# ADAS and Autonomous Driving Industry Chain Report 2018 (I) - Computing Platform and System Architecture

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## STUDY GOAL AND OBJECTIVES

This report provides the industry executives with strategically significant competitor information, analysis, insight and projection on the competitive pattern and key companies in the industry, crucial to the development and implementation of effective business, marketing and R&D programs.

## REPORT OBJECTIVES

- To establish a comprehensive, factual, annually updated and cost-effective information base on market size, competition patterns, market segments, goals and strategies of the leading players in the market, reviews and forecasts.
- To assist potential market entrants in evaluating prospective acquisition and joint venture candidates.
- To complement the organizations' internal competitor information gathering efforts with strategic analysis, data interpretation and insight.
- To suggest for concerned investors in line with the current development of this industry as well as the development tendency.
- To help company to succeed in a competitive market, and

## METHODOLOGY

Both primary and secondary research methodologies were used in preparing this study. Initially, a comprehensive and exhaustive search of the literature on this industry was conducted. These sources included related books and journals, trade literature, marketing literature, other product/promotional literature, annual reports, security analyst reports, and other publications. Subsequently, telephone interviews or email correspondence was conducted with marketing executives etc. Other sources included related magazines, academics, and consulting companies.

## INFORMATION SOURCES

The primary information sources include Company Reports, and National Bureau of Statistics of China etc.

# Abstract

ADAS and Autonomous Driving Industry Chain Report 2018 (I) - Computing Platform and System Architecture underscores the followings:

Introduction to ADAS and autonomous driving;
ADAS and autonomous driving market forecast;
ADAS and autonomous driving strategy of carmakers including Geely, GM, SAIC, Dongfeng, Great Wall, GAC, Chang'an, NIO, Xpeng and BYTON;
Software architecture of ADAS and autonomous driving, including AUTOSAR Classic and Adaptive, ROS 2.0 and QNX;
Hardware architecture of ADAS and autonomous driving, including automotive Ethernet, TSN, Ethernet switch and gateway, and domain controller;
Safety certification of ADAS and autonomous driving, including ISO26262 and AEC-Q100;
Study into processor firms, including NXP, Renesas, Texas Instruments, Mobileye, Nvidia, Ambarella, Infineon and ARM.

According to ResearchInChina, the Chinese ADAS and autonomous driving market was worth about RMB5.9 billion in 2017 and is expected to reach RMB42.6 billion in 2021 at an AAGR of 67% or so.

Automotive vision, MMW radar and ADAS are the market segments that develop first with the MMW radar market enjoying an impressive growth rate, closely followed by low-speed autonomous driving. While LiDAR, commercial-vehicle autonomous driving and passenger-car autonomous driving markets lag behind.

As the automobile enters an era of ADAS and autonomous driving, product iteration races up and lifecycle of products is shortened. The automotive market is far smaller than consumer electronics market but sees bigger difficulty in design and higher design and production costs than that in consumer electronics market. Thus automotive ADAS and autonomous driving processor is confronted with higher risks. Hence adequate financial and human resources are required to support the development of automotive ADAS and autonomous driving processors. Globally, only very a few enterprises like NXP and Renesas are capable of developing whole series of ADAS and autonomous driving processors.

With regard to safety certification, autonomous driving chips must attain ASIL B at least, a level only Renesas R-CAR H3 has reached for now. As GPU is a universal design and not car-dedicated design, it is hard to reach the certified safety level of ISO26262 from the point of design. The certification cycle of ASIL is up to two to four years.



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Reliability, precision and functionality of stereo camera are well above that of mono camera, but as the stereo camera must use FPGA, it costs much. High costs restraint the application of the stereo camera only on luxury cars. However, with emergence of Renesas and NXP hardcore stereo processors, the stereo camera will be vastly used in ADAS and autonomous driving field, expanding from luxury models to mid-range ones.

With an explosive growth in data transmission, automotive Ethernet will become a standard configuration of the automobile, and Ethernet gateway or Ethernet switch is indispensable to autonomous driving.

Autosar will act as a standard configuration in ADAS and autonomous driving field.

CNN/DNN graphics machine leaning: GPU is most suitable when data is irrelevant to sequence. Nvidia GPU can be used in multiple fields except for automobile and finds shipments far higher than that of automotive ASIC, enjoying superiority in cost performance. TPU lifts speed and reduces power consumption (only 10% of that of GPU) at the expense of the precision of computation.

