

First Sensor 

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# FROM SENSOR INTEGRATION TO SENSOR FUSION

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FIRST SENSOR'S LIDAR AND CAMERA  
STRATEGY FOR DRIVER ASSISTANCE &  
AUTONOMOUS DRIVING



# FRAMEWORK CONDITIONS

## Intensified interest in driver assistance & autonomous driving

### PERSPECTIVES

#### Market

- Demand for driver assistance systems for special & commercial vehicles significantly increased
- Higher interest in self-driving vehicles, in particular commercial vehicles
- New players in the automobile sector: Connection with environment & other vehicles (e.g. Google, Apple)
- Increasing electrification is changing the market: Consolidation, M&A & technology boom

#### Society & Politics

- Customer requirements (especially with regard to comfort & security) force development of new products
- Legal requirements for commercial vehicles: Optional ADAS equipment becomes new standard

#### Competition

##### Passenger cars

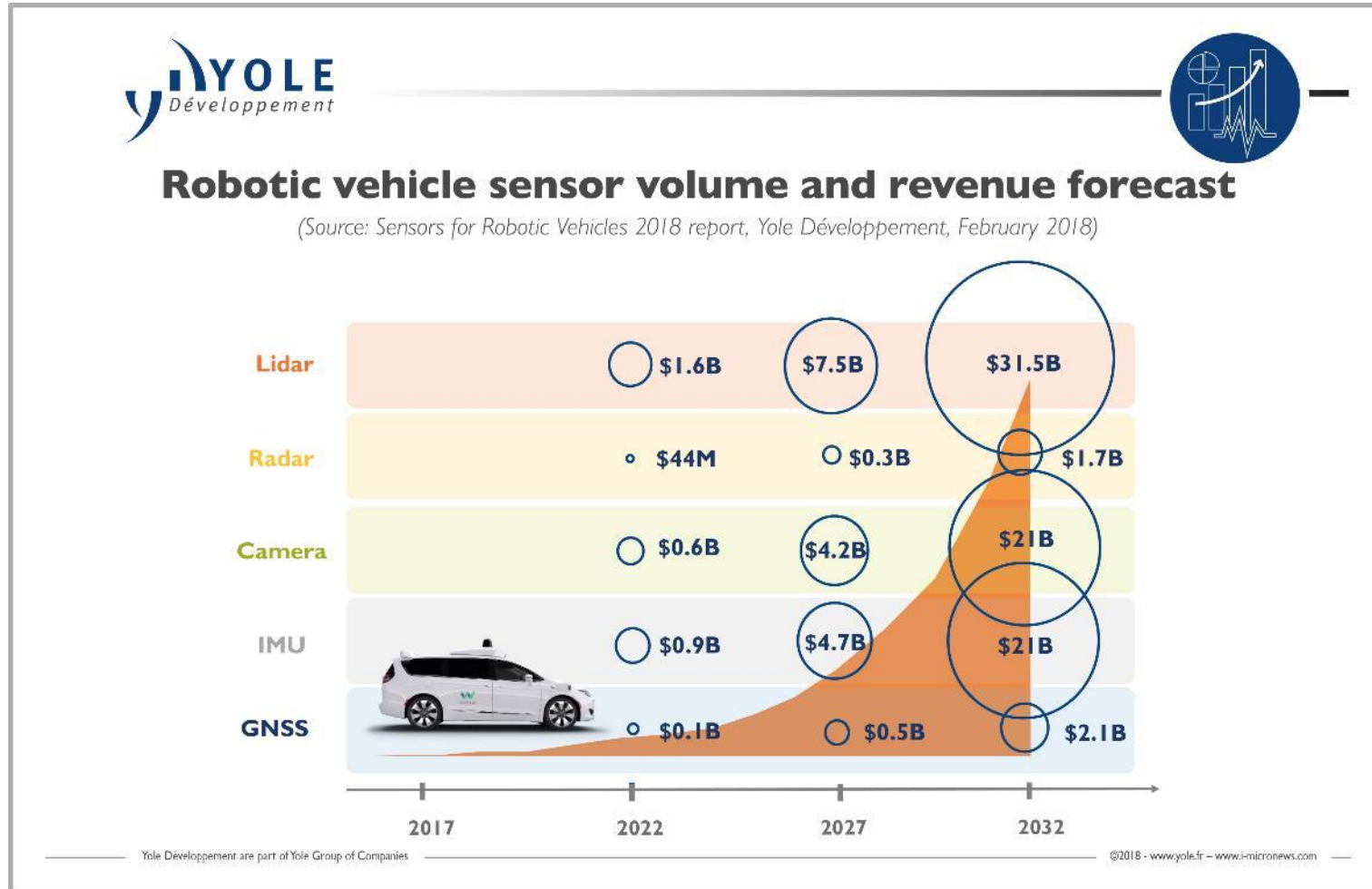
- Cameras: Tier1 with own design; produced in-house or by EMS provider
- Complete systems provided by Tier 1

