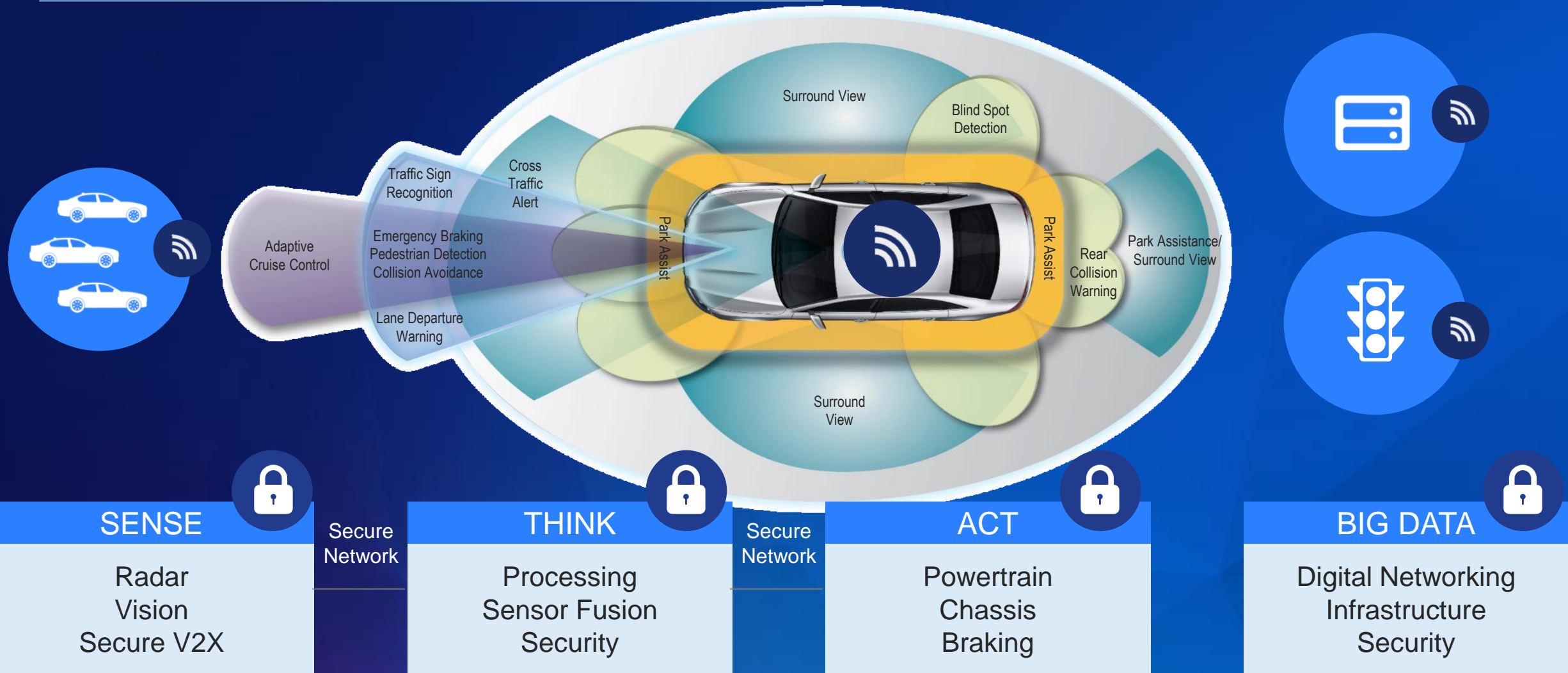
ACT

ENABLING SELF-DRIVING
“ROBOTS ON WHEELS”