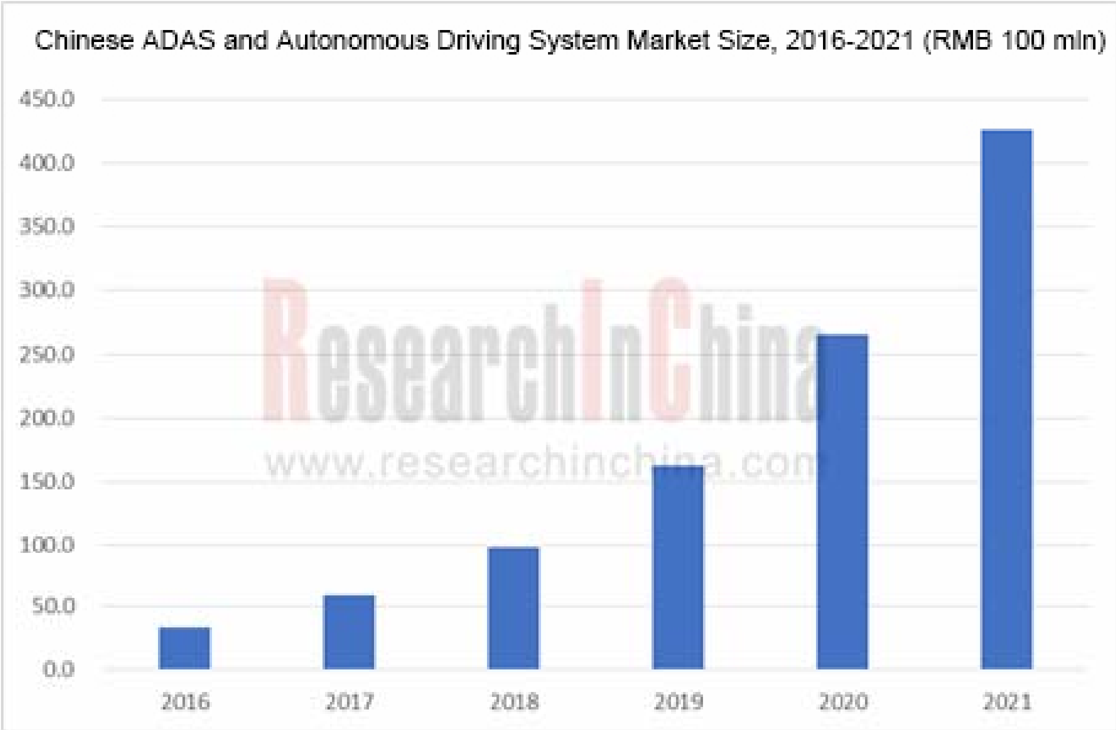
RNN/LSTM/reinforcement learning sequence-related machine learning: FPGA has distinct advantages, particularly in power consumption, consuming less than one-fifth of GPU under same performance. However, high-performance FPGA is incredibly costly. FPGA can also process graphics machine leaning and improve performance by reducing precision.

ASIC stands out by performance-to-power consumption ratio but has shortcomings of long development cycle, the highest development cost and the poorest flexibility. The unit price will be very high or firms will make losses if the shipments are small (at least annual shipments of 120 million units if 7-nanometer process is employed). Most ASICs for deep-learning graphics machine learning are similar to TPU.

