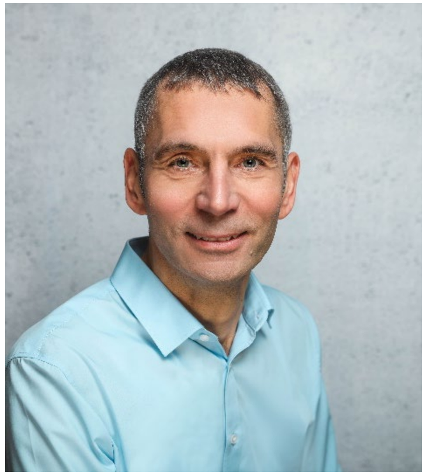
28.11.2023

AVL CONCERTO™ - User Session

Internal

Today’s Moderator



Thilo Schulz

Business Development Manager
Software Solutions, AVL Deutschland GmbH

- Virtual Testing
- Lab and Data Management
- Calibration
- Cyber Security
- ADAS/AD

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Agenda

1 **AVL CONCERTO Generation 6**

- Neue Features
- Roadmap

2 **Lizenzierung**

- Subscription-Modell
- Migrationsszenarien

3 **Use-Cases**

- E-Drive / E-Validation
- Data Quality
- Battery Testing

4 **Jahresendaktion**

5 **Q&A**

AVL CONCERTO 5™

New Features

Internal

Today’s Presenter

Robert Binder

Position

Senior Content Manager

Product and Solution Management
BU-XI Data Analytics

Responsibility

- AVL CONCERTO™
- AVL Data Analytics™

Experience

- *Master degree in Automation Technology*
- *Since 2003, various positions in the automotive industry*

AVL CONCERTO 5™ R7 – New Features

Powerful Graphical Objects

- GRIDTABLE – new graphical table object

Python - API

- Python 3.10.7 as default environment
- Python-concerto
  - Load artifacts
- Python-GUI extensions
  - new GridTable object
- Python–Data extensions
  - Create file & measurement
  - dataset_object
  - Unit conversion

Data Access and Search

- arxml information can be used to read blf files with readable names
- Save multiple attachments at once
- Support of new GTPower-Version *.glx
- Smart ASCII – enhancements

General enhancements

- Theming of FSE
- FSE-Feature “Got to Definition” or “Show all References”

AVL CONCERTO 5™ R7.9 New Features

Graphical Objects

- Configuration for hybrid channels on table objects
- Improvement on Differential contour map
- Improvements for EventScript configuration

Scripting - Enhancements

- Load CONCERTO artefacts (e.g. Layouts) with python script
- Activate and set AutoRange for Y-axis
- Auxiliary function for setting the grid intervals and value range
- Improved syntax coloring

Data Access and configuration

- Native parquet reader compatible to ASAM ODS 6
- Dynamic context variables as new data source keys
- Upgrade Matlab runtime
- Upgrade binary calibration data source to support COMPU_VTAB
- Upgrade HBM-data, AB Dynamics, ASCII/CSV – reader
- Support of Data source context-Script with Python functions

AVL CONCERTO 6™

Unleashing the Future:
A Holistic, Open, and Adaptive Data Forge.

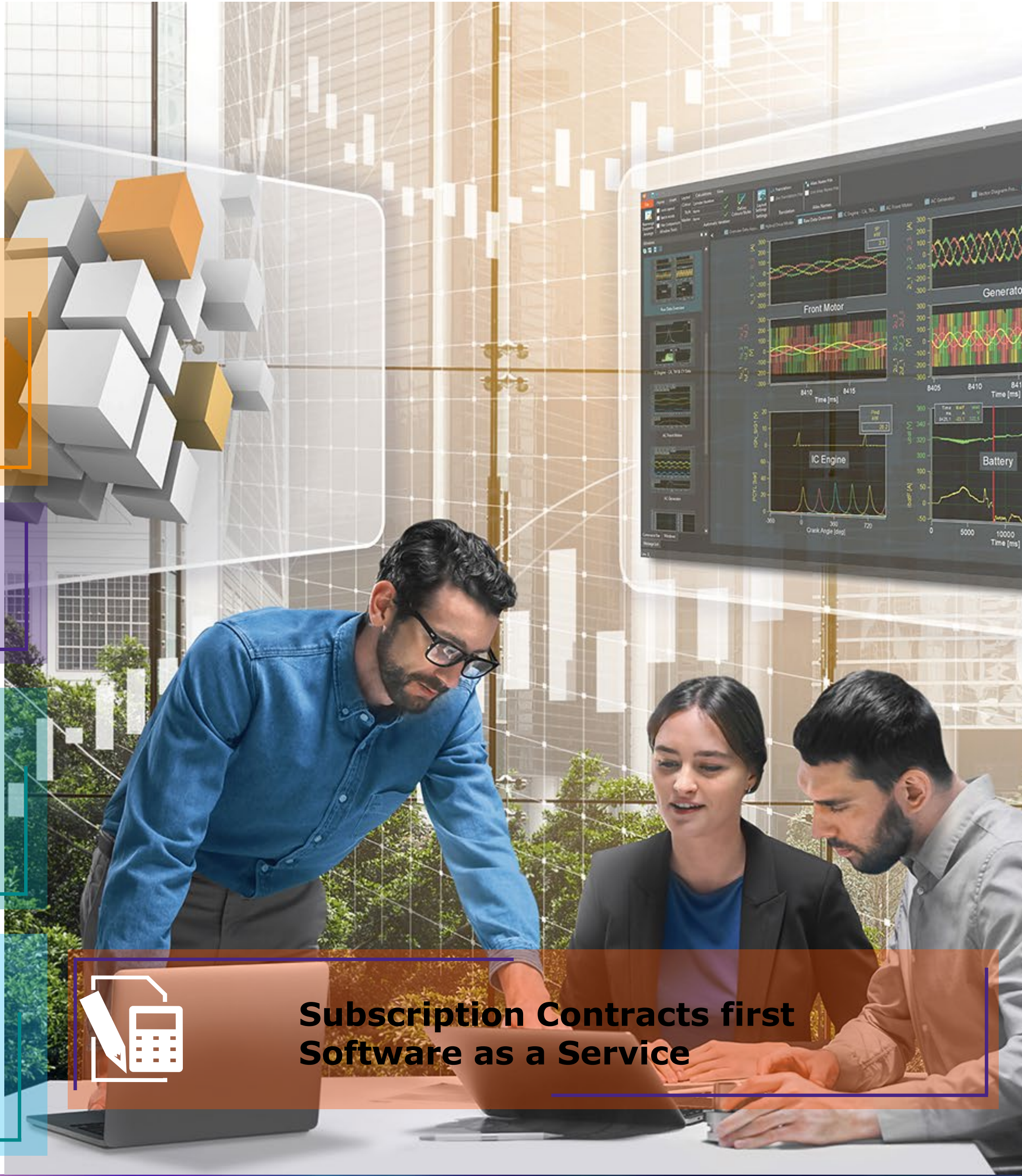
AVL CONCERTO 6™

New UI Technology and Windows 11 readiness

Python as main Scripting language
Standalone Data reader component for Python

Concerto Automation Service
Web Launch Interface

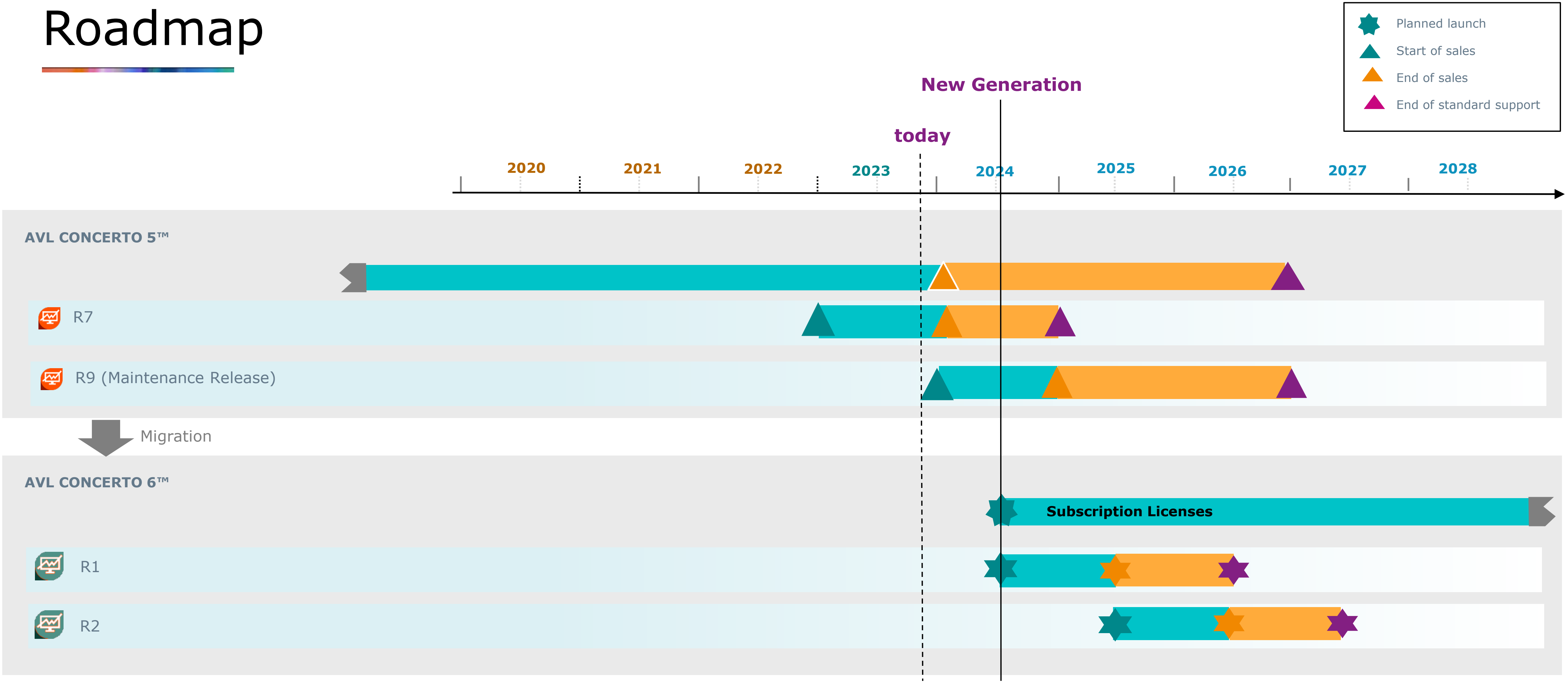
Next generation data acquisition integration



Subscription Contracts first
Software as a Service

CONCERTO™

Roadmap



AVL

AVL CONCERTO™

Licensing

Today’s Presenter

Niels Wendt

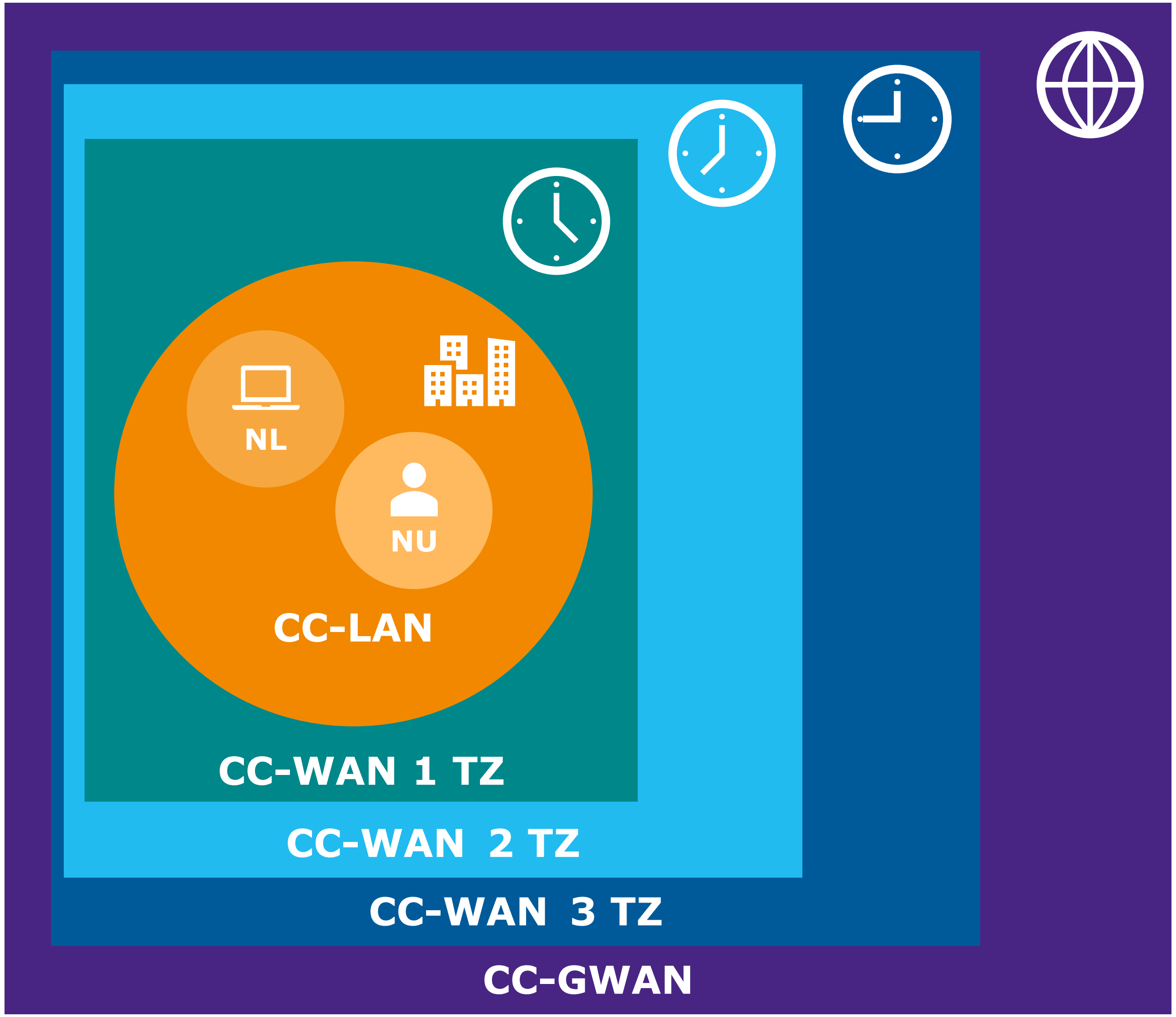
Technical Sales Specialist
Software Solution Sales, AVL Deutschland GmbH