##### Special & commercial vehicles

- Smaller Tier1 (Customers / competitors)
- Cooperation opportunities with system development

# FRAMEWORK CONDITIONS

## The camera & LIDAR market is expected to reach \$52,5B in 2032



# OVERALL OBJECTIVES

## Provider of innovative sensors and sensor systems in vehicle business



**Positioning as focused provider of innovative sensors and sensor systems  
in OEM & Tier 1 vehicle business**

**1**

**Expanding product  
portfolio and increase  
of added value**  
in the LiDAR and  
cameras segments

**2**

**Market expansion**  
Market entry into  
special & commercial vehicles  
with selected applications  
and systems

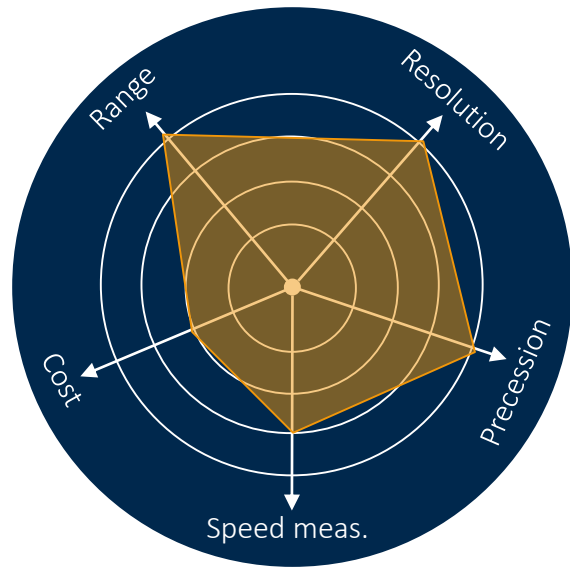
**3**

**From sensor to system**  
Camera, LIDAR >>  
advanced driving assistance  
systems (ADAS) & sensor  
fusion

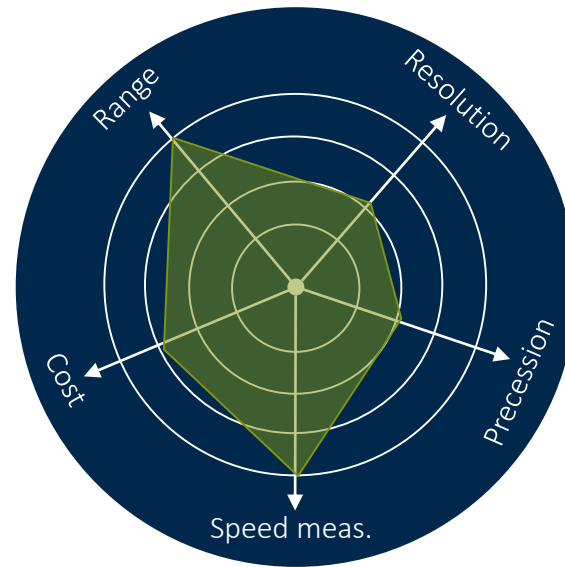
# 1. EXPANDING OUR PRODUCT PORTFOLIO

For autonomous driving a combination of sensors ist necessary