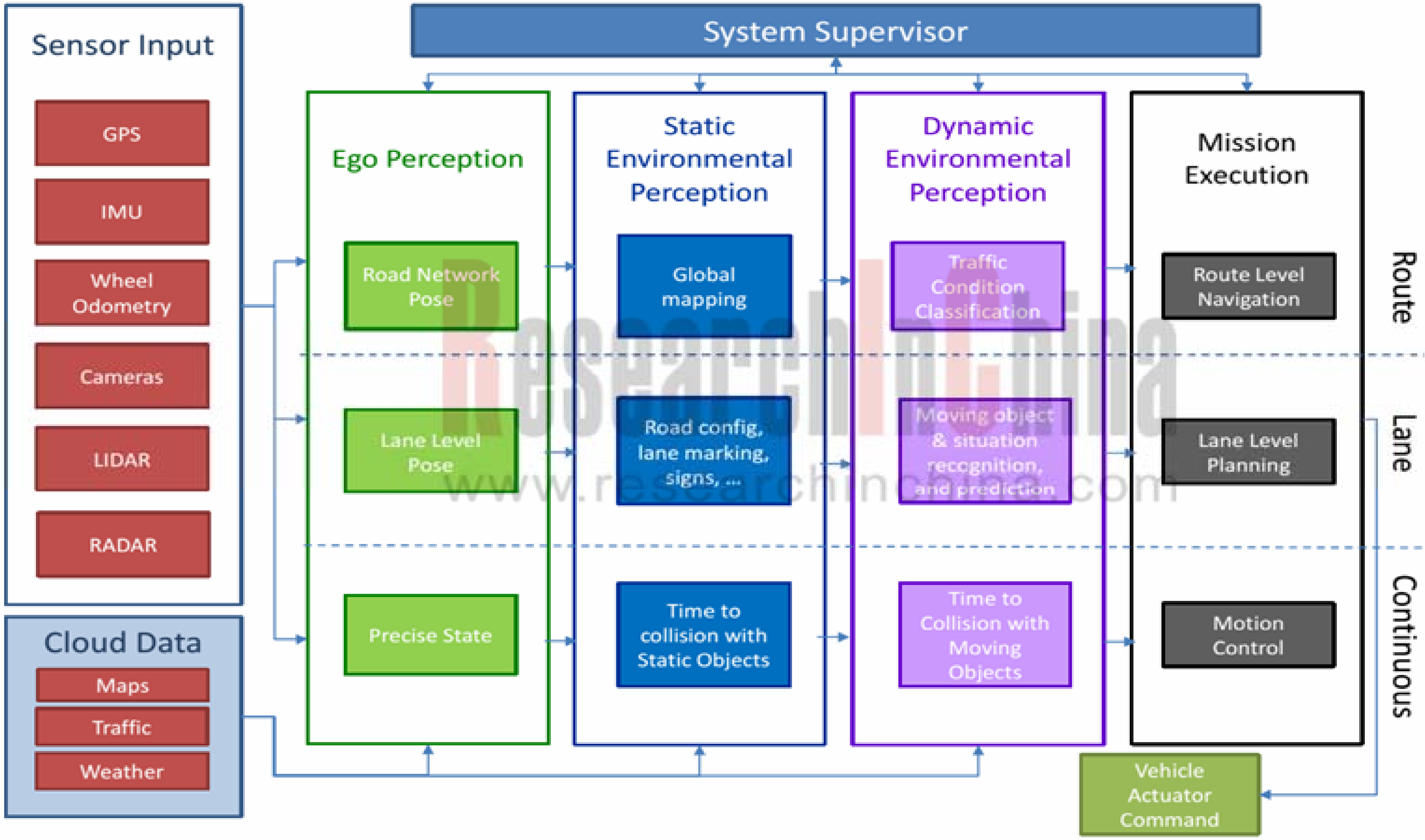
Power consumption and cost performance are crucial in in-vehicle field. GPU is no doubt a winner in graphic machine learning. However, as algorithms are constantly improved, the ever low requirements on the precision of computation, and low power consumption will ensure a place of FPGA in graphics machine learning. FPGA has overwhelming advantages in sequence machine learning.

Autonomous driving can be divided into two types, one represented by Waymo, which has solved most of the problems concerning environmental perception and concentrates on behavior decision-making with computing architecture of CPU+FPGA (usually Intel Xeon 12-core and above CPU plus Altera or Xilinx's FPGA; the other represented by Mobileye which has not solved all problems involving environmental perception and concentrates on it with computing architecture of CPU+GPU/ASIC.

CPU+GPU will be the mainstream in the short run, but CPU+FPGA/ASIC may dominate in the long term, largely due to continuous decline in the precision of computation of graphics because of improvement in algorithms and performance of sensors (LiDAR in particular), which is conducive to FPGA, while it is hardly for the power consumption of GPU to fall. It is easier for FPGA to meet car-grade requirements.
In chip contract manufacturing field, TSMC has won all 7-nanometer chip orders, including A12 exclusively provided for Apple, marking for the first time TSMC overtook Intel to become the vendor with the most advanced semiconductor manufacturing process, a must in the production of digital logic chip whose computing capability is underlined in AI autonomous driving.



## Typical Self-driving Framework



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