AI, 5G, 無人載具發展趨勢

鄭智成

商用業務總監

美商英特爾台灣分公司

A NEW WORLD IN TRANSPORTATION
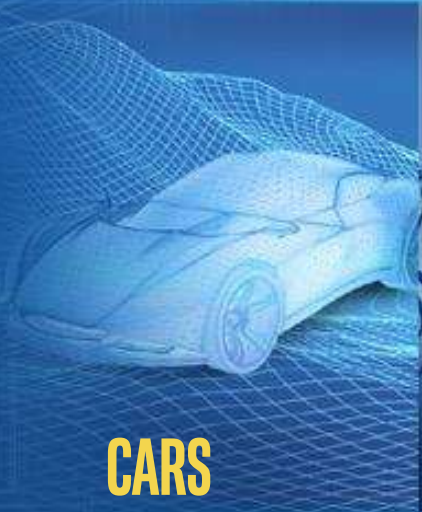
CARS FLEETS CITIES BUSINESS MODELS

. . . ARE ALL CHANGING. TRANSPORTATION IS BECOMING SMARTER AND MORE CONNECTED

COMPUTER VISION (CV) ALLOWS SELF-DRIVING CARS TO "SEE" THEIR ENVIRONMENT

Movidius
Market-leading SoCs

Acceleration for CV applications and algorithms

itseez
CV expertise

Leadership in OpenCV and OpenVX*

AUTONOMOUS DRIVING

MOBILEYE

Mobileye's technology keeps passengers safer on the roads, reduces the risks of traffic accidents, saves lives and has the potential to revolutionize the driving experience by enabling autonomous driving. Mobileye's proprietary software algorithms and EyeQ ® chips perform detailed interpretations of the visual field in order to anticipate possible collisions with other vehicles, pedestrians, cyclists, animals, debris and other obstacles. Mobileye's products are also able to detect roadway markings such as lanes, road boundaries, barriers and similar items; identify and read traffic signs, directional signs and traffic lights; create a RoadBook™ of localized drivable paths and visual landmarks using REM™; and provide mapping for autonomous driving. Mobileye's products are or will be integrated into car models from more than 25 global automakers. Mobileye's products are also available in the aftermarket.

INTEL, BMW, AND MOBILEYE ARE BRINGING FULLY AUTONOMOUS DRIVING TO THE STREETS

- Comprehensive portfolio of Intel® technology
- BMW automotive leadership
- Computer vision expertise from Mobileye

PLUS: DELPHI

MOBILEYE

Mobileye's best-in-class vision (camera) systems and real-time mapping and vehicle location

Mobileye's real-time mapping and vehicle location (REM™)

Mobileye's software and EyeQ® 4/5 System on a Chip (SOC) perform detailed interpretations of the camera images to map the area around the vehicle. The software identifies road objects like pedestrians and then plots a drivable path to navigate the vehicle.
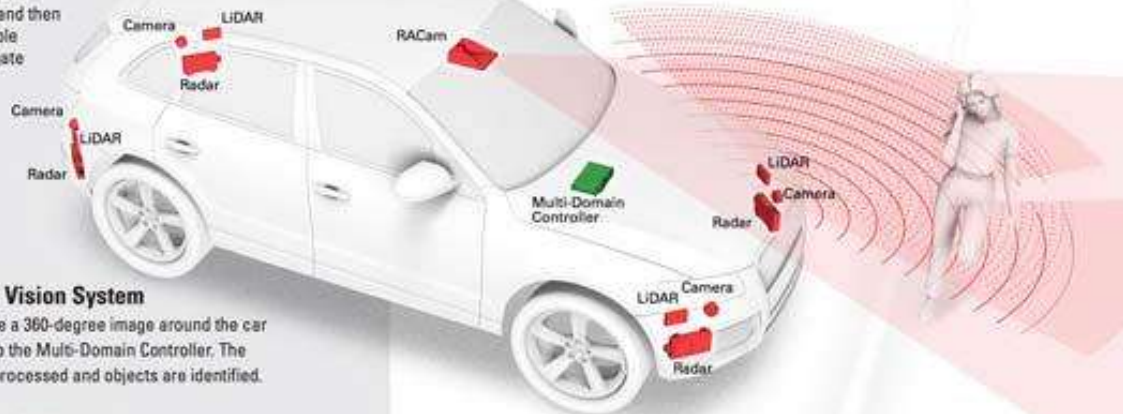
Mobileye Vision System

Cameras take a 360-degree image around the car and send it to the Multi-Domain Controller. The images are processed and objects are identified.

