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Automated Driving Applications and Technologies for Intelligent Vehicles

Designing System Architecture

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Final Event
Aachen, Germany
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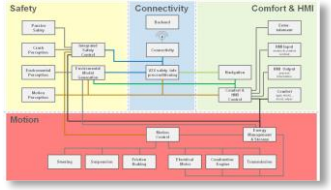
// Overview of Working Packages

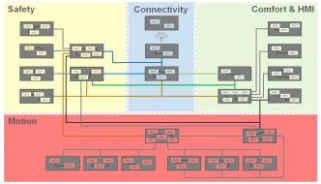
- Functional & Safety Requirements for automated driving
- Specification and harmonization of functional and system architecture
- Definition of a fail-operational & resilient system architecture:
  - Duo Duplex Architecture with fault detection selected and advantages evaluated
- Specification of harmonized driving strategies for minimum risk maneuver & lane change maneuver

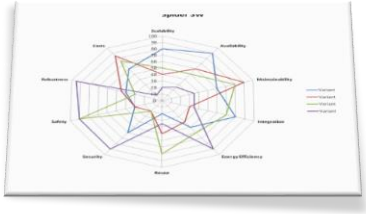
// System Architecture Design



Logical Architecture

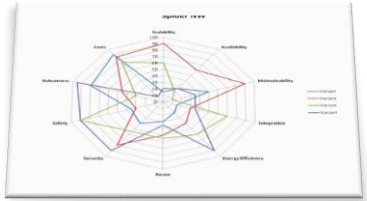
Solution independent structuring of features

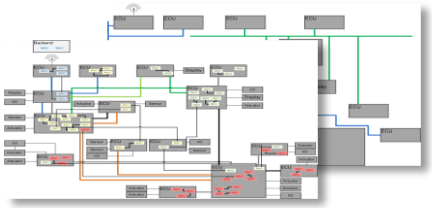




Functional Architecture

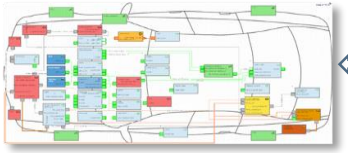
Functional description of logical features & their interfaces