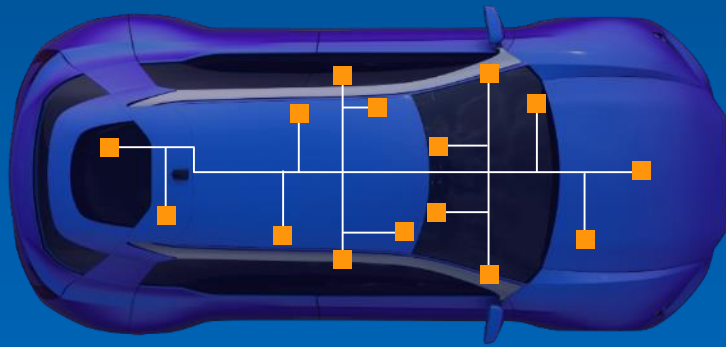
TOMORROW'S VEHICLES

SELF DRIVING, CONNECTED ROBOTS



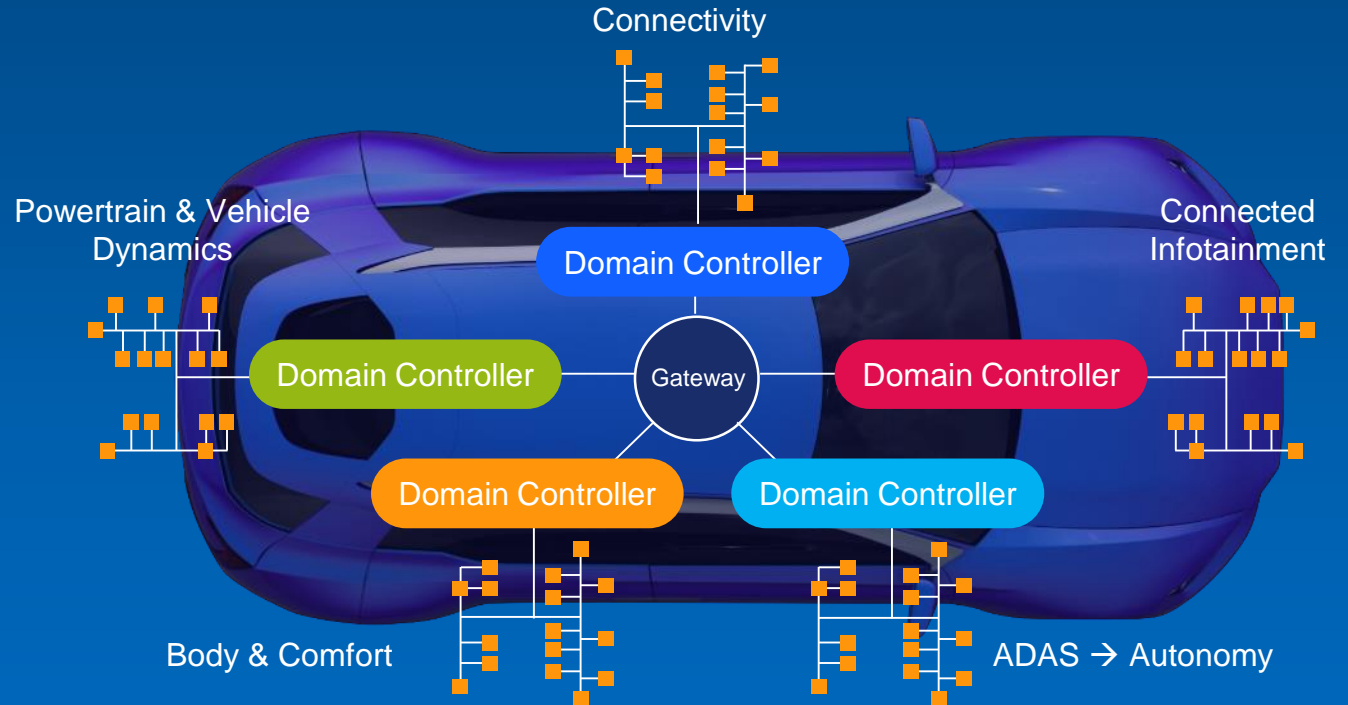
Megatrends Force Vehicle Architecture Transformation

TODAY



Distributed Flat Architecture

TOMORROW



Domain Architecture

- High performance domain MPUs
- Edge nodes & sensors
- High bandwidth
- Gateway
- Safety & security

Domain Architecture

Domain MPUs

Edge Nodes & Sensors

High Bandwidth

Gateway

Safety & Security

SENSE 

THINK 

ACT 





05.

