Emm!

mobility solutions

ENGINEERING MODERN MOBILITY

Agenda

MAC Stuttgart, 11.4.2019

1. Future Mobility System - our vision
2. Mobility System - main Items
3. Challenge – handling of complexity
4. Mathworks tools – role and usage
5. Results – development status
6. Field of actions – our system engineering strategy
7. Summary

Future Mobility System – our vision

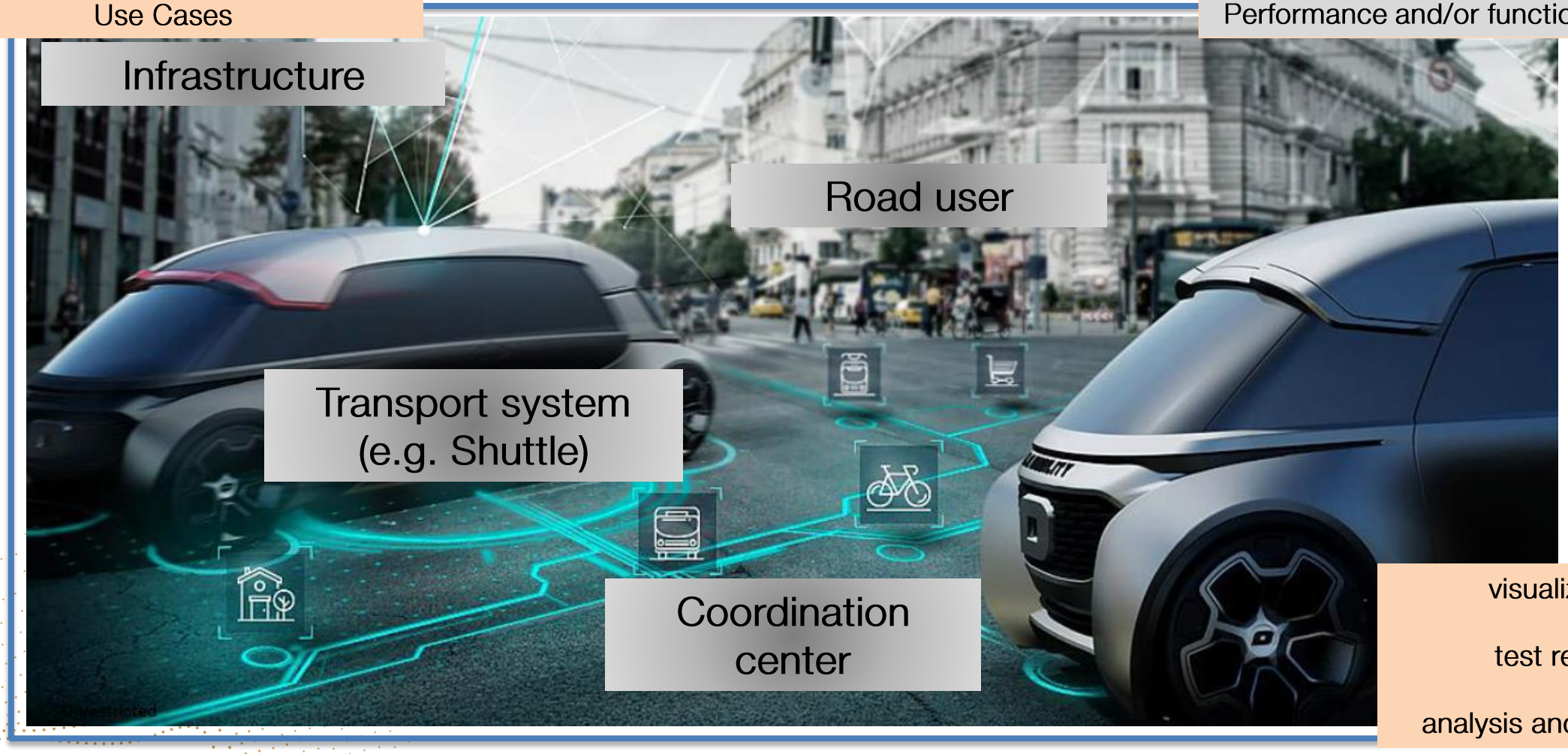
The ILO1 connects the central transport systems on the last and first mile