- Lab- and Data Management
- Data Intelligence / Analytics
- PEMS Data Management

Standort: Mainz-Kastel

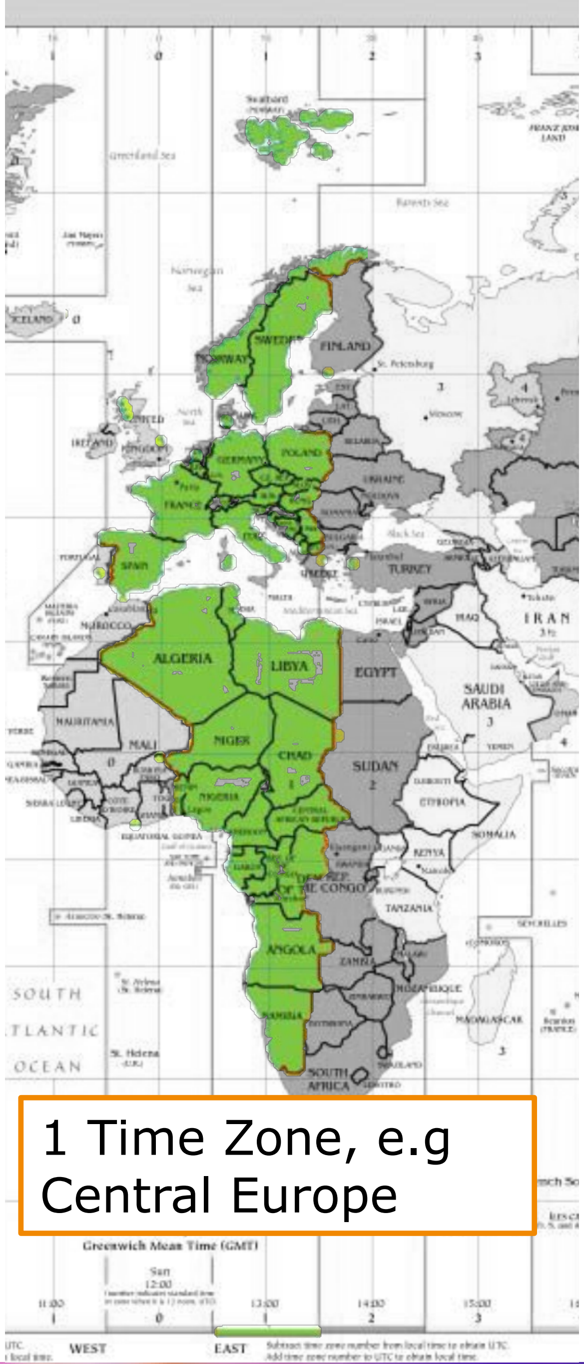
Time Zone Based Licensing

License Type	Usage Right
Named User (G-WAN)	One user
Node Locked	One machine
Concurrent – LAN	One location
Concurrent – WAN 1 TZ	One Time Zone
Concurrent – WAN 3 TZ	Whole Continent
Concurrent – G-WAN	World

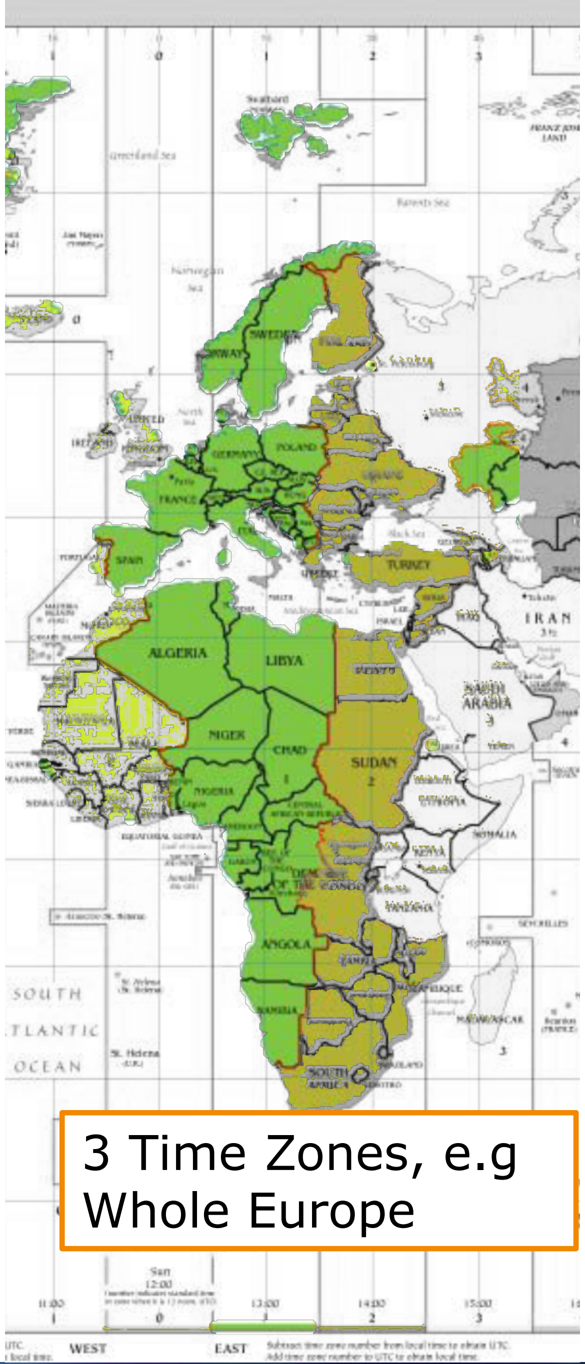


Examples

1 Location e.g Audi Ingolstadt



1 Time Zone, e.g Central Europe



3 Time Zones, e.g Whole Europe

AVL CONCERTO™

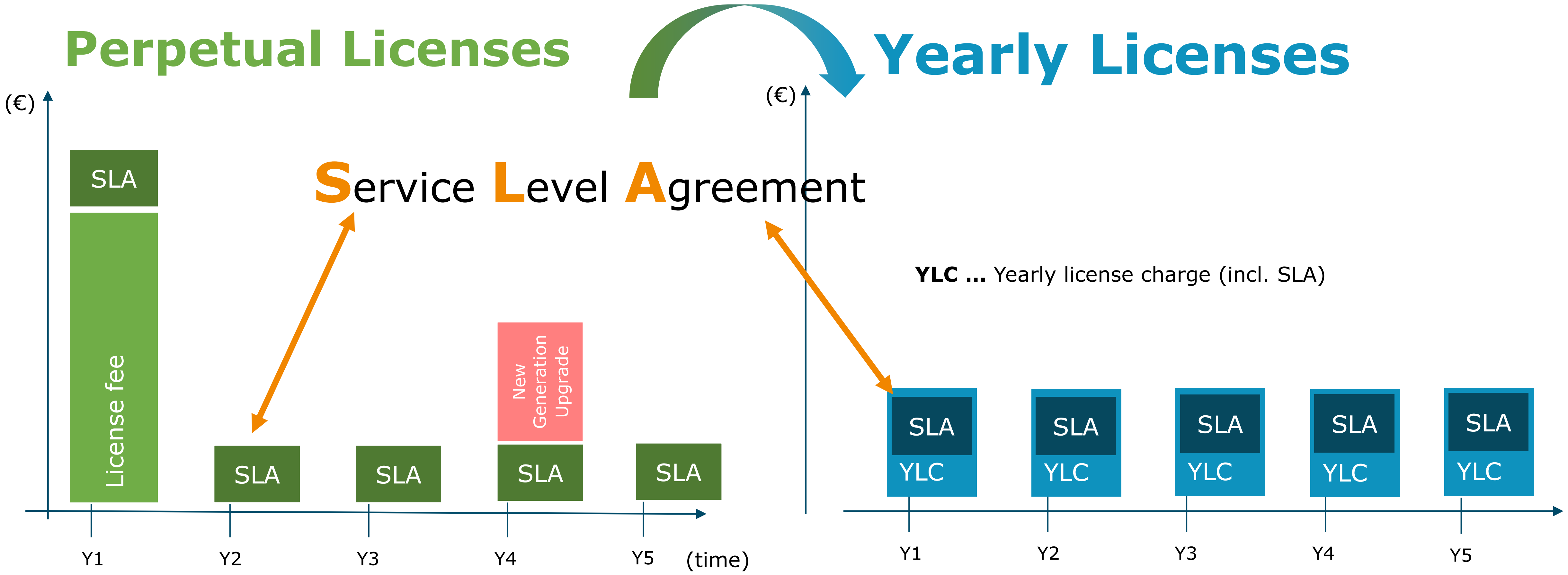
Migration
Subscription Model

Internal

Business Models - Overview

Perpetual Licenses

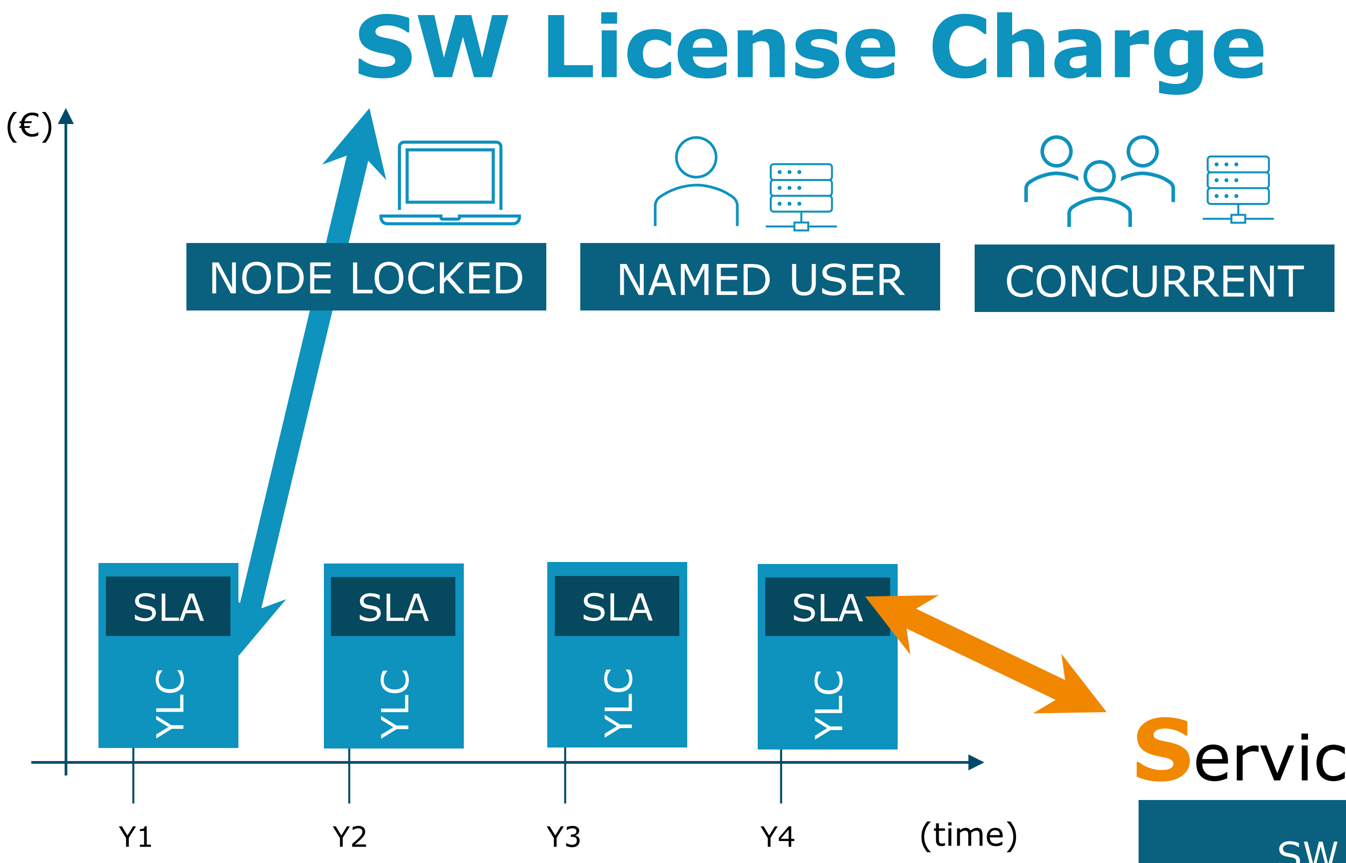
Yearly Licenses



100%+20% **20%** **20%** **20%** **20%**
⇒200%
⇒ NO GENERATION CHANGE
⇒ add. Upgrade Cost possible