CHALLENGES



INCREASING COMPLEXITY VEHICLE SOFTWARE

MODERN HIGH
END CAR



- Facebook
- Windows Vista
- Large Hadron Collider
- BOEING 787
- ANDROID
- chrome
- Linux Kernel 2.6.0
- Mars Curiosity Rover
- Hubble Scape Telescope
- F-22 Raptor
- Space Shuttle



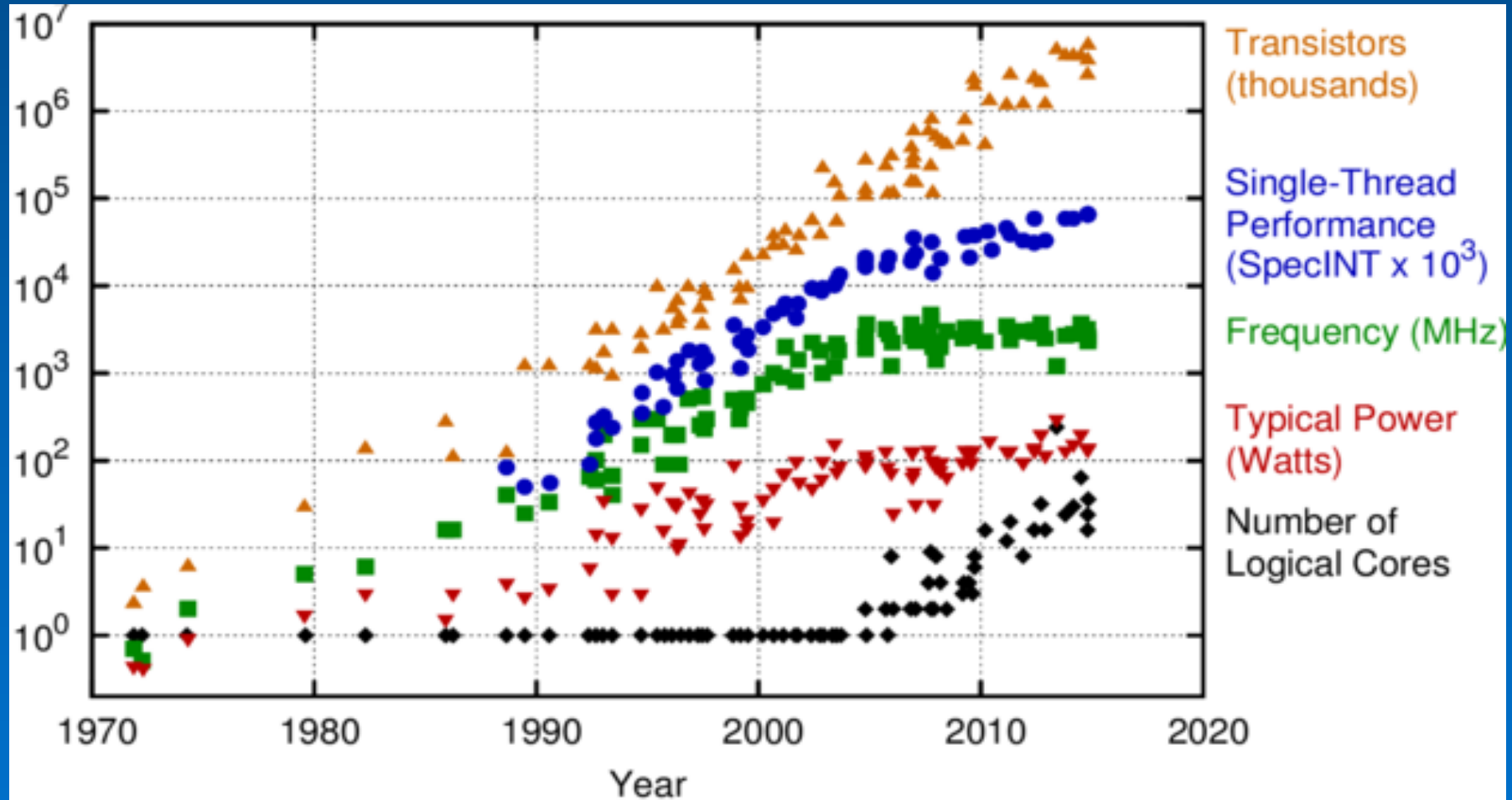
Today's Vehicles:
contain more software than
any other embedded system
and most compute applications