Mobileye's Policy and Reinforcement Learning System

Helps negotiate with other human drivers and pedestrians in complex urban scenes.

DELPHI

Delphi's Ottomatika Automated Driving software, sensor suite, and its computing platform called a Multi-Domain Controller

Delphi's Sensor Suite

- **Radars**: Radio waves sent out and bounce off objects, like this pedestrian. The speed and distance of these objects is calculated in any weather, day or night.

- **LiDAR**: Light pulses sent out and reflect off objects like this pedestrian. LiDAR identifies the object as a person and her distance from the car, day or night.

- **RACam**: Combines a mid-range radar and a forward-facing camera that can see and identify objects like the pedestrian, plus sense objects further down the road.

Delphi's Multi-Domain Controller

Information from the sensing systems as well as mapping and navigation data is fused to make driving decisions such as when to stop or go.

MOBILEYE — FLEETS

Mobileye, an Intel company, the global leader in advanced driver assistance systems (ADAS) and autonomous driving technologies, today (Sep 12) announced a unique collaboration intended to **reduce commercial fleet collisions** and enhance road safety in the United States.

Beginning immediately, Munich Reinsurance America Inc. (Munich Re, US) will make available Mobileye's aftermarket Advanced Collision Avoidance System to its clients, including commercial fleets. The new program will provide Munich Re, US clients with the option of retrofitting existing vehicles with Mobileye ADAS technology, designed to help mitigate the potential for collisions among fleets and improve driver behavior **through the use of warning signals**. Munich Re, US will also conduct a loss analysis to help quantify the potential impact of Mobileye's technology on a client company's portfolio of commercial fleet business.

An Intel Company

Mobileye aftermarket advanced driver assistance systems provide visual and audio alerts to drivers, warning them of potentially dangerous situations on the road.
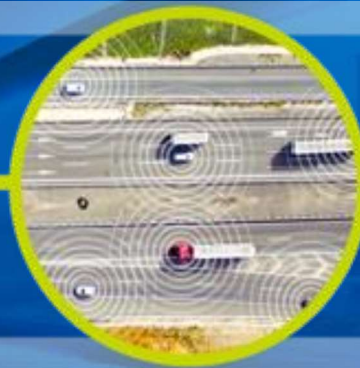
INTEL® GO™ AUTONOMOUS DRIVING PLATFORM

Transportation-as-a-service

Artificial intelligence (AI)

Over-the-air updates

HD video and entertainment

SAFETY AND SECURITY

Vehicle-to-everything (V2X) (V2V, V2I, V2N)

Fleet management

CAR

Intel GO development platforms for autonomous driving deliver the incredibly high compute performance needed for cars to react to changes on the road with split-second agility, support for advanced human-machine interface (HMI) experiences that build trust, and the broadest compute portfolio to let developers code how they need.