40% **40%** **40%** **40%** **40%**
⇒200%
⇒ GENERATION CHANGE INCL.
⇒ no add. Upgrade Costs

Yearly Model



YLC ... Yearly license charge

- LOW FIRST TIME INVEST & PLANNABLE BUDGET
- HIGH FLEXIBILITY BASED ON REAL DEMAND
- EXPERT SUPPORT INCLUDED
- ALWAYS ON THE LATEST SW VERSION
- GENERATION CHANGE INCLUDED

Service Level Agreement

SW MAINTENANCE & SUPPORT

Scenarios of existing M&S contracts CONCERTO

1st Scenario: Subscription

2023

CONCERTO 5™R7

Perpetual Licenses

Migration to Subscription

Q1/2024

CONCERTO 6™R1

Subscription Licenses

- Starting with Concerto 6™ R1
- Available as annual license only
- Optimization of license portfolio
- Agreement to discontinue old licenses

2025

CONCERTO 6™R2

Subscription Licenses

2026

CONCERTO 6™R3

Subscription Licenses

Generation Change

- Optimization of license portfolio
- Agreement to discontinue old licenses

2nd Scenario: Stay in M&S

CONCERTO 5™R7

Perpetual Licenses

- Last Version Concerto 5™ R7
- Only Maintenance Releases
- No new functionality

- End of Support 5R7 & End of Maintenance contracts

STOP

AVL CONCERTO™

Use Cases
E-Motor-Validation Toolbox

CONCERTO Portfolio

Conventional powertrain
M.O.V.E Data Toolbox
Combustion Analysis Toolbox
Emission Quality Toolbox
IGEM Data Toolbox

Electrified powertrain
E-Library for Module & Pack
E-Library for Inverter
E-Library for Fuel Cell
Battery Testing Toolbox
E-Power Toolbox
E-Drive Toolbox

Other automotive toolboxes
NVH Toolbox
Calibration Toolbox (Map Expert)
Application Development Toolbox
VTB Data Toolbox

CONCERTO Toolbox Demo

Electrified powertrain

E-Motor Validation Toolbox v1R0

E-Motor: Challenges and Solutions

Challenges

- Reduce repetitive calibration loops
- Identify the efficient and non-efficient areas of your e-drive system
- Achieve the maximum electric range by considering various circumstances in multiple dimensions.

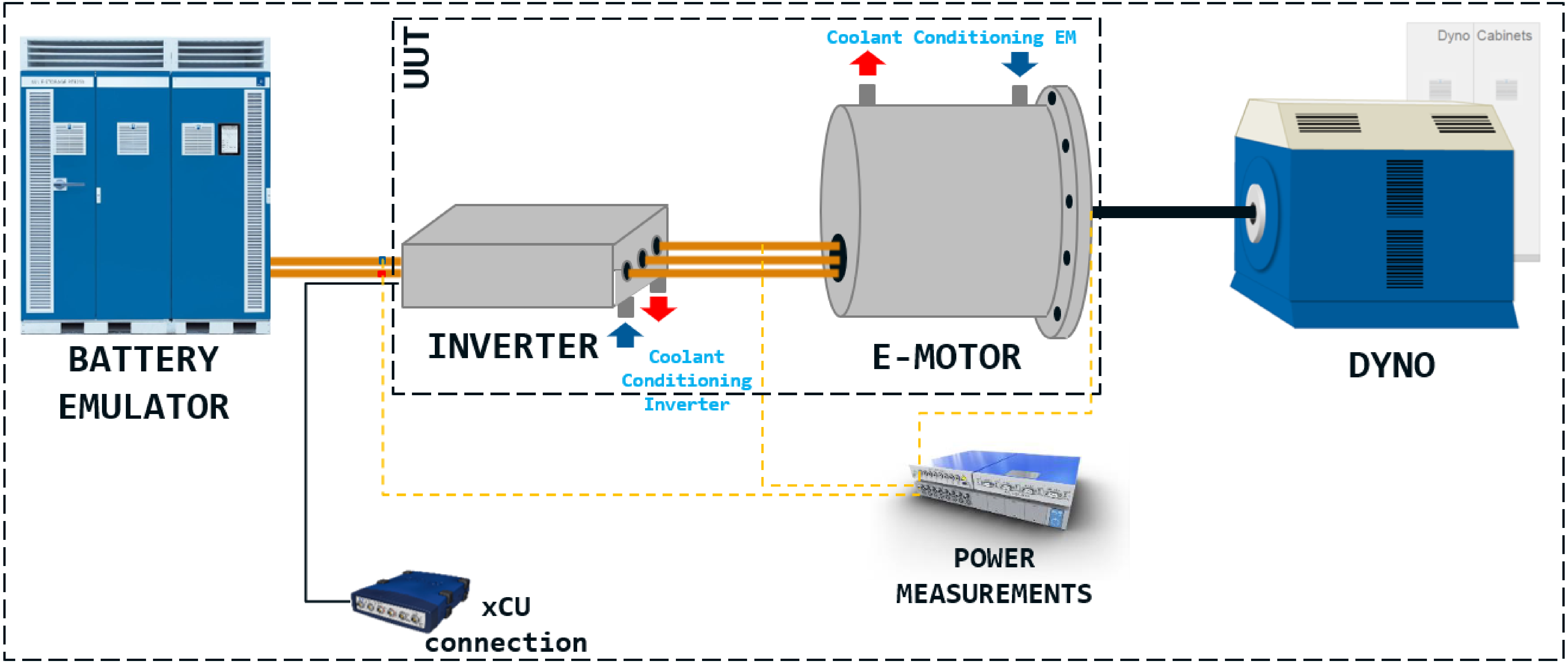
Questions for solutions

- How can I increase the efficiency on the testbed?
- How can I identify the critical and most efficient areas of the system
- How can I achieve a robust calibration for different conditions?.

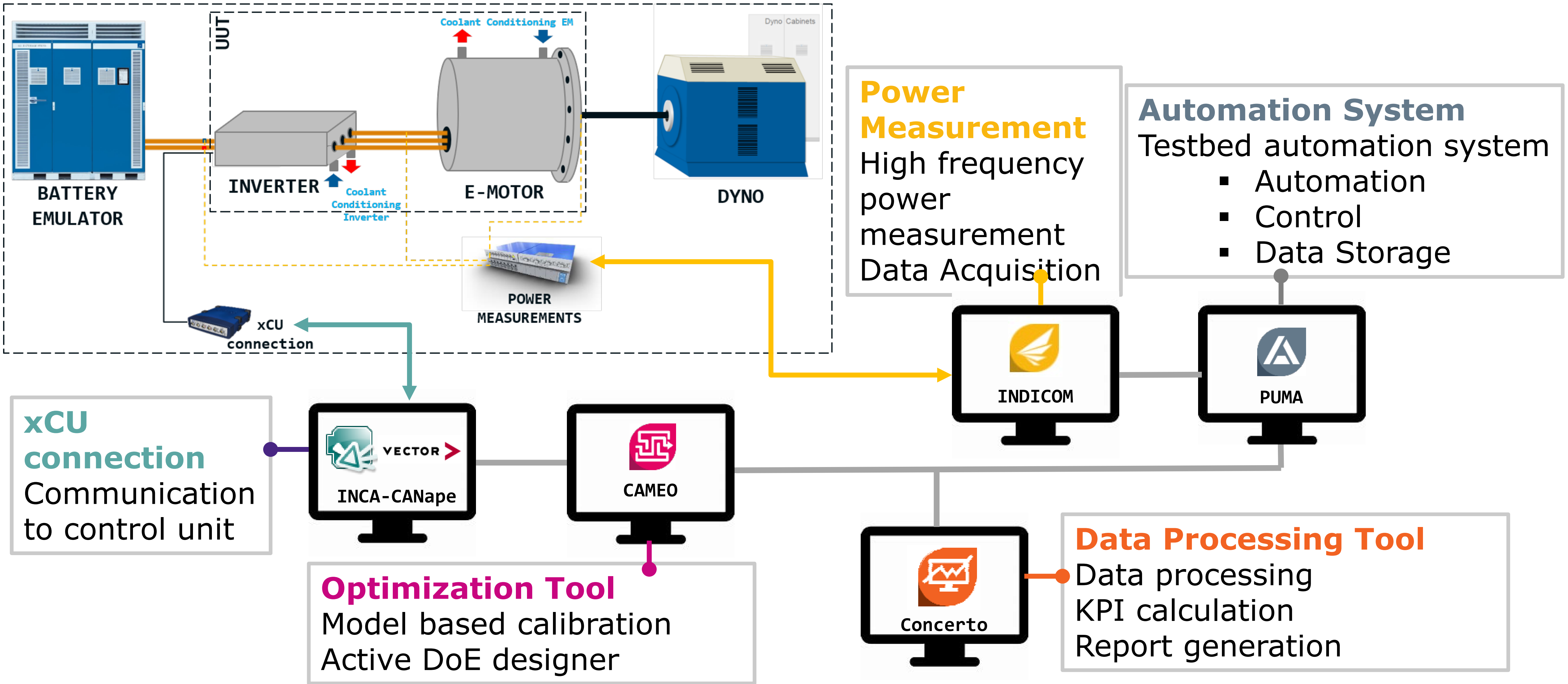
Solution & Answers

- AVL provides an already proven methodology and powerful toolchain
- The **eMotor-Validation Toolbox** identifies the critical and most efficient areas of your system by providing you alle information in a standardized report.

Advanced AVL E-Drive Testbed – Toolchain



Advanced AVL E-Drive Testbed – Toolchain

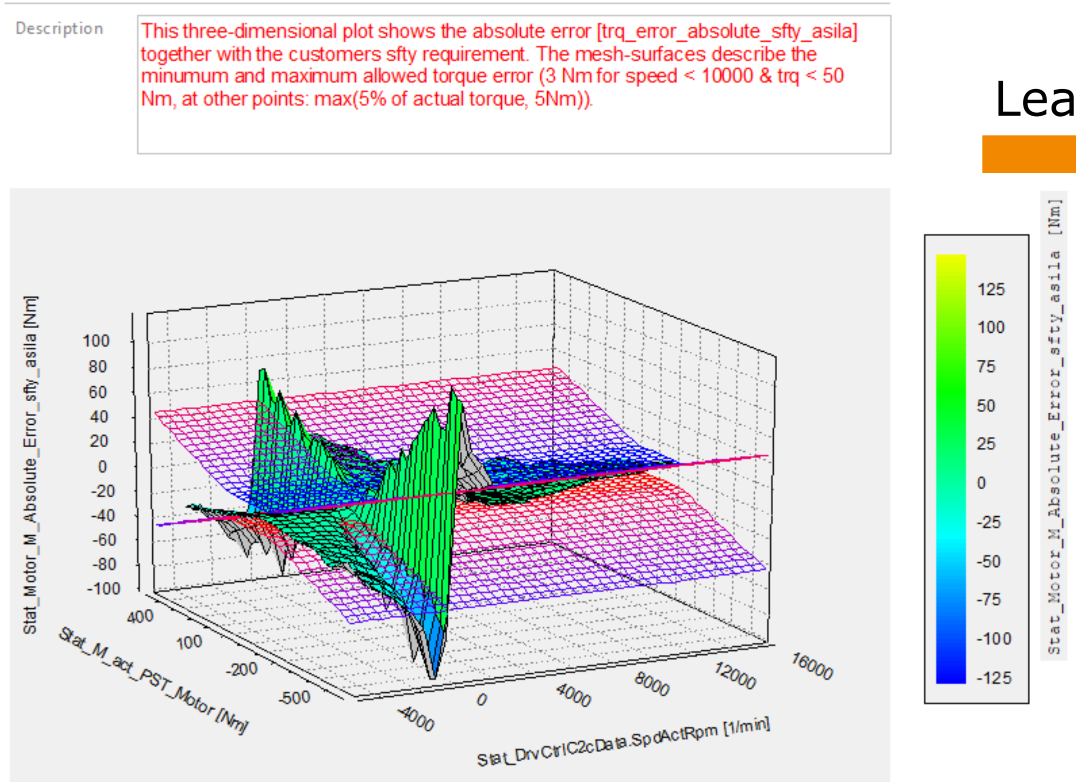


AVL CONCERTO 5™ eMotor-Validation Toolbox

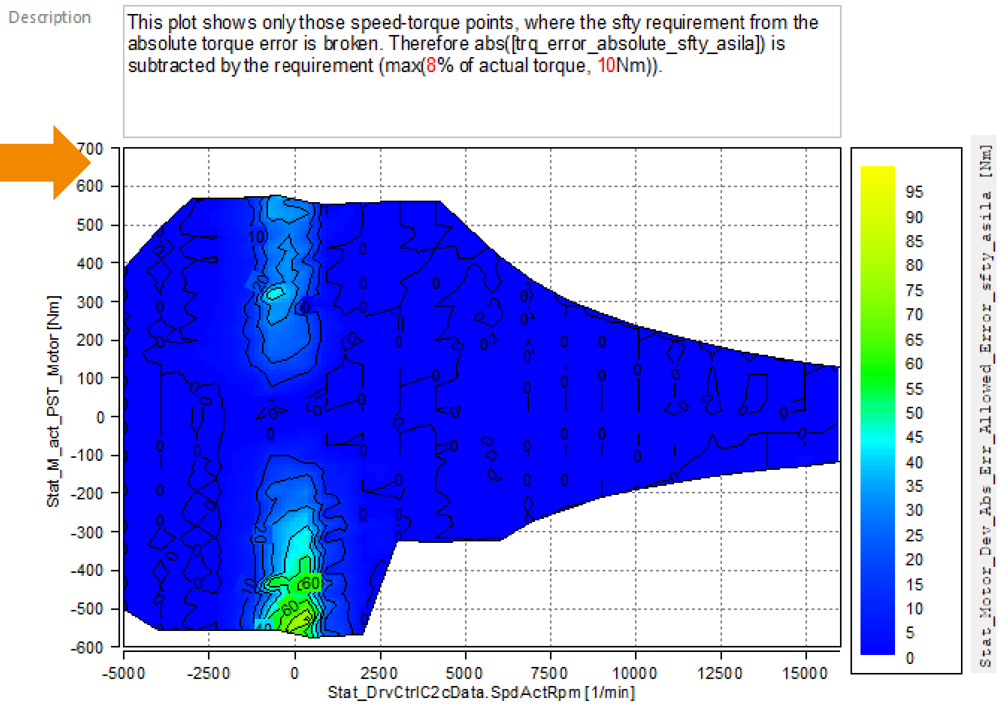
Insights of a small set from the entire validation report