Tomorrow's Vehicles:
6X more software lines of code

Source: Informationisbeautiful.net

CATCHING UP WITH HUMAN BRAIN

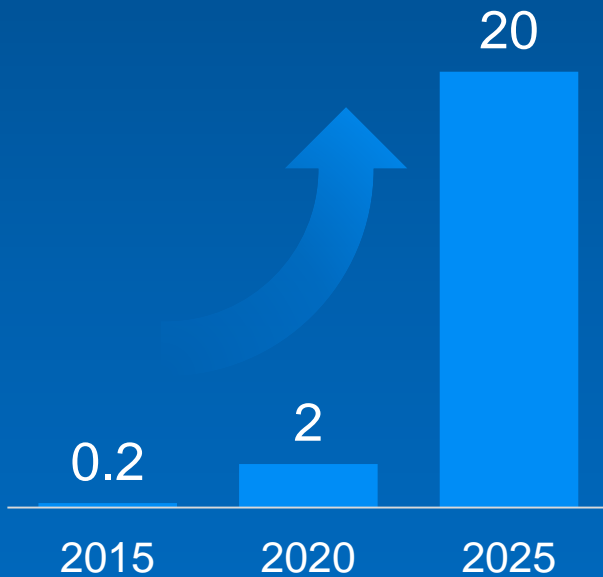
50 YEARS OF MICROPROCESSOR DATA TRENDS



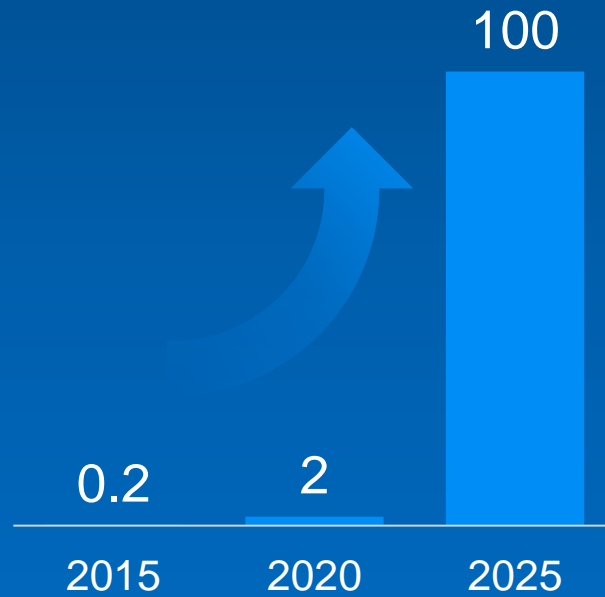
Original data up to the year 2010 collected and plotted by M. Horowitz, F. Labonte, O. Shacham, K. Olukotun, L. Hammond, and C. Batten
New plot and data collected for 2010-2015 by K. Rupp

Megatrends Drive Exponential Performance Requirement¹

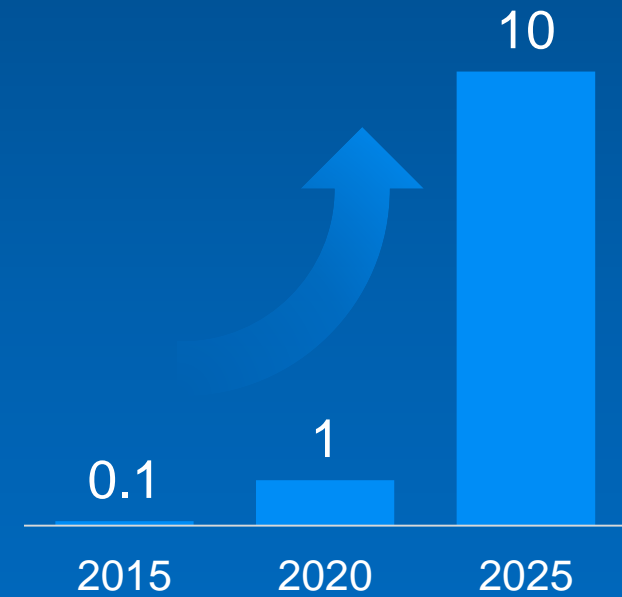
Data Generation
(TeraByte per hour)



Compute Performance
(TFLOPS)



Network Bandwidth
(GigaBit per Second)