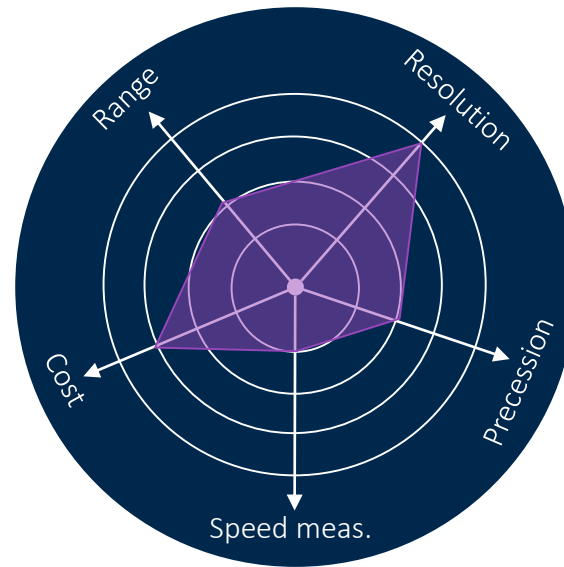
LiDAR



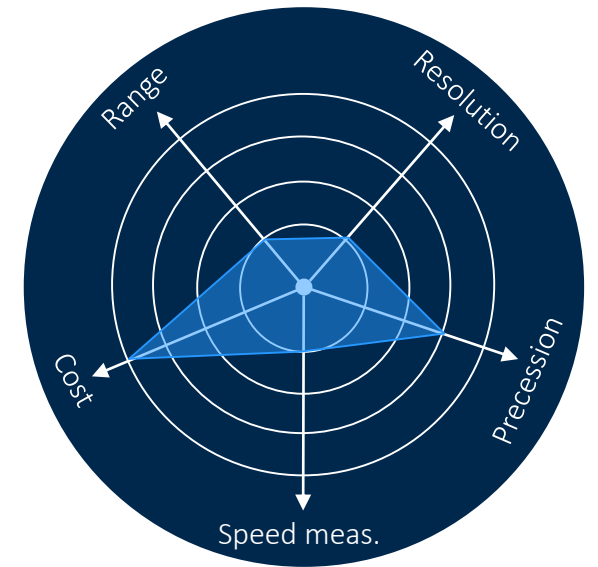
RADAR



Camera

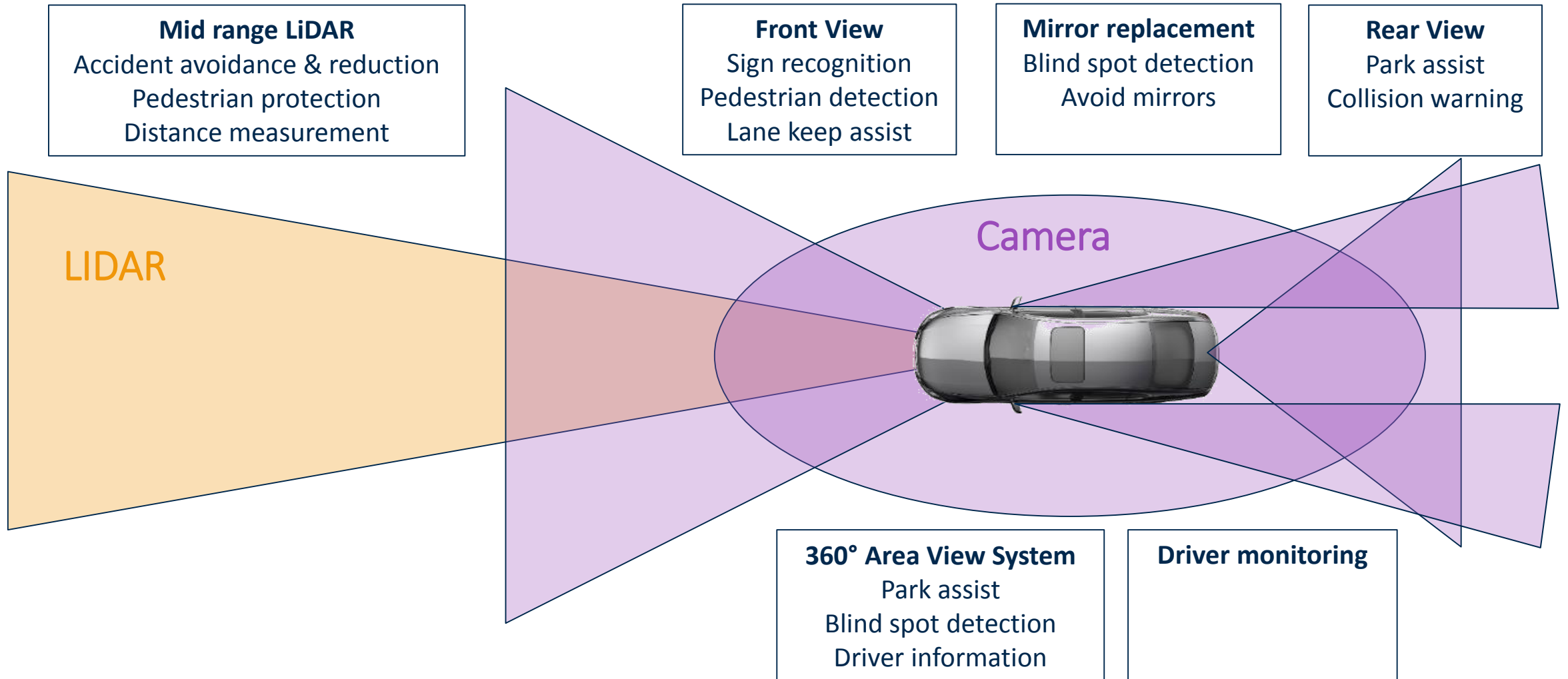


Ultrasonic



# 1. EXPANDING OUR PRODUCT PORTFOLIO

## We concentrate on LiDAR and camera applications



# 1. EXPANDING OUR PRODUCT PORTFOLIO

## LiDAR: We differentiate through 8 key respects

1

20+ years experience  
in APD production

2

Customizing capability  
for die, package and  
modules in-house

3

ISO TS 16949 certified  
production and testing

4

Sensor only company

5

Lowest noise

6

Highest sensitivity  
for 905nm

7

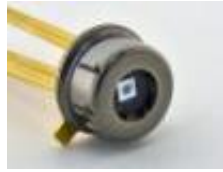
AEC-Q 101 qualified  
APD arrays

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Innovative roadmap

# LIDAR

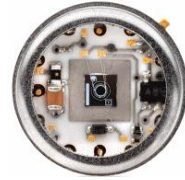
## We have a long standing experience and expertise



Single APD with amplifier



