zFAS the Brain of piloted Driving and Parking

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AUDI AG

Audi
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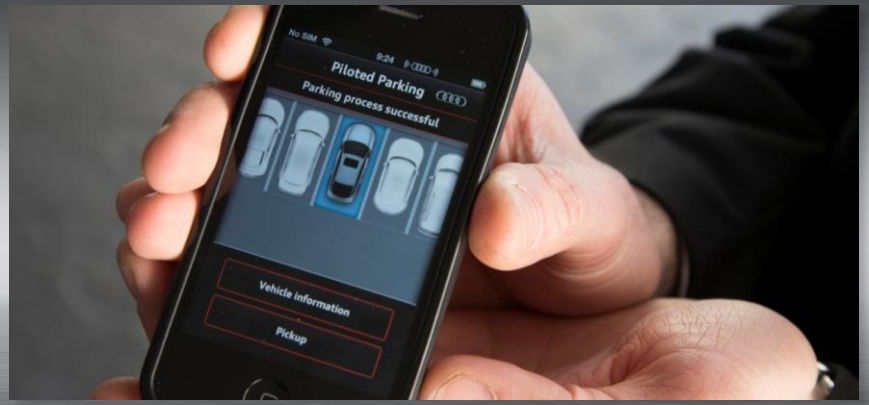
Piloted driving in the next Generation

Traffic jam pilot

- Highly automated driving at up to 60 km/h
- More safety, comfort and time
- Other activities within the legally permitted scope

Parkpilot



- Partially automated maneuvering in and out of parking spaces
- Convenient entry and exit
- Operated by smartphone or key

Driver assistance systems today

1. Systems assist the driver
2. Driver has to intervene in a critical situation
3. Driver constantly has to monitor

Today’s driver assistance systems assist the driver with their driving task

Piloted driving tomorrow

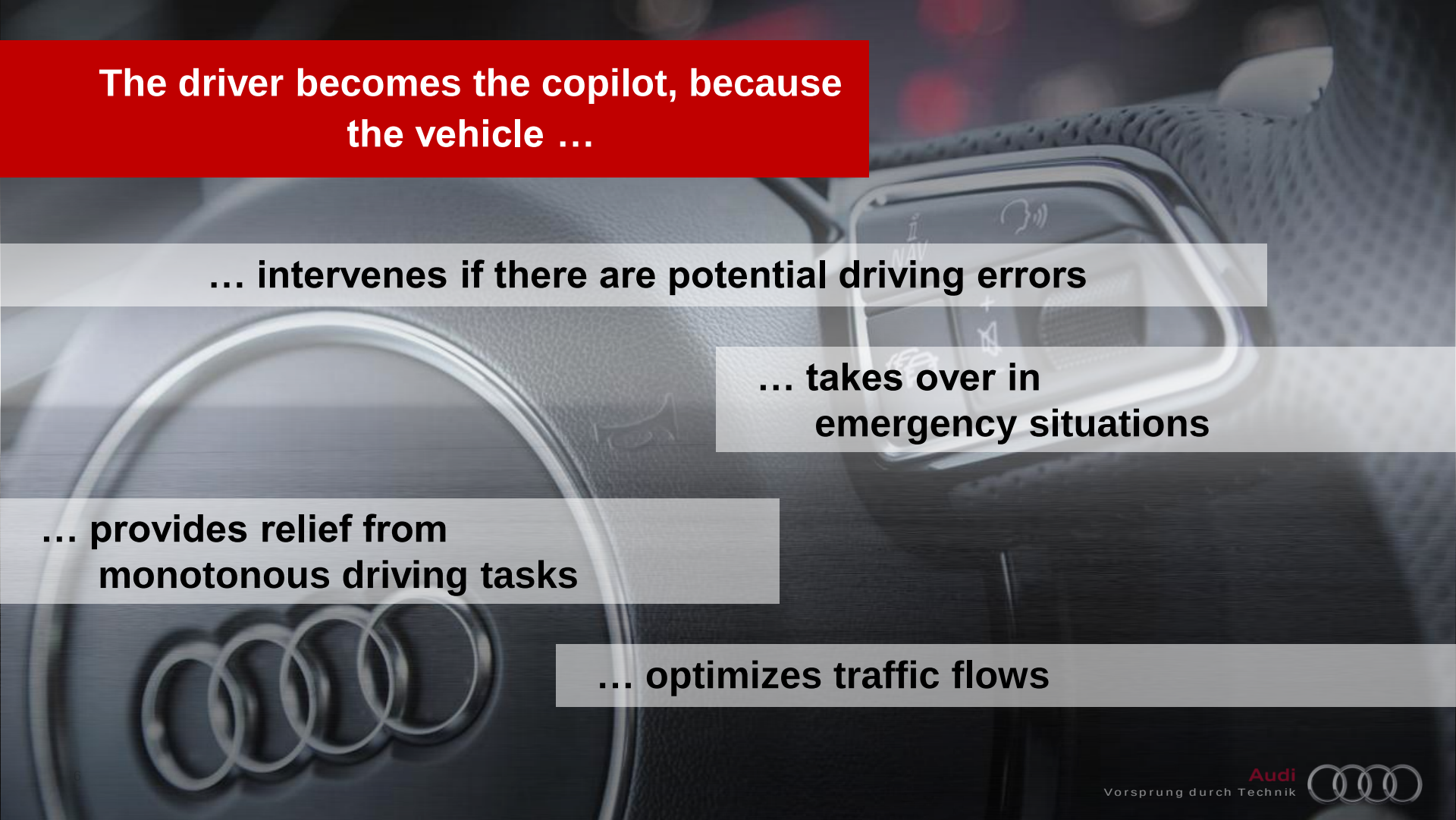
1. System anticipates
2. Constant monitoring not necessary
3. Driver requested to take over with plenty of notice
4. Use of other vehicle-integrated functions (if permitted by law)