CONNECTIVITY

By working closely with device manufacturers and network operators, Intel is paving a path to 5G. We're enabling a more streamlined design process and accelerating prototype development with our Intel GO automotive 5G platform.
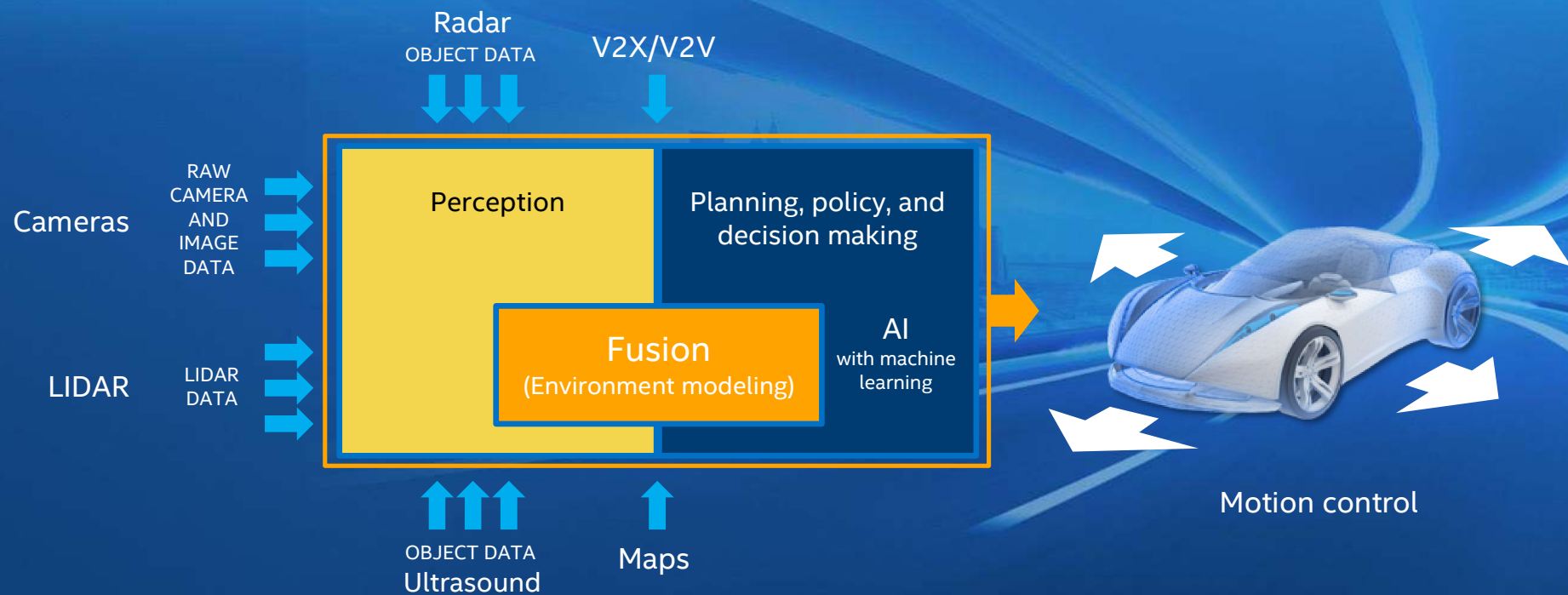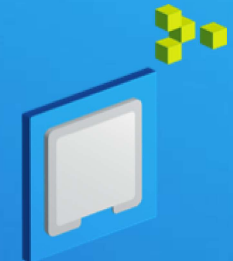
CLOUD

Intel® technologies for the data center support Intel GO autonomous driving solutions by scaling to meet the demands of new workloads, including artificial intelligence (AI).

Responsive HMI

Environment modeling

Voice controls

Perception

Path planning

AUTONOMOUS DRIVING

INTEL® GO™ DEVELOPMENT PLATFORM FOR AUTOMATED DRIVING

Radar
OBJECT DATA

V2X/V2V

Cameras
RAW CAMERA AND IMAGE DATA

Perception

Planning, policy, and decision making

Fusion
(Environment modeling)

AI
with machine learning

LIDAR
LIDAR DATA

OBJECT DATA
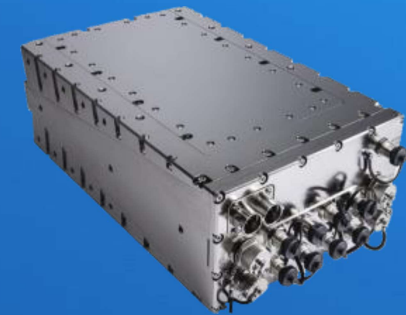Ultrasound

Maps

Motion control

INTEL® GO™ DEVELOPMENT PLATFORM FOR AUTOMATED DRIVING

Intel® Atom™ processor version

Accelerator Card (Arria®
10 or ASIC

ON Semiconductor
PMIC (ASIL D)

Power

PCIe* 2x8

GbE x2

UART x2

FuSa

Functional Safety (FuSa)

Next-Gen Intel® Atom™
Processor

FuSa

UART

FuSa

Infineon AURIX*
(ASIL D)

UART

2x FlexRay

2–8x CAN FD

PS15

Ethernet Switch Fabric

4x GbE

5x 100BASE-T1

INTEL® GO™ DEVELOPMENT PLATFORM FOR AUTOMATED DRIVING

Intel® Xeon® processor version

CPU Board 1

Accelerator Card (Arria® 10 or ASIC)

2x PCIe* x8

DDR4 DRAM

Next-Gen Intel® Xeon® Processor

2x 10 GbE

I/O Board

2x 10 GbE

Ethernet Switch

8x 1/10 GbE

2x 10 GbE

DDR4 DRAM

Next-Gen Intel® Xeon® Processor

2x 10 GbE

1 GbE

2x PCIe* x8

Infineon AURIX* (ASIL D)

6x CAN

FlexRay

Accelerator Card (Arria® 10 or ASIC)

