Automotive Electronics & Semiconductor Market Trends

LIDARs and sensor fusion ECUs advancing ADAS architectures towards automated driving

The Annual Tokyo SOI Workshop, 2017

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Agenda

• Automotive electronics and semiconductor market trends
• ADAS architectures towards automated driving
  • Current state of ADAS sensor architectures
  • Key technologies enabling next-gen ADAS architectures
• Market Outlook & Key Takeaway
Addressing strategic challenges with interconnected capabilities

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Automotive market trends
Vehicle production rises slowly with various degrees in emerging and established markets

Vehicle production volume forecast in million units

Source: IHS Markit

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Average value of electronic systems per car to cross $1500 by 2022

![Chart showing the average value of electronics per car from 2014 to 2022. The chart indicates a 5.6% CAGR (2016–22) with projected values reaching $1500 by 2022.](source: IHS Markit)
Automated driving, connectivity and electrification fueling automotive semiconductor growth

Automotive semiconductor revenue by device

7.1% CAGR (2016 – 22)

Source: IHS Markit
Current state of ADAS architectures
Old generation: C-segment with 1 ADAS ECU
Proliferation of ADAS ECUs on the new platform
Old generation: E-segment with 14 ADAS ECUs
Advancement of features on new platform
# Typical ADAS architecture requirements

<table>
<thead>
<tr>
<th>ADAS Module</th>
<th>Avg. per L3</th>
<th>Avg. per L4</th>
<th>Avg. per L5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sensor Fusion</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Exterior Camera</td>
<td>5</td>
<td>8</td>
<td>8</td>
</tr>
<tr>
<td>Interior Camera</td>
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<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Short/Mid-range Radar</td>
<td>4</td>
<td>6</td>
<td>6</td>
</tr>
<tr>
<td>Long-range Radar</td>
<td>1</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Long-range LIDAR</td>
<td>1</td>
<td>1</td>
<td>1-2*</td>
</tr>
<tr>
<td>Short-range LIDAR</td>
<td>2*</td>
<td>2-4*</td>
<td>4</td>
</tr>
</tbody>
</table>

*Architectures based on existing pilot car platforms*
Key technologies enabling next-generation ADAS architectures
Addressing the gaps in automotive LIDAR technology

Typical gap in LIDAR performance specifications

Source: IHS Markit

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Pure solid-state technology to dominate LIDAR space by 2025

**LIDAR shipment forecast in million units**

Source: IHS Markit © 2017 IHS Markit

**LIDAR shipments CAGR (2020-26)**

Source: IHS Markit © 2017 IHS Markit
Machine vision – a software driven market

System revenue for front-view camera modules to grow fourfold by 2022

• Basic cameras: Mass adoption in economy segments to meet regional guidelines with declining semiconductor BOM and software costs
• Mid-range and high-end cameras: adoption on premium segments with increasing semiconductor BOM and software costs

Semiconductor revenue for front-view camera modules will reach up to $1.5 billion by 2022

• SoCs based on MPUs or FPGAs?
  • Intel (Mobileye) and the rest (S32V, TDAx, R-car, Visconti, Zynq,)
  • Key benchmarks: power consumption, performance and safety compliance

Revenue share of front-view camera modules

Source: IHS Markit

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Sensor fusion modules – Growth in semiconductor value for safety-critical functions

System level:

- **Challenge**: Software for enabling AD via machine vision, deep learning, sensor fusion and etc.

- **Opportunity**: Universities, technology labs and start-ups working on unconventional technologies (deep learning, machine vision, etc.)

Chip level:

- **Challenge**: High performance processors meeting traditional automotive requirements (power consumption, functional safety temperature, life-time, etc.)

- **Opportunity**: Suppliers with high-performance computing platforms at lower power consumption and small die size

ADAS sensor fusion module forecast

Source: IHS Markit

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Market Outlook & Key takeaway
Market share for ADAS sensor suppliers (in revenue)

2016 ADAS electronics system supplier
- Bosch
- Continental
- Valeo
- Autoliv
- Magna
- Delphi
- Panasonic
- Denso
- ZF TRW
- Tung Thih Electronic
- Sony
- Hyundai Mobis
- Hella
- Clarion
- Aisin
- Sharp
- Gentex
- Velodyne
- Samsung
- Kyocera
- Others

Source: IHS Markit © 2017 IHS Markit

2016 ADAS semiconductor* supplier share
- On Semiconductor
- Omnivision
- Bosch
- Murata
- Valeo
- Nicera
- Infineon
- STMicroelectronics
- FLIR
- Panasonic
- NXP
- Sony
- Melexis
- Gentex
- ULIS
- Others

*Only for radar transceivers, image sensors, ultrasonic sensors and infrared sensors
Source: IHS Markit © 2017 IHS Markit
Key Takeaways

- Economy vehicle segments – proliferation of sensors and ECUs for compliance (NCAPs, NHTSA,..).
- Premium vehicle segments – Addition of LIDARS and high-end sensor fusion modules for automated driving.
- No compromise on sensor technology for automated driving – redundancy is a must.
- Functional safety and performance for autonomy will drive the semiconductor growth through artificial intelligence and sensor fusion.
- Consolidation of ECUs to drive high-performance computing platforms.
Thank You!