



DigiFed

Lighting, Reliability testing, Autonomous Vehicles

11th May, 2020

AVL, Budapest University of Technology and
Economics– BME, CEA



This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 864266.

Welcome



Welcome



The screenshot shows the BLUMORPHO virtual meeting interface. At the top, there is a navigation bar with the BLUMORPHO logo, the text "Bootcamps DIGIFED", and a user icon. On the right side of the top bar, there is a green box containing icons for mute, unmute, and a menu. Below this, the text "Présentateur" is visible. The main area of the interface is a virtual space with a geometric pattern. In the center, there is a dark box with the text "Partager un contenu ou projeter des webcams". On the left and right sides, there are smaller boxes labeled "Table 4" and "Table 5" respectively. At the bottom, there is a toolbar with icons for zooming in and out, a full-screen icon, and a live chat icon. Red arrows point from text annotations to these icons: "To zoom in and out" points to the zoom icons, "To display the presentation full screen" points to the full-screen icon, and "To chat with us" points to the live chat icon. The bottom right corner of the interface shows "Participants" and "Live Chat" buttons.

At this table, you can't speak, and it is normal.

To zoom in and out

To display the presentation full screen

To chat with us

Agenda

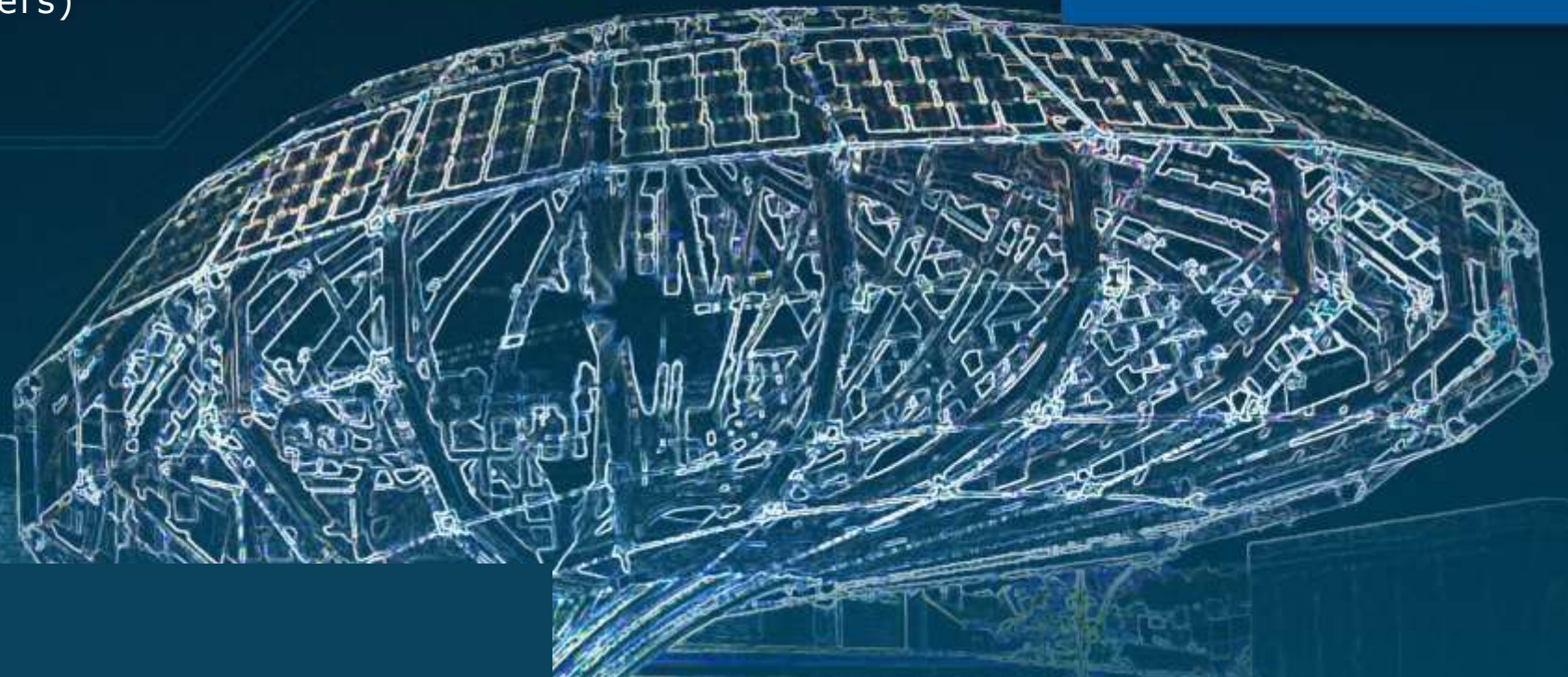
- **Introduction, objectives and agenda (10 minutes)**
- **How to use Digifed capabilities in Lighting, Reliability Testing and Autonomous Vehicles as part of your project while leveraging DigiFed Partners to maximise your proposal scores: Excellence, Impact, Implementation Quality (45 minutes)**
 - AVL
 - BME
 - CEA
- **Open floor discussion with Q&A**



AVL

DI Dr. Josef Zehetner | Chief engineer IODP system architecture

AVL List GmbH (Headquarters)



AVL IODP

Mastering complexity and speed with the
Integrated and Open Development Platform

Dr. Josef Zehetner

About myself



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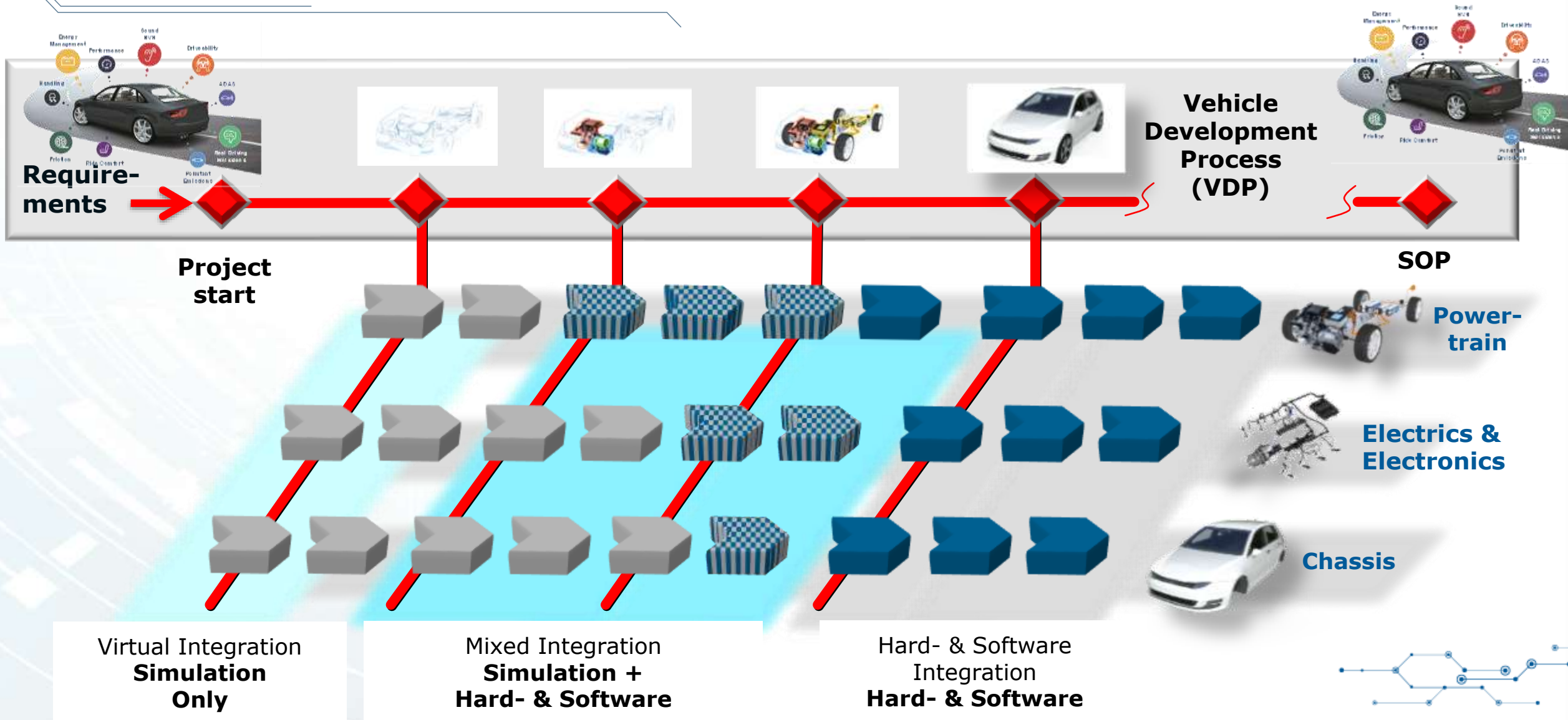


INTEGRATED AND OPEN DEVELOPMENT PLATFORM (AVL)

- **Function:** integration of all elements of the modern product development process - independent of tools.
- **Principle:**
 - Integrate real (HW) and virtual (simulation models) components into a single development framework
 - Bridge the gap between development environments to allow reliable, holistic decisions
 - Bringing transparent contributions from various teams into an overall context
- **Key Performances:**
 - Model.CONNECT™ connects simulation models of different components and systems
 - Testbed.CONNECT™ merges simulation models and testbeds into a complete system
 - Data.CONNECT™ guarantees traceability and interoperability between data sources
 - Device.CONNECT™ interlinks globally distributed devices and data centers
- **Uniqueness:**
 - Collaboration through step-by-step integration
 - 100% focus on a functional representation
 - Smooth interaction of teams, processes and tools
- **Maturity/TRL:**

- **Applications:**
 - Optimal product design based on standardized parameters, exchangeable models and neutral tool interfaces
 - Step-by-step integration of virtual/real components throughout the development process