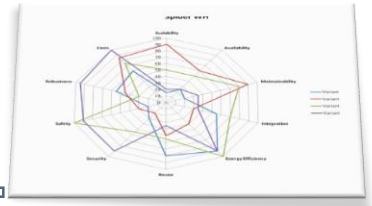




Network Architecture

Electric infrastructure of the system and
partitioning of SW functions and I/Os

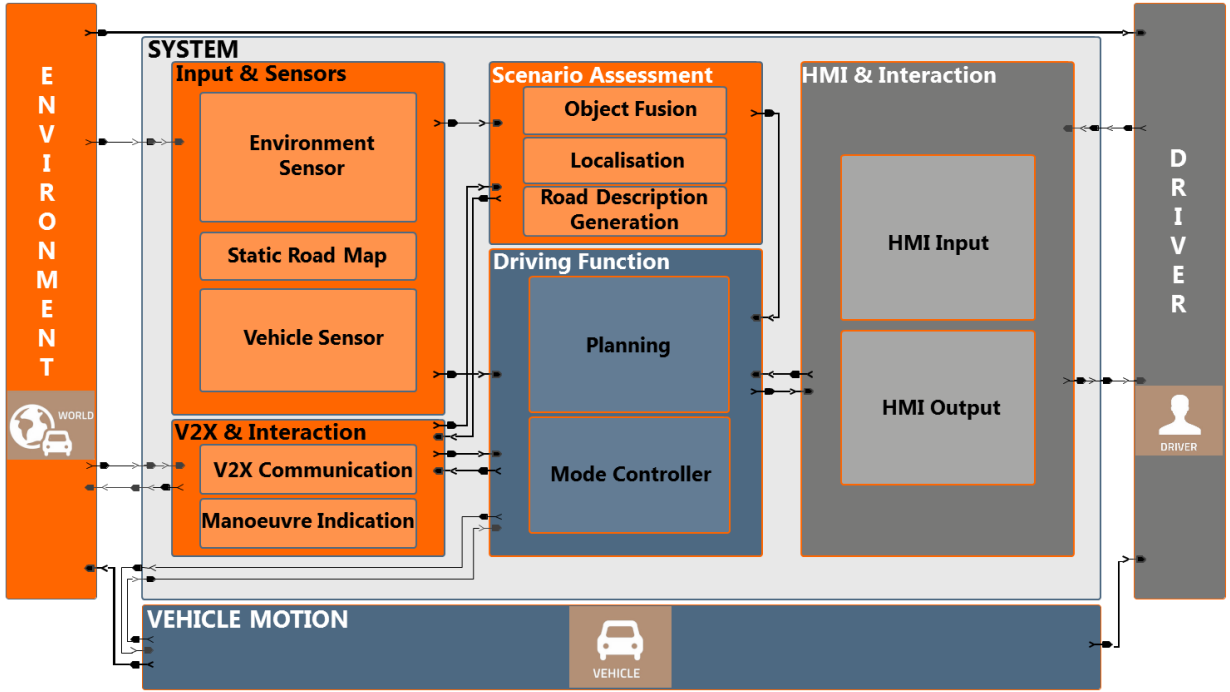




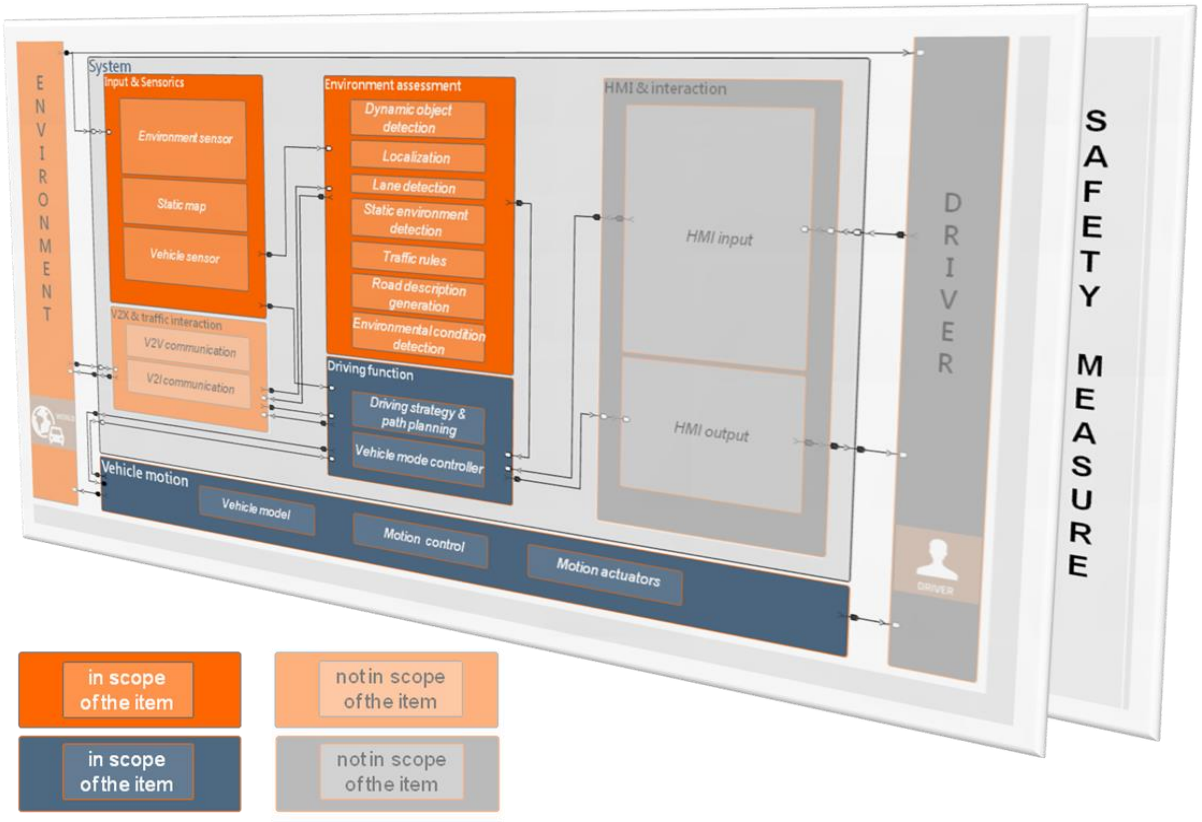
Wiring Harness Architecture

ECU placement and the electrical & physical connections

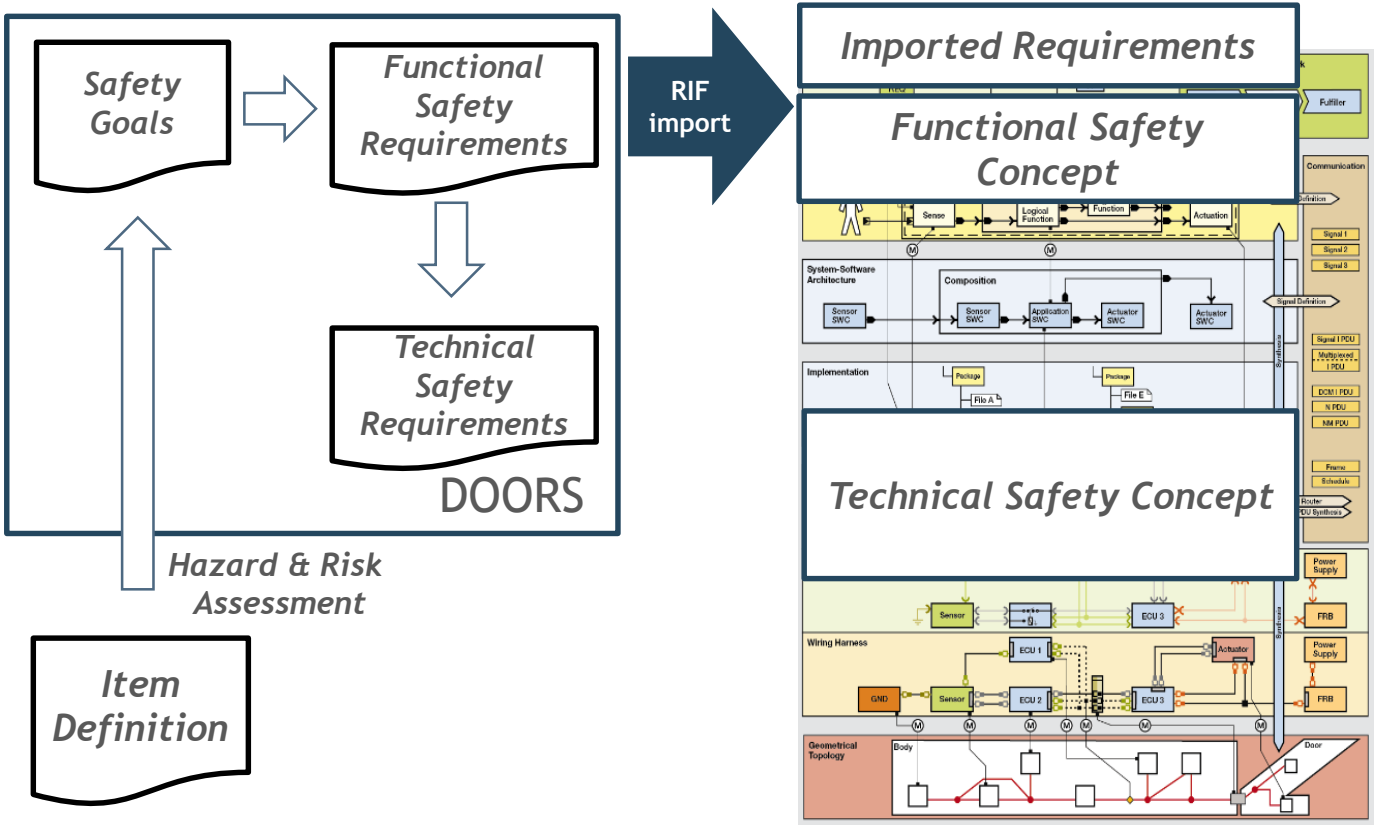
//Initial System Architecture



// Refined System Architecture



// Technical Architecture Design



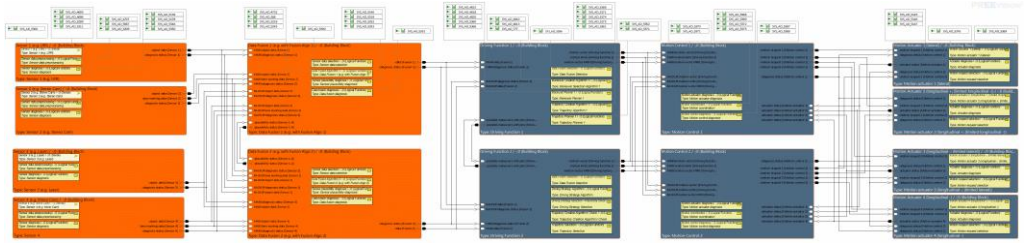