In certain situations piloted systems take over the task of driving

Pilotiertes Fahren: Advantages

Piloted driving relieves the driver in traffic jam situations

Average time spent in traffic jams per day in minutes


The driver becomes the copilot, because the vehicle …
… intervenes if there are potential driving errors
… takes over in emergency situations
… provides relief from monotonous driving tasks
… optimizes traffic flows
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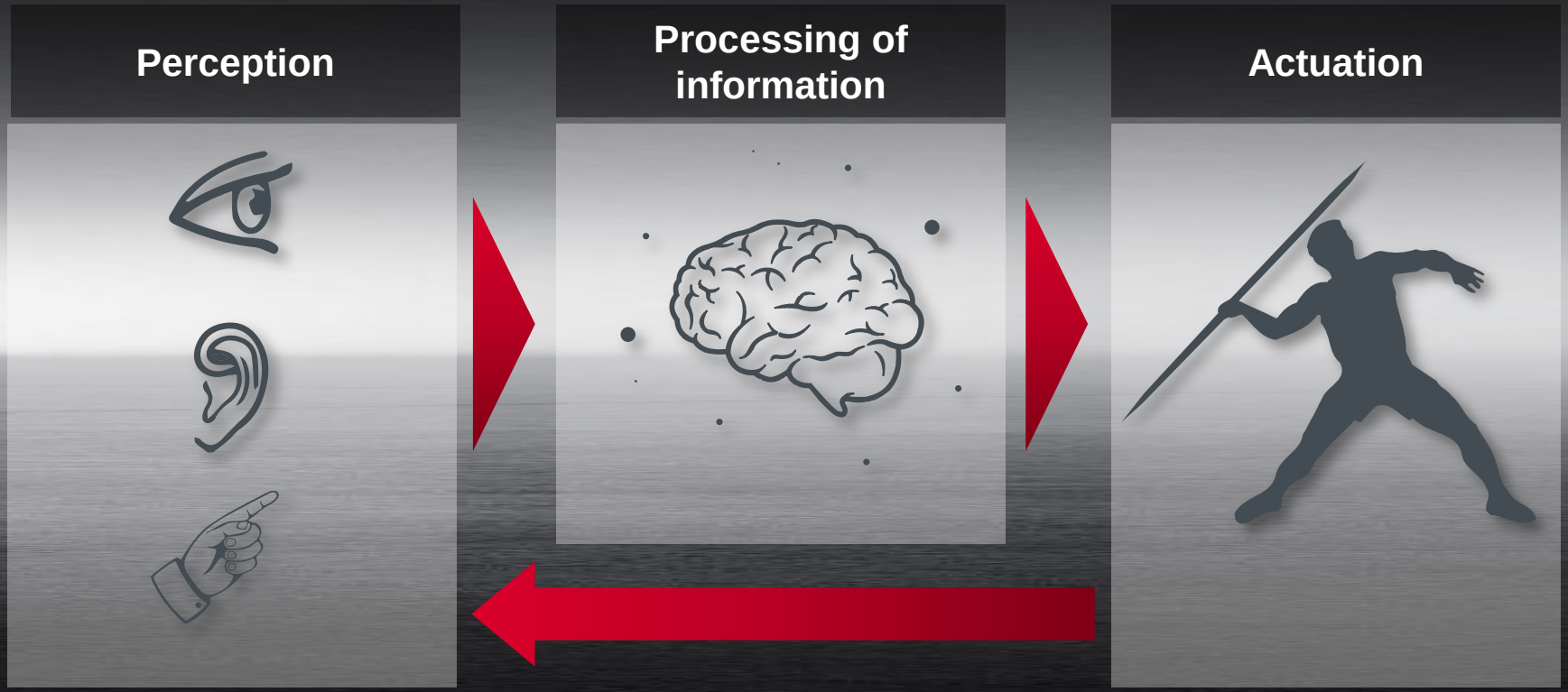
What needs to be done to implement this?