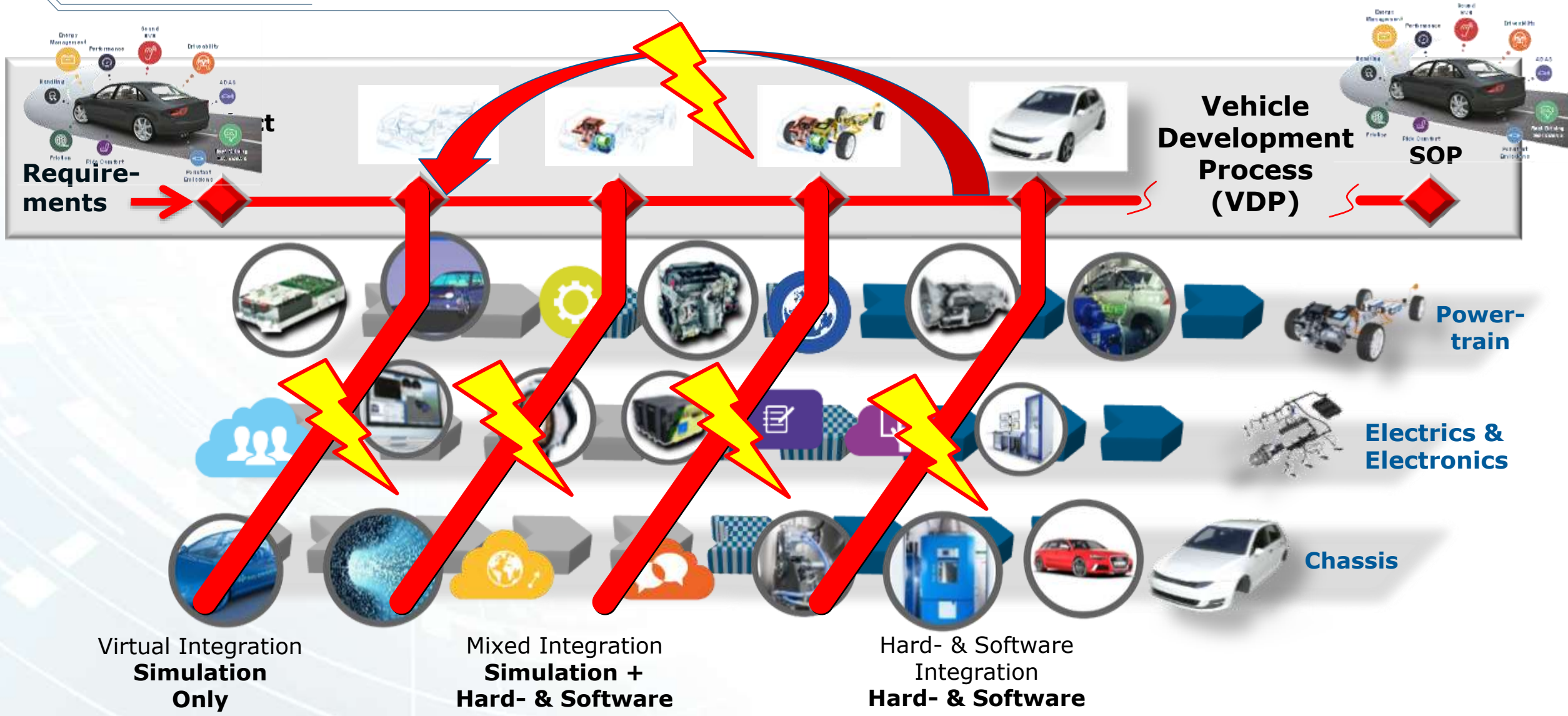
Vehicle Development Process



Heterogeneous Tool Landscape



Heterogeneous Tool Landscape



Main limiting factor entering MBD

Capabilities already existing and established in an organization ...

Testing
Environments

Simulation Models

Data Storage
Systems

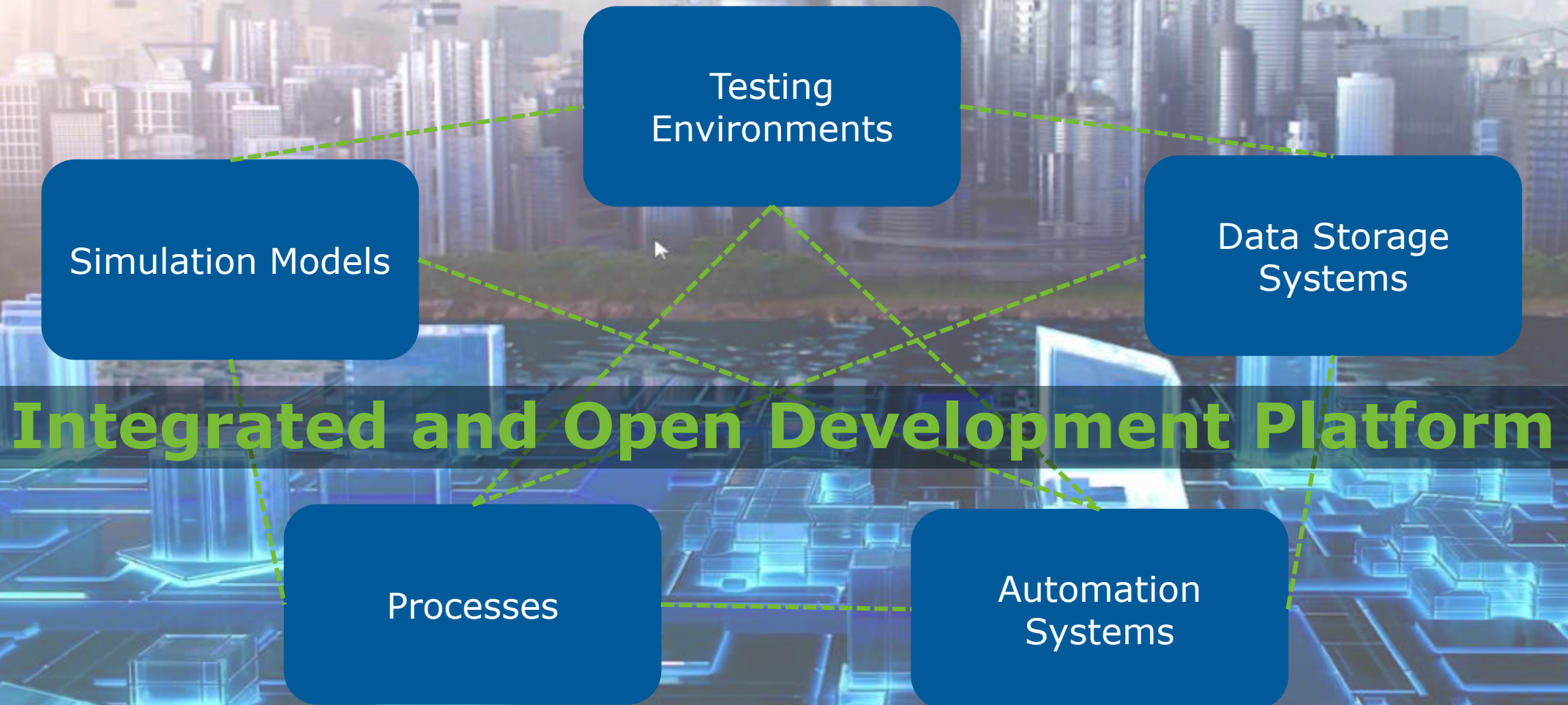
... but **DISCONNECTION** of the **VIRTUAL AND THE REAL** worlds

Processes

Automation
Systems

AVL's Answer to Smart Development

Capabilities already existing and established in an organization ...





Model.CONNECT™

Connects virtual components



Testbed.CONNECT™

Connects real with virtual components



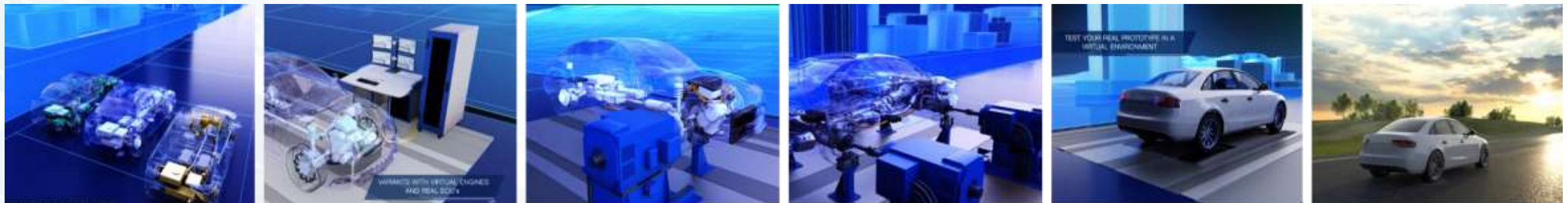
Data.CONNECT™

Connects different data sources



Device.CONNECT™

Connects different devices to data sinks



Value proven in many use cases

Integrated and Open Development Platform

... AVL's answer to smart development

Customer References

Connect Simulation and Test for many Tasks



Thermal management

CRUISE, GT, AMESim, FLOWMASTER, SIMULINK, Exothermia, SIMPACK

Control development

Dymola, Simulink

Turbo-lag behavior

CRUISE M, VSM, DRIVE, GTP

Advanced Calibration of Drivability

CAMEO, PUMA, DriCon, VSM, DRIVE, INCA,...

Virtual Shift Strategy Calibration

Model.CONNECT, VSM, SPA, Simulink,...

