University of Chinese Academy of Sciences

Impact of Big Data on SoC Design
ADAS and SoC Design

Chun-Zhang Chen, Ph.D.

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ADAS *(Advanced Driver-Assistance Systems)*

ICE,
In-Car Entertainment or
IVI,
In-Vehicle Infotainment

Telematics,
Vehicle Telematics →
Intelligent vehicle technologies

BCM, Body Control Module or
BCS, Body Control System

ECU
MCU
SoC

IoV,
Internet of Vehicles

AI-Big Data & SoC Design

ADAS and SoC Design

Automotive Electronics & Electric Vehicle ▷

AI and ISO in ADAS ▷

ECU and MCU in ADAS ▷

SoC and IP in ADAS ▷

Discussion ▷

Highlights of ADAS - *Vehicle safety technology*

- ADAS, Advanced Driver Assistance Systems

  - AUTO connected car

- ADAS relies on inputs from multiple data sources, including

  - Automotive imaging, LiDAR, radar, image processing, computer vision, and in-car networking

- Vehicular safety systems ISO 26262

- Waymo (Google, Inc, 2009–2016; Alphabet, Inc., 2016–present)

AE (and/or EV)

- Overall for AE:
  - engine management, ignition, radio, <u>carputers</u>, <u>telematics</u>, <u>in-car entertainment systems</u> and others
- Engine electronics, ECU (<u>engine control units</u>, up to 80)
- Transmission electronics
- Chassis electronics and passive safety
  - ABS, TCS, EBD, ESP
- Driver assistance
- Driver assistance and infotainment systems
- Electronic integrated cockpit systems
- Functional safety requirements

AI-Big Data & SoC Design

Tesla Motors

- As of March 2015, Tesla Motors has delivered

   about 70,000 electric cars

  - Tesla Roadster the first EV (sports car in 2008)
  - Model S (lux. sedan), Model S/X and Model 3
  - Sales today ranking: #1 BYD Auto, #2 Tesla Motors

- Founded July 2003 by Martin Eberhard and Marc Tarpenning; also Elon Musk and others are considered co-founders.

Automotive and IoT

- Some key technology
  - Wireless solutions for the Automotive IoT
  - Automotive Ethernet Application
  - LIDAR
- Reliability

ADAS & SoC Design

- **Automotive Electronics & EV:** Background & Intro

- **ADAS and AE/EV:** Definition

- **AI and ISO in ADAS:** Safety and Reliability

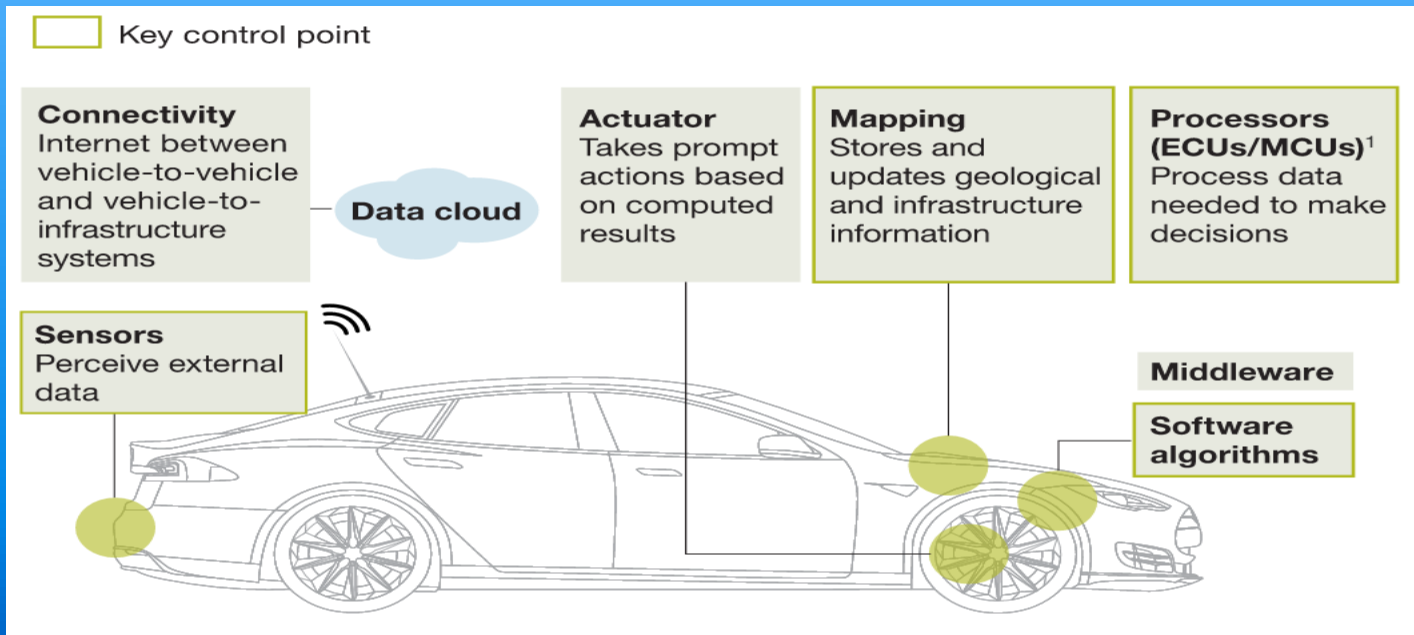- **ECU and MCU:** SoC and IP Designs

- **Discussion**

ISO and ADAS

- ISO 13400, Ethernet-based connectivity over Analog IP (LVDS) for ADAS

- ISO 26262, ASILs (ASIL-B, ASIL-D)