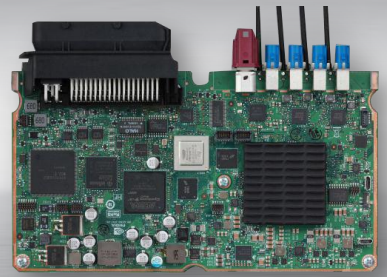
Human control process



Piloted driving control process

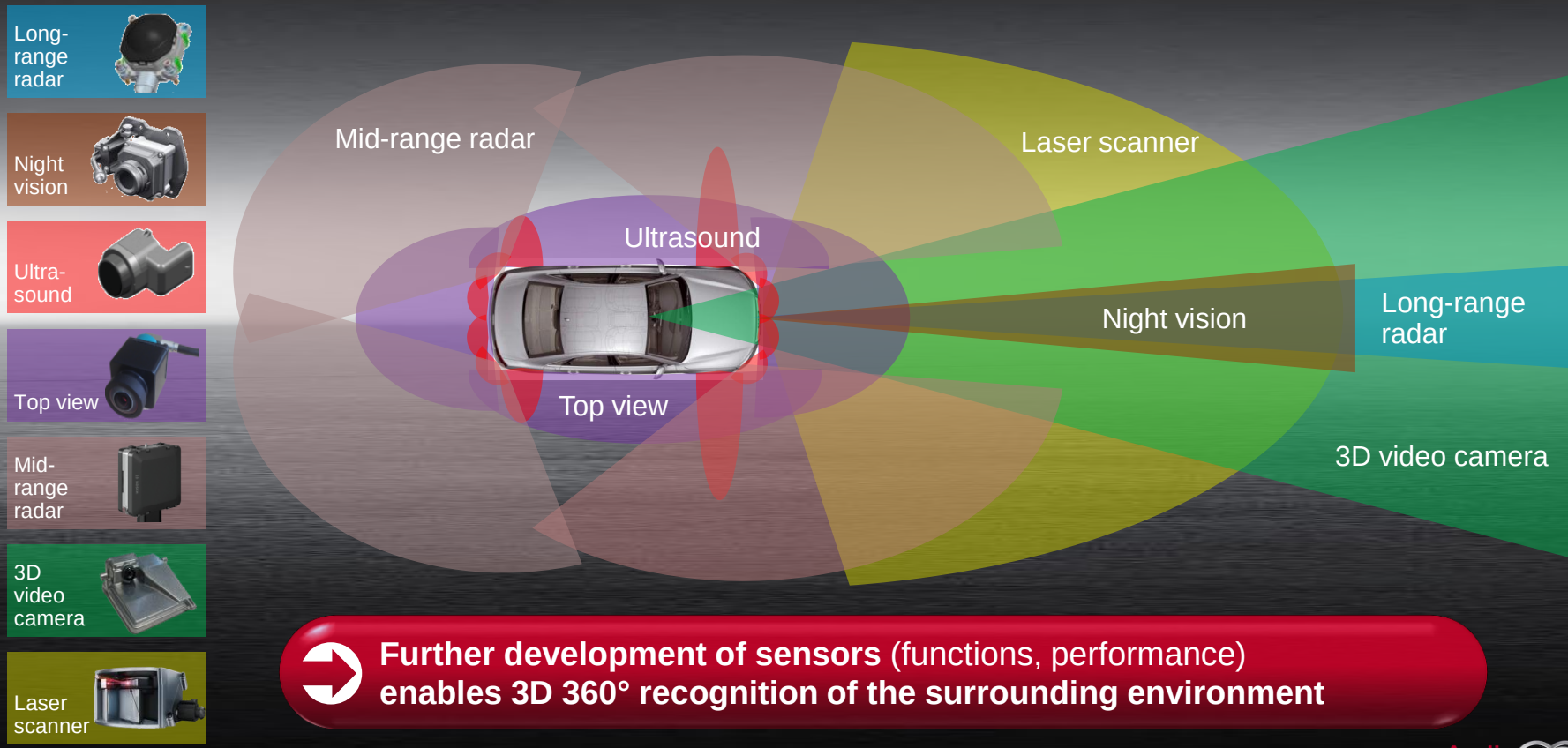
Environment detection

Data processing



Actuation

Sensorset to enable piloted functions



Further development of sensors (functions, performance)
enables 3D 360° recognition of the surrounding environment

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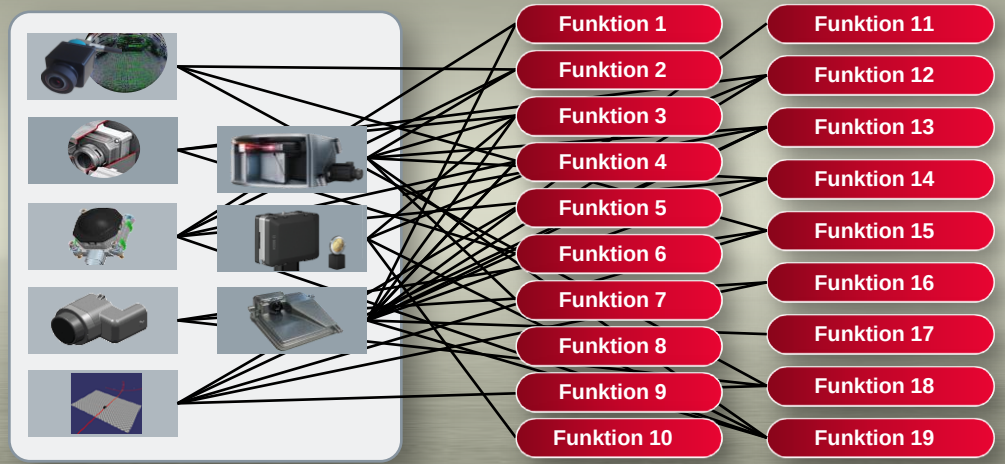
zFAS and Sensor-Daten-Fusion

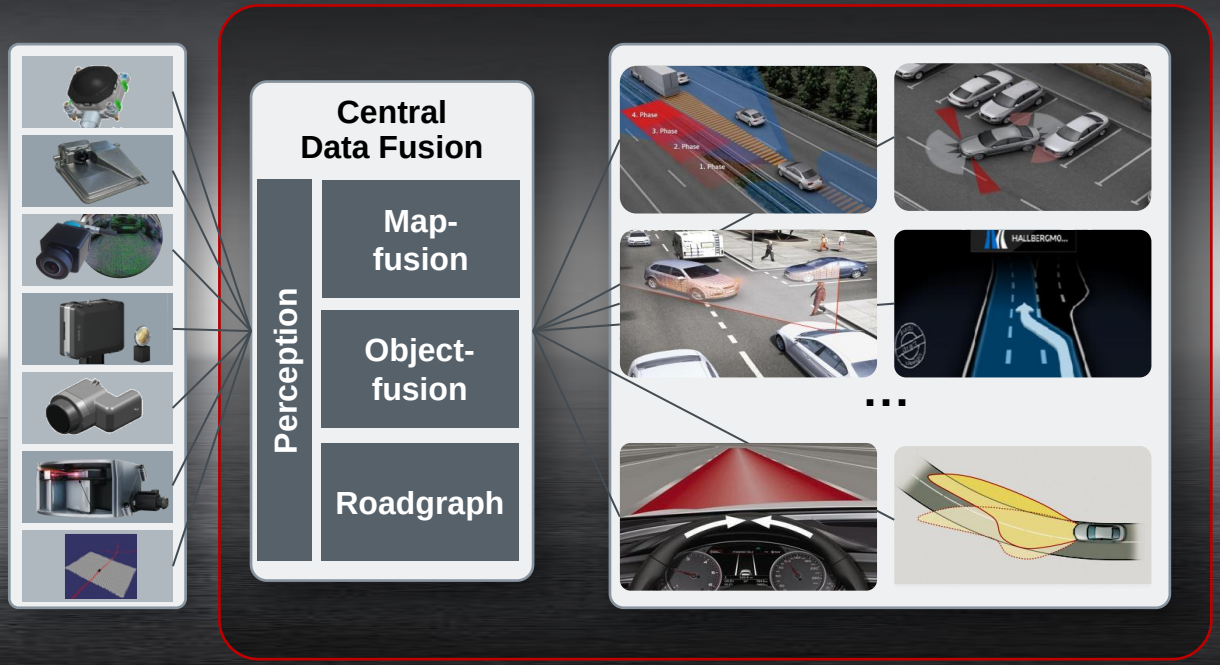
Today

Future



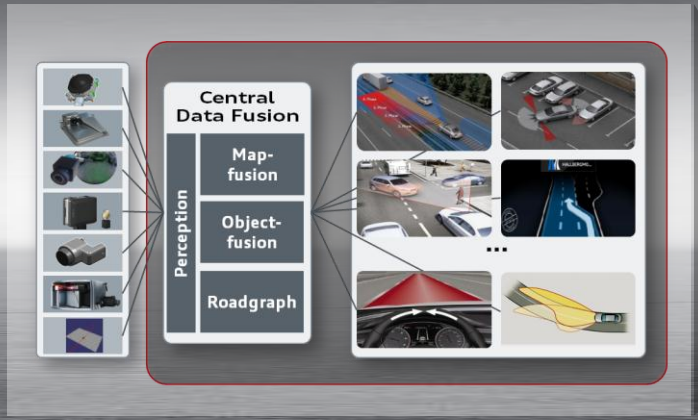
Optimale Sensornutzung führt bei Beibehaltung der heutigen dezentralen Datenverarbeitung in Zukunft zu signifikantem Komplexitätsanstieg!

