



DSC 2024 EUROPE^{VR}

Driving Simulation & Virtual Reality Conference & Exhibition

18-20 September 2024

Palais des Congrès et de la Musique, Strasbourg | France



From Digital vehicle to Virtual twin to Immersive virtual twin

Didier WAUTIER

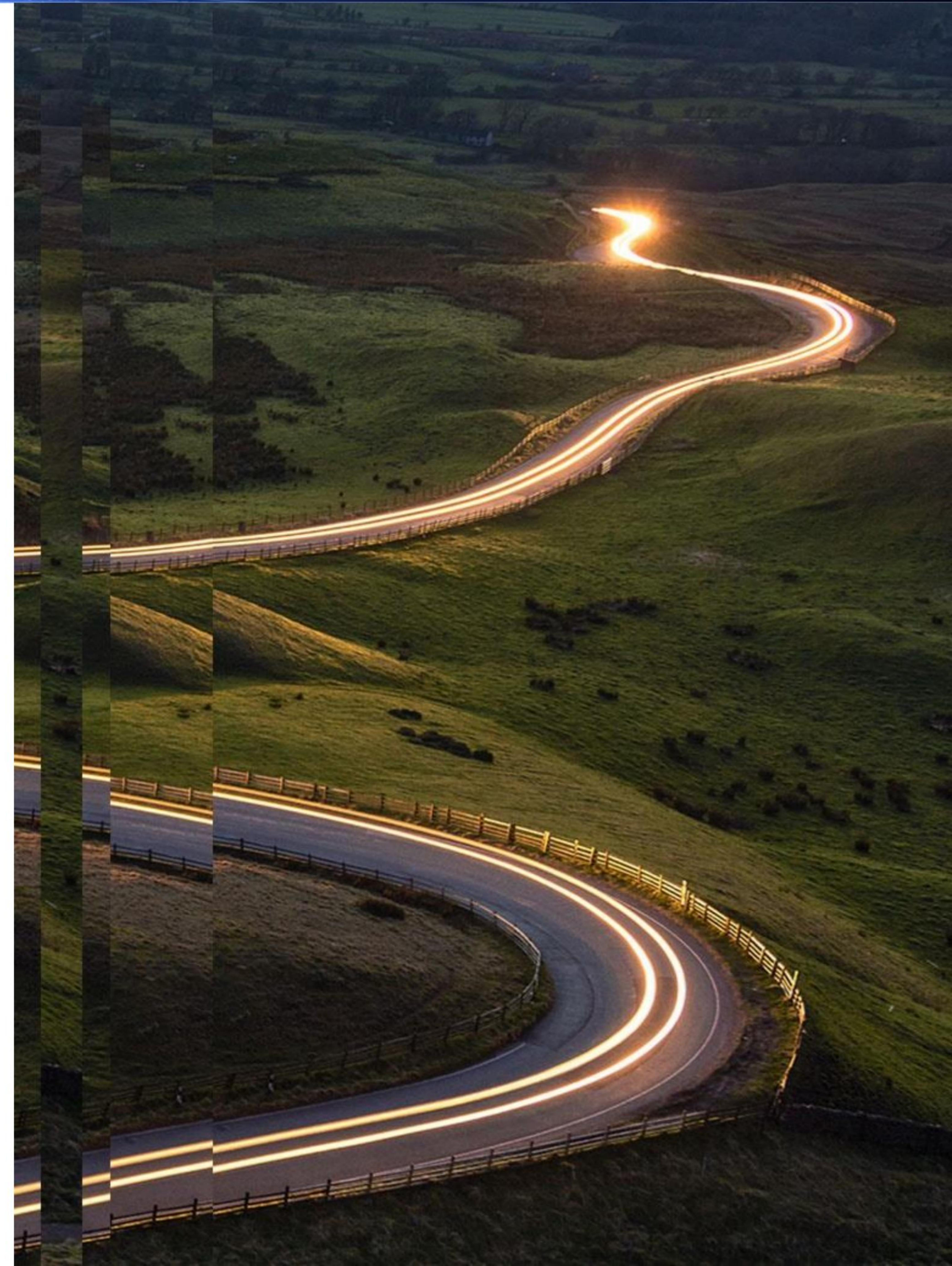
RENAULT General Manager "Synthesis and Immersive Simulation"