Confidential



Data driven solutions

Integrative different data sources

Belt Starter Generator Control on ETB

PUMA, CRUISE M

Advanced Driver Assistance Systems

VTD, ADAMS, Simulink

Electrification, Thermal Management, ADAS

CRUISE, CRUISE M, VSM, VTD Vires, Simulink



Thermal management in the loop

Cruise, Simulink, Kuli, FMUs, CarMaker

Vehicle controls

Adams, Simulink

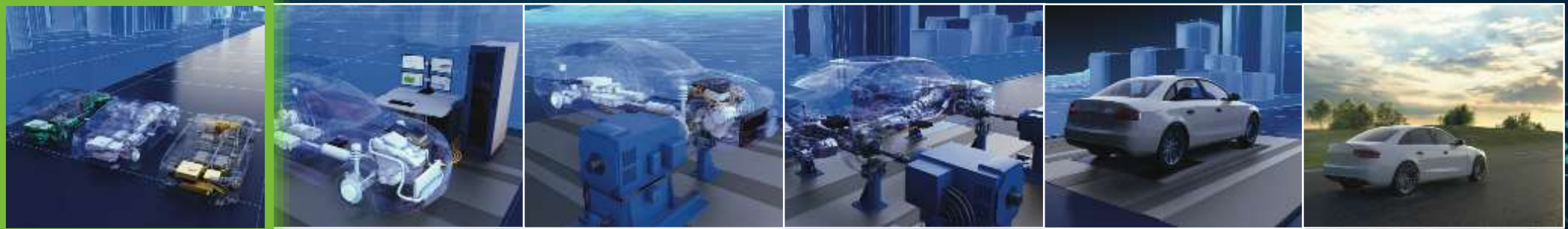
Engine and powertrain control function development

CarMaker, GT, Simulink, Saber
Optimization tasks via DVI server

RDE applications expanding to Testbed.CONNECT

CarMaker, VSM, GT, Simulink, Silver-QTronic

Value proven in many use cases

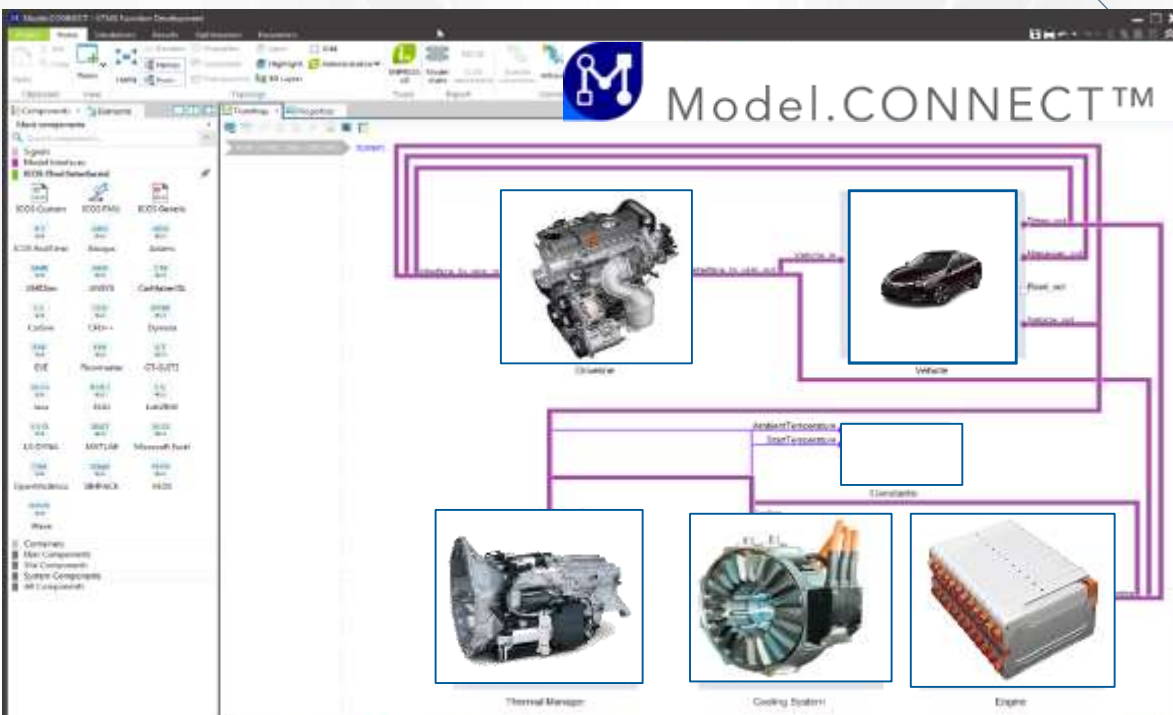


Office Simulation Solutions

Connect components



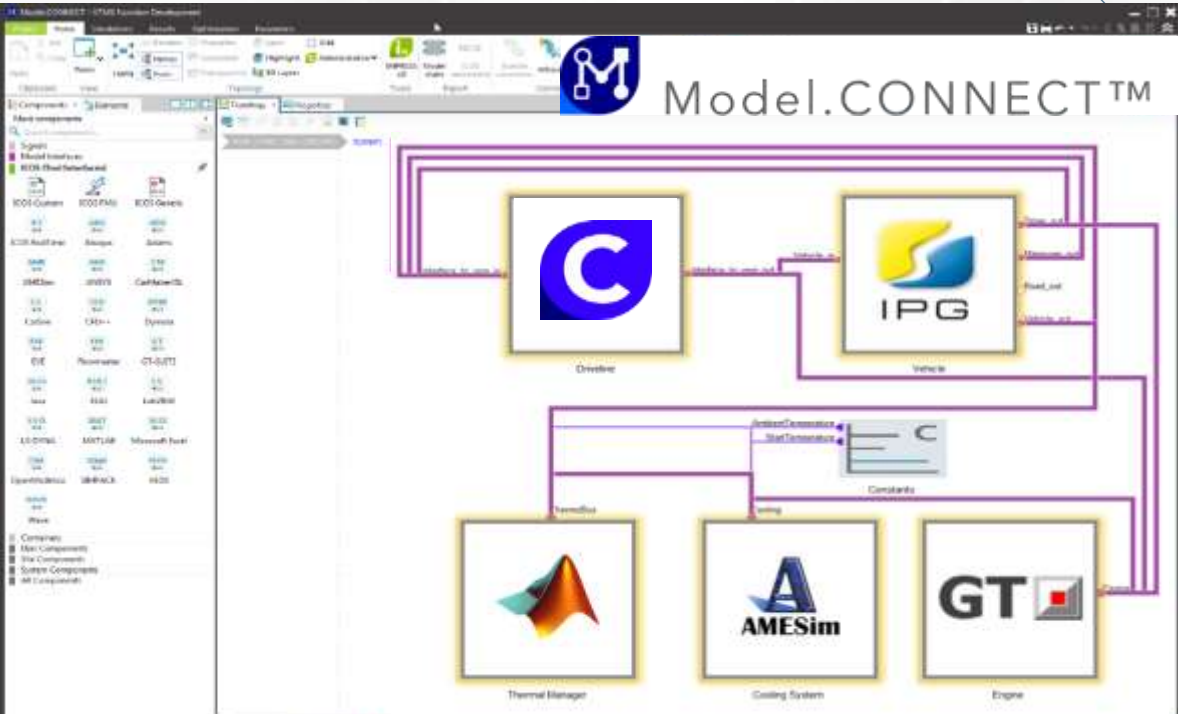
Virtual Prototype



NEUTRAL and OPEN Integration Platform













Connect components



NEUTRAL and OPEN Integration Platform

Virtual Prototype

- Connect different simulation tools
(Reuse existing models)
- Virtualization of testbeds
(Connect hardware & software, simulation & test)
- Use case oriented
(Flexible architecture supporting multiple tasks)

 Performance
  Driveability
  ADAS
  Sound / NVH
  Real Driving Emissions
  Pollutant Emissions
  Energy Management
  Friction
  Handling
  Ride Comfort

Tools specific interfaces (30+ software vendors) and interface standards (FMI)



Customer Reference

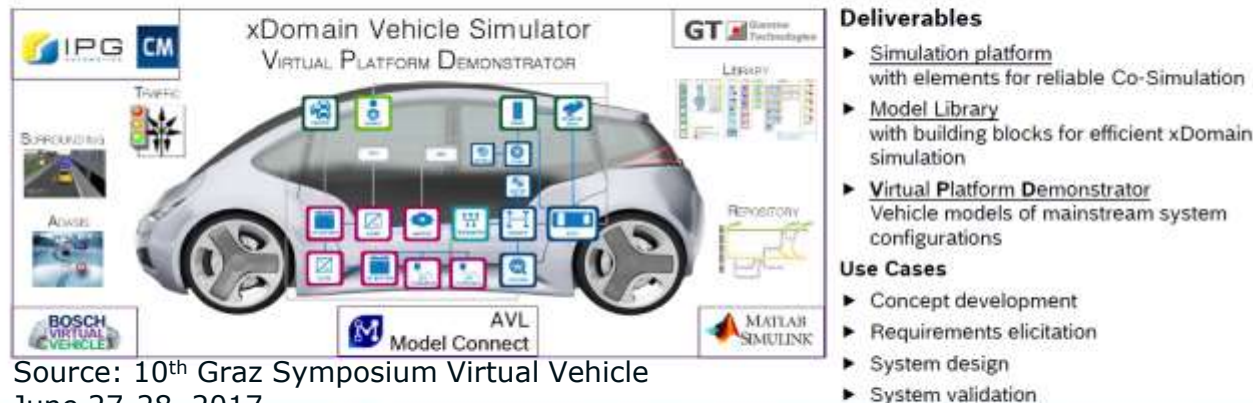
BOSCH: Cross-domain vehicle system development



Model-based development with reliable co-simulation

SIMULATION CENTRIC APPROACH

xDomain simulation: backbone for vehicle systems engineering
BOSCH xDomain vehicle simulator: big picture



Source: 10th Graz Symposium Virtual Vehicle
June 27-28, 2017

xDomain Vehicle Simulator is starting point for simulation use cases in several BOSCH business units & in central automotive Systems Engineering organization (BBM-SE)

Proven Benefits



Reduction of
development and
testing time

- Reuse of existing models from different tools (modeling time saving / model: 2-12 month work)
- X-domain integration of components



Reduction of cost

- Reduce development iterations
- More efficient collaboration between Supplier and OEMS
- **Avoid misunderstandings**



Increased product
quality

- Better understanding of overall system impact
- Sound decisions in early phases