Example -> about measured **torque accuracy** compared to Asil-A requirements

Example on how to visualize the outliers from previous 3D-result



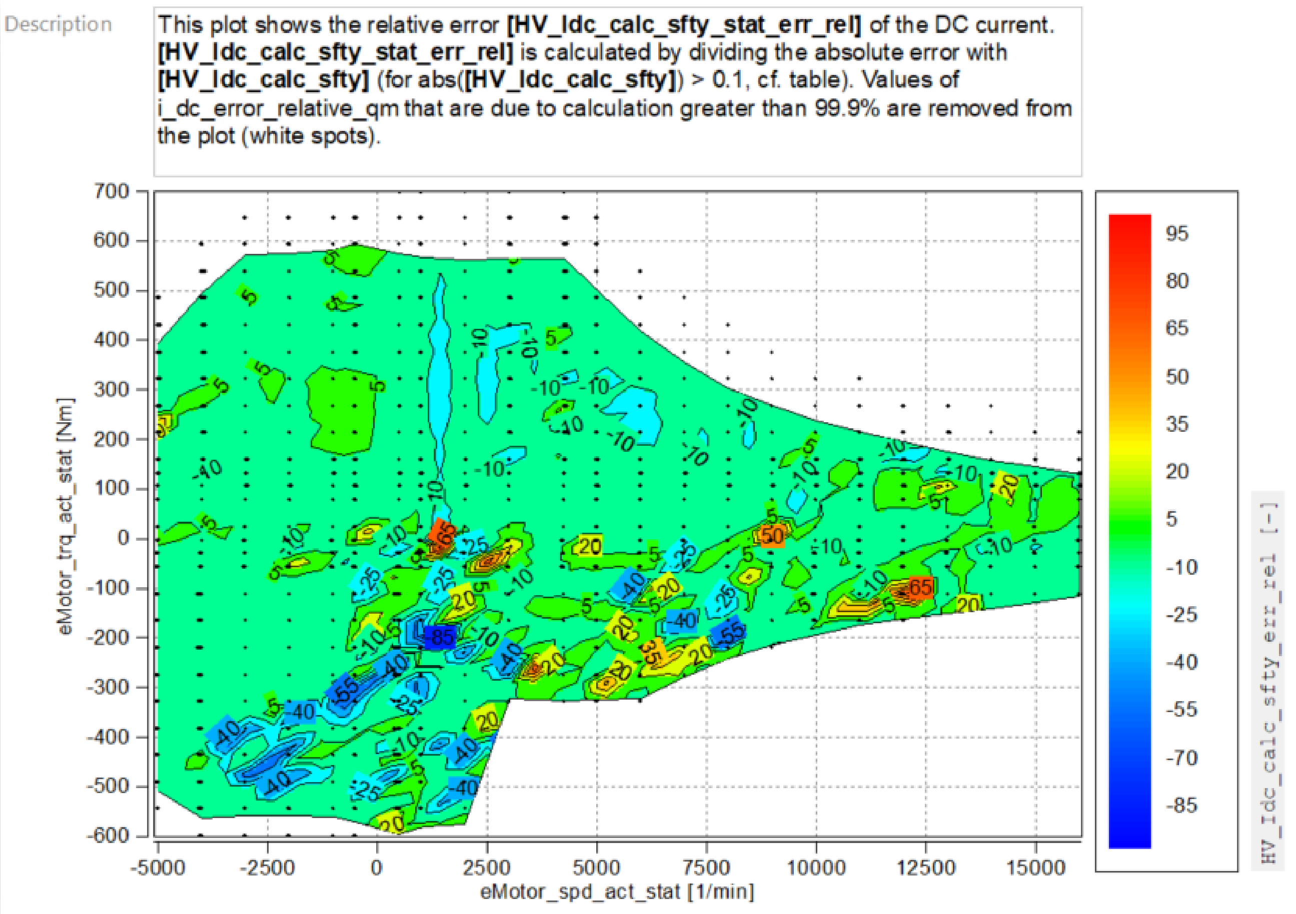
Leads to ...



AVL CONCERTO 5™ eMotor-Validation Toolbox

The standardized report consists of different chapters to analyze

- Peak performance
- Measured Torque accuracy
- Estimated Torque accuracy
- Measured DC-Current accuracy
- Estimated DC-Current accuracy
- Optional, safety-related analytics:
  - on Torque accuracy
  - on DC-current accuracy



AVL CONCERTO 5™ eMotor-Validation Toolbox

AVL CONCERTO™

Use Cases
Data Quality

Today’s Presenter

Dominik Wibbeler

Application Engineer
Applikationssupport, AVL Deutschland GmbH

- Lab- and Data Management
- CONCERTO
- Santorin MX / Data.CONNECT

Standort: Mainz-Kastel

Motivation – Offline Plausibilisierung

- **Wann ist Plausiblisierung sinnvoll?**

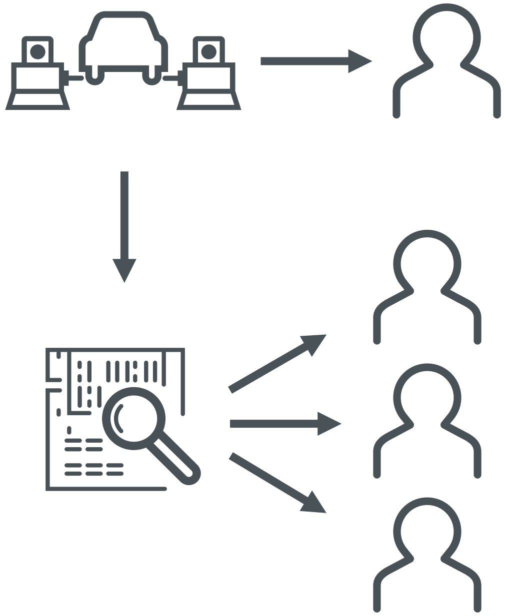
  Traditioneller Ansatz

  Ingenieur fordert spezifische Messung an -> Test erreicht Endlichkeit

  Big Data Vision

  Riesiger Datenstamm vorhanden -> muss nutzbar gemacht werden

- **Warum Offline Plausibilisierung?**
  - Überprüfen bestehender Daten auf Integrität
  - Datenreduzierung
  - Während Laufzeit (Online) sind Ressourcen und damit Komplexität begrenzt



Kundenwunsch

- **Automatisierte Auswertung**, die in Datenbank angehängt wird

- **Plausibilisierung von Stationärmessungen**

  Stationärmessungen messen einen Betriebspunkt im eingeschwungenen Systemzustand

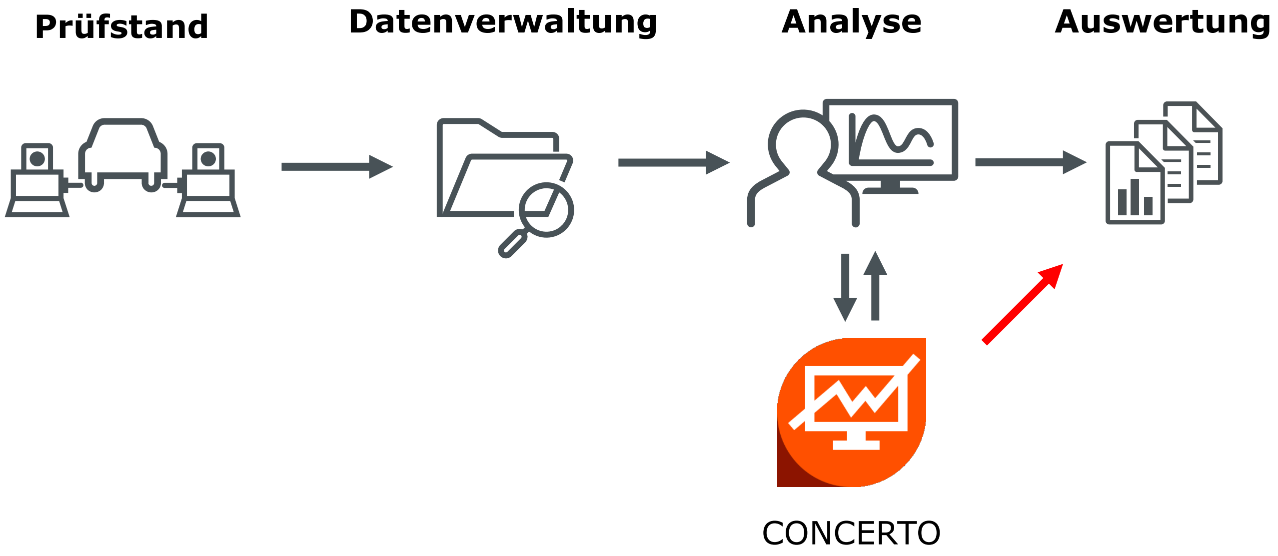
  -> engere und stabilere Grenzwerte

  -> physikalischer Grenzen leichter definierbar

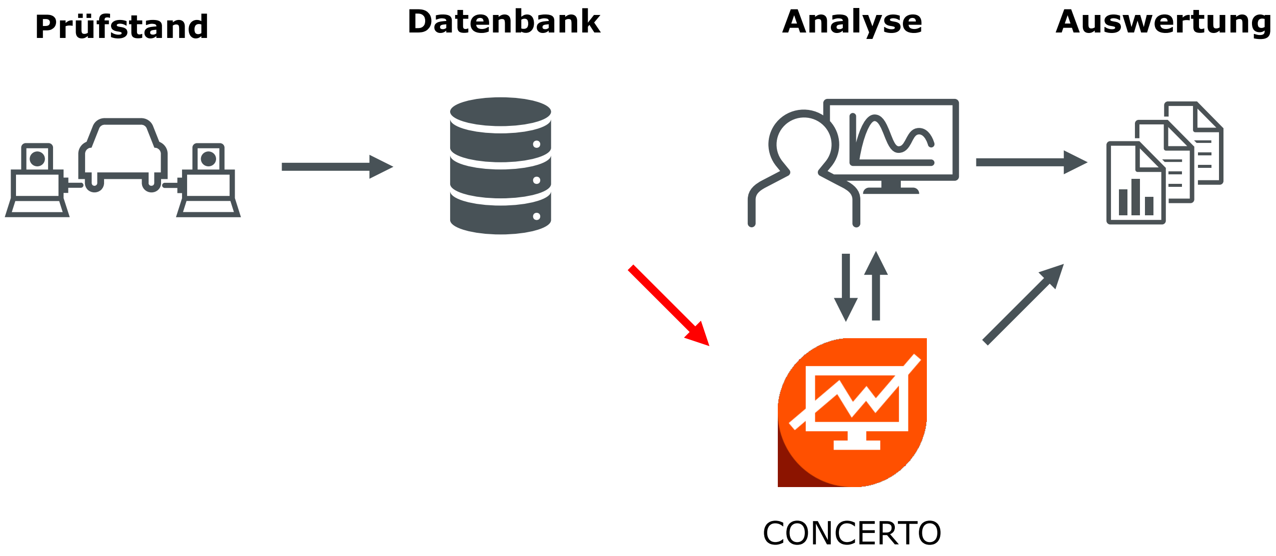
- **Generische Überprüfung** – einfach konfigurierbar via Checkliste