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- **Why:**
 - COMPLEXITY: SYSTEM OF SYSTEM
 - HOMOLOGATION: AD ADAS DESIGN, VALIDATION AND APPROVAL
 - LEAD TIME REDUCTION





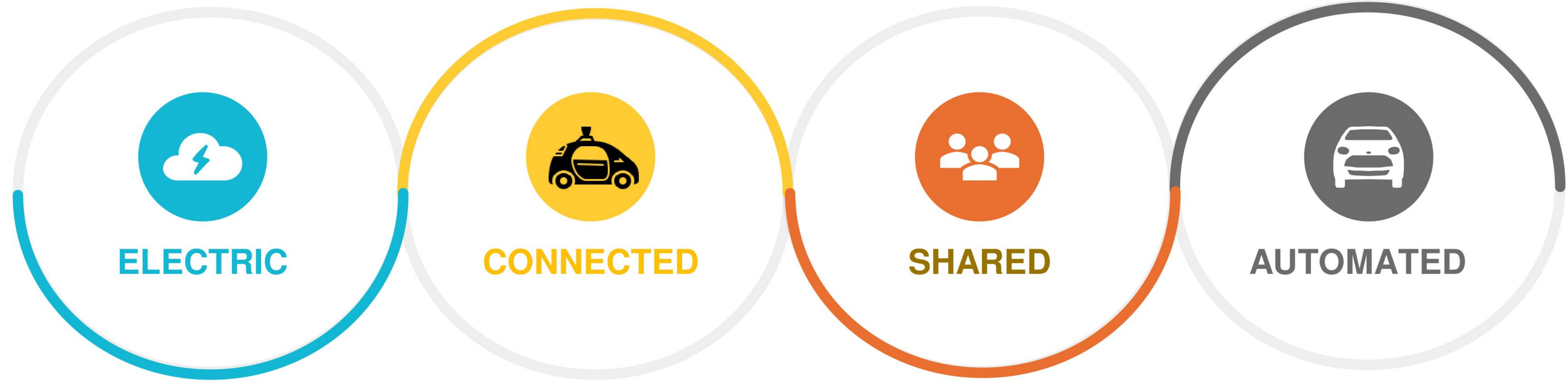
Complexity: System of System

➤ **Automobile is facing not one but 4 disruptions**



➤ **Lead time reduction**

Tomorrow's mobility will be





Complexity: Software Defined Vehicle

ET SI ON DÉFINISSAIT VRAIMENT LE SDV?
 *AND IF WE REALLY DEFINED WHAT THE SDV IS!

SOFTWARE DEFINED VEHICLE

SDV: MAJOR STAKES

DEF. A NEW SOFTWARE-DEFINED ARCHITECTURE

OBJECTIVE

- IMPROVE CARS ALONG THEIR LIFECYCLE
- CONNECT USERS TO ECOSYSTEMS
- NEW BUSINESS MODELS

PLANNING

- INITIATED IN 2016 WITH F.A.C.E.
- LAUNCH IN 2026 WITH FLEXEVAN

REPORT

- INVEST. IN AUTONOMOUS DRIVING: +500B \$
- INVEST. IN CONNECTED AUTONOMOUS SHARED ELECTRIC

OPEN PLATFORM

- VEHICLE ANDROID ECOSYSTEM: INFOTAINMENT & BEYOND
- ENFORCED BY PARTNERSHIP GOOGLE/QUALCOMM

ELECTRONIC COMPONENTS

SEMICONDUCTORS

DIODE, TRANSISTOR, PROCESSOR

≈ 50 (on a scale of 1000 to 10000)

NODE SIZE REDUCTION

1 PROCESSOR IS:

- ≈ 1000 CONNECTIONS
- ≈ 1 BILLION TRANSISTORS

2 MAIN USES

COMPUTE & POWER

ADD X THINER THAN A HAIR

HARDWARE PLATFORM

DEF. ZONAL & CENTRALIZED ARCHITECTURE

SOFT/HARD DECOUPLING

SMARTMOS: ELECTRONICAL SWITCH

- REPLACES FUSES & RELAYS
- VERY LOW (ENERGY) CONSUMPTION
- 1 PER LOAD (FAN, MOTOR, LAMP...)
- OPTIMIZATION OF THE ENERGY USED

AUTOMOTIVE ETHERNET

DEF.