Mobility System – main items

Our objective - development of functions to increase performance and safety for the overall system

Use Cases

Performance and/or functional safety



visualization

test results

analysis and validation

Challenge – handling of complexity

The Mobility System is decentralized, unclear, unsynchronized and solutions are interest driven

Our company objective
- maximum development speed and high-performance creativity - with minimal developers

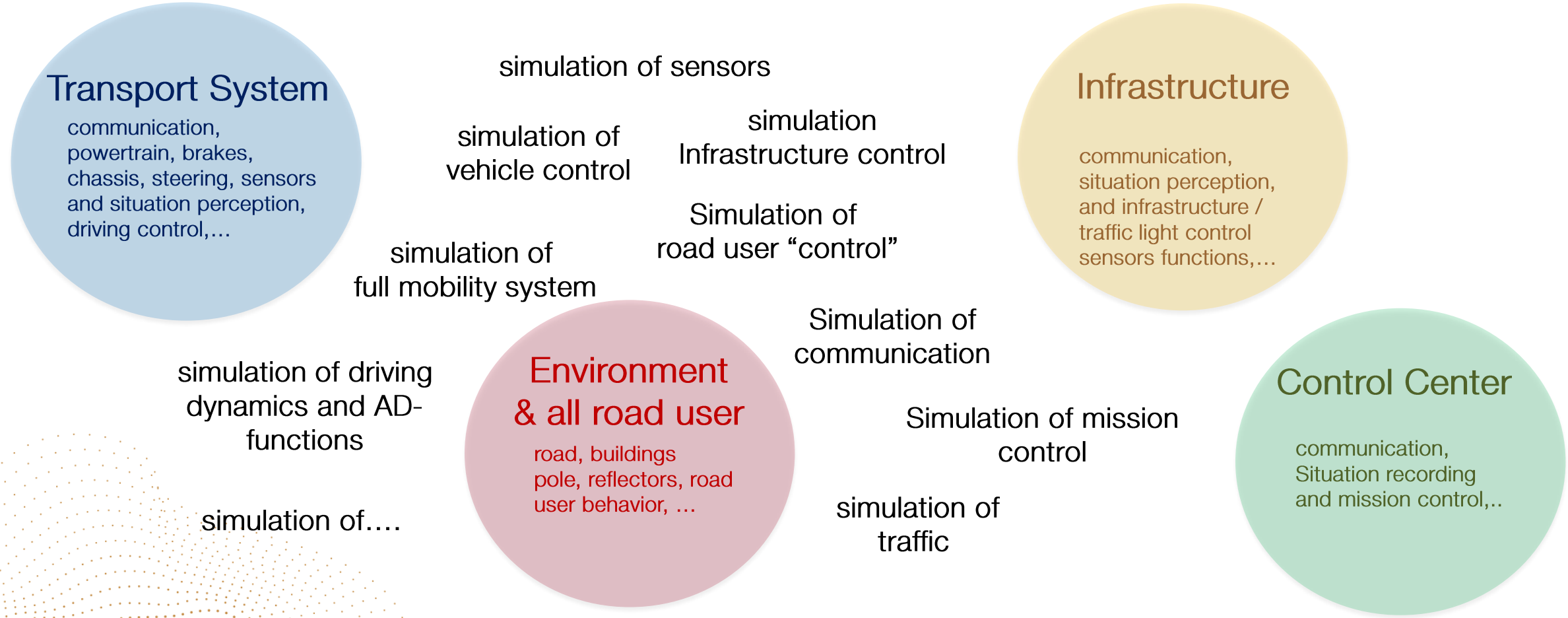
Our technical system objective
- Modularization and strong integration
- Automatization
- Requirement & Testing solutions in a reals and virtual world

Our human system objective
- Active part in systems working groups

Our organizational strategy
- Use and support of standards
- Build interfaces and bridges
- Discovering good and innovative system partners