zFAS and Sensor-Data-Fusion

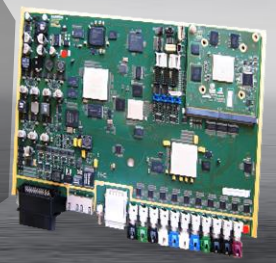


zFAS for the realization of a central Data Fusion and Functions

Central FAS control unit



Integrated
functional architecture



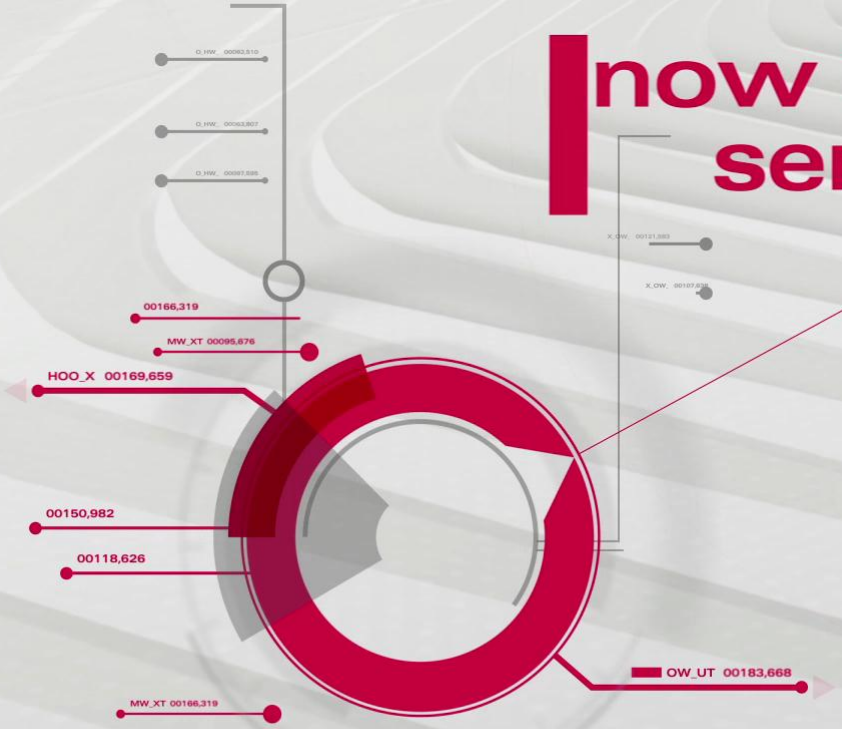
zFAS

Benefits:

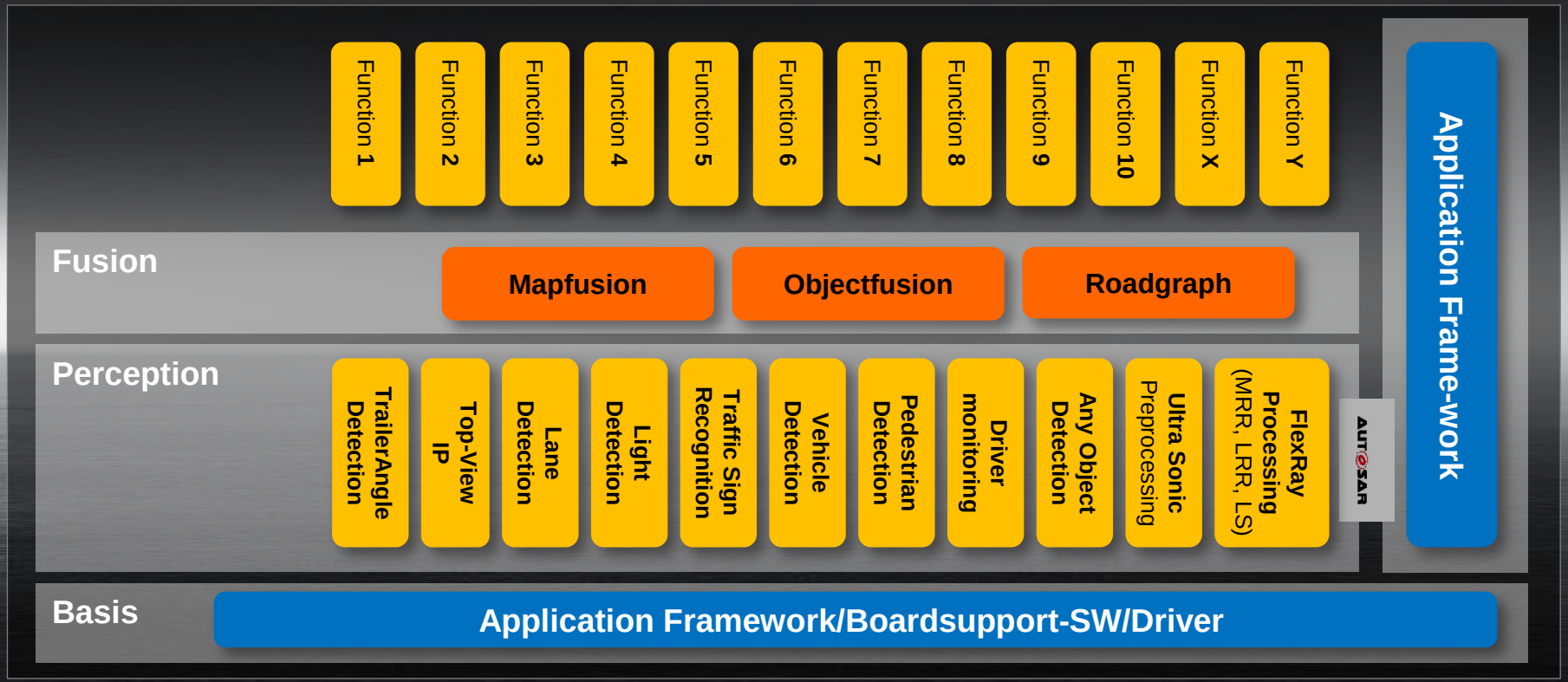
- **High integration of multiple control units**
- **Modular architecture** (application and hardware decoupled)
- **Modular possibility of adding functions**
- **Significantly improved recognition of the vehicle's surroundings through fusion of sensor data**
- **Information is available to all FAS functions**

Piloted driving has reached series technology

now it's time for series production



Software-Architecture zFAS



Tier 1	SW of ECU supplier	Tier 2	3rd Party Software	Audi SW Group	SW from AUDI with AEV-2/EFS/Astec/…