- COMMUNICATION STANDARD ADAPTED TO AUTOMOTIVE NEEDS
- ENABLER OF SOA COMMUNICATION BETWEEN ELECTRONIC CONTROL UNITS
- NEED TO UPGRADE WITH MORE BANDWIDTH AND FLEXIBILITY

SOA (SERVICE ORIENTED ARCHITECTURE)

DEF. BUILDING BLOCK METHODOLOGY TO IMPLEMENT FUNCTIONALITIES CLIENT/SERVER BASED COMMUNICATION

CAR OS

Android + Google

DEF. VEHICLE FEATURES DEVELOPED BY RENAULT ON ANDROID OS

OBJECTIVE

- SCALABILITY: 1 SOFTWARE FOR ALL CONFIGS
- UPGRADABLE: UPDATE & NEW FEATURES
- BUSINESS: OFFER APPLICATIONS AND SERVICES
- DATA COLLECTION: DEBUG, BUSINESS VALUE...

stick? Explain it to the duck

CYBER SECURITY

OBJECTIVE

- MAINTAIN A SAFE CAR
- PROTECT FUNCTIONS PERFORMANCE

HOW

A DESIGN PER ZONE

EXPOSED WORLD, DEMILITARIZED WORLD, AUTOMOTIVE WORLD

DETECT & REACT

THREAT →

ADAPT TO THREAT EVOLUTION

TRANSFORMATION

HOW

- COLLABORATE WITH MODEL-BASED
- PROGRESS IN AGILE MODE
- TEST & VALIDATE AUTOMATICALLY

WHO

MI, SYSTEM, SERVICE



AD ADAS Design, Validation and Approval

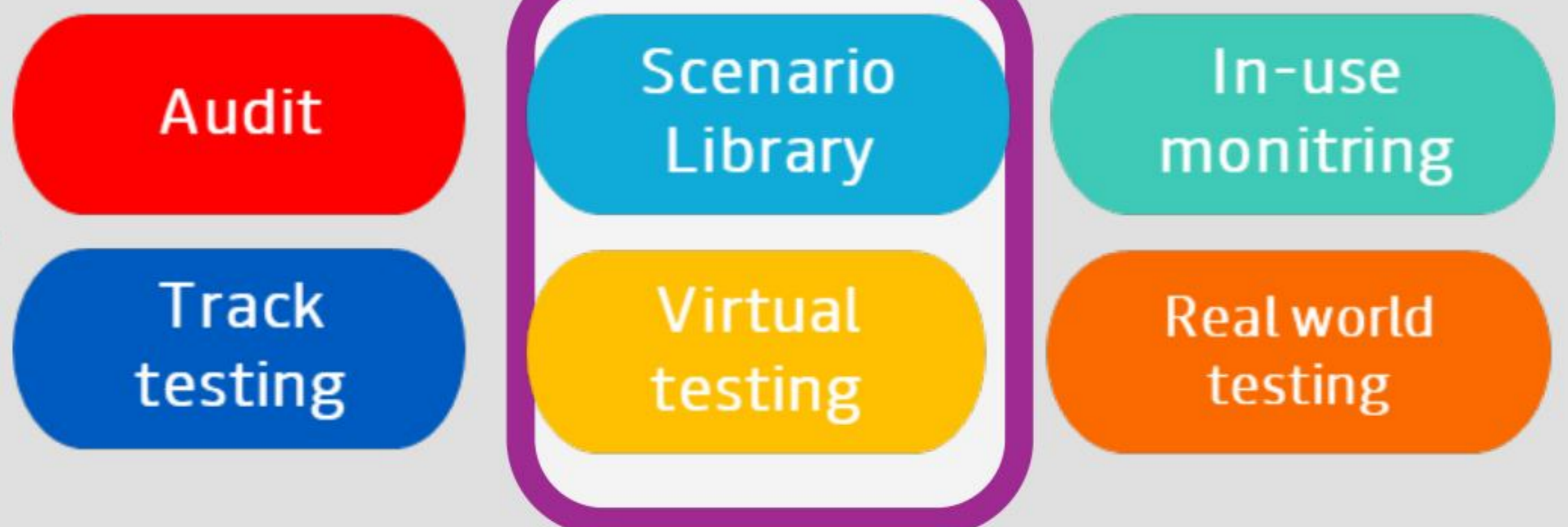


DESIGN & validation Approval

- Lead time Reduction
- Increase in the number of ADAS in vehicles
- Increased number of validation scenarios (201 GSRII & Ncap logic scenarios)
- Complexity and danger of certain scenarios on runways (LSS: On coming, AEB multi-target ...)

ADAS and AD L2, 3 & 4 validation / safety proof through scenarios mandatory

MULTIPIILLAR APPROACH



SIMULATION IN THE REGLEMENTATION :

- Credibility assessment (L2 +)
- Amendment de l'UN R152 (AEBS) : application 2025