DARPA Urban Challenge; First Sensor APDs in all winning teams



Industrial hybrids (APD+TIA in one package)



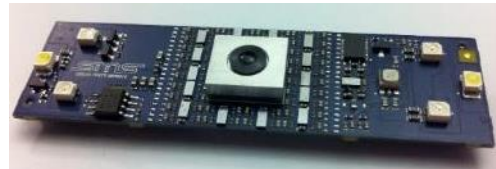
Few Pixel APD-Array in SMD package for ACC / AEC-Q 101 qualified by FIS



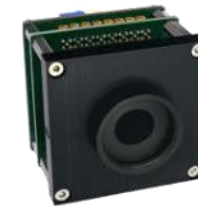
12 Pixel APD-Array in ceramic package for ACC



Gesture recognition with 64 pixel APD-Array



Receiver module with APD-Array, HV, TIA, MUX, Timing discriminator



Receiver module with APD and electronics integrated in one package



# LIDAR

## Next steps: Securing and further developing our competitive advantage

- 1** "First LiDAR": Crossfunctional tiger team for enhanced impact  
Marketing/Sales/Solution/Development
- 2** Alliances with complimentary suppliers for extended reach  
Solutions/Development
- 3** Innovative product roadmap and forward integration to ensure market leadership  
Solutions/Development
- 4** Cost down to meet future requirements of volume markets  
Production