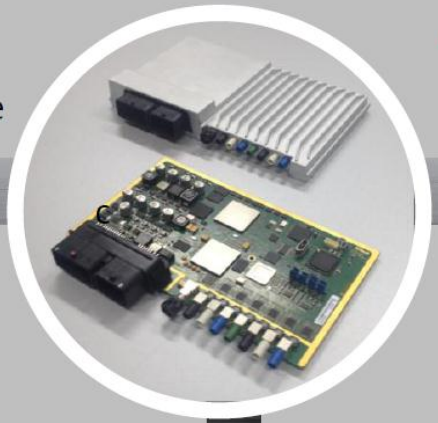
Technical Realization – zFAS

Infineon - Aurix

- Hosting different functions
  - A-SIL D complient
- Interface to the Car architecture

Altera - Cyclone

- Responsible for Sensor Fusion
- Preprocessing Ultrasonic Sensors
  - Internal Gateway



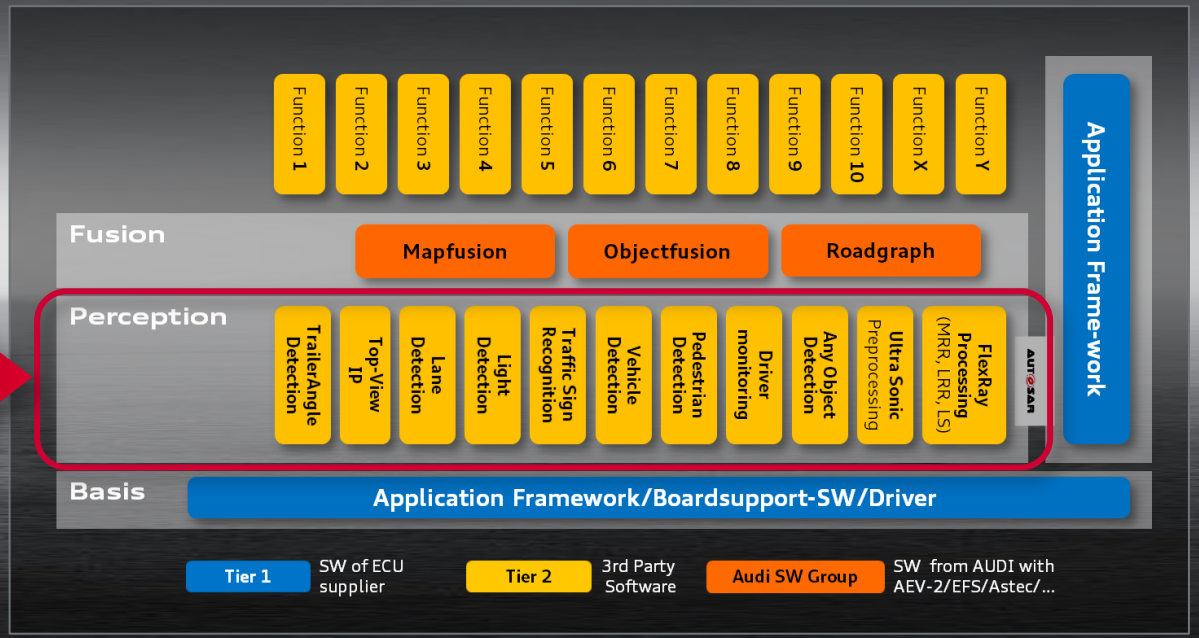
- Imageprocessing for Parking
  - 4 Kameras computed
    - Drivermonitoring

NVIDIA K1

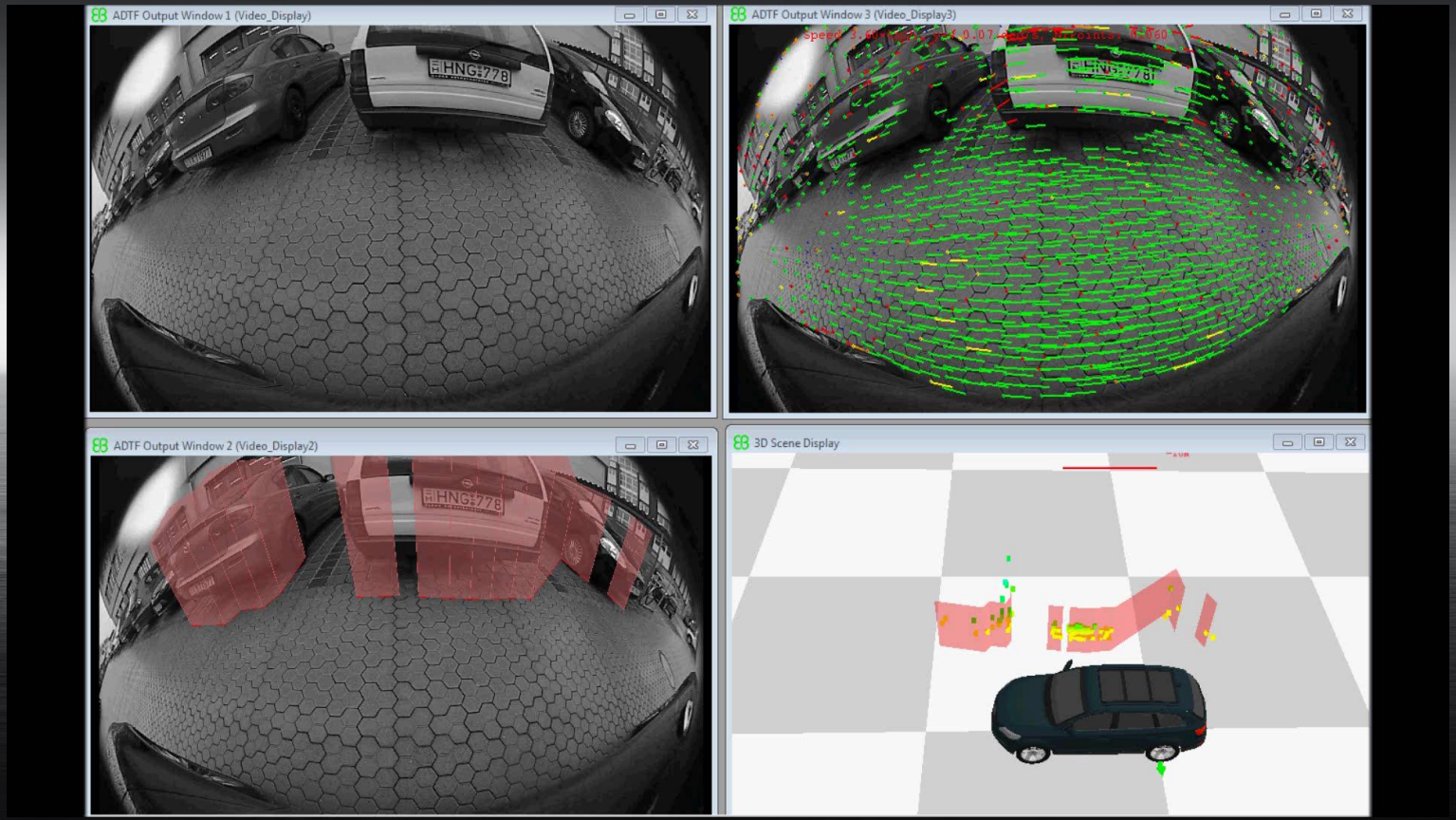
- Frontcamera Image Prcoessing
  - AEB Cars
    - AEB Pedestrians

