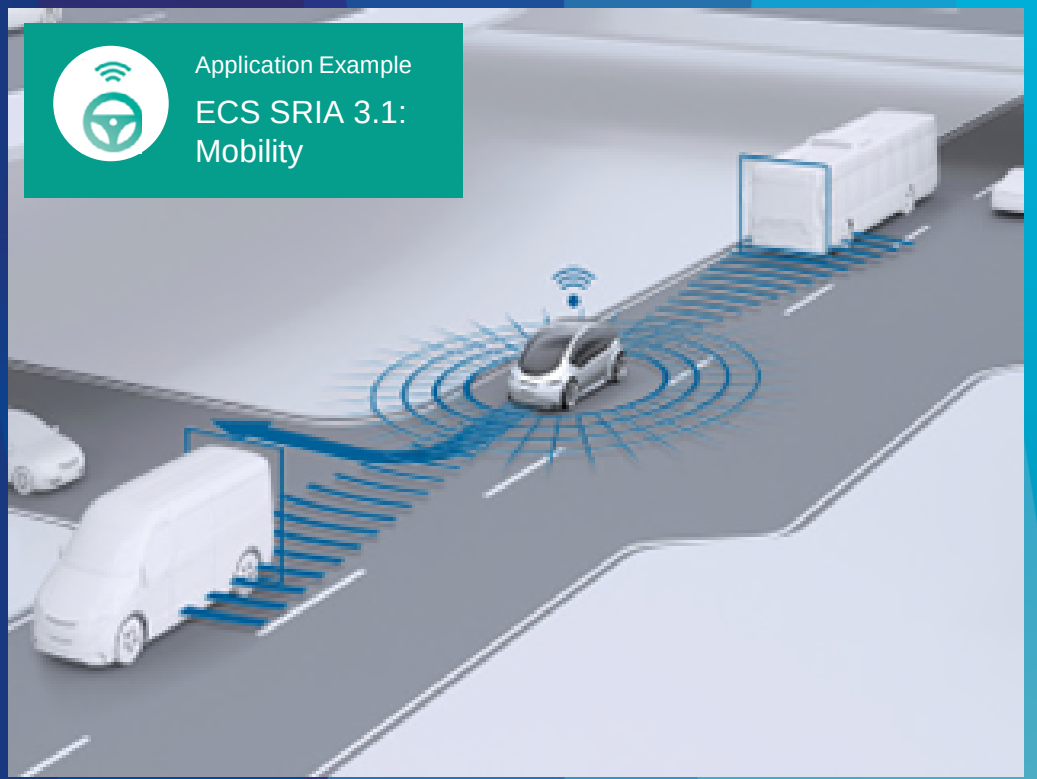
HOW **AR** , **EDGE AI** AND **ADVANCED MEMS** ENABLE BREATHTAKING NEW APPLICATIONS



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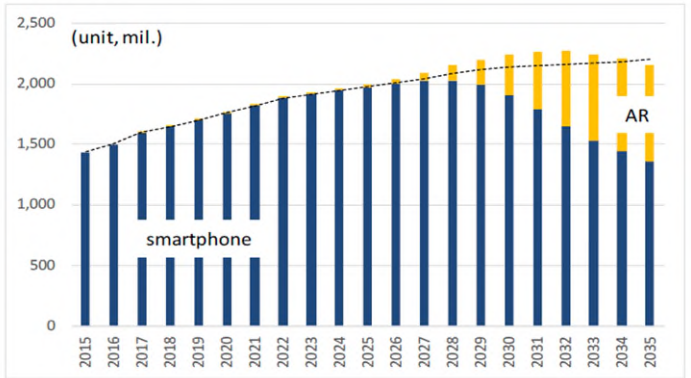
Next-level MEMS and Microsystem Technology
Application: Smart AR Glasses and Smart MEMS

- All-day smart / AR glasses are the next big thing (“the new Smartphone”)
- Key will be to achieve low weight („magic 40 gramm“) & excellent picture quality for smart glasses
- Advanced positioning by using smart & high performance MEMS sensors enriched by embedded AI
- **Technology needs to evolve significantly to fulfil the challenging requirements**



Huge market upcoming

Digital assistant
Sports
Increase quality of life
Hands-free support
Efficiency
Learning
Assistant for all ages
Working
Increase safety

Many use cases for all people

Attractive & minimal
… design, design, design

Comfortable & lightweight
… and a natural display in line of sight

Bright & transparent
… and glare-free at night

Precise & fast localization
…. continuous self-improvement by AI

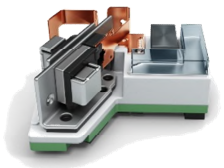
Requirements not solved so far

Next-level MEMS and Microsystem Technology
Challenges

A great user experience of the overall smart optical system can be achieved by

- low weight & high picture quality using highly miniaturized optical components (Display, MEMS projector)
- best-in-class MEMS sensors (e.g. IMU = Inertial Measurement Unit) w. ultra-high performance/robustness
- optimized embedded Software/AI and algorithms for HMI, visualization, picture stabilization and localization