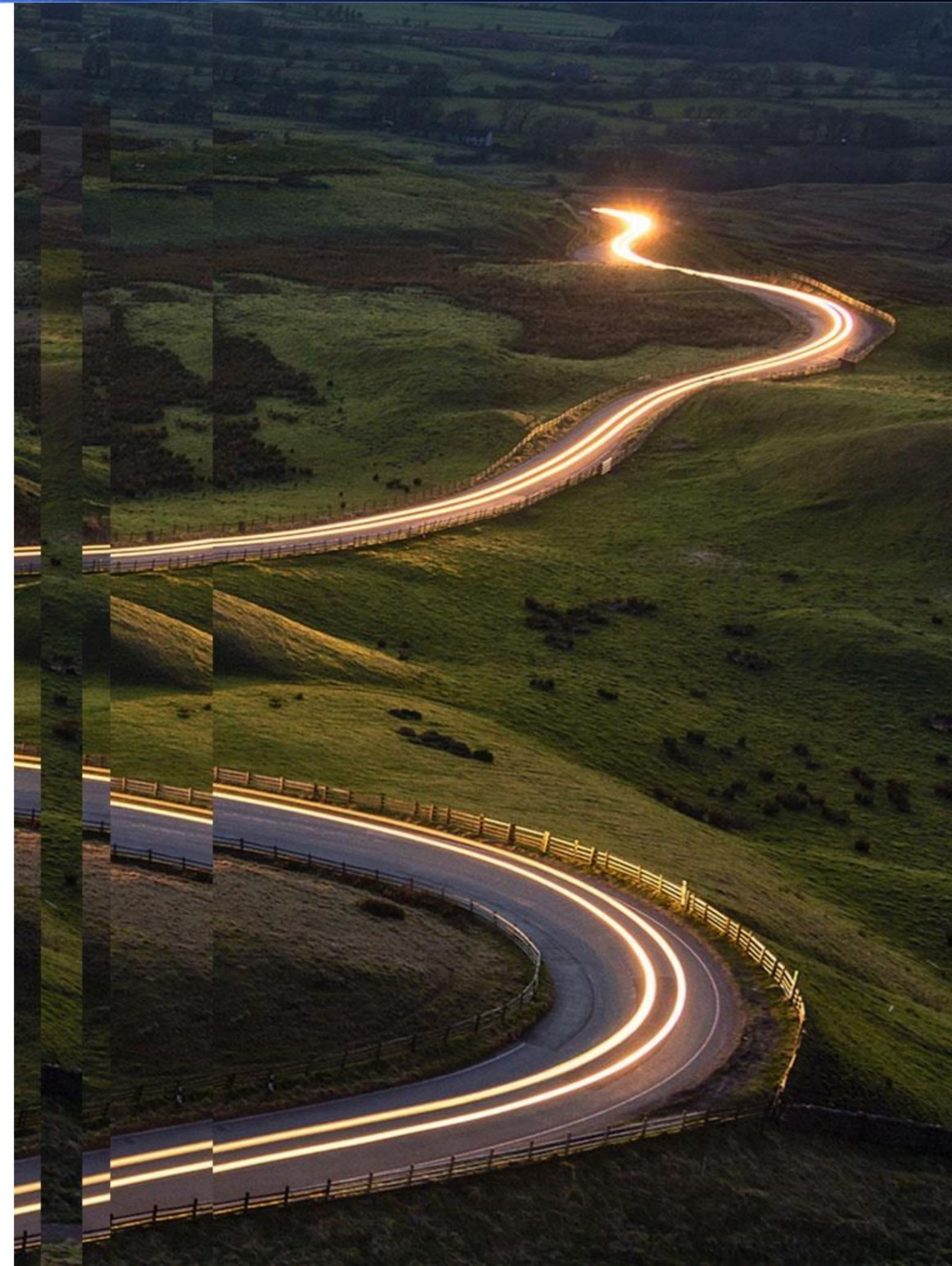
ECOSYSTEM OF SCENARIOS DATABASE FOR DESIGN, VALIDATION AND APPROVAL