# LIDAR

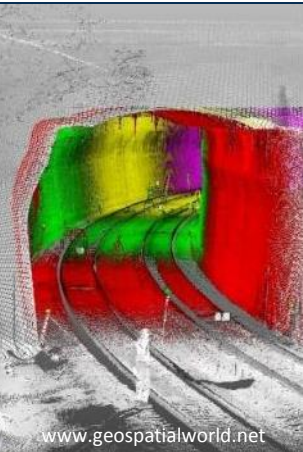
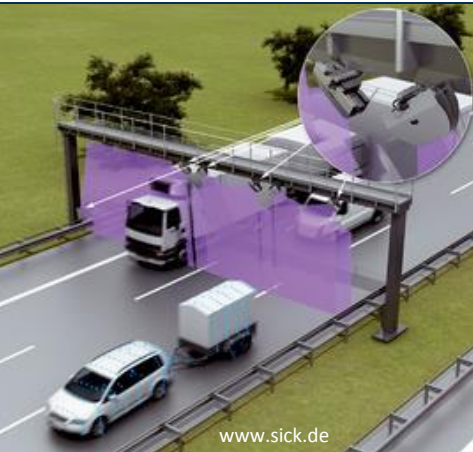

## Our activities are aimed at automotive and industrial applications

Automotive



- Safety, comfort and cost reduction infrastructure drive development of partly or fully autonomous vehicles
- First adaptation: special vehicles
- Large volume: passenger car

Industrial



- Mix of mature and emerging applications
- Industrial area applications include
  - Unmanned guided vehicles (UGV)
  - Security scanners
  - Mapping applications
  - Range finding (Point measurement)