Value proven in many use cases



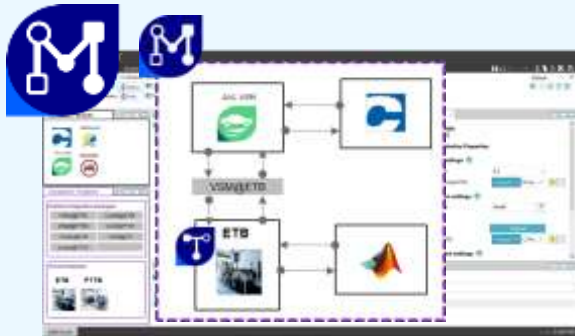
Simulation-based Testing Solutions

Connect Simulation and TestBEDS

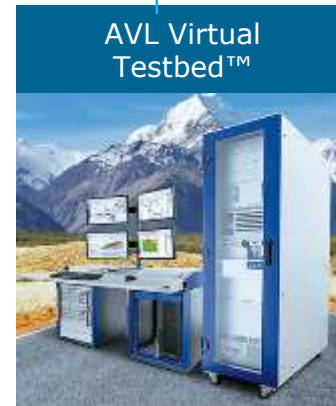


Testbed.CONNECT™

Simulation in the office



Simulation on the testbed



AVL Virtual Testbed™



Testbed



AVL Testbed with AVL PUMA Open 2™

Testbed.CONNECT™ RealTime



Testbed.CONNECT™ Workstation

Testbed.CONNECT™



Testbed.CONNECT™ Workstation

Testbed.CONNECT™

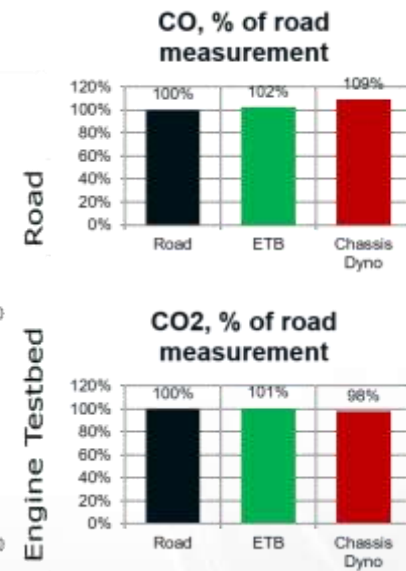
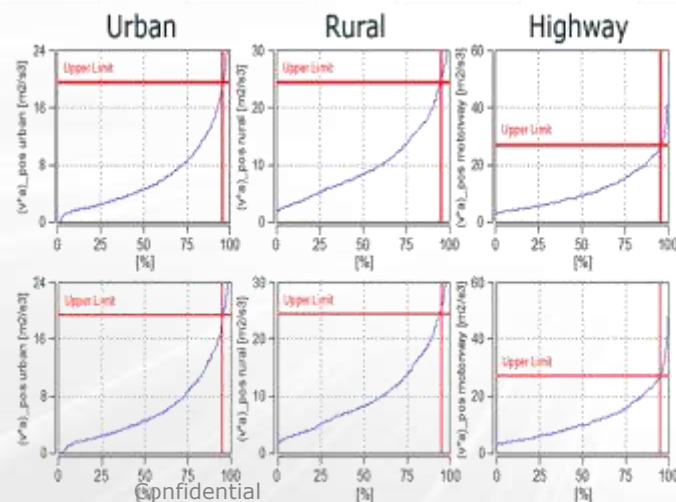
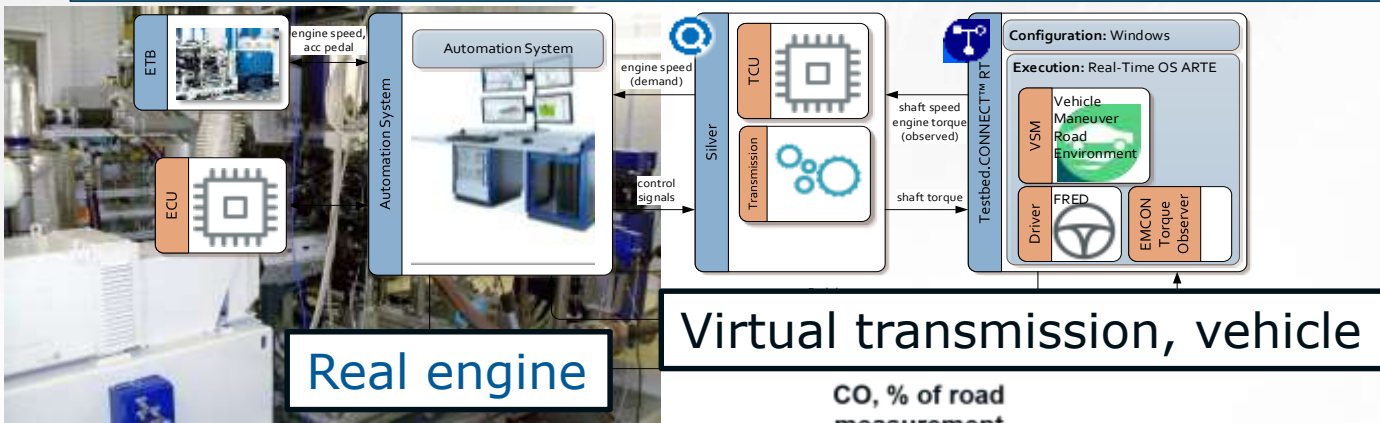
Customer Reference

German OEM: RDE - Real Driving Emissions



Reproduce and analyze emissions-relevant driving cycles on the Engine Testbed

ROAD → ENGINE TESTBED



Comparison

■ Road
 ■ Engine Test Bed
 ■ Chassis Dyno

Proven Benefits



Reduction of development and testing time

- **High automation** - 24/7 (168 hours a week)
- **Repeatability** between dyno measurements high (same driving style)
- Higher tests/time rate with **rapid cooldown**



Reduction of cost

- Potential to **increase prototype usage** by factor 12
- Less manpower for testing due to automation
- Reuse of data for drive mode calibration

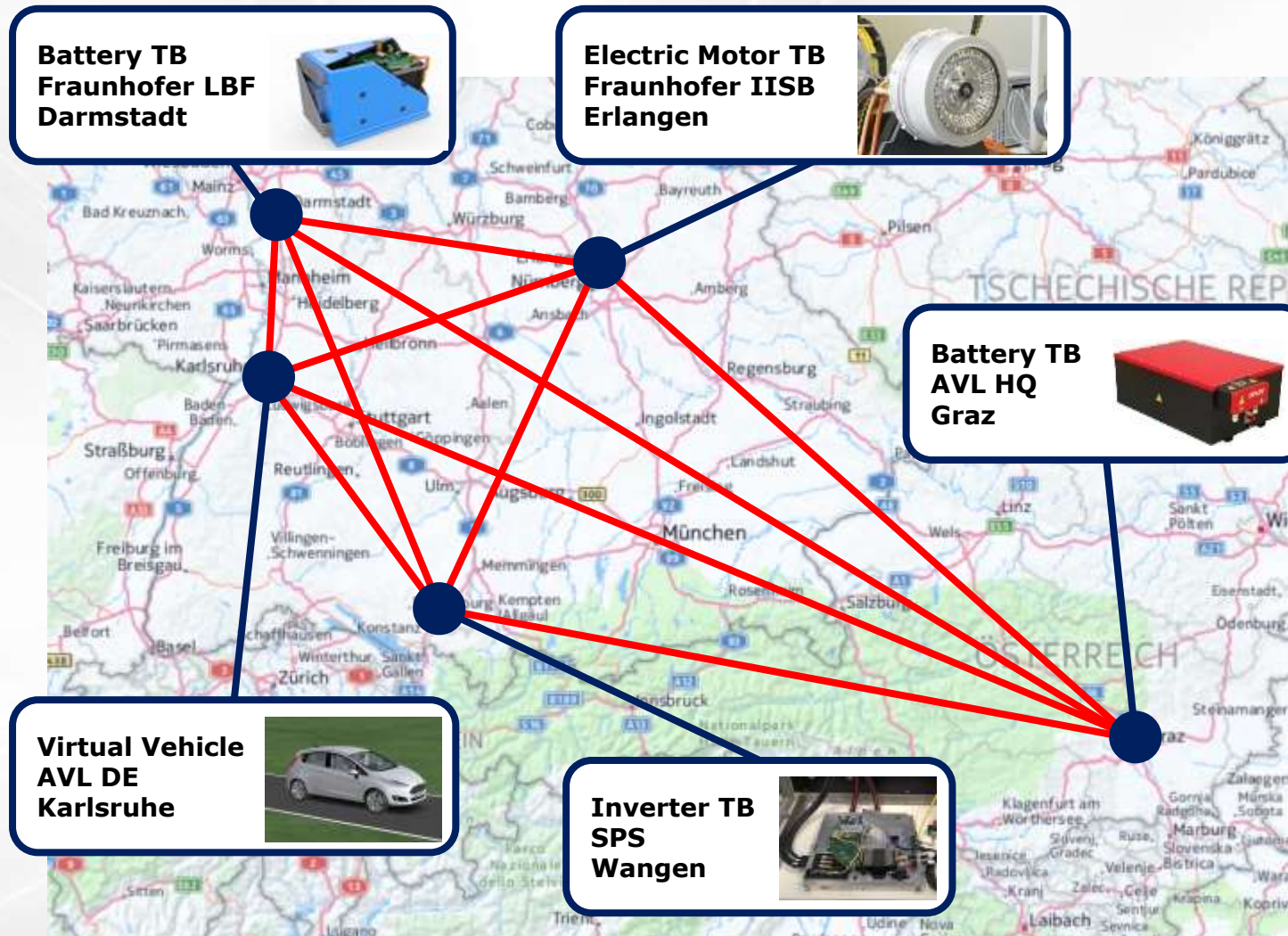


Increased product quality

- **Higher testing coverage** leading to higher product quality
- Road and maps (e.g. Google, Here) based cycles
- Reproducibility Road → Engine Testbed high

Distributed Testing – Research Project

TechReal 



Comprehensive Test Driving
at any time from anywhere

Virtual test tracks

- Acceleration / Braking
- Circular driving
- Sinus steering
- Slalom
- Lane change
- mu-Split / mu-Jump
- Handling course
- Rough road