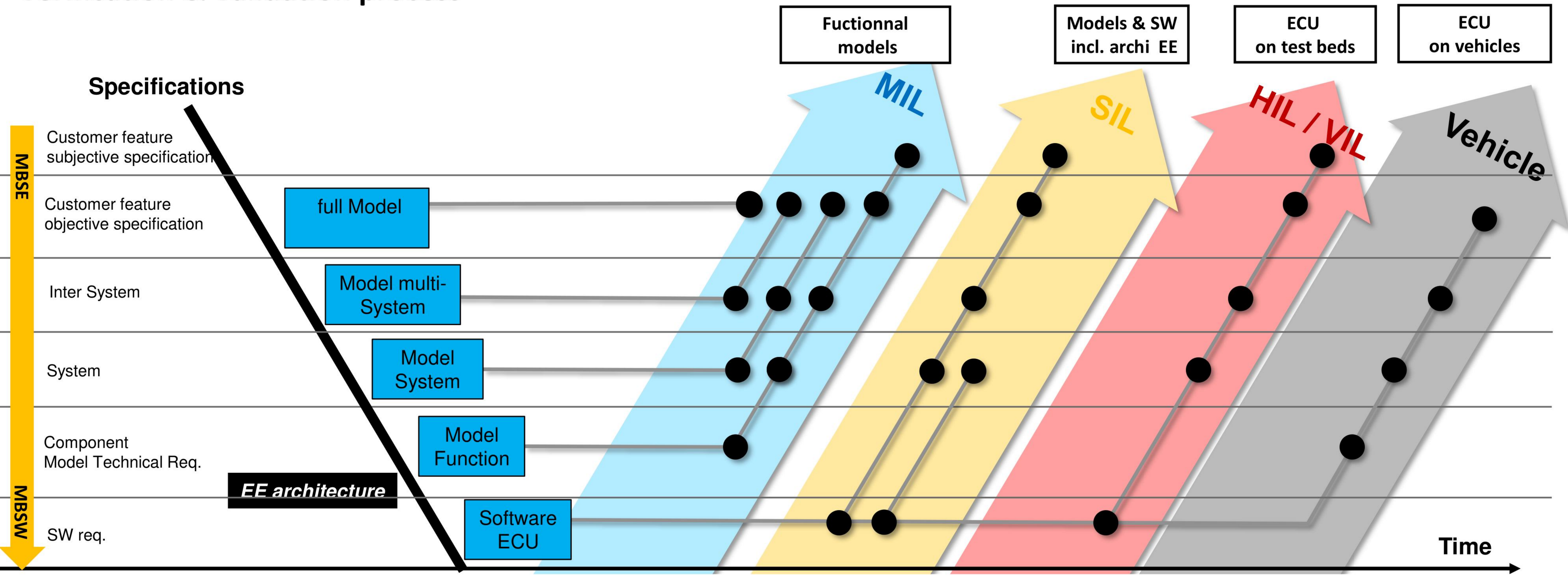
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- **What:**
- DIGITAL VEHICLE AT ALL STEPS