Mobility System – handling of complexity

The understanding of the system is trained through a virtual environment

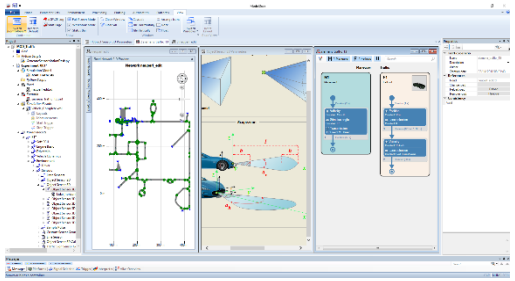


Mobility System – Virtual World

The virtual use cases and analysis are controlled with Matlab Simulink

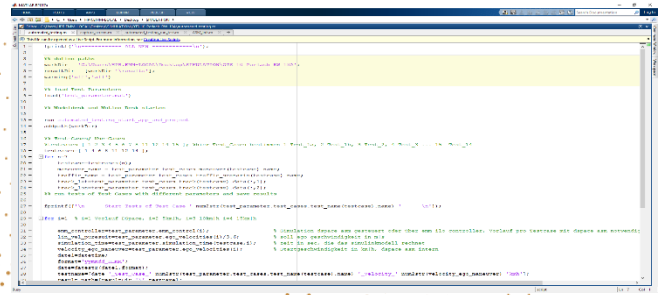
parametrisation

full virtual environment



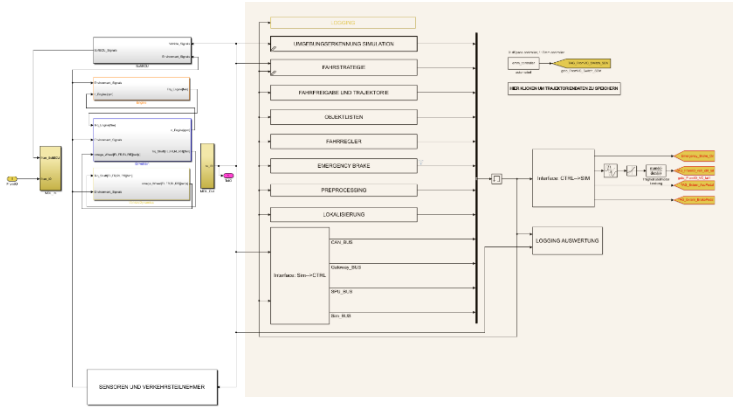
automated Emm! parametrization und Emm! simulation control

Emm! matlab-scripts



simulation

vehicle model incl. Emm! controller and AD-functions



interfaces

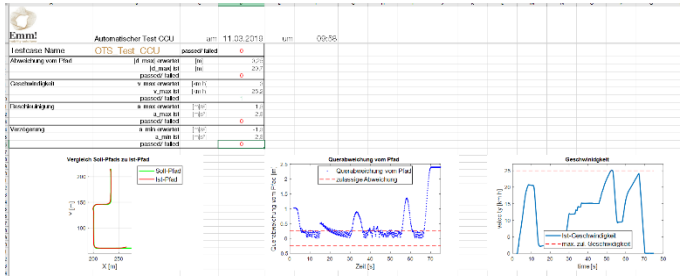
integration with Simulink-blocks (C++, ROS, TCP-IP)

visualisation

full item visualization / .mp4-Video

automated Emm! analysis

Emm! simulation analysis

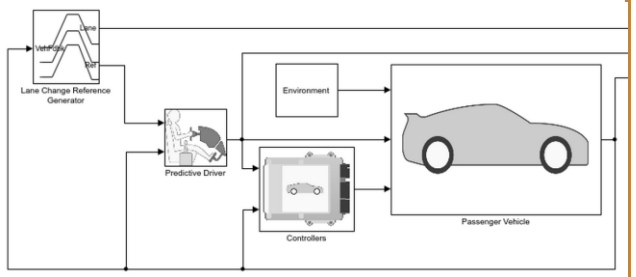


Mobility Subsystems - Real-Time function (HW&SW) testing

The system testing of real time functions testing are controlled with Matlab Simulink