- Dramatically more sensors
- Higher precision

- ADAS & autonomy
- e-Cockpit

- Loads of data (on & off board)
- Real-time distributed applications

1. Source: NXP

MACHINE LEARNING CREATED ILLUSIONS

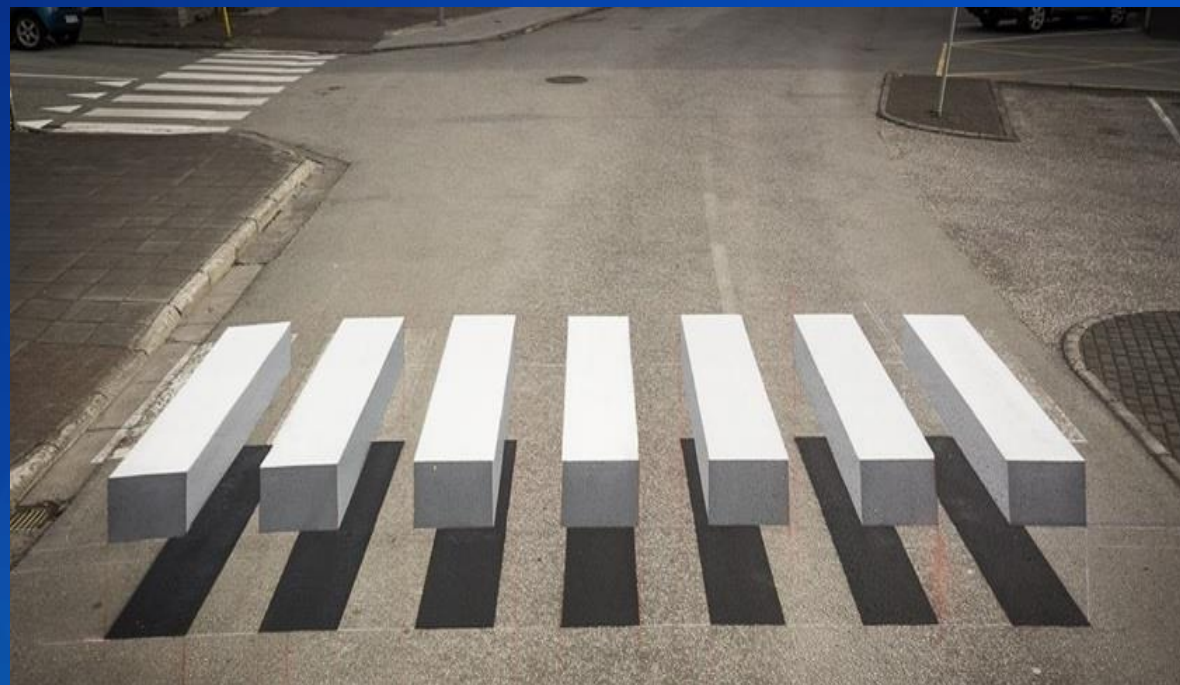


Machine Learning algorithms processed a husky as wolf

POTHOLES AND SNOW



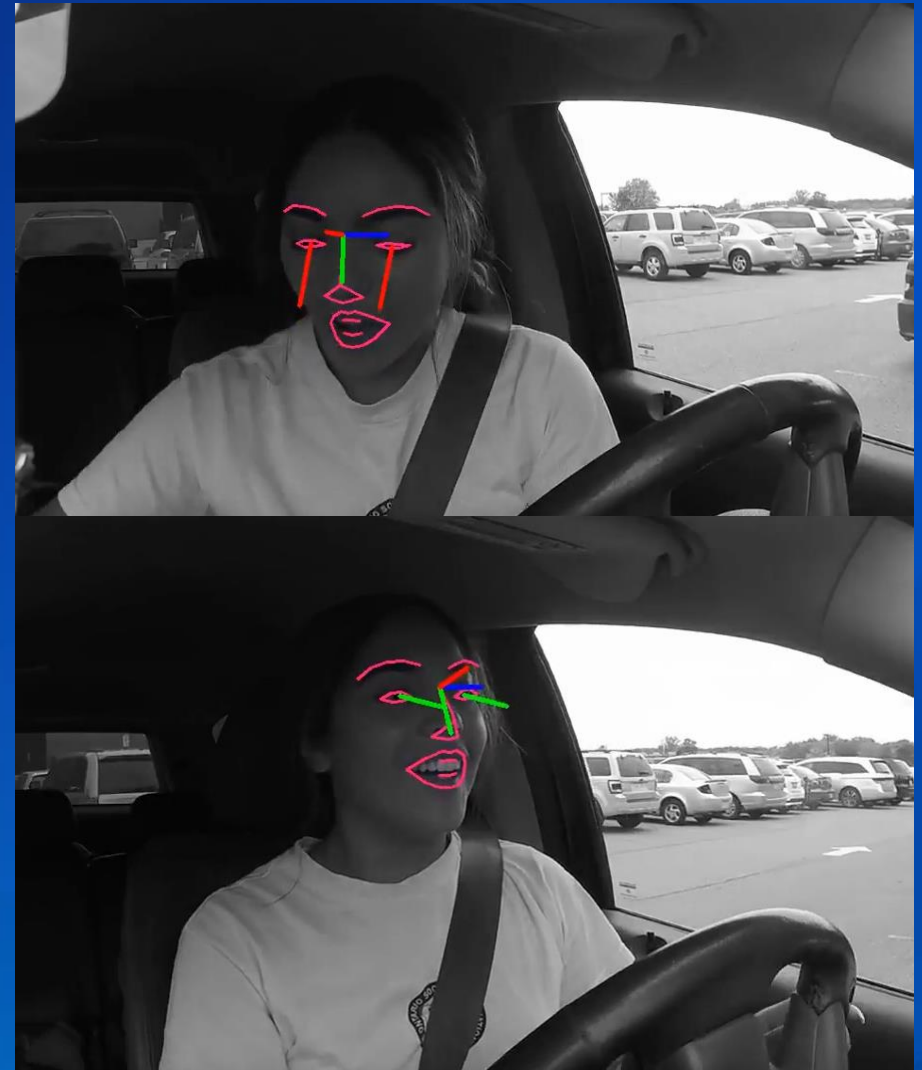
OPTICAL ILLUSIONS



DRIVER MONITORING AND SCORING



* Dreamworks Pictures



* Edgetensor Technologies

KEY CHALLENGE

MORE DATA = MORE HACKING OPORTUNITIES

>25

Vehicle hacks
published since 2015

1.4M

Vehicle recalled
in the largest
incident to date



Why hacking?

Valuable Data
attracts hackers

Car-generated data
may become a USD
750B market by 2030



Why is it possible?

High System Complexity
implies high vulnerability

Up to 150 ECUs per car,
up to 200M lines of
software code



Why now?

Wireless Interfaces
enable scalable attacks

250M connected
vehicles on the
road in 2020

SECURITY IS A **MUST-HAVE** FOR CONNECTED & AUTONOMOUS VEHICLES

If it connects to the outside world, it is hackable.



Fiat Chrysler issued a **safety recall affecting 1.4 million vehicles** in the US, after security researchers showed that one of its cars could be hacked