Virtual public roads

- Urban driving
- Highway driving
- Mountain driving

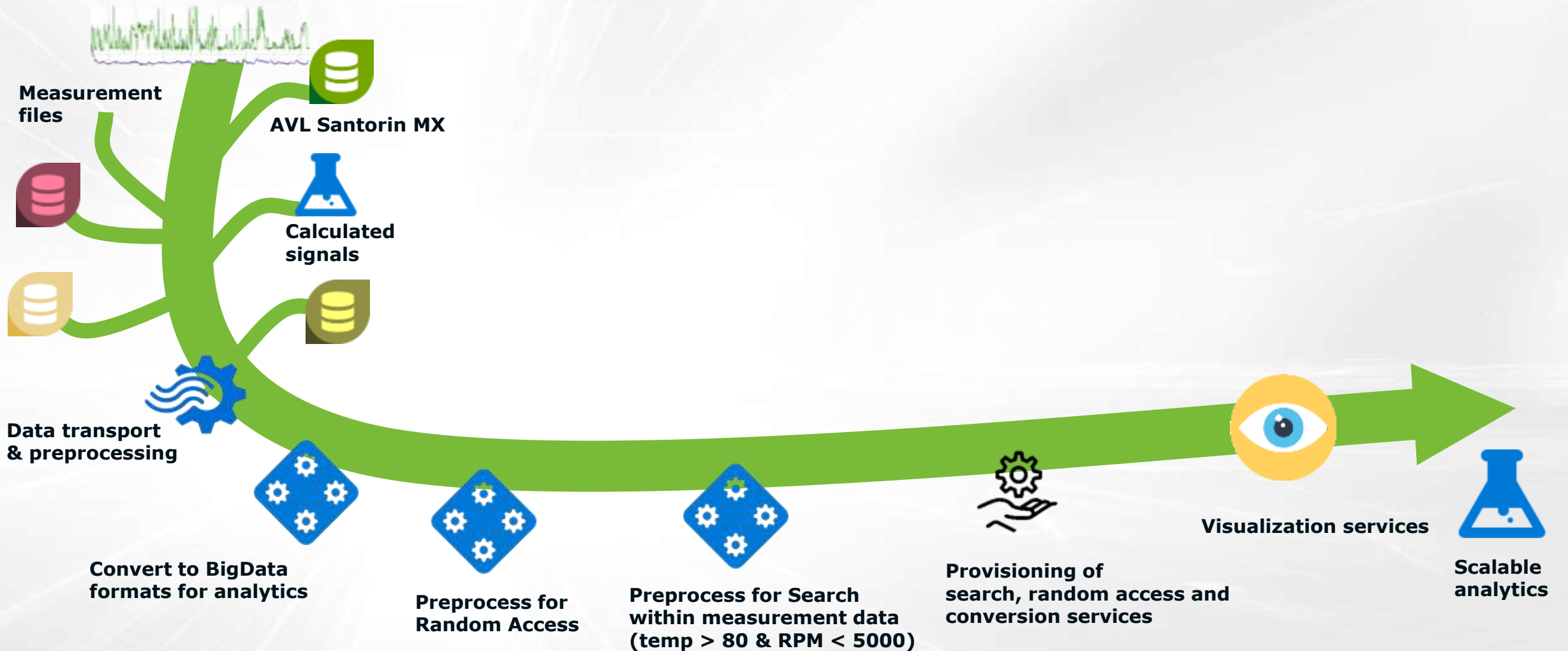
Value proven in many use cases



Data Connecting Solutions



Time series data





Time series data

Measurement files

AVL Santorin MX

Calculated signals

Data transport & preprocessing

Convert to BigData formats for analytics

Prep
Rand

Search and Explore

Show me all data where the coolant temperature of the inverter is above 65°C
... and where the cooling fan is on

First step towards predictive analysis

Simulation

Testbed

Vehicle



Scalable analytics



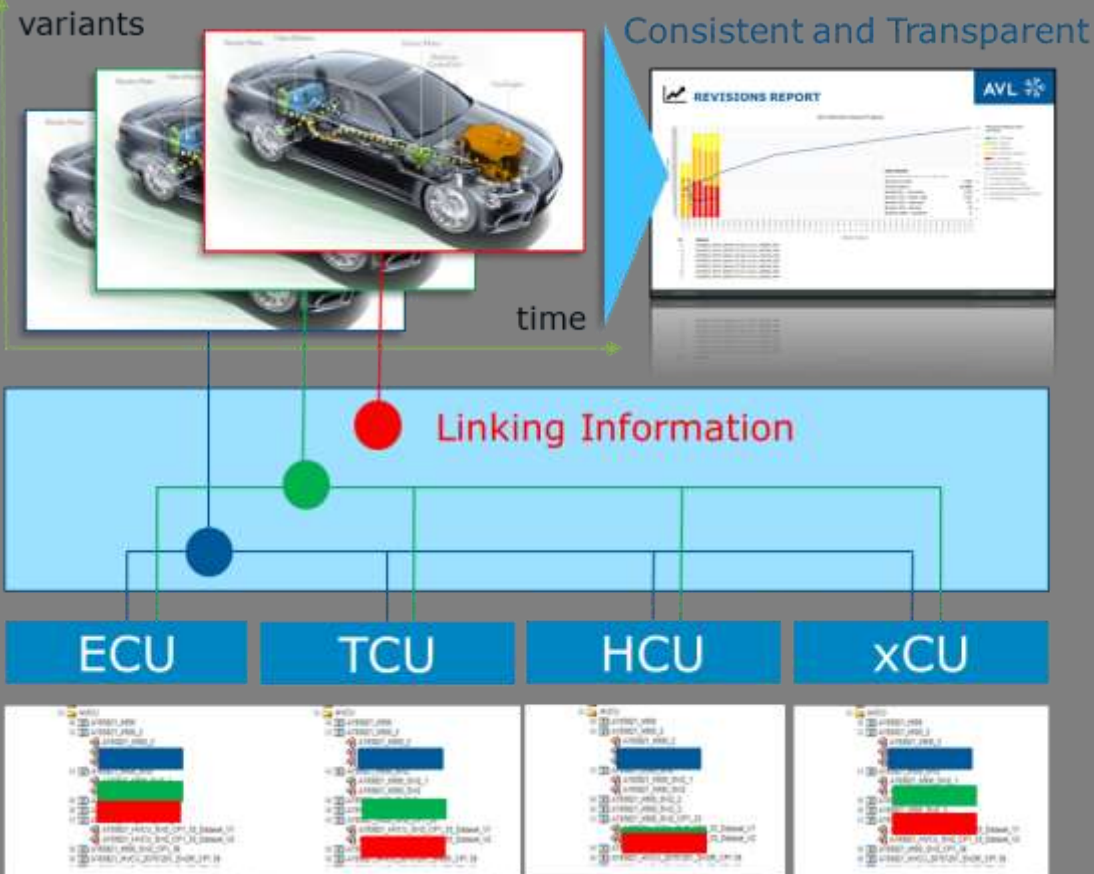
Internal Customer Reference

AVL Calibration: Consistent Flash sets for test vehicle



CALIBRATION PARAMENTER MANAGEMENT and FLASHING

ROAD



Proven Benefits



Reduction of development and testing time

- Significant reduction of time for **finding the right combination of xCU software** versions (data sets)



Reduction of cost

- **Avoiding, repeating of calibration work** because of wrong xCU software combinations (data sets); (**up to 30%** MP costs savings)



Increased product quality

- Consistent and transparent process for **evaluating maturity of calibration over time**