  Checks sind flexibel und testspezifisch

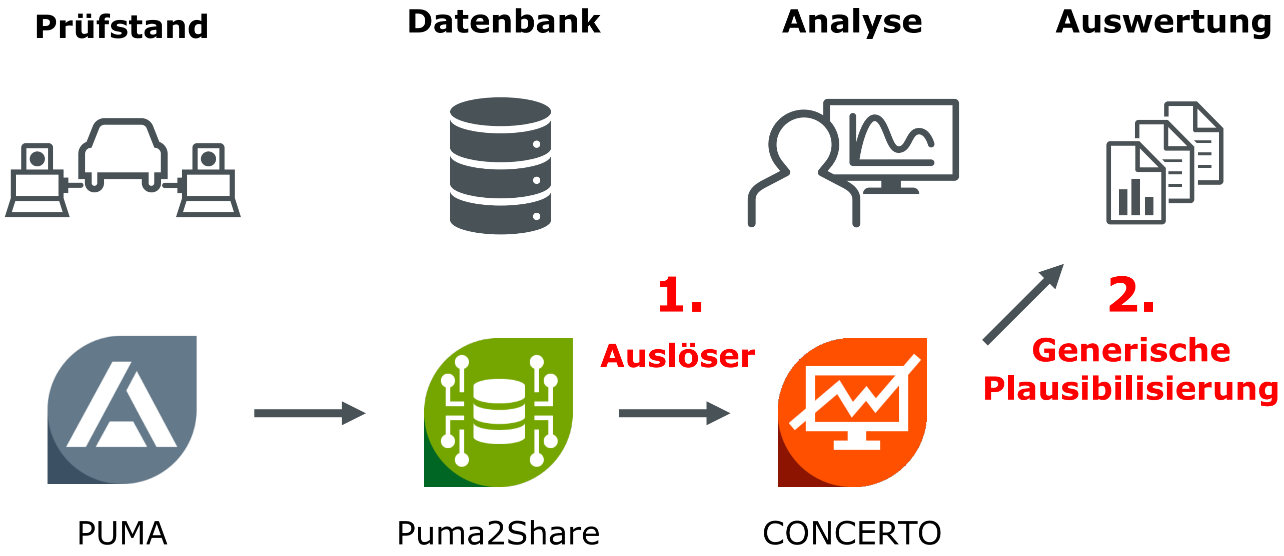
Toolchain – CONCERTO



Toolchain – Datenbank



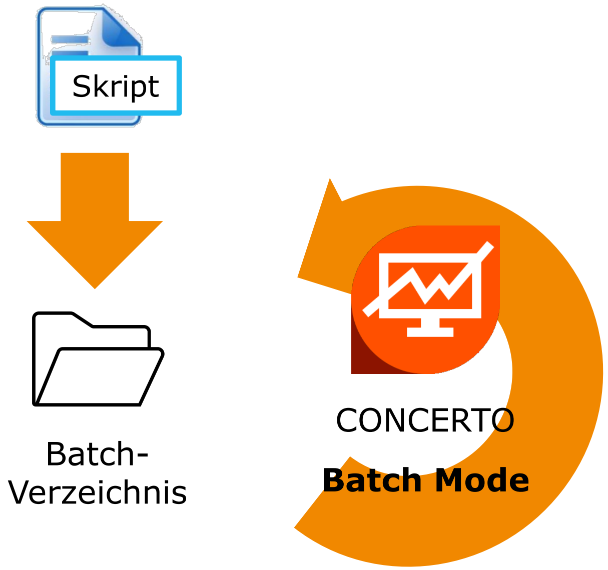
Toolchain – Kundensystem



1. Automatisierte Datenverarbeitung

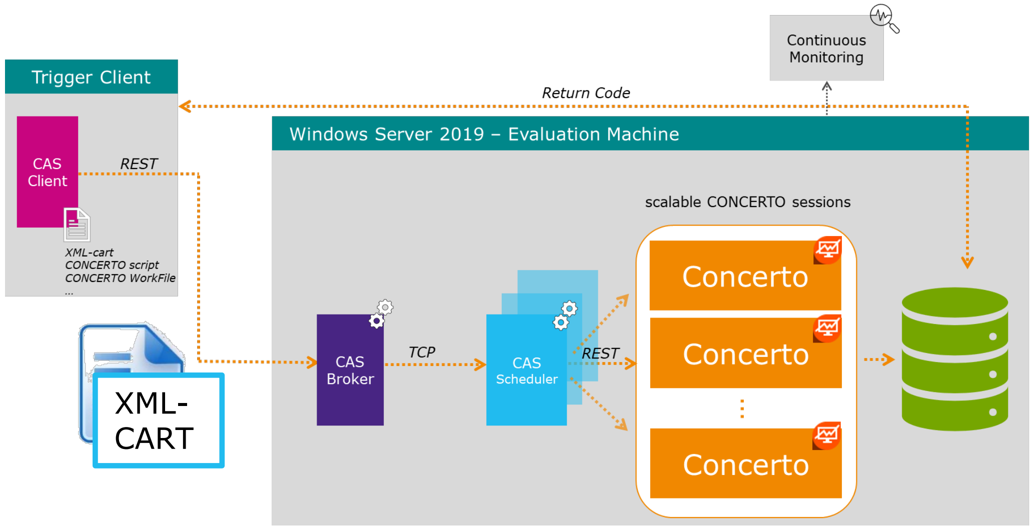
CONCERTO Automatisierungssysteme

Batch Mode – Legacy



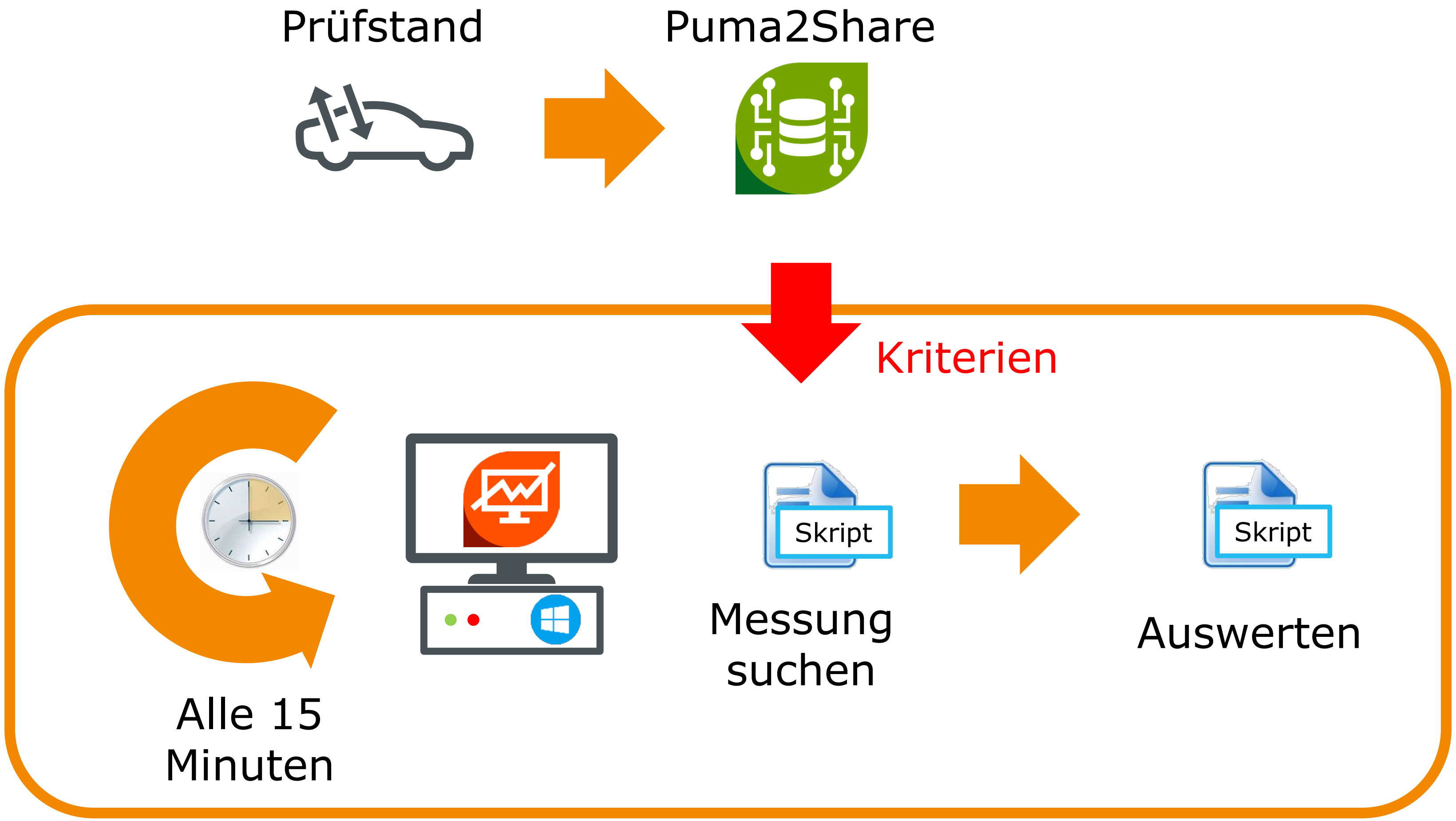
- Skripte in Batch-Verzeichnis legen
- Sequenzielle Abarbeitung in CONCERTO
- Logs werden abgespeichert

CAS – CONCERTO As a Service



- Serverseitig
- CONCERTO Client überprüft Batch-Verzeichnis auf neue CART-Files
- Jobs werden auf CONCERTO-Instanzen verteilt
  -> ermöglicht parallele Ausführung
- Logs werden abgespeichert

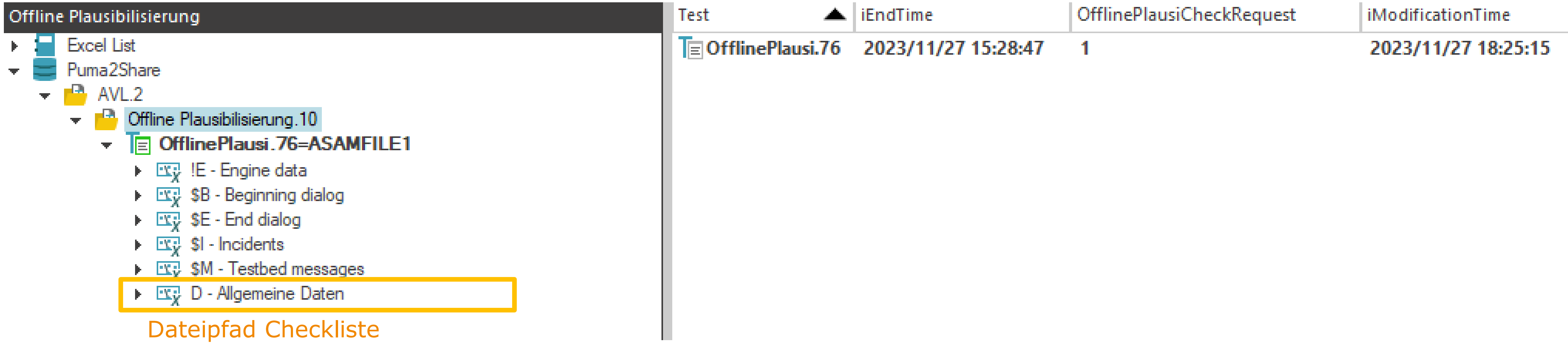
Datenplausibilisierung



Messung suchen - Kriterien

- Messung in Datenbank wurde seit letzter Suche verändert
- Auswertung ist angefordert
- Messung ist abgeschlossen
- Enthält aufgezeichnete Daten
- Checkliste vorhanden

- Weitere mögliche Kriterien: Projekt, Messkanalwerte (Bsp.: Geschwindigkeit > 0)



Weitere Aspekte

Features

- Konfiguration der Applikation
- Prüflaufspezifische Checklisten
- Ergebnisse in Datenbank zurückspiegeln
- E-Mail Benachrichtigung
- Stabilität (Logs, Neustart)
  - Abgebrochene Auswertung wiederholen
  - CONCERTO automatischer Neustart
  - Logs
    - Suchläufe
    - Auswertungen

2. Auswertung: Plausibilisierung

Internal

Checklisten

- Automatisierte Validierung von Testdaten basierend auf Checkliste
- Checklisten sind erweiterbar und können spezifisch für Projekte, Prüfling, etc definiert werden
- Checks sind generisch und via Excel konfigurierbar (Bereich, Vergleich, Relativ, Statistik)

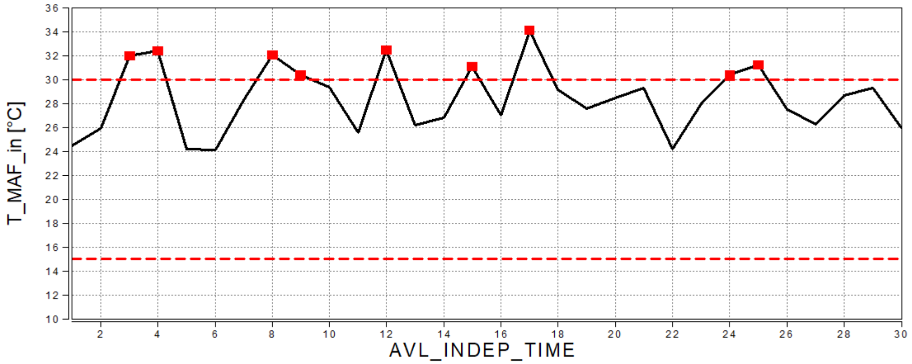
Beispiel:

Checkname	Kanal	Check Typ	Bedingung
Motor läuft	N_Motor	Bereich	>1 rpm
Wellenbruch	N_Motor	Vergleich	= N_Abtrieb
Sollgeschwindigkeit	N_Motor	Relativ	N_Soll ± 5%
Geschwindigkeitsabweichung	N_Motor	Statistik	σ < 100 rpm