CPU Board 2

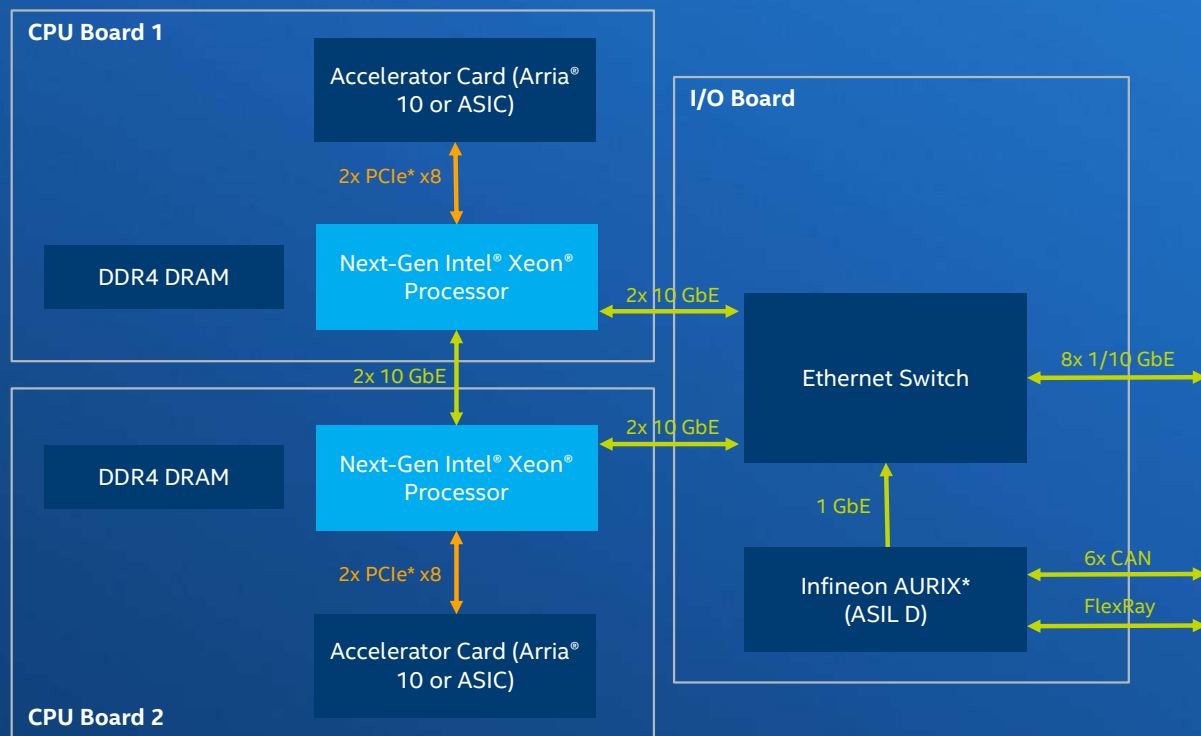# INTEL® GO™ DEVELOPMENT PLATFORM FOR AUTOMATED DRIVING

	Intel® GO™ Development Platform for Automated Driving (Intel® Atom™ processor version)	Intel® GO™ Development Platform for Automated Driving (Intel® Xeon® processor version)
Processor	Next-generation Intel® Atom™ processor for automotive	Next-generation Intel® Xeon® processor for automotive
Support for multiple SoCs/CPUs	Boards can be daisy-chained via GbE	2 CPU boards per system
DRAM	2 channels DDR3L/DDR4 DRAM	Multiple channels DDR4 DRAM per board
Acceleration module	Arria® 10 FPGA acceleration module Additional hardware acceleration modules to be developed	Arria® 10 FPGA acceleration module Additional hardware acceleration modules to be developed
Microcontroller	Infineon AURIX* MCU, ASIL D	Infineon AURIX* MCU, ASIL D
System I/O	6 x 1 Gigabit Ethernet 5 x 100BASE-T1 2-8 x CAN FD FlexRay* USB 2.0/USB 3.0 UART	8 x 1/10 Gigabit Ethernet 6 x CAN FD FlexRay* USB 2.0/USB 3.0 UART
Integrated storage	eMMC flash drive	Solid-state drive
Software	Sample applications, runtimes and libraries, programming tools, operating system, and more	
Software development kit (SDK)	Intel GO automotive software development kit (SDK) : • Deep learning SDK • Computer vision SDK • OpenCL™ SDK • Sensor data labeling tool • Performance libraries • Optimizing compilers • Performance and power analyzers • System and application-level debuggers	