Challenges Are Not Only Technical



**Legislation &
Harmonization**

**Legal &
liability**

**Technology &
Infrastructure**

**Trust &
Dependability**



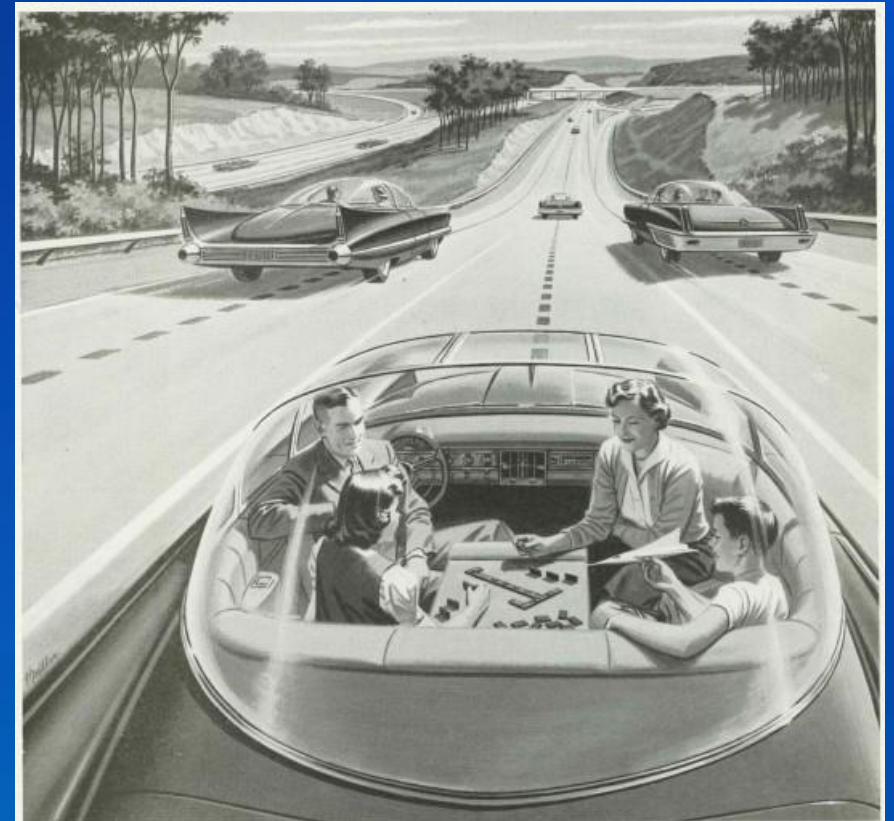
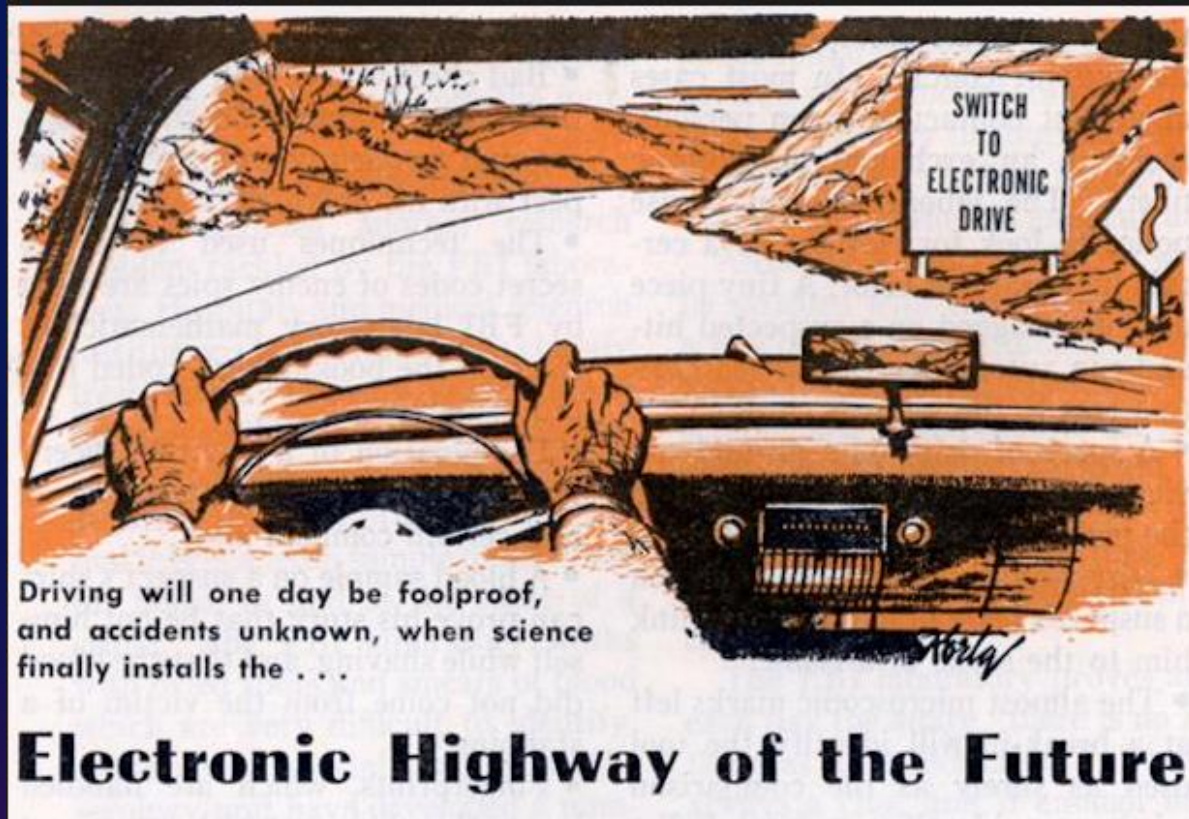
07.

SUMMARY



A VISION FOR AUTONOMOUS VEHICLES 75 YEARS AGO

- In 1939, New York World's Fair were presented a vision of automated cars
- In 1950, an advertisement showing a family on road trip



Will it happen in our lifetime ?



WINNER

- Cake is BIG enough for everyone
- Will be most likely work in partnerships and through collaborations
- Will establish the software model that best fits security and safety
- Will be investing largely in Artificial Intelligence and system solutions
- Leverage silicon technology most intelligently using multi die packages, e-FPGA's and reducing cycle time for first platform



THANK YOU