MobilEye - EyeQ3

Examples of Perception

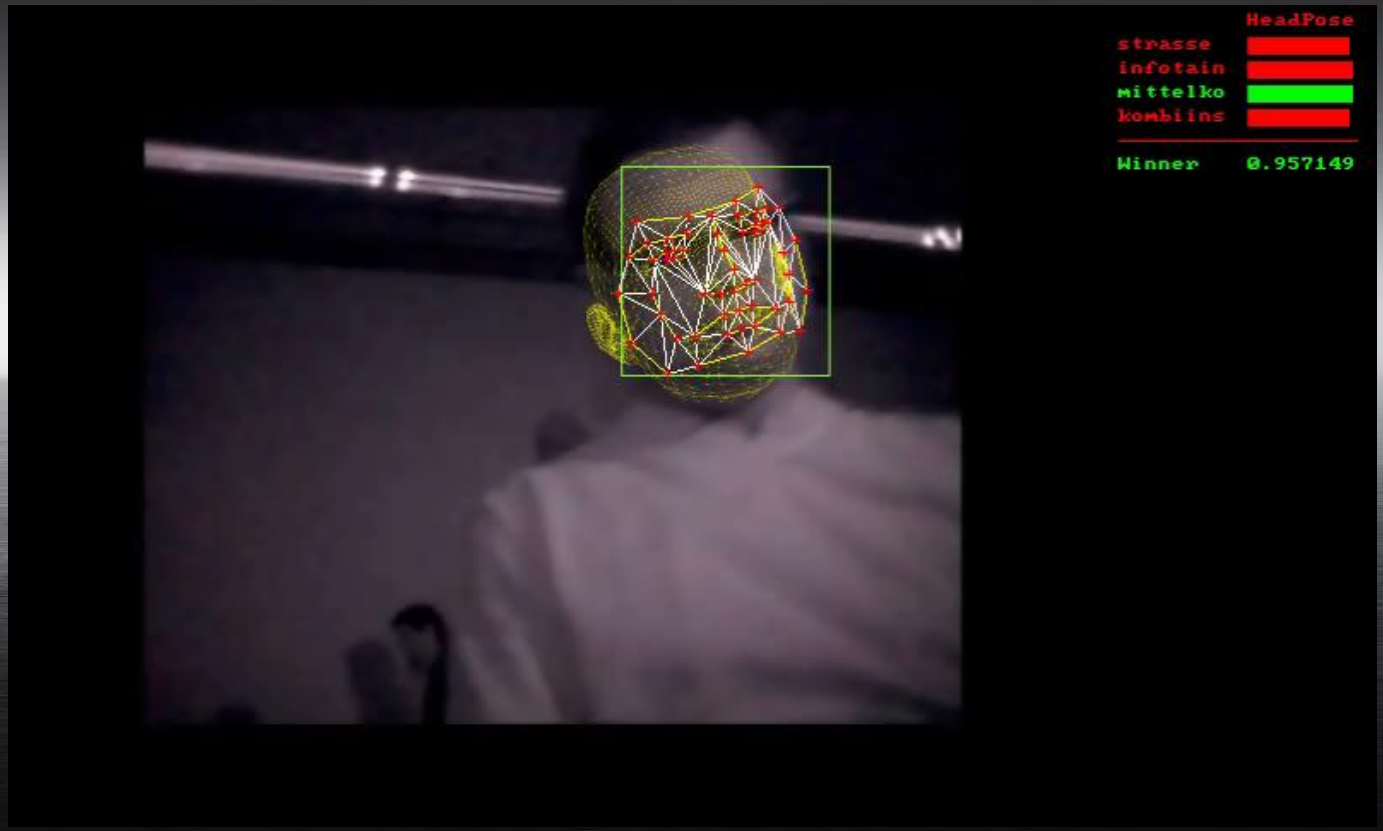


Structure from Motion with Top View Cameras

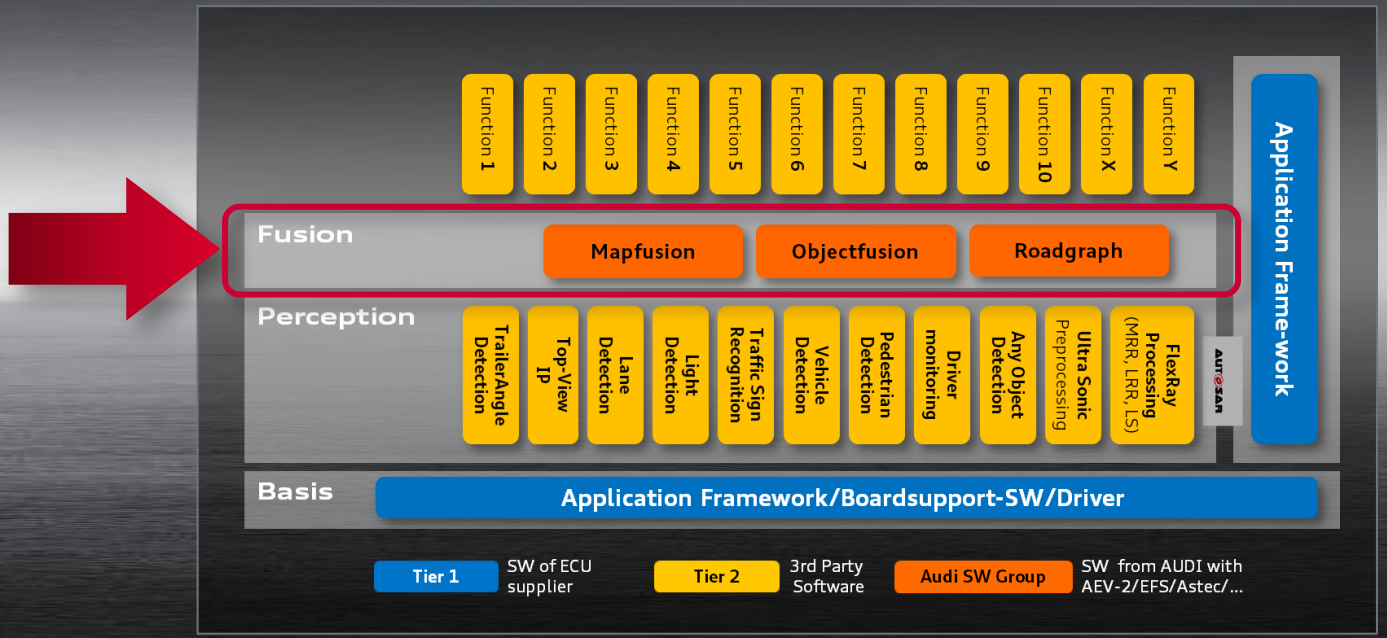


Parkmarking detection

Driver Monitoring



Fusion at Work

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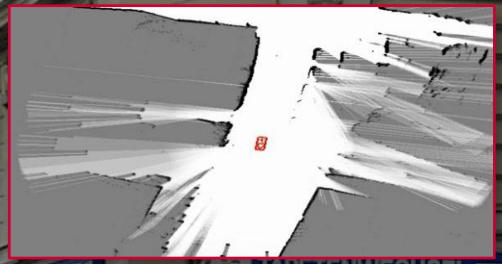
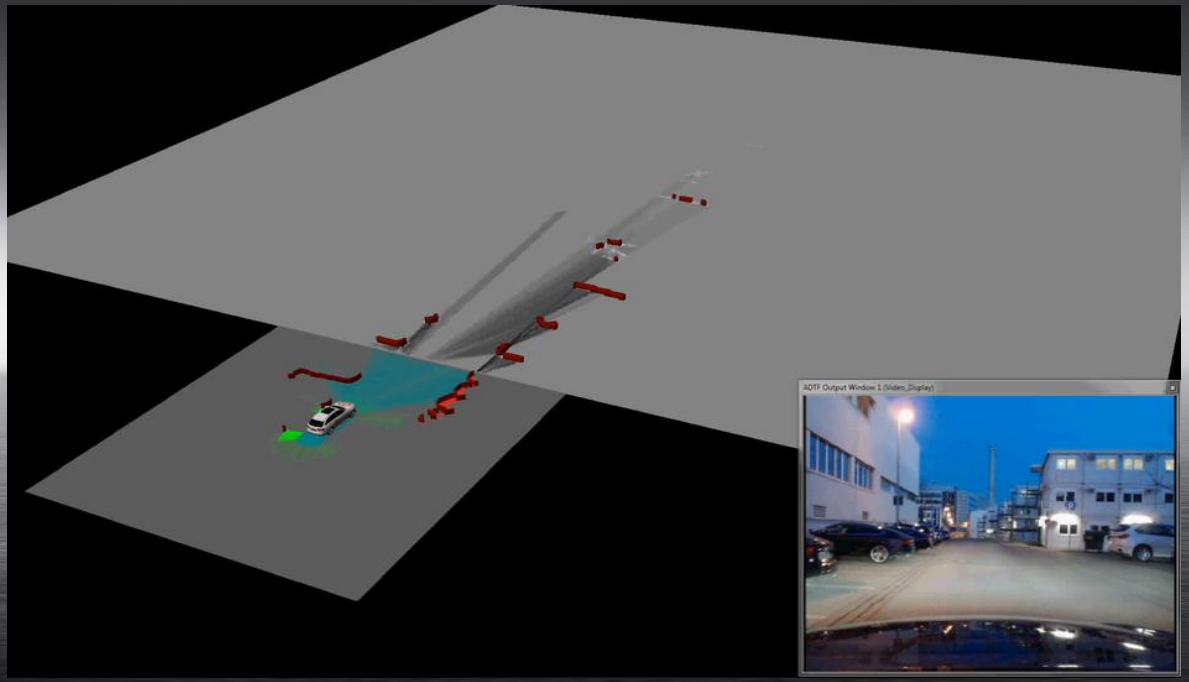
Kartenbasierte Fusion



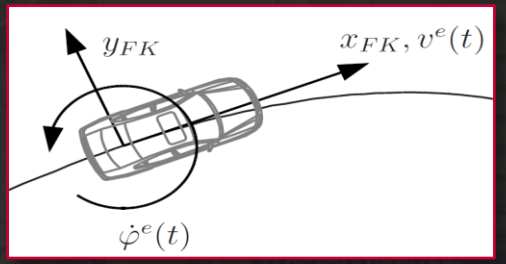
Map fusion



Fusion:

- Representation of statical obsticals
- Representation with self defined interfaces called fences
- Interacting Short and Long and range map
- Seperation in drivable and non drivable obsticals
- Long range map 160m
- Short range map accuracy cm-level