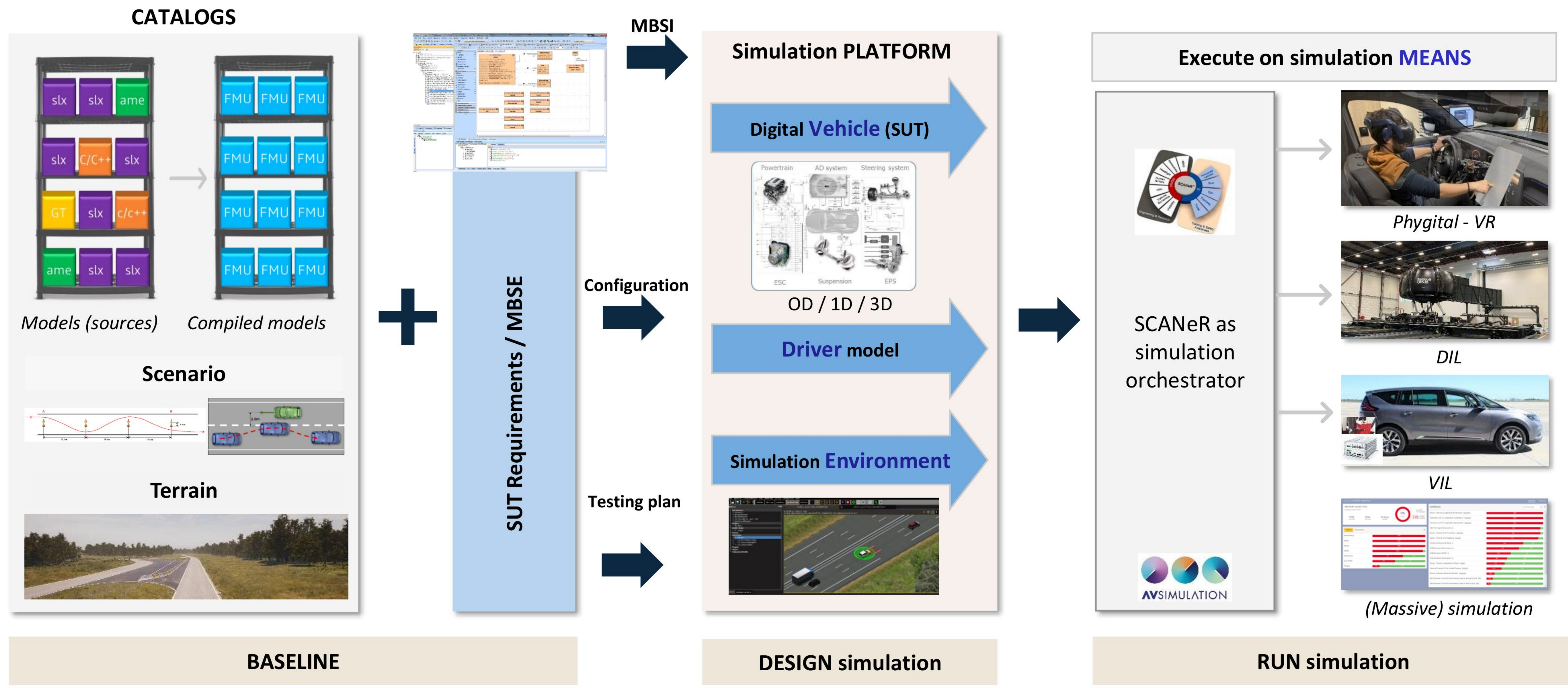
Verification & Validation process



- **Validation by CAE can start before reaching the bottom of V-cycle**
- **High level test plans can be run at any step**
- **MBSE (model based system engineering) is mandatory for continuity / tracability**
- **Interoperability for simulation tools**