parameterization

VDTB Blockset Matlab



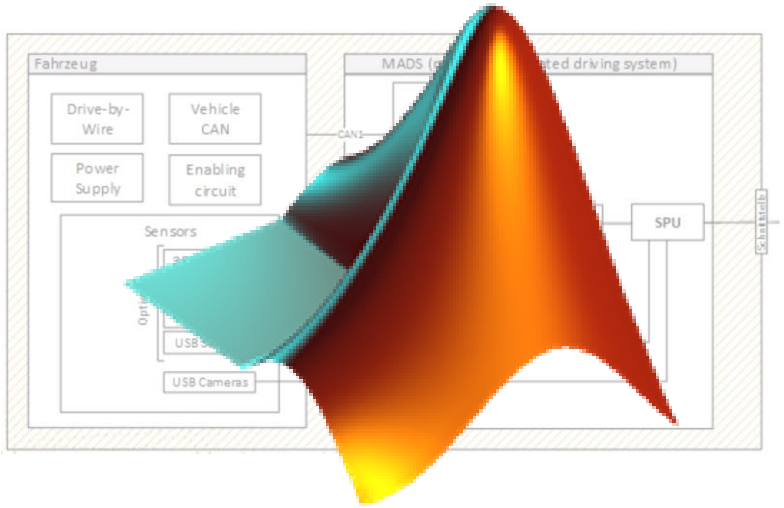
automated Emm! parametrisation und Emm! simulation control

```
% ConID==9 --> Joystick
% ConID==10--> Encoder
% ConID==253-->GW_HeartBeat
%ChannelTable=[1,1;2,2;4,2;5,2;6]


if strcmp(Component,'GPS')||strcmp(Component,'Bat')||strcmp(Component,
    strcmp(Component,'Enc')||strcmp(Component,'IMU')
    txCh=canChannel('PEAK-System','PCAN_USBBUS5');
elseif strcmp(Component,'LD13')
    txCh=canChannel('PEAK-System','PCAN_USBBUS1'); %LID1,3
elseif strcmp(Component,'LD24')
    txCh=canChannel('PEAK-System','PCAN_USBBUS2'); %LID2,4
elseif strcmp(Component,'PRV')
    txCh=canChannel('PEAK-System','PCAN_USBBUS6');
elseif strcmp(Component,'RD')
    txCh=canChannel('PEAK-System','PCAN_USBBUS3');
elseif strcmp(Component,'CVJ')||strcmp(Component,'ReN')
    txCh=canChannel('PEAK-System','PCAN_USBBUS4');
end
```

real-time simulation

HW, vehicle model and Emm! controller and functions

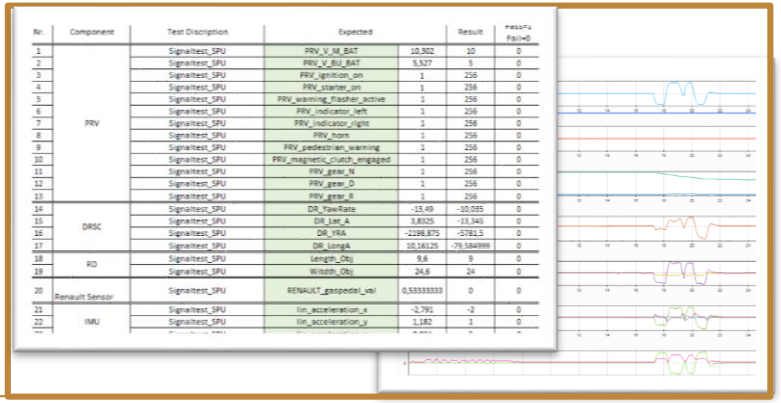


interfaces

integration with Simulink driver blocks (UDP, TCP-IP)