Device.CONNECT™

Bridge the trust gap

Your Benefits

Enables **highly secure**, hardware protected connectivity

Enhances intelligence at your devices with the **Smart Hub**

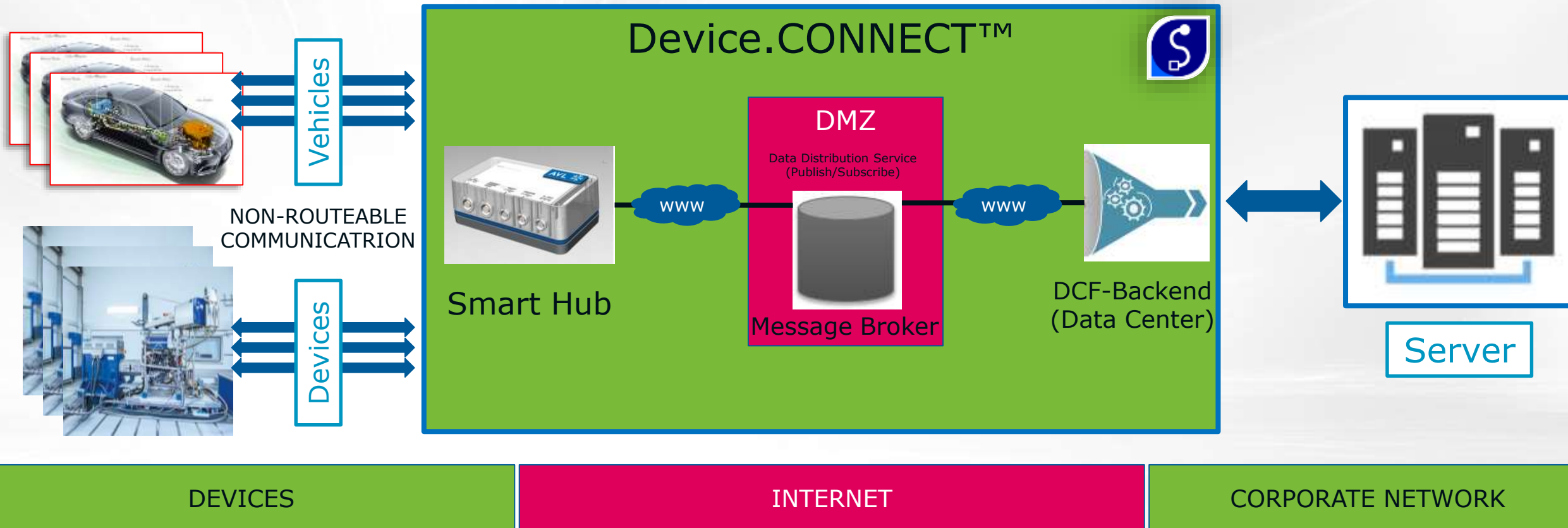
Full control over data exchange

Highest standards in data transport and **theft protection**

No compromises to **product safety**

Designed under **ISO 270xx/IEC62443** consideration

Device.CONNECT



DATA EXCHANGE WITHOUT COMPROMISES ON SECURITY



EMPOWER VIRTUALIZATION



Thank You



www.avl.com





BME

Dr. Andras Poppe

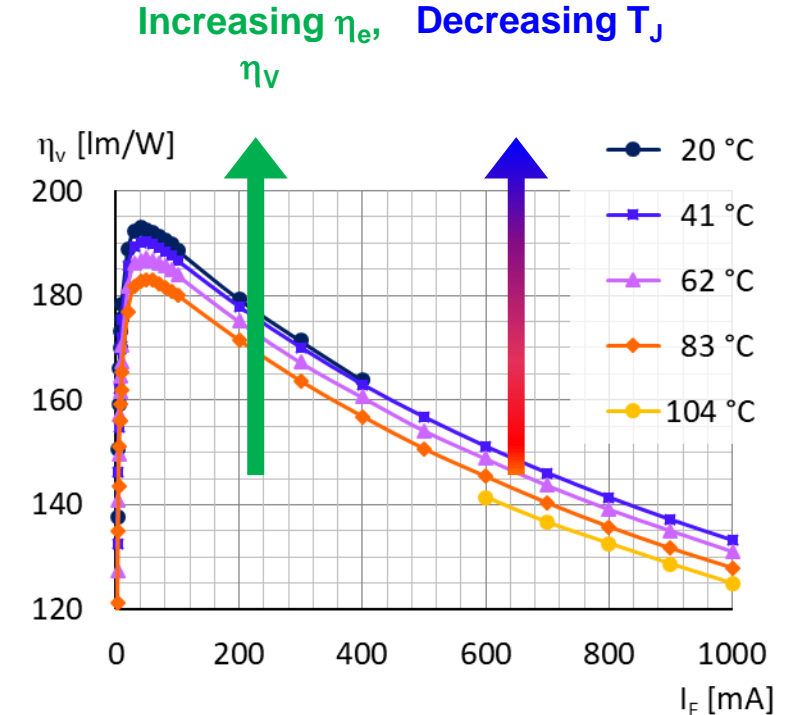
DigiFed offer at BME

Technologies at BME offered for application experiments:

- **LEDbeSmart** – modelling methodologies and workflow for optimized LED based application design
- **Versatile Reliability Tester** – test methods and tools for assessing how smart hardware will likely to behave under application conditions

LEDbeSmart: *background for energy saving*

- At **constant forward current** with **decreasing junction temperature** efficiency and efficacy **increase**
- *This results in increasing light output of luminaires*
- Street-lighting luminaires are designed for **the highest possible ambient temperature**
- **Power saving potential by adaptive dimming**
 - In **colder** weather conditions the forward current can be reduced ...
... while the **light output remains constant**



- **Constant light output (CLO) operation**
- **Changes in light output characteristics of SSL devices are compensated:**
 - to assure consistent visual comfort
 - to possibly improve product reliability
 - to achieve additional power savings throughout the entire product life span

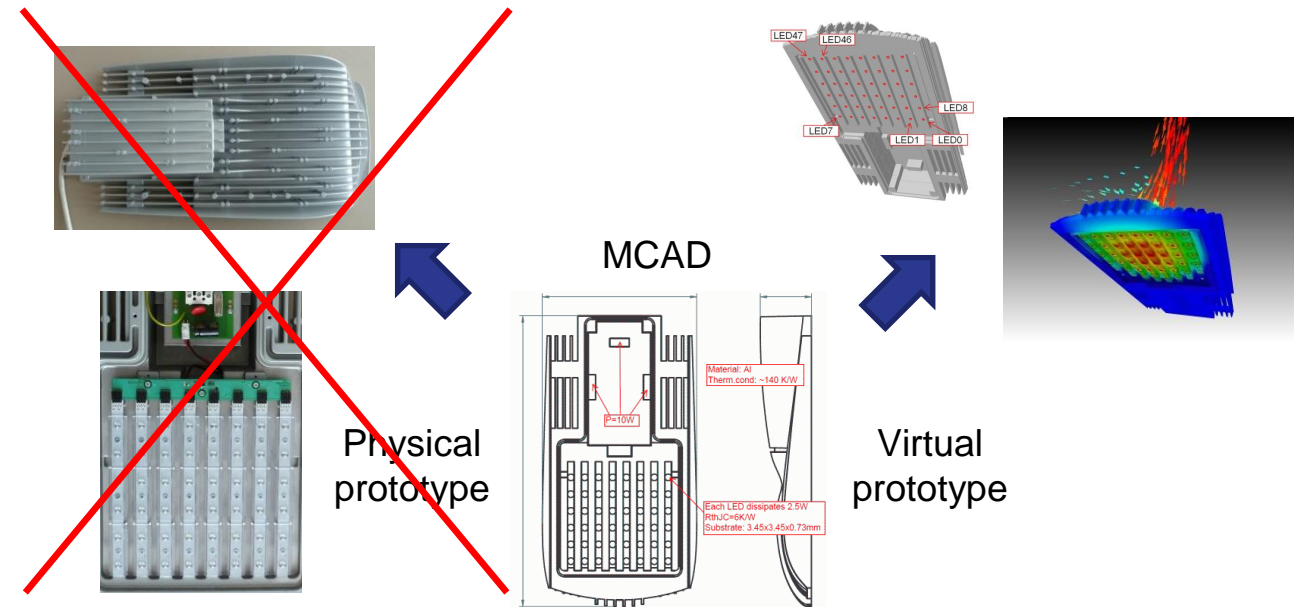
LEDbeSmart overview

BME proposes a methodology to develop LED based applications in which physical prototyping is almost avoided...

- **Design optimization is fully by digital means**
- **Reduce development time and cost by replacing physical prototypes by virtual prototypes**

- **Methodology:**

- virtual prototyping based on the Delph4LED industry 4.0 design workflow
- simulation experiments to explore the target parameter space (temperature, current, elapsed life-time, luminous flux)



LEDbeSmart overview

- **Function:** complex testing, modelling and simulation methodology for LED luminaires to achieve reduced power consumption and improved reliability
- **Principle:**
 - Constant light output (CLO) control realized through multi-domain, embedded digital twin of the LED luminaire
 - Temperature compensation of the LEDs' driving current
 - CPS approach in the implementation: luminaires with communications & "self-awareness" (sensors + edge computing)
- **Key Performances:**
 - **Predicted annual power saving: ~6-8%**
 - With pre-compensation for LED ageing total power saving further reduced over the entire product lifetime
 - With a fully digitalized product optimization workflow there is a substantial potential for reducing development reductions*
- **Uniqueness:**
 - CLO control scheme based on the LEDs' actual multi-domain characteristics
 - Prepared for future predictive maintenance approaches

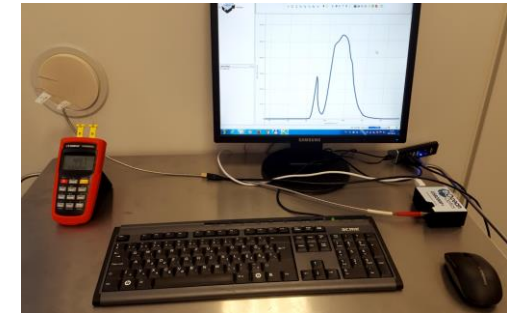
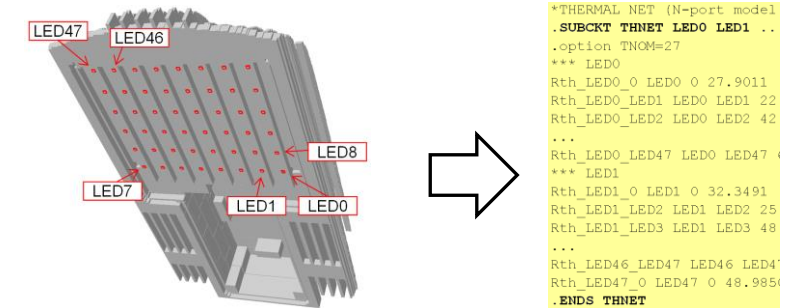
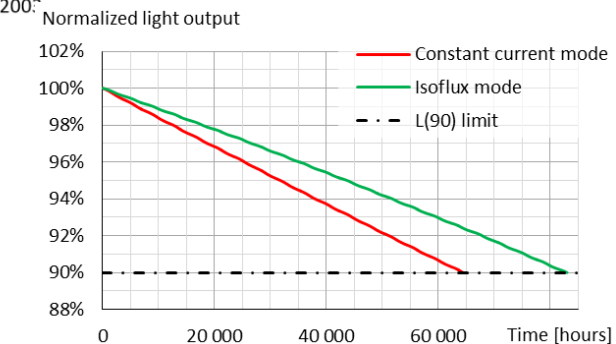
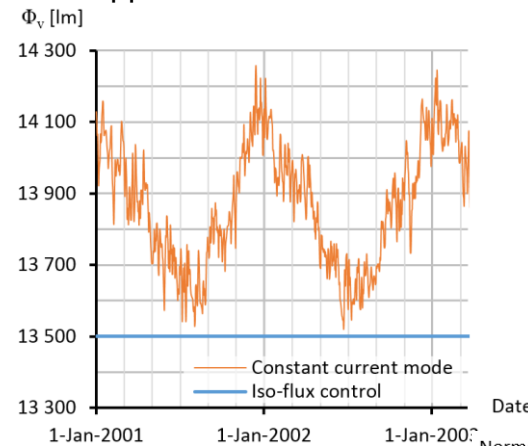
Maturity/TRL:

- Technology Readiness Level



Applications:

- LED based streetlighting / tunnel lighting
- Methodology can be adapted to other LED lighting applications such as automotive headlights



*Demonstration experiments in the Delphi4LED project reported 30-40% development cost reduction, depending on the company profile.