// Technical Architecture Design

Imported Requirements

- 1.5.5 Perception Requirements / -;0 (Requirement)
  - 1.5.5.2 SYS_AD_4695 / -;0 (Requirement)
  - 1.5.5.3 SYS_AD_4696 / -;0 (Requirement)
  - 1.5.5.4 SYS_AD_5311 / -;0 (Requirement)
  - 1.5.5.5 SYS_AD_5310 / -;0 (Requirement)
  - 1.5.5.6 Traffic sign/rules detection / -;0 (Requirement)
    - 1.5.5.6.1 SYS_AD_2504 / -;0 (Requirement)

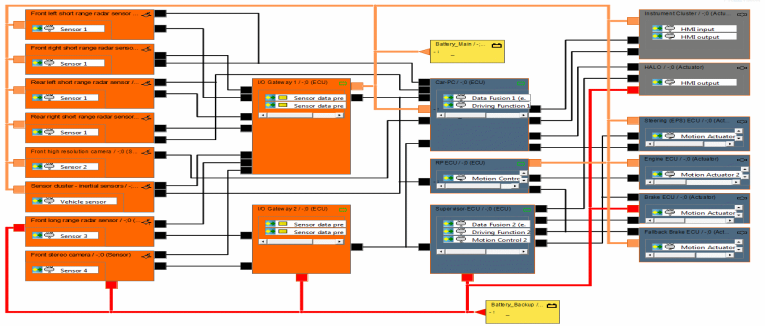
Requirements Mapping

Functional Safety Concept