visualization in unreal engine

automated Emm! analysis

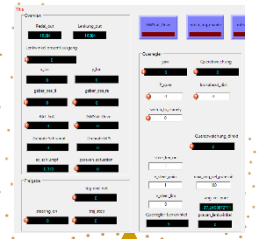


Mobility System – Integration testing

All real time control functions are based on Matlab Simulink

test execution

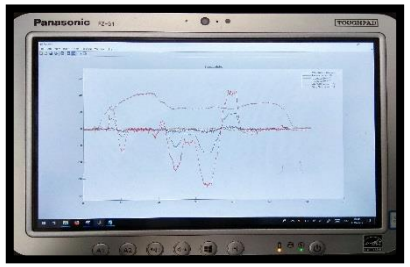
with real-time signal diagnostics



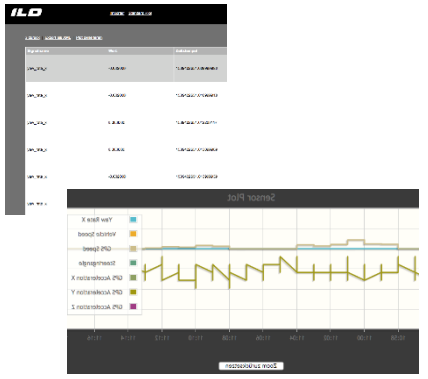
Control

Diagnosis

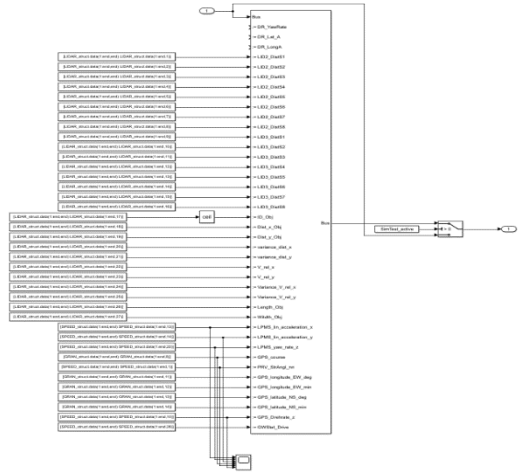
Visualisation of measurements



… in webinterface



simulative analysis offline



Correction steps

Results - ILO 1 in Singapore 1.19

Executed rides commissioned from the "Infrastructure" for greater safety and better traffic flow

- Development from scratch within 9 months
- Modularized architecture – e.g. execution with external AD-modules possible
- Conformity according to ISO 26262
- Constantly improved of system stability
- Ongoing improvement of functionality

Results – System Engineering capabilities

Emm! solutions offers engineering services with full coverage of system understanding

Requirements

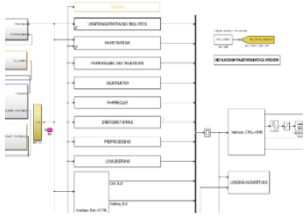
Release Managment

Integrationstest

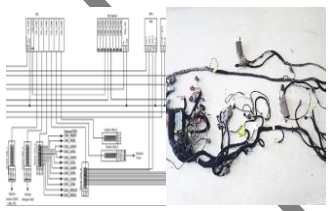
Requirements Management of Mobility Systems

Automated Simulation and Testing

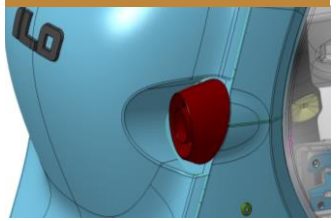
Design SW



Design Wiring



Design Package, CAD



Design of new functions

Testing Signal & Communication

Simulation SIL/HIL

Testing Sensor functions

PT Build EE

PT Build EE

Prototype build and certification

Field of actions – our system engineering strategy

Based of our todays status there are options for improvement

Our company objective

- maximum development speed and high-performance creativity - with minimal developers