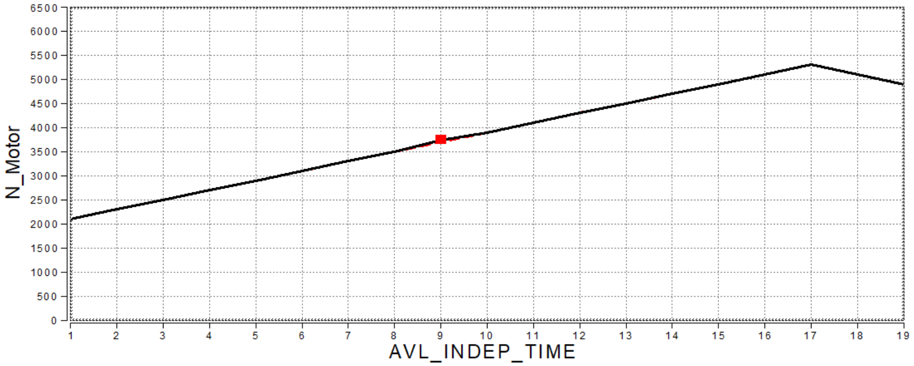
Generische Checks

Check Typ	Beispiel	Kanal	Bedingung
Bereich	Motor läuft	N_Motor	>1 rpm
Vergleich	Wellenbruch	N_Motor	= N_Abtrieb
Relativ	Sollgeschwindigkeit	N_Motor	N_Soll ± 5%
Statistik	Geschwindigkeitsabweichung	N_Motor	σ < 100 rpm

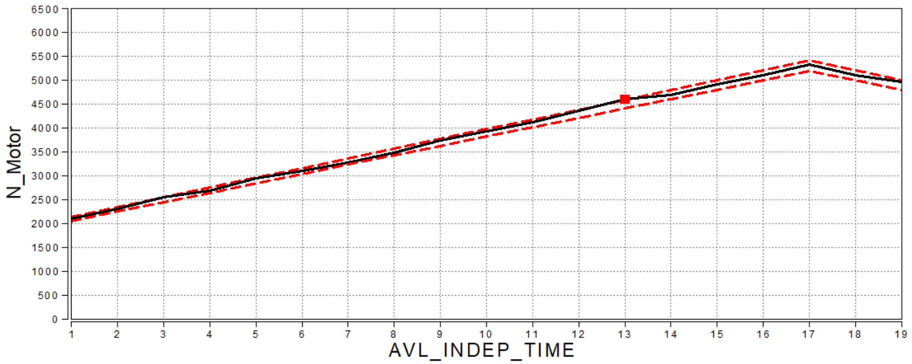
Bereich



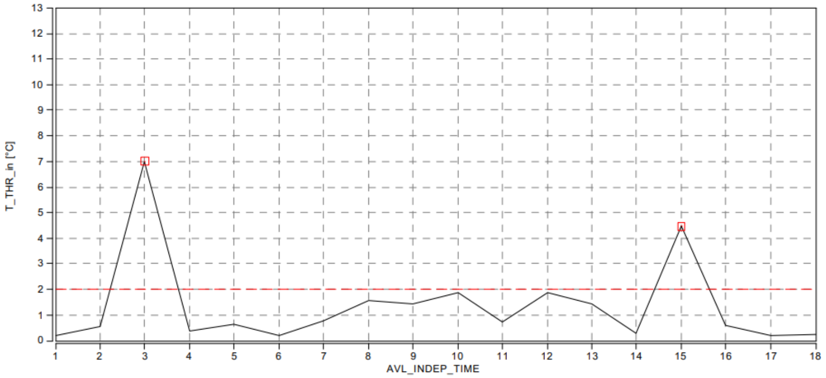
Vergleich (<,>,=)



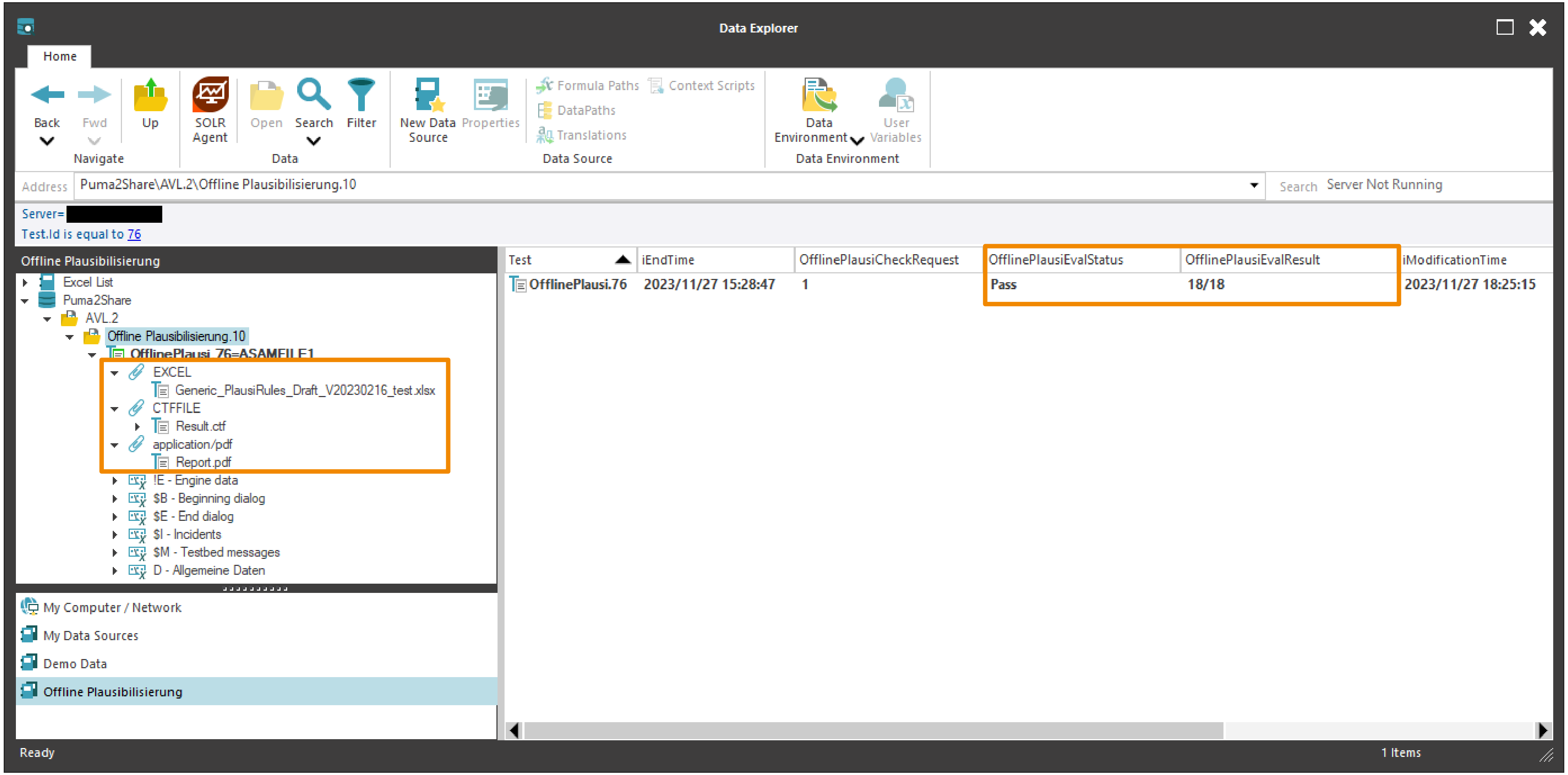
Relativ



Statistik



Auswertung



Data Explorer
Home
Back
Fwd
Up
Navigate
SOLR Agent
Open
Search
Filter
Data
New Data Source
Properties
Formula Paths
Context Scripts
DataPaths
Translations
Data Source
Data Environment
User Variables
Data Environment
Address Puma2Share\AVL.2\Offline Plausibilisierung.10
Search Server Not Running
Server= [redacted]
Test.Id is equal to 76
Offline Plausibilisierung
Excel List
Puma2Share
AVL.2
Offline Plausibilisierung.10
OfflinePlausi_76=ASAMFILE1
EXCEL
Generic_PlausiRules_Draft_V20230216_test.xlsx
CTFFILE
Result.ctf
application/pdf
Report.pdf
!E - Engine data
$B - Beginning dialog
$E - End dialog
$I - Incidents
$M - Testbed messages
D - Allgemeine Daten
My Computer / Network
My Data Sources
Demo Data
Offline Plausibilisierung
Test
iEndTime
OfflinePlausiCheckRequest
OfflinePlausiEvalStatus
OfflinePlausiEvalResult
iModificationTime
OfflinePlausi.76
2023/11/27 15:28:47
1
Pass
18/18
2023/11/27 18:25:15
Ready
1 Items

Bericht - Übersicht

Offline Plausibilisierung

AVL

Test Information

NAME	Wert
OPERATOR	Dominik Wibbeler
TEST_SERIES	Offline Plausibilisierung
TEST_ID	OfflinePlausi.76
NUMBER_OF_TB	2
DATE	28.11.2023
ENG_FAMILY	AVL_SIM
STAGE	01
MODEL	112
INJECTION_TYPE	simu
CHARGE_TYPE	NA
ENG_NO	01
DESTINATION	AVL_DEMO
ECU_SUPPLIER	Customer
ROM_NAME	NA
OVERALL_TEST_STATUS	
NUMBER OF PASSED TEST	17/18

Date: 2023/11/27 Time: 17:26:15

Report erstellt in AVL Concerto

Check Name	Check Typ	Status
01_T_in	Range	
02_T_ACL_in	Range	
03_T_ACL_out	Range	
04_T_MAF_in	Range	
05_T_MAF_out	Range	
01_N_ENGINE	Relative	
02_FVG_POS	Relative	
03_TORQUE	Relative	
04_T_WATER_EG_out	Relative	
05_T_INTK_PORT1	Relative	
01_P_atm	Comparison	
02_P_THR_in	Comparison	
03_P_GPF_in	Comparison	
04_P_uf_CAT_in	Comparison	
05_T_EGR_CLR_in	Comparison	
01_T_in	Statistics	
02_T_ACL_in	Statistics	
03_T_ACL_out	Statistics	
04_T_MAF_in	Statistics	
05_T_MAF_out	Statistics	

Hinweis
Grün - Check bestanden
Rot - Check verletzt
Gelb - Check übersprungen

Bericht - Übersprungene Checks

Channel Name	Type of Check	Error Message
02_T_ACL_in	Range	Missing channel D'T_ACL_in
05_T_MAF_out	Range	Missing channel D'T_MAF_out
08_T_MAF_out	Range	Missing channel D'T_MAF_out
11_ALPHA_d_	Range	Required attribute Stats is missing!
01_N_ENGINE	Relative	Missing channel D'N_set_D
04_T_WATER_EG_out	Relative	Missing channel D'T_dem_E_CW
05_T_INTK_PORT1	Relative	Missing channel D'T_INTK_PORT1
06_T_INTK_PORT1	Relative	Missing channel D'T_INTK_PORT1
07_T_INTK_PORT1	Relative	Missing channel D'T_INTK_PORT1
08_T_INTK_PORT2	Relative	Missing channel D'T_INTK_PORT2
09_T_INTK_PORT2	Relative	Missing channel D'T_INTK_PORT2
10_T_INTK_PORT3	Relative	Missing channel D'T_INTK_PORT3
11_T_EX_PORT1	Relative	Missing channel D'T_EX_PORT1
12_T_EX_PORT1	Relative	Missing channel D'T_EX_PORT1
13_T_EX_PORT1	Relative	Missing channel D'T_EX_PORT1
14_T_EX_PORT2	Relative	Missing channel D'T_EX_PORT2
15_T_EX_PORT2	Relative	Missing channel D'T_EX_PORT2
16_T_EX_PORT3	Relative	Missing channel D'T_EX_PORT3
18_N_ENGINE	Relative	Required attribute Storage Key is missing!
19_N_ENGINE	Relative	Required attribute Storage Key is missing!
01_P_atm	Comparison	Missing channel D'P_ACL_out
04_P_uf_CAT_in	Comparison	Missing channel D'P_uf_CAT_in
05_T_EGR_CLR_in	Comparison	Missing channel D'T_EGR_CLR_in