Function Mapping

Technical Safety Concept



// Functional Safety and Redundancy Concept

- **Vehicle E/E – Architecture needs a holistic approach**
  e.g Service Oriented Architectures, Cloud services, Update over the air

› Safety & system architecture/ interface must be **defined together**

› **Safety**, **reliability** and **availability** has important implications for analyzing

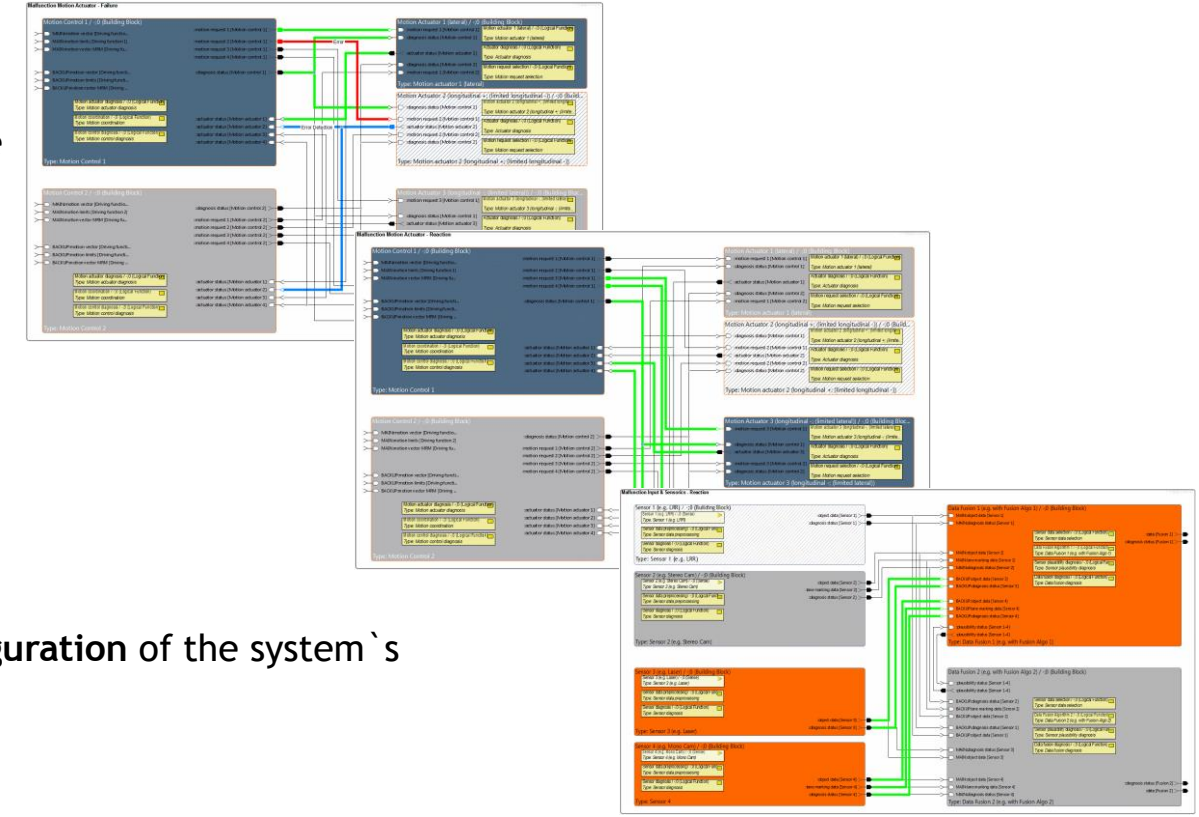
› **Fail Operational** Behavior – fail silent