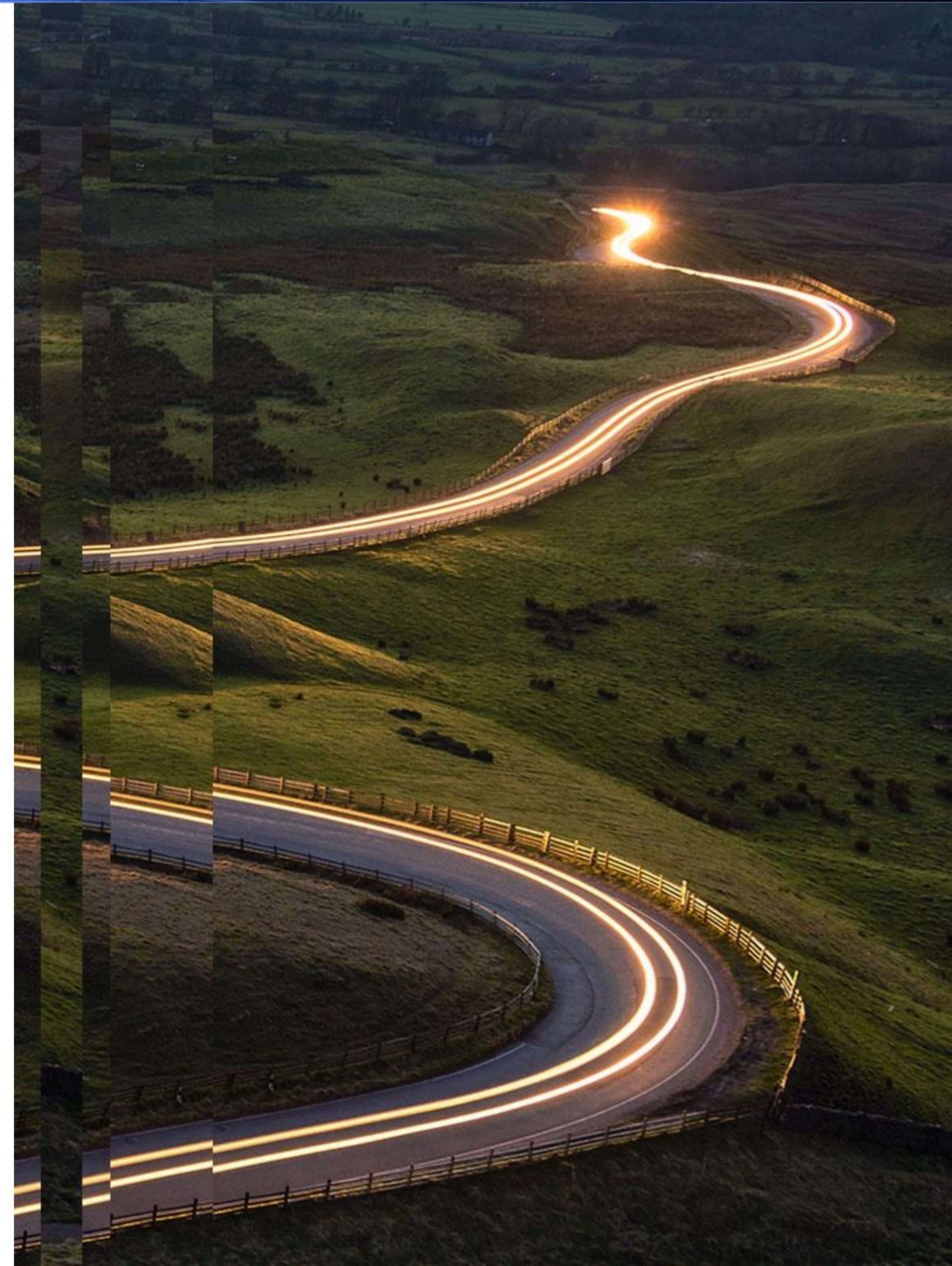
Simulation workflow: continuity / interoperability / tracability