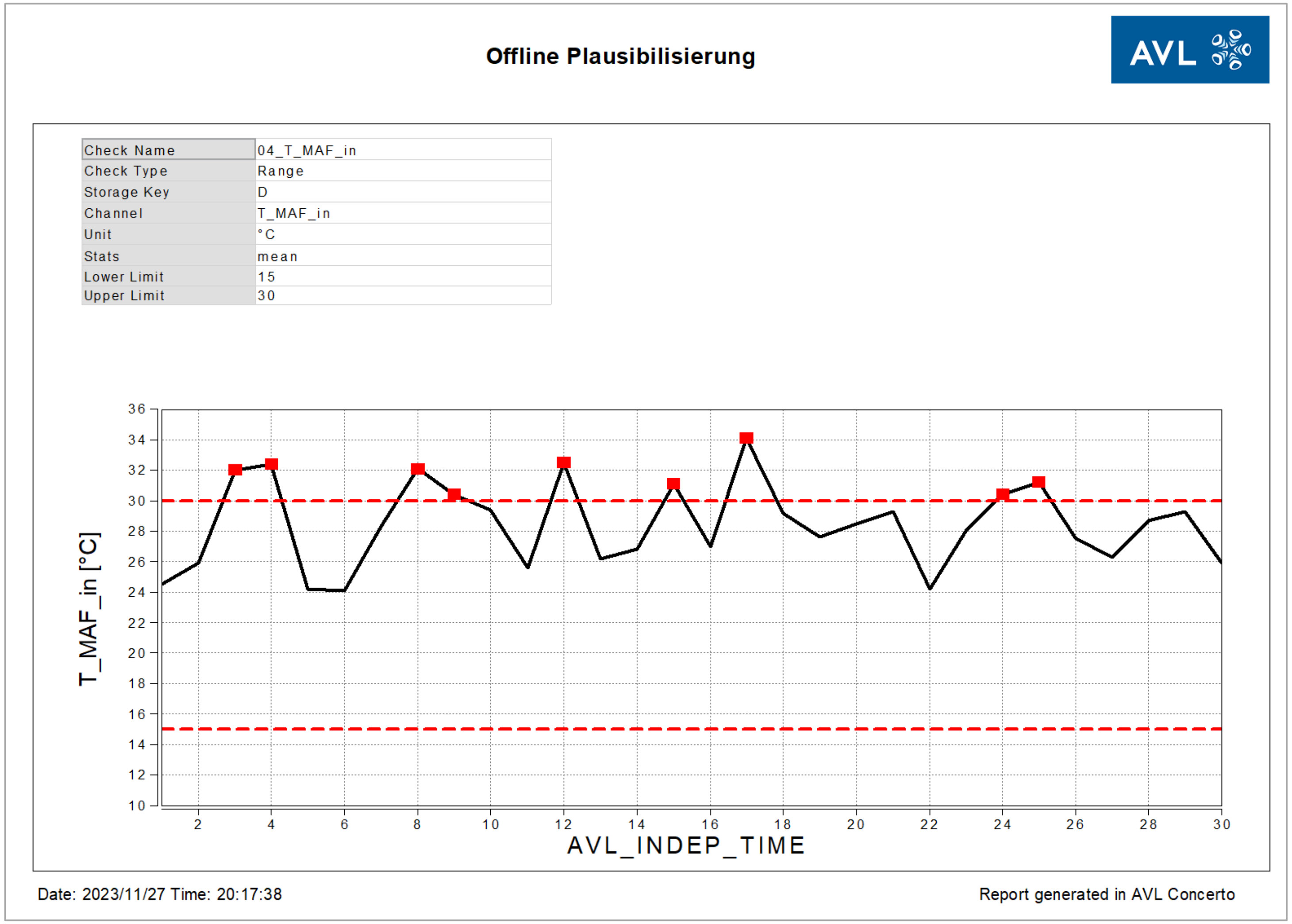
Beispiel Meldung:

- Fehlende Kanäle
- Inkorrekte Eingaben

➡ Checks werden übersprungen

Verletzte Checks

- Seperates Berichts Fenster
  - **nur** für verletzte Konditionen
  - Check Einstellungen
  - Kanal-Diagramm
    - Limits
    - Verletzungen



Zusammenfassung

- Vollautomatisierte Standardisierte Plausibilisierung von Stationärmessungen
  - Spezifisch Konfigurierbar via Checklisten
  - Automatisierte Berichterstellung

- Erspарnis Beispielrechnung:

  Anzahl anfallender Messungen pro Woche: 20

  Zeitersparnis pro Messung: 30 min (Auswertung) + 30 min (Bericht)

  -> Zeitersparnis pro Woche: 20 x 1h = 20h pro Woche
- Welcher Zeitaufwand war nötig?
  - Ca 300h

- Wir bieten Ihnen:
  - Kundenspezifisch entwickelte Applikationen
  - Support bei Entwicklung oder mit bestehenden Applikationen

AVL CONCERTO™

Use Cases
Battery Testing Toolbox

CONCERTO Toolbox Demo

Electrified powertrain

Battery Testing Toolbox v1R3

Battery-Analytics: Challenges and Solutions

Challenges

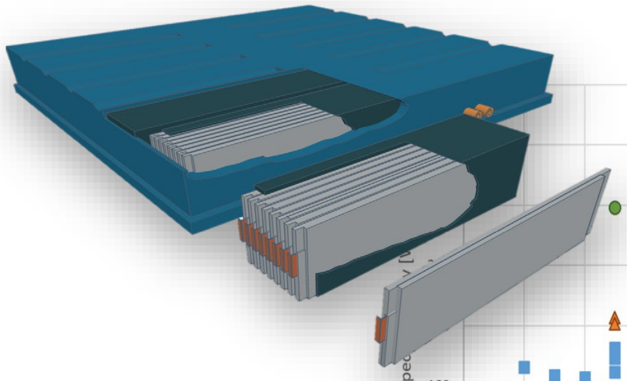
- **Reliable cell selection** with the guarantee to reach the final range, performance and lifetime of a battery pack
- **Consolidation of many test results** from different institutes and at different component levels for fast and correct decisions on further development measures

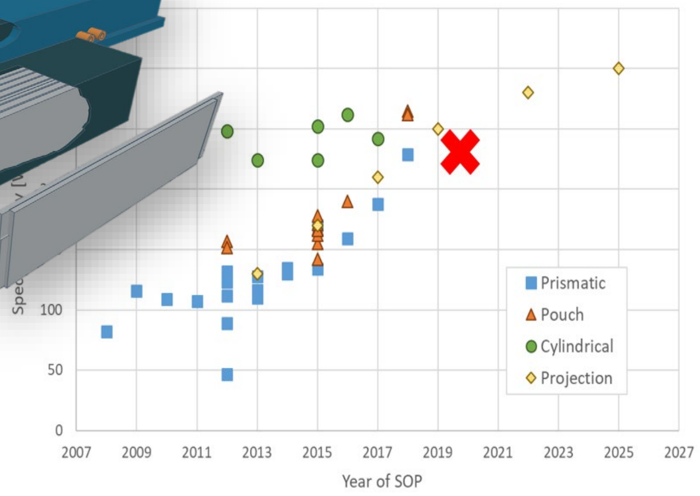
Solution & Answers

- Battery Testing Toolbox provides you a **flexible configurations** to create **comparable reports** from different measurement results and **different component level**
- In addition, with thís Toolbox you have a set of **helpful python packages** which you can use to automate easily your custom post-processing tasks

Challenges at Cell selection

"The battery pack is only as performant as its weakest cell!"
&
It defines the main characteristics of the vehicle!





- Cell chemistry ?
- Cell design ?
- Capacity performance?
- Capacity degradation ?
- Predicted Cell life time ?

Driving Range
Energy storage capability of the cells reflects the driving range of the vehicle.

Driving Performance
Cell provides power to accelerate the vehicle.

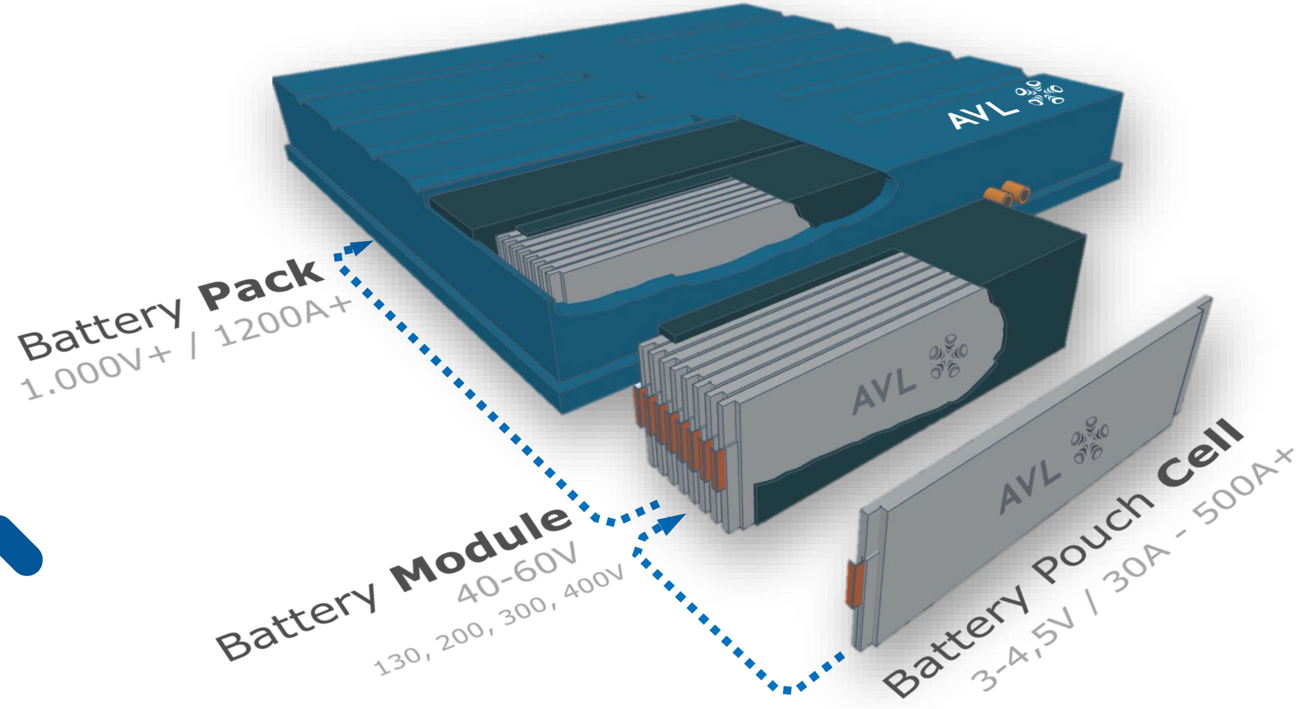
Charging Time
Quick charging relies on the cell current-rate capability.

Vehicle Lifetime
Cell aging reduces powertrain performance over time.

Understand right operating conditions

Conditions	Chemical Results
High Temperature Over Voltage Low Temperature High Current	SEI Dissolution SEI Formation Lithium Plating

Impact on Vehicle	Electrical Results
$P_{joule} = R_i \times I^2$ $E_{storage} = U_{cell} \times C$	Increase in Resistance Decrease in Capacity

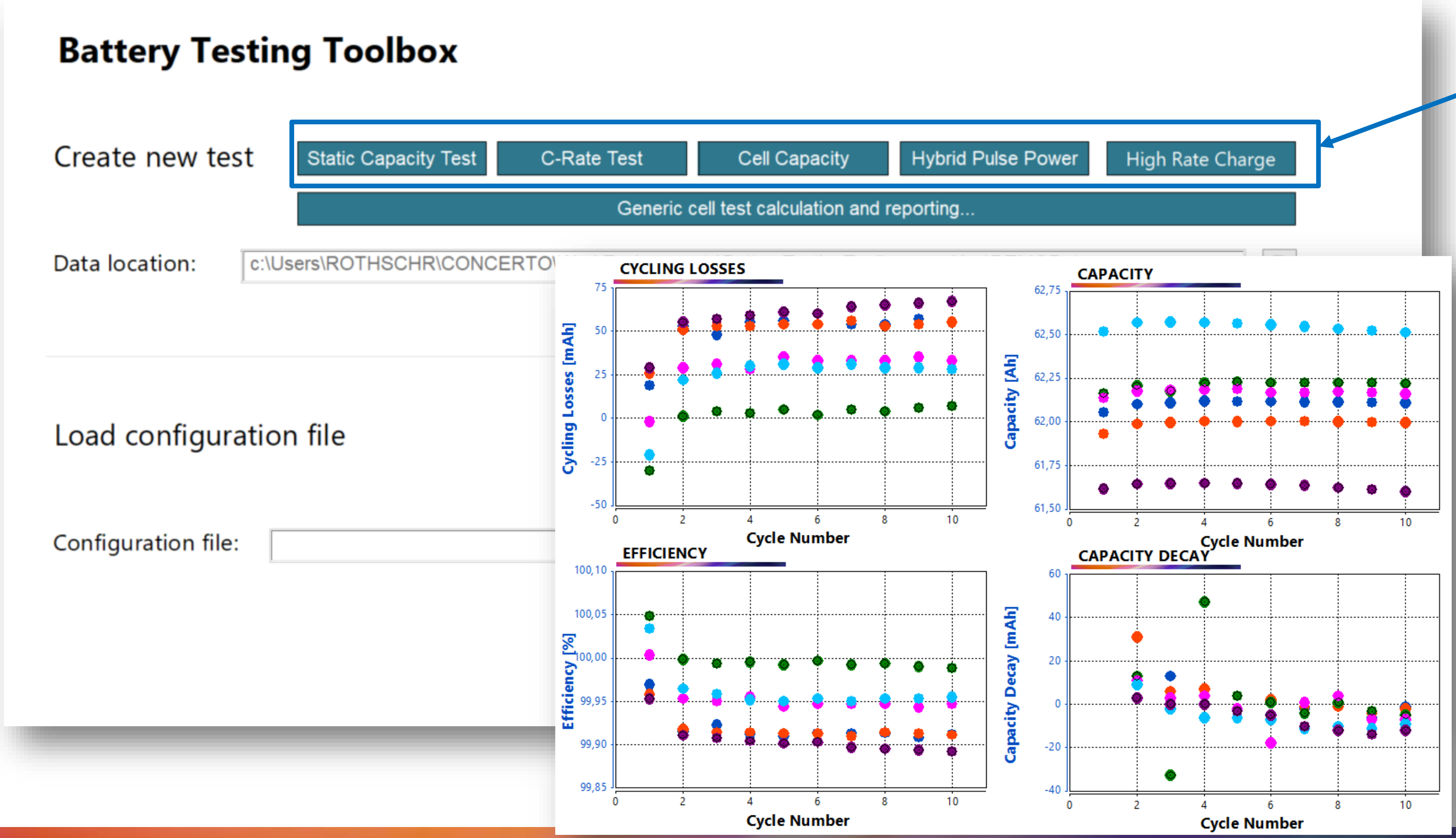


When to Test Cells: Overview

Cell testing is **necessary at multiple stages** of the battery pack development process

Cell Selection	Simulation	Pack Hardware Design	BMS Software Design
Validate cell supplier	Get model parameters	Understand & prevent aging	Get BMS algorithm data