// Functional Safety and Redundancy Concept

- A method for functional safety analysis is developed and applied to the representative case of ‘Lane Change’.
- Relevant impact for the definition of a fault tolerant architecture.
- A structured approach is established regarding the implementation of the sensor system.
- The work addresses aspects:
  - redundancy,
  - data fusion
  - specific demands to bring the vehicle to a safe state in case of failure.

// Functional Safety and Redundancy Concept

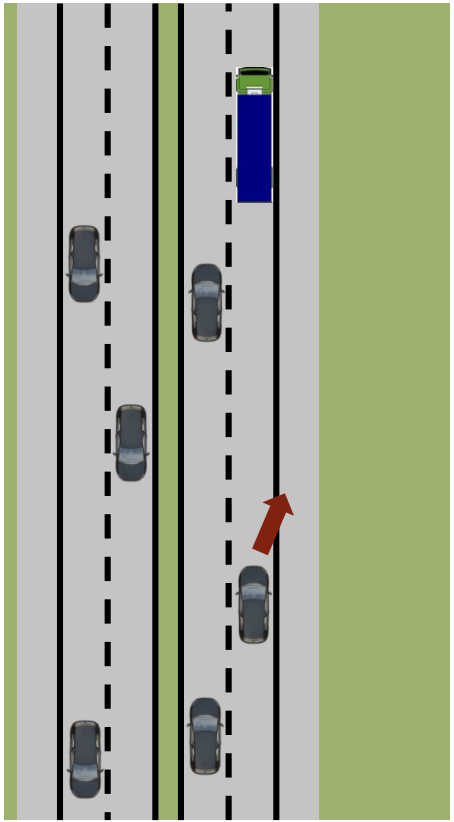
- Fault Tolerant System Architecture
  - Proposal for **Error Detection** and **Recovery Mechanisms**
  - Detection of:
    - Sensor Fault
    - Data Fusion Failure
    - Actuator Failure
  - **Fault Handling** and **Reconfiguration** of the system`s functionality



// Harmonization of Driving Maneuvers

The MRM is a manoeuvre to bring the vehicle into a minimal risk condition only if:

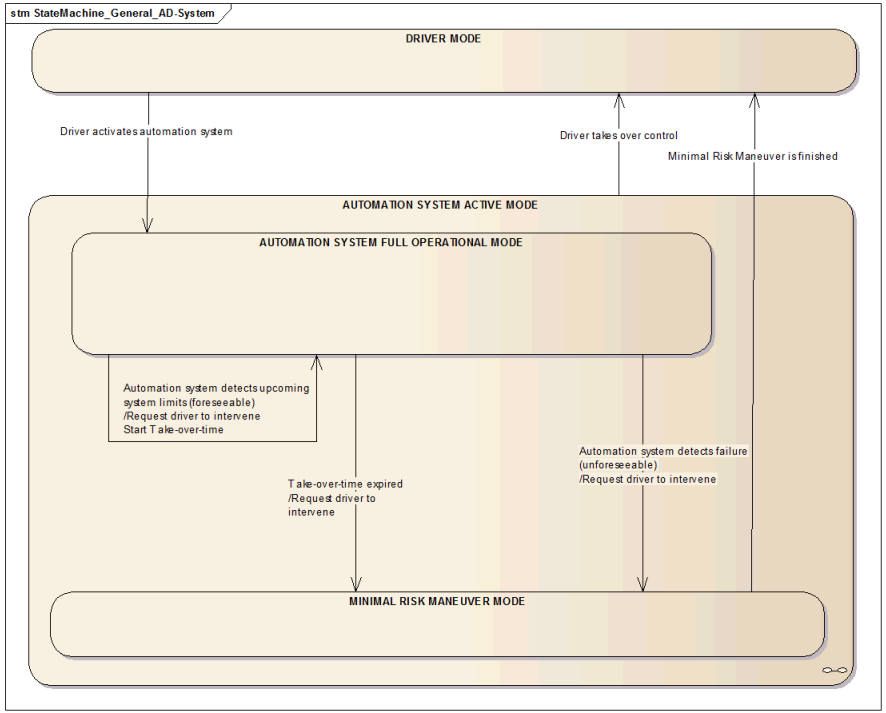
- driver does not react on a planned and initiated by automation system (with sufficient take-over time) take-over-request
  - upcoming situation cannot be handled by automation system (e.g. infrastructural reasons, technical limitations like heavy rain, fog,…)
    -> foreseeable situation
- an unplanned automation system related failure appears (take-over time may be limited to zero in worst case);