# 1. EXPANDING OUR PRODUCT PORTFOLIO

## Camera: We differentiate through 8 key respects

1

Long-standing camera experience

2

Automotive network in new markets

3

Specialist for harsh environment and low-light applications

4

Tailor maid solutions also possible in small-scale production

5

New industrialized "Blue Next" camera generation

6

Camera to system concept

7

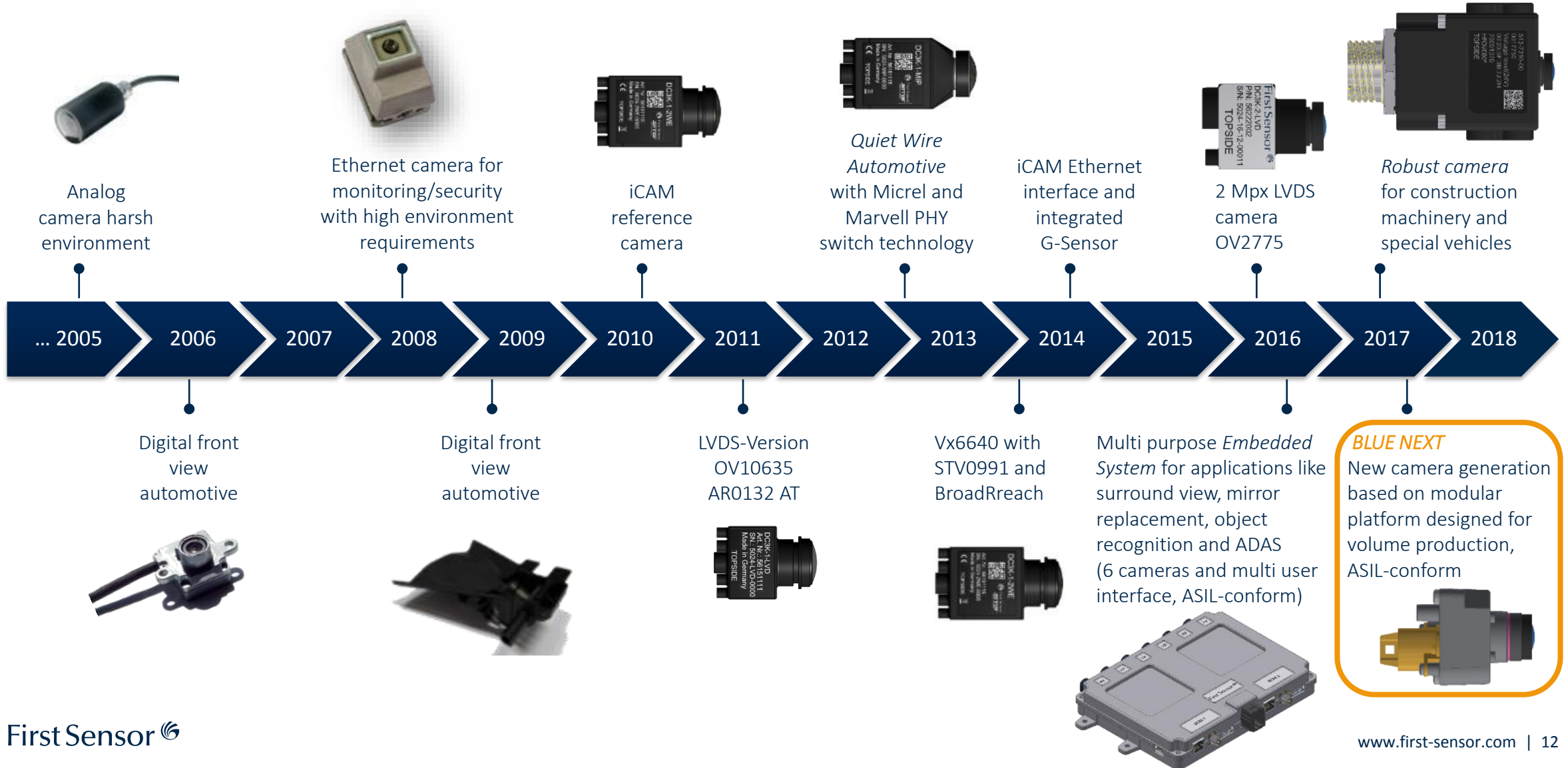
Embedded ECU platform for sensor fusion

8

Production and development "Made in Germany"

# CAMERA

## Our volume production of a new camera generation has started



# CAMERA

## Next steps: Increase market presence

- 1** Expand “Blue Next” camera family  
Development and industrialization of “Blue Next” camera solutions
- 2** Worldwide sales offensive  
Enter identified target customers
- 3** Potential in related markets  
Use existing market position in industrial area



## 2. MARKET EXPANSION

Today, car OEM & Tier 1 account for the majority of sales



## 2. MARKET EXPANSION

We can develop further potential with commercial & special vehicles

<div style="text-align: right;"><b>Segments</b></div> <div style="text-align: left;"><b>Customers</b></div>	<b>LIDAR</b>	<b>Cameras</b>	<b>Camera Systems</b>	<b>ADAS Systems Multiple Sensors Sensor Fusion</b>
Car OEM & Tier 1	Components	Customized cameras		
Commercial & Special vehicles OEM & Tier 1	Components, Subsystems and Manufacturing services	Standard cameras, tailor made solutions	Surround view, Mirror replacement, Blind spot detection	Turn assist, Break assist, Platooning, Pedestrian recognition, Autonomous driving

## 2. MARKET EXPANSION

Our focus is on target customers & leads with significant annual sales

1 Focus on defined target clients

2 Leads with potential annual sales > €500.000 per project / product

Car OEM & Tier 1



Trucks



Bus



Special vehicles

(agriculture, mining machines, fork lifters)





## 2. MARKET EXPANSION

### We focus on the European truck market

- Mediocre annual growth of Truck sales 3 % p.a.  
BUT double digit growth of revenue expected
- Focus on innovations; trend to fully or partly autonomous driving
- European key manufacturers: ~50% market share