INTEL® GO™ AUTOMOTIVE SOFTWARE DEVELOPMENT KIT (SDK)

- Suite of tools for automated driving software application developers

- Support for in-vehicle code and cloud development

- Machine learning/deep learning, computer vision algorithm development on Intel® architecture and accelerators

- Acceleration libraries, compilers, debuggers and IDE

Deep Learning, Computer Vision, and Sensor Fusion Tools
Sensor Data Tool *[NEW]*
DL Training and Deployment Tools
Intel-optimized DL Frameworks
OpenVX* Kernel Library and Graph Builder

FPGA & Heterogeneous Programming Tools
FPGA OpenCL

Full Stack Optimization Tools and Libraries
Compiler (ICC), JTAG debugger
Intel® Vtune™ Amplifier, Thread Check, Thread Profiler
Performance and Threading Libraries (Intel® MKL, IPP, TBB)

In-Vehicle Platform Tools
Yocto* Recipe
Board Flashing Utility

IN-VEHICLE COMPUTE REQUIREMENTS ARE INCREASING

2017

Distributed microcontroller network

- **L2/L3 TFLOPS:** 0.5–10 teraflops
- **Pixels**: Millions
- **Embedded storage:** Gigabytes
- **In-vehicle net bandwidth**: Tens of Mbits/s
- **Safety:** "Fail safe"
- **ECUs:** 150+ (microcontrollers)

2025

Consolidated server-class computer

- **L5 TFLOPS:** 50–100 teraflops
- **Pixels:** Billions
- **Embedded storage:** Terabytes
- **In-vehicle net bandwidth:** Hundreds of Gbits/s
- **Safety:** "Fail operational"
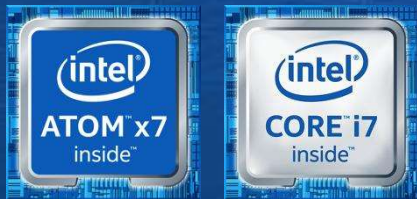- **ECUs:** 50 (consolidated/virtualized)

IN-VEHICLE EXPERIENCES

INTEL® GO™ DEVELOPMENT PLATFORM FOR IN-VEHICLE EXPERIENCES

- Intel Atom® A3900 series processor
- Flexible architecture for digital cockpits and digital instrument clusters

Next generation (in development): Keystone Lake

- Keystone Lake family of automotive systems-on-a-chip (SoC)
- A roadmap to redefine in-vehicle experiences so they build trust in autonomous driving, with repeatable solutions that save automakers time and money

INTEL ATOM® A3900 SERIES PROCESSOR

Digital Features in Demand

In-vehicle experience (IVE) features add cost and complexity, so **it's critical for automakers and suppliers to manage costs for current and future implementations.**

Getting to Market Faster

The Intel Atom® A3900 series processor makes designing and incorporating digital and connected features **simple, powerful, and cost effective.**

Optimized

- Excellent compute in a compact, low-power package
- One flexible, scalable architecture
- Low development costs and complexity

Intel Atom A3900 series processor

Module

Development kit

Scalable Platform with Hardware-Level Security

- Intel Atom A3900 series processor
- Scalable architecture
- Sophisticated virtualization
- Integrated, validated components
- Powerful processing and graphics
- Hardware-level security

IN-VEHICLE EXPERIENCES

AUTOMOTIVE EDGE COMPUTING CONSORTIUM

- Denso, Ericsson, Intel, NTT, NTT Docomo, and Toyota

- The Automotive Edge Computing Consortium will propose standards, best practices, and architecture to connect big data from autos to the cloud.

- The objective of the consortium is to develop an ecosystem for connected cars to support emerging services such as intelligent driving, the creation of maps with real-time data and driving assistance based on cloud computing.

- The consortium will focus on increasing network capacity to accommodate automotive big data in a reasonable fashion between vehicles and the cloud by means of edge computing and more efficient network design. It will define requirements and develop use cases for emerging mobile devices with a particular focus on the automotive industry, bringing them to standards bodies, industry consortiums and solution providers. The consortium will also encourage the development of best practices for the distributed and layered computing approach recommended by the members.