Need for ultra-compact, light-weight and high performance MEMS systems



All aspects need to come together

- New high performance and lightweight MEMS components
- Low weight and robust packaging concepts
- Low power laser diodes
- Efficient micro-optics assembly technology
- Seamless Audio-Video integration
- Sensor fusion to enable AR by eye-tracking, head-tracking and camera-free orientation

Sensing is key to move from display glasses to augmented reality

Now it is the time to bring Europe in the pole position

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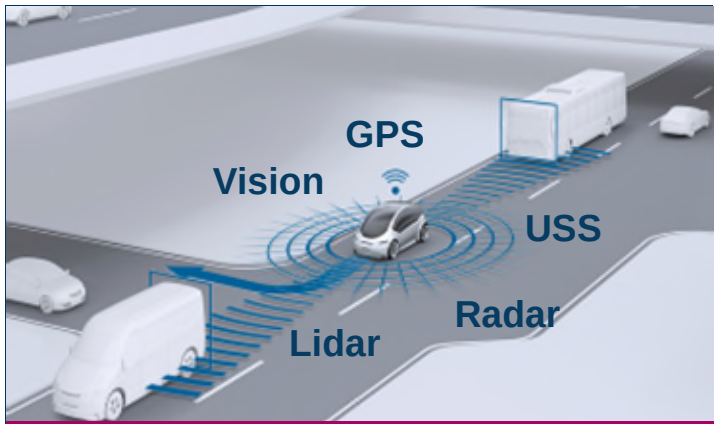
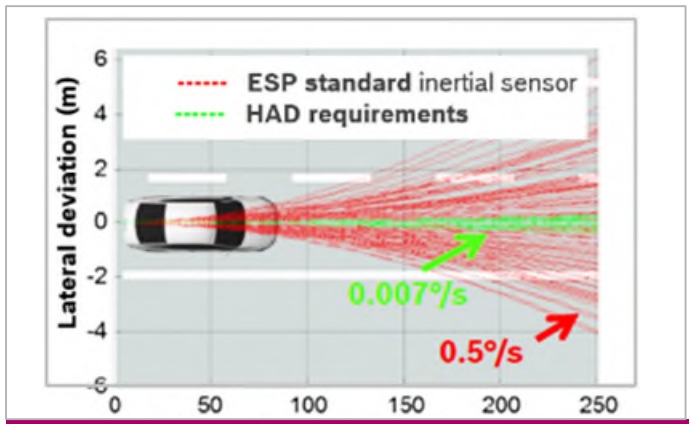
High-performance inertial sensors
Application: Highly automated driving HAD

- Localization based on satellite and sensor data fusion – Cam, USS, Radar, Lidar
- Secure safe-stop requires relative **short-term localization with high precision**
- Localization can be realized with high-performance inertial sensors
- **Key features for inertial navigation: high offset stability and low noise**



Sensor fusion for HAD



@ 100km/h: up to 4m error / 9s

Navigation error (offet drifts)

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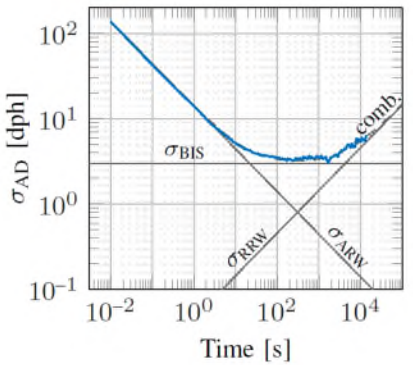
High-performance inertial sensors
Challenges

- On the path from “level 0” to truly autonomous driving (“level 4/5”) we need to improve the performance of inertial sensors by orders of magnitude:
- Improvement factors for bias stability: ×50 – 100, noise: ×10 – 30, offset: ×20 – 40

SMU2 inertial sensor
High-performance IMU for L2+ systems

“State of the art” Allan variance

- *Typical IMUs have a bias stability between 1 – 10 °/h (see graph).*
- *For SAE level 5 performance below 0.1 °/h seems accessible.*



Normal vs. high-performance IMU

Localization needs to be safe, precise, and available on highways and in cities, for all driving and weather situations.
Safe Stop requires high performance sensors – otherwise the car leaves its lane.

Multifunctional Integration
Summary

- Advanced functional innovation of complex systems requires multifunctional integration of technologies and components
- Europe‘s strength in complex systems is based on smart combination of dedicated technologies generating sustainable USP
- Continued high innovation speed possible and needed

ECS-SRIA 1.2.4.3 :
Technologies, manufacturing and integration processes