**Daimler Trucks**  
(500 Tsd / a)



**VOLVO Group**  
(200 Tsd / a)



**VW Group**  
(450 Tsd / a)



**PACCAR**  
(150 Tsd / a)



## 2. MARKET EXPANSION

### Next steps: Target market for commercial & special vehicles

- 1** Expand products experience with car OEM & Tier 1  
Offer products for trucks, buses and special vehicles
- 2** Initial focus on European market  
Sales team targets key manufacturers
- 3** Innovate according to market specific requirements  
Basis for future orders
- 4** Sensor fusion and system expertise  
Groundwork for long term market presence

### 3. FROM SENSOR TO SYSTEM

The trend is towards the fusion of different sensors

Autonomous Level	Level 1 Assisted Driving	Level 2 Partly Automated	Level 3 Highly Automated	Level 4 Fully Automated	Level 5 Driverless
Functionality	Active Cruise Control (ACC) Lane departure warning system (LDWS)	Lane Keep Assist (LKA) Park Assist (PA)	Automatic Emergency Brake (AEB) Driver Monitoring (DM) Traffic Jam Assist (TJA)	Autopilot on Highway (AP)	Autopilot everywhere
Sensors	Ultrasonic Radar (long range) Front Camera	Surround Camera	Radar (short range) Driver Camera Lidar	SENSOR Fusion	SENSOR Fusion

# 3. FROM SENSOR TO SYSTEM

## The sensor fusion has already begun



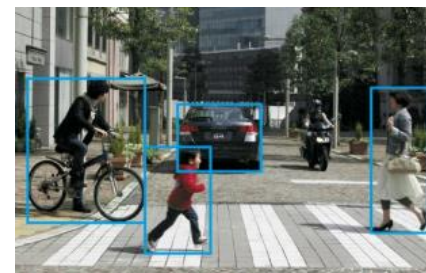
### Camera Platform:

- Blue Next Family
- LVDS, ETH, 2 WE ETH ..



### Camera Systems

- Surround View
- Virtual Mirror



### Camera Systems & object recognition:

- Lane departure
- Sign recognition
- ...



### ADAS Systems & Sensor fusion

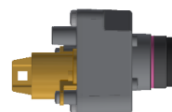
- Turn Assist
- Night Vision



Digital front view automotive



**BLUE NEXT** – Camera generation based on modular platform designed for volume production, ASIL-conform



**ECU Platform:**  
Multi purpose *Embedded System* for various applications  
Scalable processor family ASIL-conform



**Software Platform:**  
Base software with application specific modules:  
- Area view  
- Object recognition  
- ...

**Sensor fusion:**  
Camera, Radar, LIDAR, US

## 3. FROM SENSOR TO SYSTEM

We are taking part with our Embedded ECU



### Sensor Fusion

- Camera
- Radar
- Ultrasonic
- LiDAR

### Target Applications

- Area View
- Mirror Replacement
- Turn Assist
- Object/Sign Recognition

## 3. FROM SENSOR TO SYSTEM

### Next steps: We lay the foundations for sensor fusion

- 1** Extend software capabilities  
Form a dedicated software team
- 2** Entry into systems market  
Strategic customers worldwide
- 3** Partnerships with customers and suppliers  
Identify and strengthen alliances
- 4** Development of software platform  
Modular software on system-, com- and application-level

# OUR STRATEGY FOR DRIVER ASSISTANCE & AUTONOMOUS DRIVING

## Summary

- 1 For autonomous driving a combination of sensors is necessary
- 2 Expanding our product portfolio: We concentrate on LiDAR and camera applications
- 3 Market expansion: We focus on the commercial and special vehicles market
- 4 From Sensor to System: We develop our own software platform
- 5 Our LiDAR and camera sales will increase significantly in the upcoming years

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# FROM SENSOR INTEGRATION TO SENSOR FUSION: FIRST SENSOR'S LIDAR AND CAMERA STRATEGY FOR DRIVER ASSISTANCE & AUTONOMOUS DRIVING

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## **Capital Market Day**

March 22, 2018

Martin Kümmel

First Sensor AG

[www.first-sensor.com](http://www.first-sensor.com)

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