Object Fusion



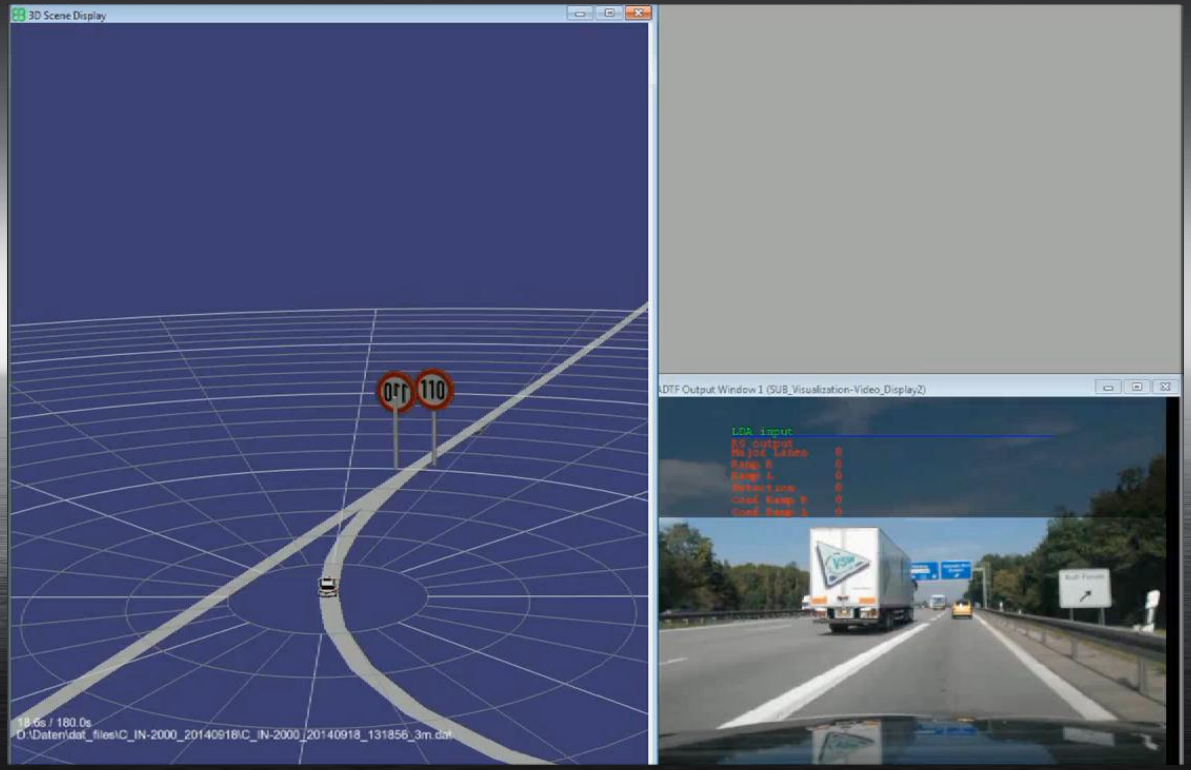
Object fusion

Benefits:

- Fusion of dynamic object
- Cars, trucks vulnerable road uses and animals
- Estimation of dynamic properties of the vehicle (Yaw rate , Accelation, velocity ,..)
- Object map 360 Degrees
- Furthest objects in map 800m for WLA
- All sensors provide input to the objects fusion

Roadgraph

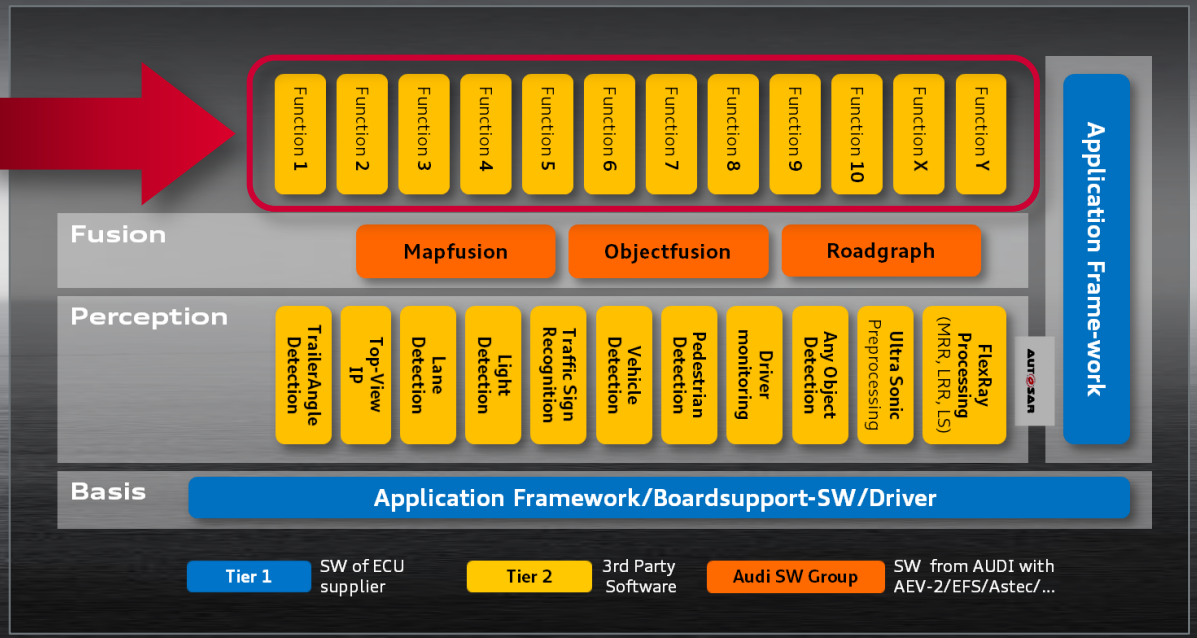
Roadgraph



Benefits:

- Focus: Road and lane model and traffic rules
- Fuses digital maps of Navigation system with detected onboard information (lanes, …)
- Exact positioning done with enhancemnt of th e naviation with detected properties
- Big Loop: Roapgaph is from the vehicle side the cental elemend of backend fleed mapping approach

Functions on-top of the fusion?



Piloted Parking

Piloted Parking

First OEM to launch a full AEB with a monokular 3D Camera

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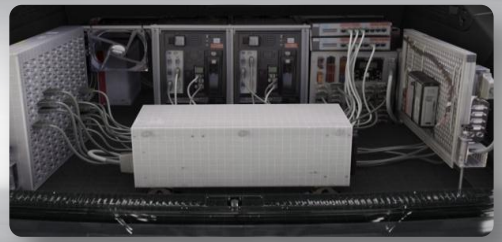
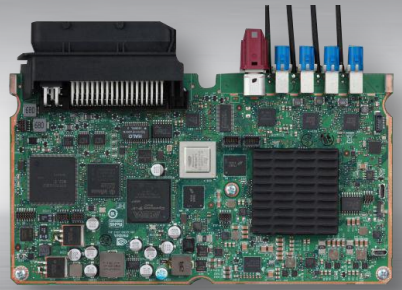
The history of the zFAS Showcases

CES 2013



CES 2014
(A sample)



B sample

The history of the Piloted driving Showcases

2009
Audi TT
Salt desert
Bonneville

2010
Audi TT
Pikes Peak

CES 2013
Parking & jam pilot
Release trial in
Nevada

CES 2014
Parking & jam pilot
implemented on
zFAS

August 2014
Release trial
in **Florida**

September 2014
Release trial
in **Californien**

Oktober 2014
RS7 drives piloted around
Hockenheim
race circuit