Overview about Interactive capabilities

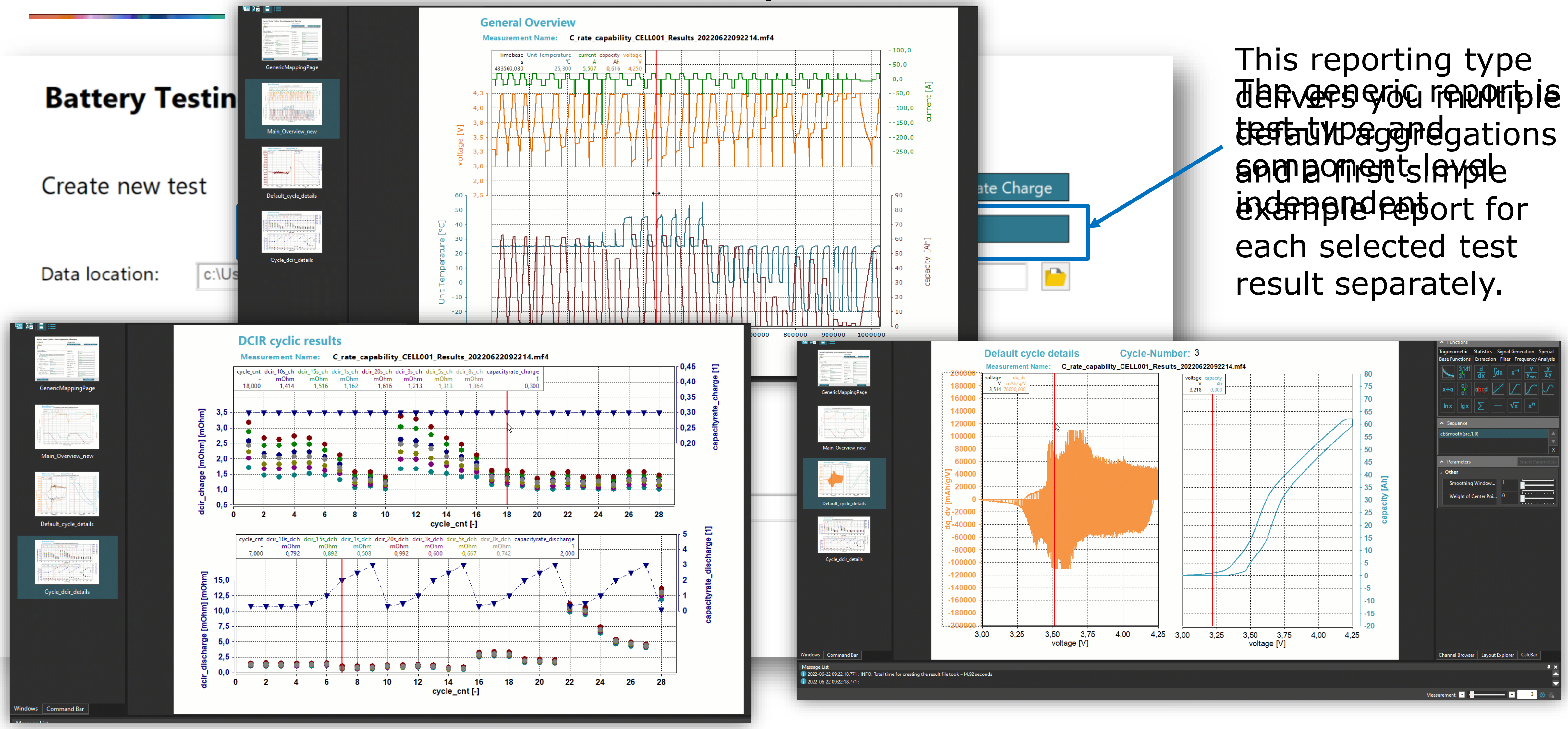


Reporting features to compare specific types of test cycles

Reporting result of „**Static capacity test**“

Delivers an objective comparision between the different units under test over 4 different criterias

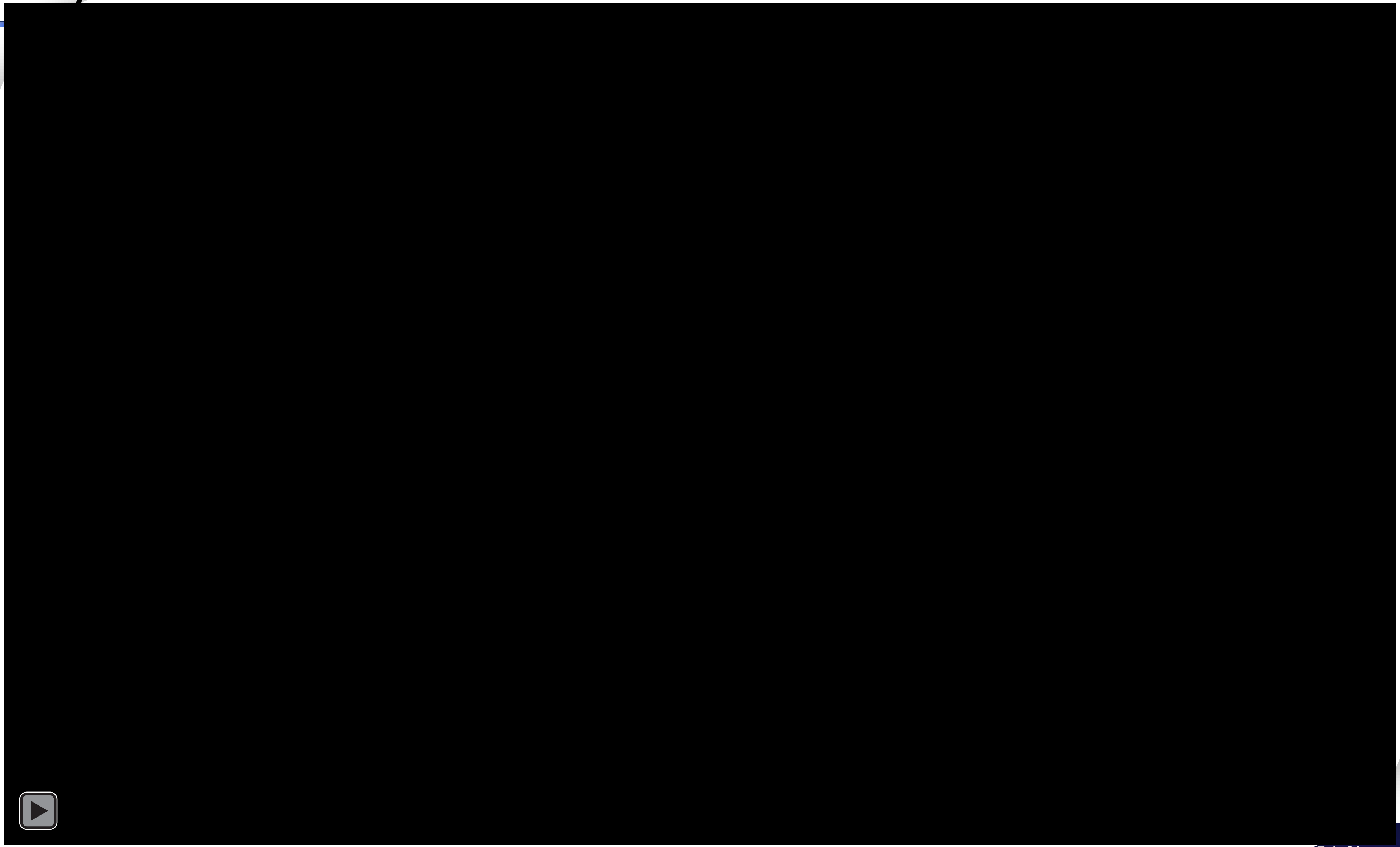
Overview about Interactive capabilities



This reporting type delivers you multiple default aggregations and a first simple example report for each selected test result separately.

The generic report is test-type and component-level independent

Battery Analytics new Features



AVL CONCERTO 5™ - Battery Testing Toolbox

The CONCERTO 5™ - Battery Testing Toolbox provides standards for testing storage components for the end user. It focuses on the evaluation of measurement data from cell tests according to worldwide or local standards, such as IEC 62660 -1 or INL/EXT-07-12536 and provides pre-configured reports and templates for multiple test cycles

THE ADDED VALUE

- Standard application for the evaluation of cell test data with focus on the test standards
- Easy parameterization and configuration for different test devices
- Creation of comparable reports to help you make the right decisions
- Open for extensions and specific calculations
- Global support and application experts

AVL CONCERTO™

Jahresendaktion

CONCERTO Toolboxen – Jahresendaktion

Conventional powertrain
M.O.V.E Data Toolbox
Combustion Analysis Toolbox
Emission Quality Toolbox
IGEM Data Toolbox

Electrified powertrain
E-Library for Module & Pack
E-Library for Inverter
E-Library for Fuel Cell
Battery Testing Toolbox
E-Power Toolbox
E-Drive Toolbox

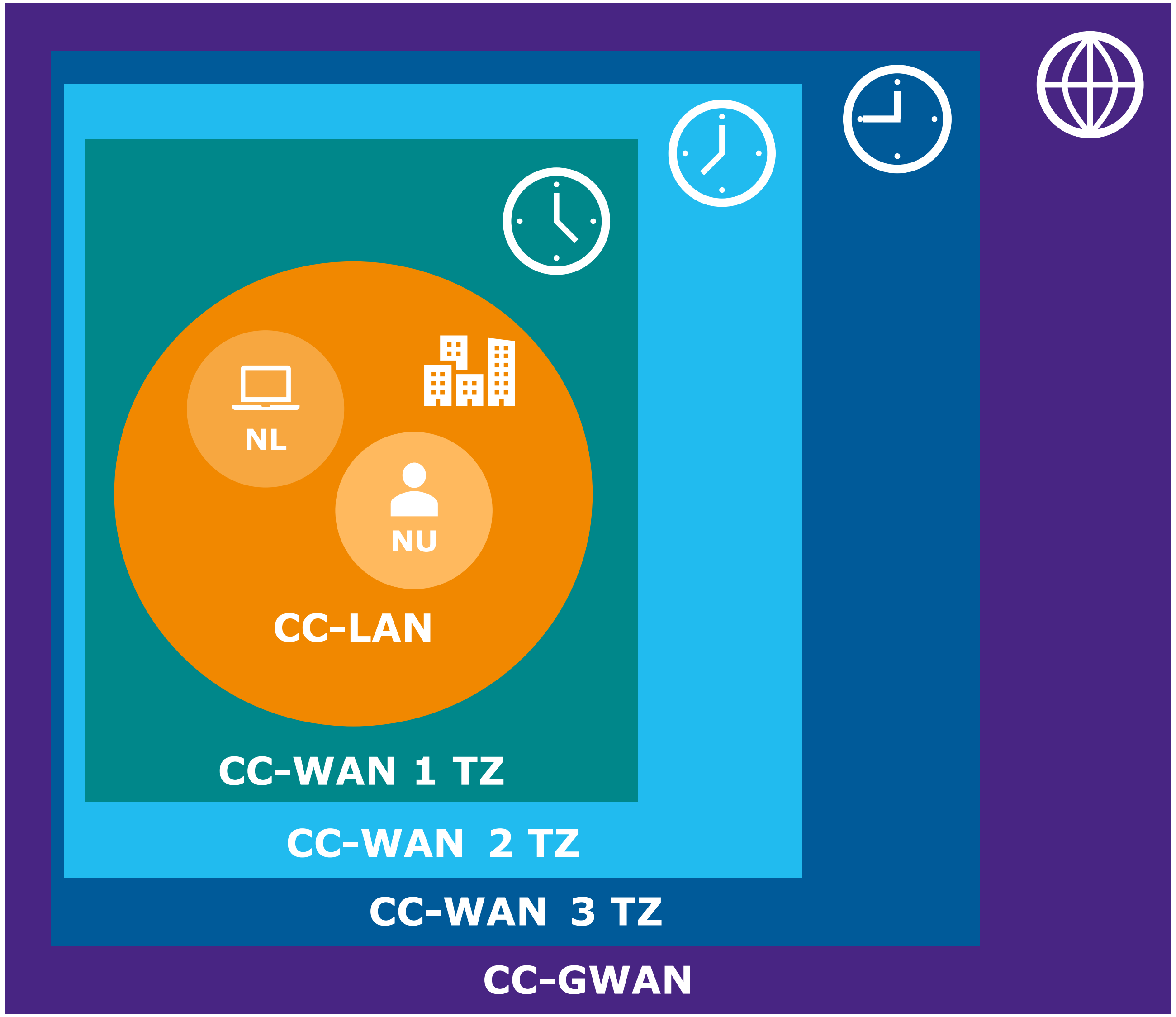
Other automotive toolboxes
NVH Toolbox
Calibration Toolbox (Map Expert)
Application Development Toolbox
VTB Data Toolbox

Time Zone Based Licensing

License Type	Usage Right
Named User (G-WAN)	One user
Node Locked	One machine
Concurrent – LAN	One location
Concurrent – WAN 1 TZ	One Time Zone
Concurrent – WAN 3 TZ	Whole Continent
Concurrent – G-WAN	World

Price

Lizenzen sind kombinierbar



AVL CONCERTO™

Q & A

Vielen Dank

Haben Sie noch Fragen, Feedback oder benötigen weitere Informationen?

concerto.support@avl.com

Niels.Wendt@avl.com

+49 6134 7179 50

https://experience.avl.com