From Car to Cloud, the Most Scalable Automated Driving Platforms are Built on Intel

More than 30 vehicle models are powered
by Intel automotive technology for in-vehicle experiences

Faster innovation with
scalable architecture

Trusted by leading
automotive brands

Strong ecosystem and
industry leadership

Contributions to policy
and regulation

LEARN MORE

intel.com/automotive

How to Get the Intel® Automated Driving SDK

1. Request access at:
   software.intel.com/automated-driving-sdk

2. Await access approval email (up to 2 business days). Then follow "Download" link in email.

3. Review system requirements. Then follow Intel Software Download Manager prompts to select modules depending on usage needs.

4. Download documentation files for specific tools (these are **not** available online), and the SDK installer package (zip file).

5. Uncompress and launch installer package on host development system.

6. Users may customize installation further during installation.

Intel Software Download Manager

INTEL® AUTOMATED DRIVING SDK 2019 BETA

Choose the Intel® Automated Driving SDK modules that you would like to download and install.

The Intel® Developer Zone has more information about the Intel® Automated Driving SDK. Learn more >

Development Environment Modules

|	
In-Vehicle Software Development Develop, debug, and optimize CPU-based in-vehicle applications, including system bring-up and validation.	**Data Center Software Development** Develop, debug, and optimize multinode data center applications, and measure software performance.

Task-Specific Modules

FPGA Development Program, debug, analyze, and optimize FPGAs.	**Deep Learning Deployment** Optmize and integrate deep learning models for deployment in autonomous vehicles.

More Resources

- Intel® Automated Driving site

- Intel® Automotive Solutions site

- Intel® Automated Driving SDK
  - Features
  - Documentation
  - Tuning Autonomous Driving Using Intel® System Studio article

- Get Help
  - For **SDK specific questions**, contact Priority Support via Online Service Center (select Intel® Automated Driving SDK forum)
  - For questions with Intel Autonomous Driving Development platforms and general support, contact your Automated Driving Group (ADG) or Intel field representative for more information.
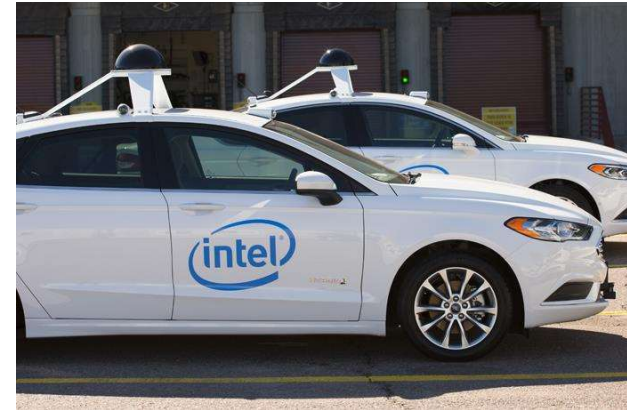
PRODUCT MESSAGES

- Intel, a world leader in smart and connected technologies, announces **Intel® GO™ automated driving solutions**, a 5G-ready scalable end-to-end system designed for the future of autonomous driving. Intel GO automated driving solutions enable industry innovators to build rapidly and pursue countless design iterations across brands and fleets with world-class scalable, standard architecture.

- The **Intel GO in-vehicle development platforms** deliver scalability, with compute that ranges from power-optimized next-gen Intel® Atom™ processors to high-performance Intel® Xeon® processors for automotive. The Arria® 10 FPGAs manage incoming data from multiple vision sensors and perform accelerator functions. Intel is also developing hardware acceleration capabilities for computer vision and deep learning.

- **The Intel GO automotive 5G platform** offers the industry's first 5G-ready platform for the automotive segment. Specially designed for the automotive industry, this platform allows automakers to develop and test a wide range of use cases and applications.

- The **Intel GO automotive SDK** delivers highly interoperable tools, allowing data to flow smoothly and provides a consistent development experience. It helps developers and system designers maximize hardware capabilities while speeding the pace of development.

- **Intel technologies for the data center** provide unmatched capabilities and expertise to support these demanding workloads. An Intel-based data center offers full scalability to continuously store and manage unprecedented volumes of data. The data center powered by Intel® Xeon® and Xeon® Phi™ processors is responsible for all artificial intelligence (AI) simulation and ongoing training

INTEL® GO™ AUTOMOTIVE 5G PLATFORM

- Industry's first 5G-ready automotive platform

- Rapid development and testing of 5G solutions

- Target use cases:

    - HD map downloads in real time

    - HD content for in-vehicle infotainment

    - Over-the-air software updates

    - Sensor uploads from vehicle for machine learning

    - Safety, smart intersections, cooperative driving

AUTONOMOUS DRIVING