LEDbeSmart way of working

Principle: Virtual prototyping using the Delphi4LED Industry 4.0 workflow

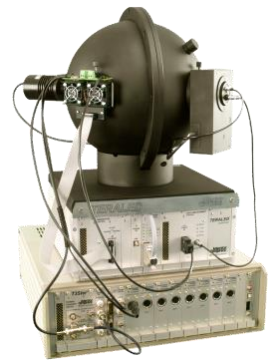
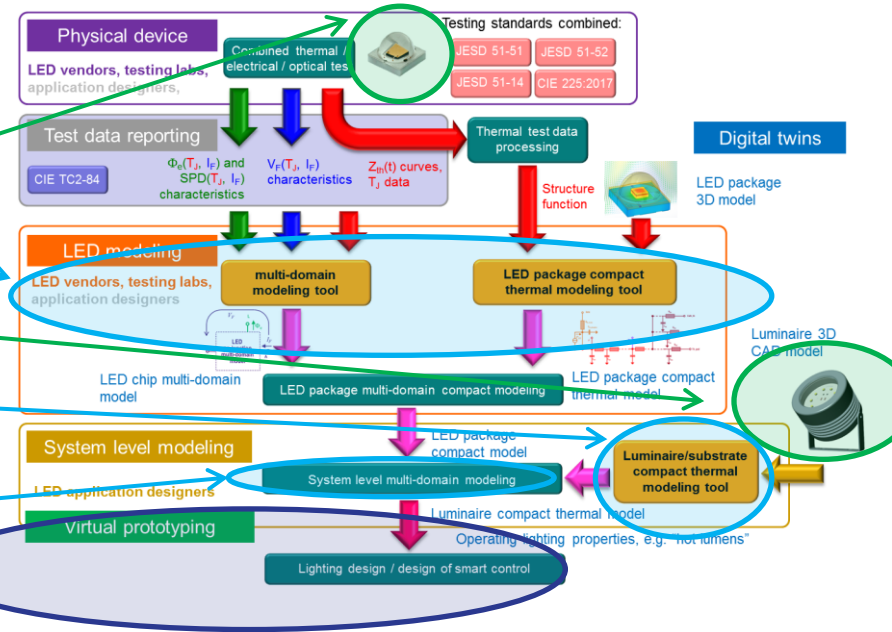
- SME provides BME with LEDs to measure/characterize and model → LEDs' multi-domain digital twins for system level simulation
- SME provides BME with luminaires' MCAD models → luminaires' system level compact thermal model for system level simulation

Application use-case, implementation : temperature compensated CLO

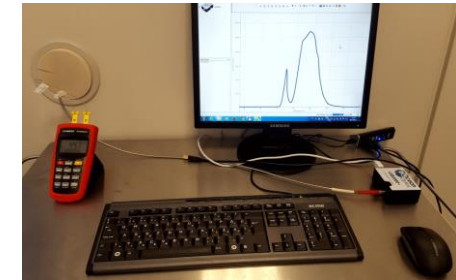
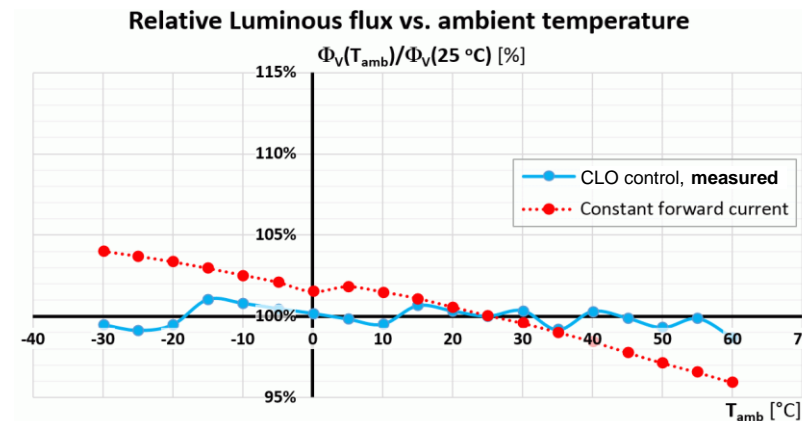
- BME performs luminaires' system level simulation to identify the $I_F(T_{amb})$ function that assures constant luminous flux output

BME and SME decide together how to implement the in the actual luminaire the $I_F(T_{amb})$ function that assures constant luminous flux output

- SME implements the corresponding embedded luminaire model
- BME provides test facilities to check the implementation



Temperature dependence of luminaires' total light output tested in a climate chamber



Versatile Reliability Tester

- **Function:** The reliability test environment integrates a set of appropriate hardware and software components built around the de facto industry standard T3Ster equipment of Mentor Graphics. This versatile system monitors the electric, thermal and even optical parameters of the device under test during freely customizable test sequences.
- **Principle:**
 - Power/temperature cycling
 - In-situ thermal transient measurements and structure function analysis of the DUTs during cycling
 - Options to measure other performance indicators of DUTs
- **Guidelines:**
 - Environmental and endurance test methods for semiconductor devices: https://home.jeita.or.jp/tsc/std-pdf/ED-4701_100.pdf
 - Whitepaper on an application:
G. Hantos, J. Hegedüs, M. Rencz and A. Poppe, ", **Aging tendencies of power MOSFETs — A reliability testing method combined with thermal performance monitoring**", The 22nd International Workshop on Thermal Investigations of ICs and Systems (THERMINIC), Budapest, 2016, pp. 220-223.
<https://doi.org/10.1109/THERMINIC.2016.7749055>

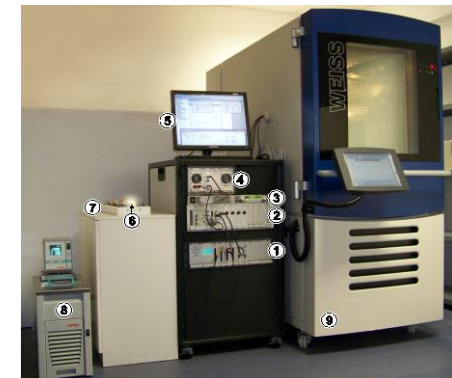
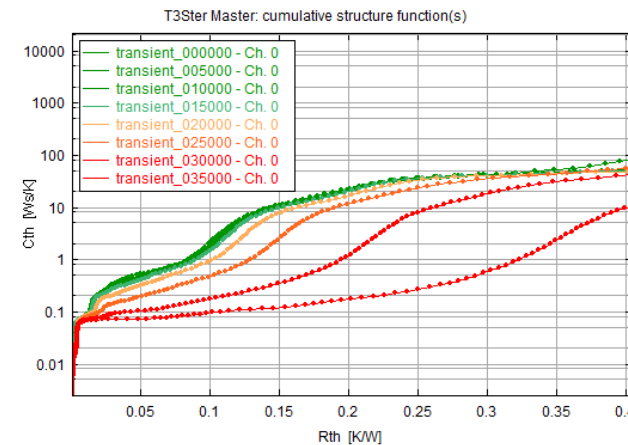
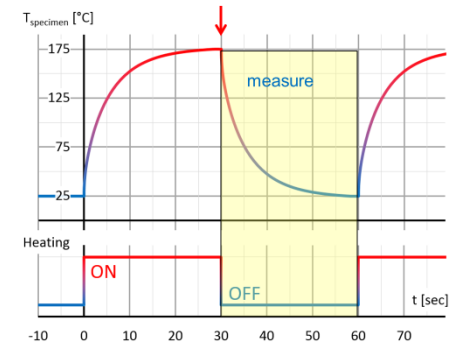
- **Maturity/TRL:**

- Technology Readiness Level



- **Applications:**

- Cycling and structural integrity test of RF modules, sensors, PSUs, drivers, LEDs, FETs
- LED luminaires' thermal assessment
- When designed properly, applicable to certain reliability assessment of DigiFED demonstration systems



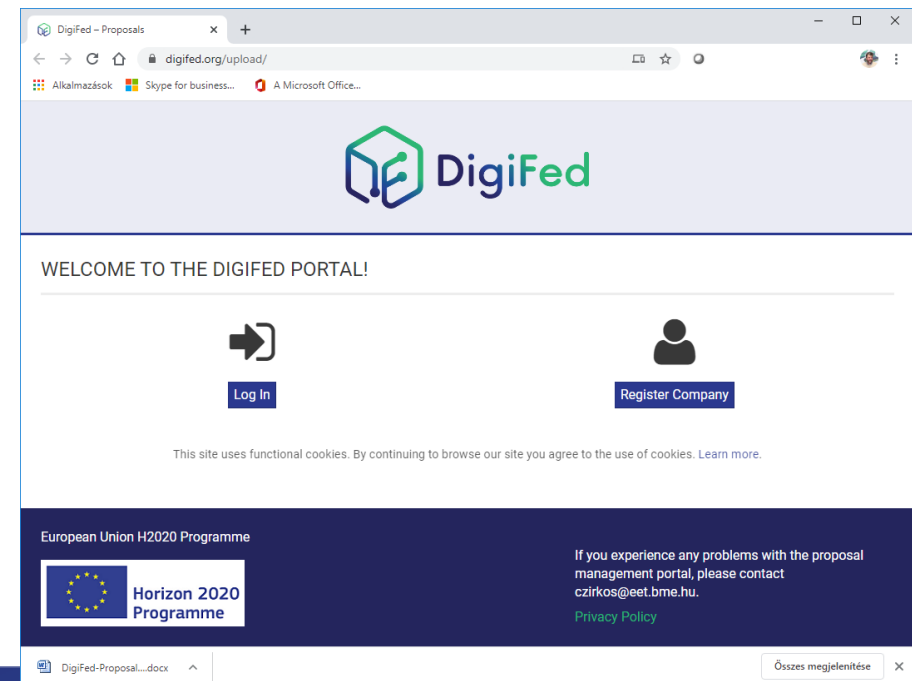
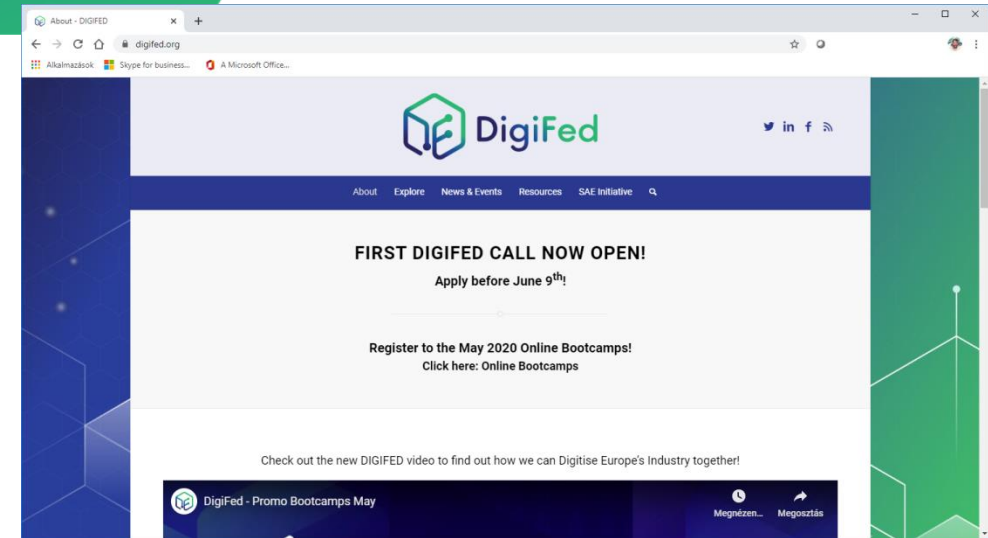
DigiFed Application Experiments