Our technical system strategy

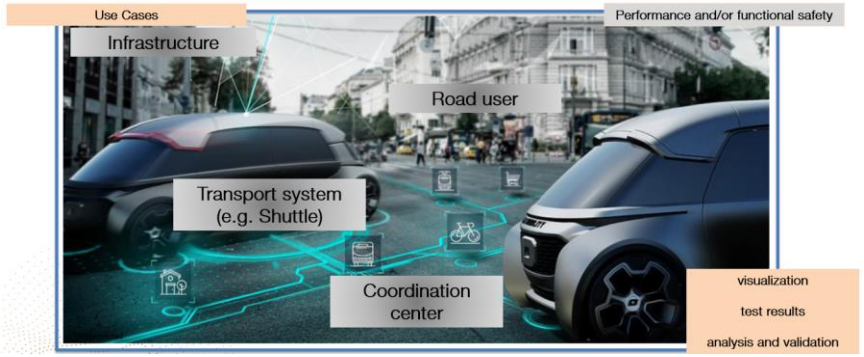
- Modularization and strong integration
  - increase completeness - with partners
  - flexible robust interface management

- Automatization
  - increase execution speed
  - extend flexibility
  - in conformance with standards (e.g. ISO 26262)

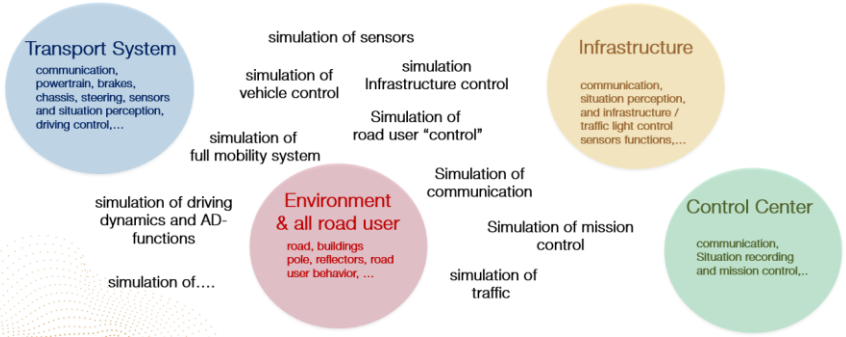
- Requirement & Testing solutions in a augmented world
  - extend perception capabilities
  - adapt machine learning
  - use data analytics
  - extend our requirement and testing management

Summary

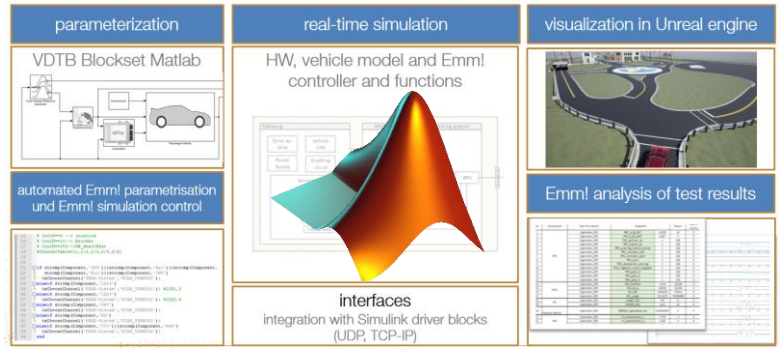
A Future Mobility System (FMS) was described – system engineering capabilities are a key success factor



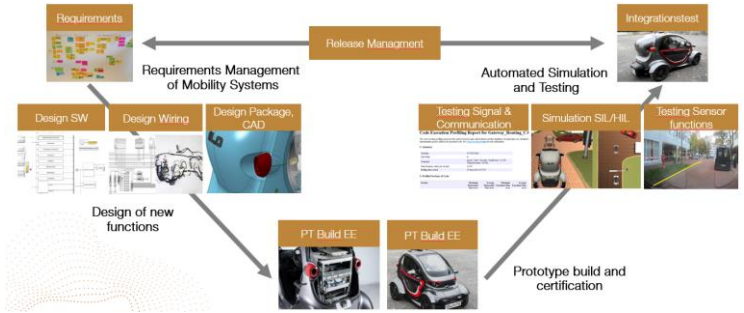
Future Mobility System – how it works



Handling of complexity is a core competence



Requirements and Testing – powerful tools are a must



Functional solutions – system engineering capabilities are key success factor

Thank you very much for your attention

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