- ISO 14001, EMSs

AI-Big Data & SoC Design

ADAS Awareness

- Key control points …

- Processors: ECU, MCU

Key control point

Connectivity Internet between vehicle-to-vehicle and vehicle-to-infrastructure systems

Data cloud

Actuator Takes prompt actions based on computed results

Mapping Stores and updates geological and infrastructure information

Processors (ECUs/MCUs)[1] Process data needed to make decisions

Sensors Perceive external data

Middleware

Software algorithms

Types of ECU – G.U.I.
Multiple Modules – up to 80 ECUs in a single car

- ECM, Electronic/engine Control Module
- PCM, Powertrain Control Module
- TCM, Transmission Control Module
- BCM, Brake Control Module
- CCM, Central Control Module
- CTM
- GEM
- BCM
- SCM

Enable Cars …

- **to see**, auto-pilot

- **to think**, complete platform for the digital cockpit

- **to learn**, deep learning system

- **V2V**, Vehicle-to-Vehicle

- **V2X**, Vehicle-to-Infrastructure

  - such as mobile telephony or Wi-Fi data network systems

ADAS features

- Intelligent speed adaptation (ISA)
- Adaptive cruise control (ACC)
- Lane departure warning system (LDWS)
- Collision avoidance system
- Automatic parking
- Traffic sign recognition
- Blind spot detection
- Driver drowsiness detection
- Electric vehicle warning sounds

AI-Big Data & SoC Design

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SoC used in an Automobile

- CPU
- GPU
- AP
- Sensors
- DRAM
- NAND Flash
- SAF4000 for IVI by NXP
  - SW SDR solution: AM/FM, DAB+, DRM(+), HD

NXP SAF4000 Processor

ADAS IC (1/3)

- QCOM/NXP
  - 820A based platform, SNPE engine
- Intel/Mobileye/Altera
  - FPGA + XEON Processor
  - Mobileye EyeQ series are in use by 10+ auto makers
- Renesas
  - R-Car product, ARM Cortex-A57/A53 … Video Codec, GPU, ISP

ADAS IC (2/3)

- Infineon

  - 24/77/79 GHz Radar

- TI

  - Jacinto series, TDA series

- NVIDIA

  - Tesla (GPU ← Mobileye)

ADAS IC (3/3)

- ADI
  - Blackfin series
- Fujitsu

- Toshiba
  - Visiconti, Visconti2
- Xilinx

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Tesla, Inc.

- Tesla, Inc. (2003-)

- SpaceX (2001-)

- Superloop (2013-)
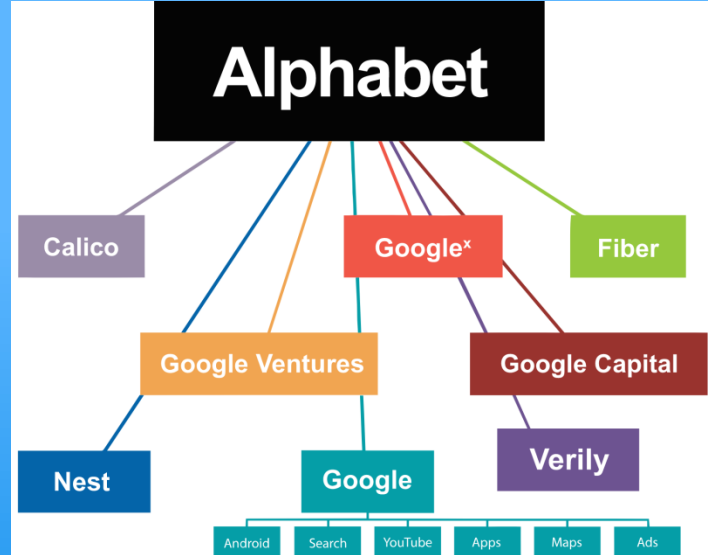
- OpenAI (2015-) OpenAI

Mobileye

- Founded in 1999

  - Ziv Aviram, President

  - Amnon Shashua (Hebrew University), Chairman and CTO

  - Vision tech, 2004: EyeQ2 Chip,

    - a camera and software to detect car

    - 2010 Goldman Sachs inveted, $37M

  - Took over by Intel March 2017 ($15B)

Waymo Car (Google Car)

- Waymo car (← Google car)

Alphabet

"Do the right thing"

WAYMO

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Inputs for ADAS

- automotive imaging,

- LiDAR,

- radar,

- image processing,

- computer vision, and

- in-car networking