- Open call for Application Experiment (AE): **DigiFed offers grants of up to 55k** as well as **technical and business support*** for the development of smart applications in Europe.
- If you are:
 - Developing novel and innovative smart solutions worthy of market leaders.
 - Bridging the physical and virtual worlds with advanced technologies and industrialized solutions.
 - Interested in using premium resources and competencies to speed up development.
 - Wishing to access a unique European ecosystem composed of: leading industrial companies, world class research organizations, innovation accelerators and private investors.
- Key to success for getting a proposed Application Experiment funded:
 - *Excellence:*
 - **Introduce the your own unique selling points**, e.g. what makes your luminaire competitive / what is your value proposition in the SSL market
 - **How your foreseen innovation would exceed** the present state of the art in your market segment (e.g. reduced light pollution / reduced disturbance to wildlife, better maintenance schemes, etc.)
 - *Impact:*
 - **Quantify the financial and other major business consequences** of the improvement of your lighting product through the proposed innovation
 - Benefits for you, such as reduced development cost, shorter time-to-market, possibility for more diverse/custom lighting product portfolio – describe how and to what extent
 - Benefits for your customers, such as reduced total cost of ownership (through energy saving, longer lifetime, cheaper maintenance)
 - Describe how the proposed innovation would boost your business

**BME is a technical support partner*

Important DigiFed links

- **Website:** <https://digifed.org/>
- **Open Call for Application Experiments:** <https://digifed.org/explore/open-calls/>
 - [Guide for applications](#)
 - [Application portal](#)
- **BME contact for AEs:** [Andras Poppe](mailto:Andras.Poppe@edu.bme.hu)
andras.poppe@edu.bme.hu





CEA

Suzanne LESECQ | **Director of research**

SigmaFusion™ for environment perception

- **Function:** fuse range data to build a digital model of the environment in the form of an occupancy grid
- **Principle:**
 - **Bayesian fusion** based on **integer arithmetic**
- **Key Performances:**
 - Real-time fusion of a huge quantity of data
 - Light-weight computing solution
- **Uniqueness:**
 - “Embeddable” on microcontroller

- **Maturity/TRL:**

- Technology Readiness Level

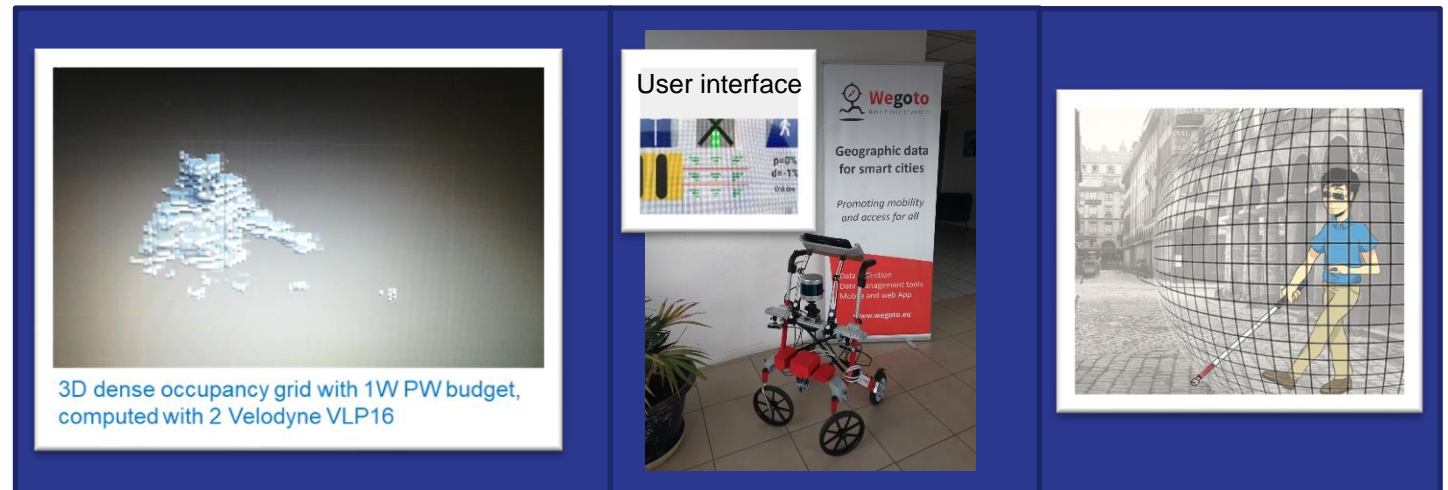


- **Applications:**

- Environment perception for Automotive
- Environment perception for urban mapping
- Environment perception for obstacle detection embedded in a portable device – application to a smart white cane



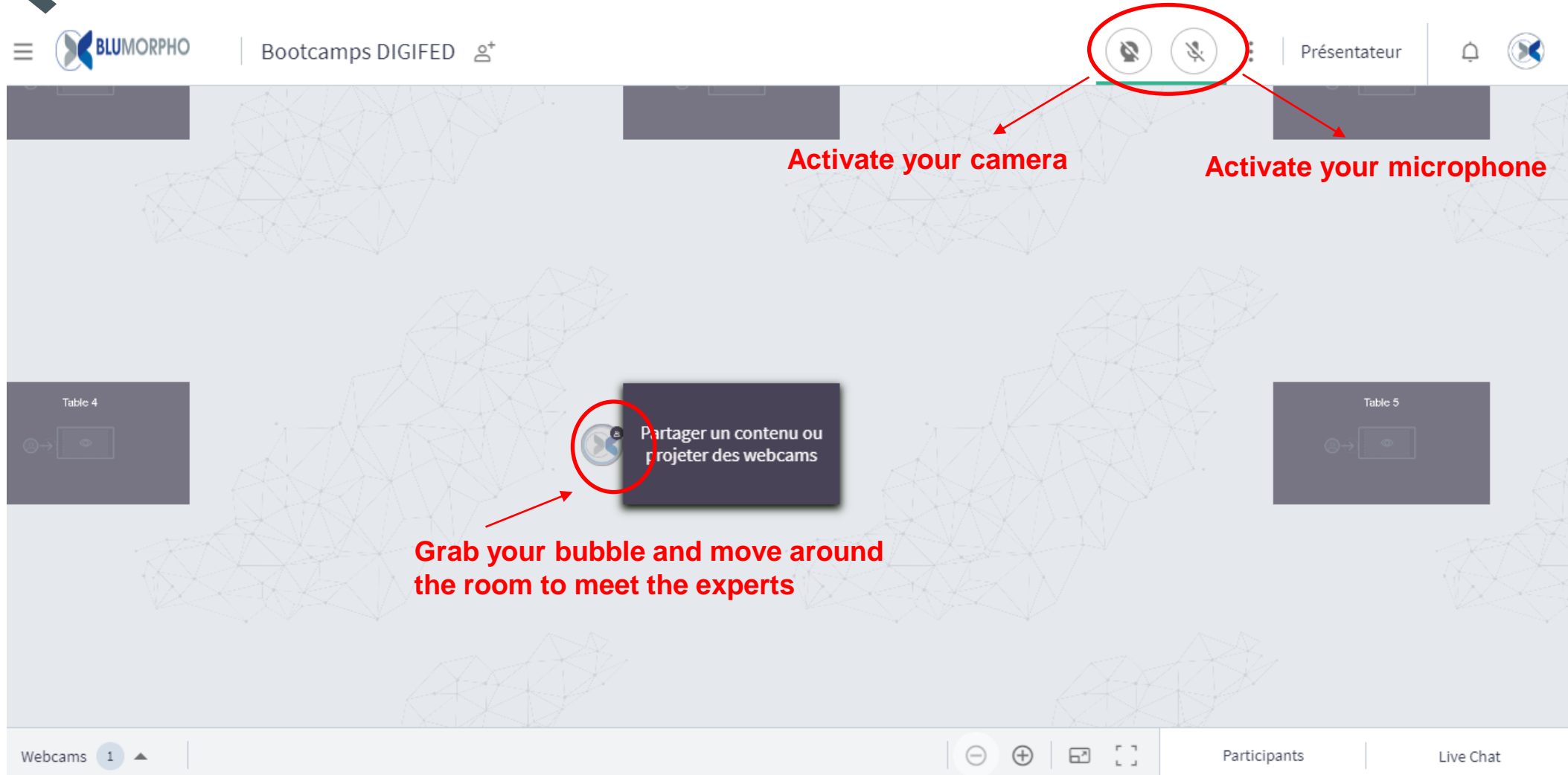
Contact : Suzanne.lesecq@cea.fr





Introduction to the Q&A session

Q&A session



Q&A session