// Harmonization of Driving Maneuvers

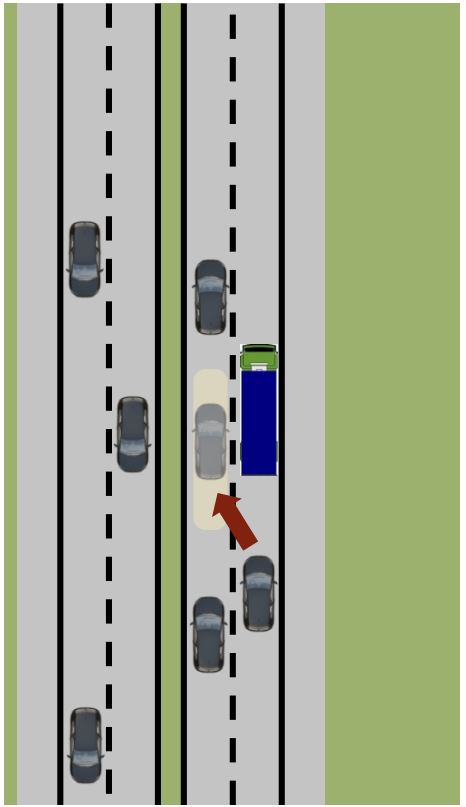
The minimal risk condition depends strongly on the situation and the characteristic of the system failure. For automated driving on highway, urban or close distance scenarios a safe stop shall be achieved.

- The MRM is **not**:
  - a degradation of the automation system
  - a collision avoidance functionality



// Harmonization of Driving Maneuvers

A Lane Change is a short term driving manoeuvre with a clearly defined start and end condition to bring the host vehicle from the current driving lane to an adjacent driving lane, either to the left or right. Before starting and after finishing a Lane Change manoeuvre the host vehicle is in Lane Following.



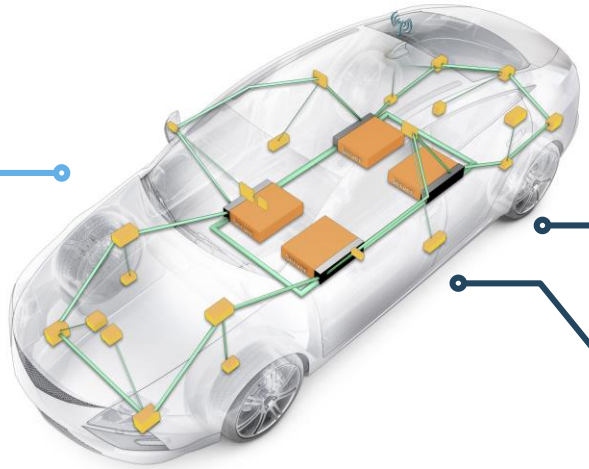
- A Lane Change shall be clearly identifiable by the surrounding traffic participants and driver of host vehicle
- Conditions harmonized
- Reasons to trigger a Lane Change defined
- Sequence of an automated lane change harmonized

//Conclusion

Key Drivers

- eMobility
- Automated Driving
- Mobility Services
- Connectivity

- Market
- User experience



- Updatable
- Upgradable
- Dependable (reliable, available, safe & secure)

- Technology
- Function
- Costs
- Quality

Challenges

System orientation **enables us to handle the challenges**

Co-funded by
the European Union

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Thank you.

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