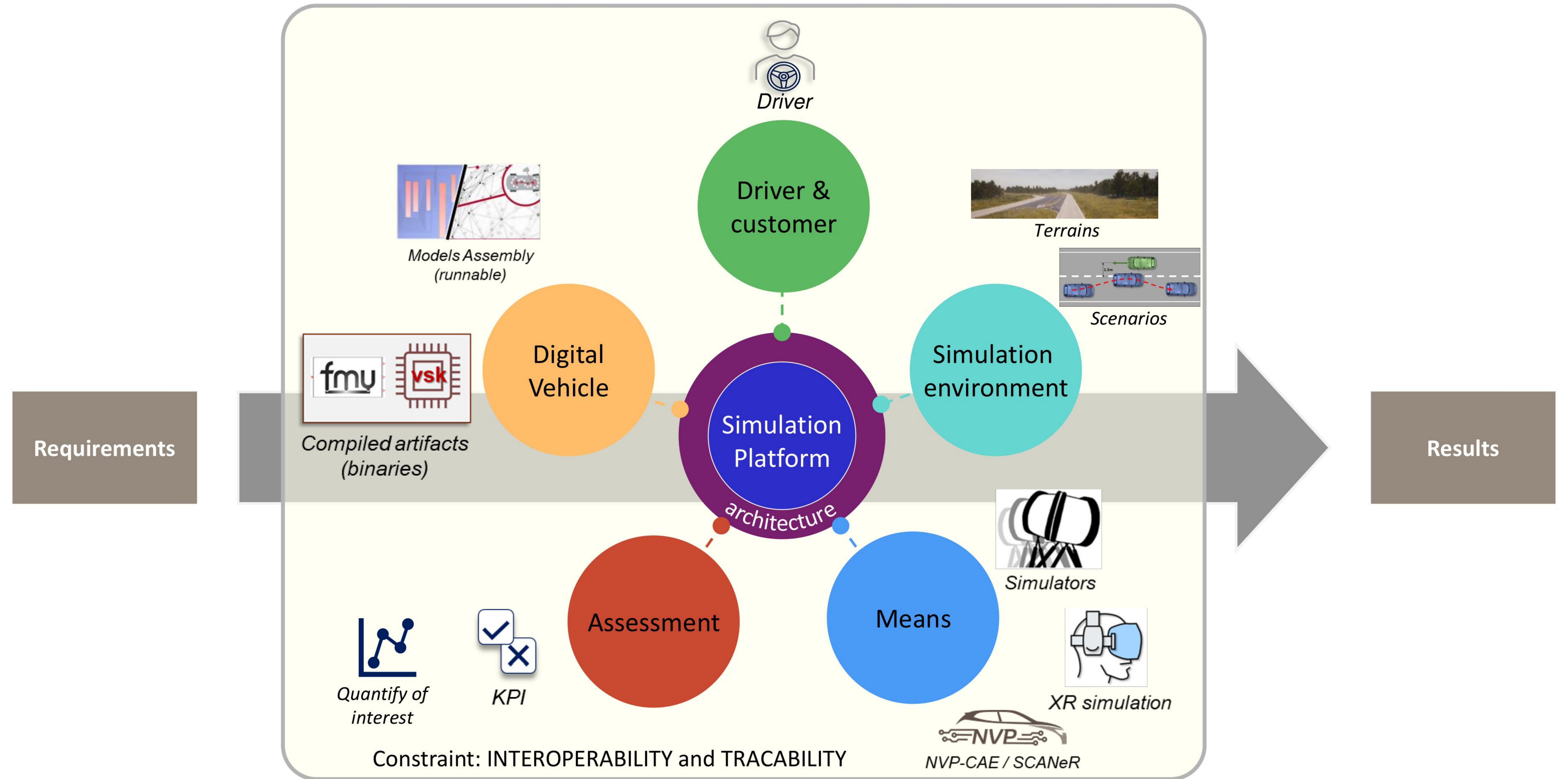
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- **How:**
 - SIMULATION PLATFORM WITH CONSTRAINT CONTINUITY AND INTEROPERABILITY AND TRACABILITY
 - DIGITAL VEHICLE TOWARDS DIGITAL TWIN AND IMMERSIVE TWIN





What is a Simulation platform?





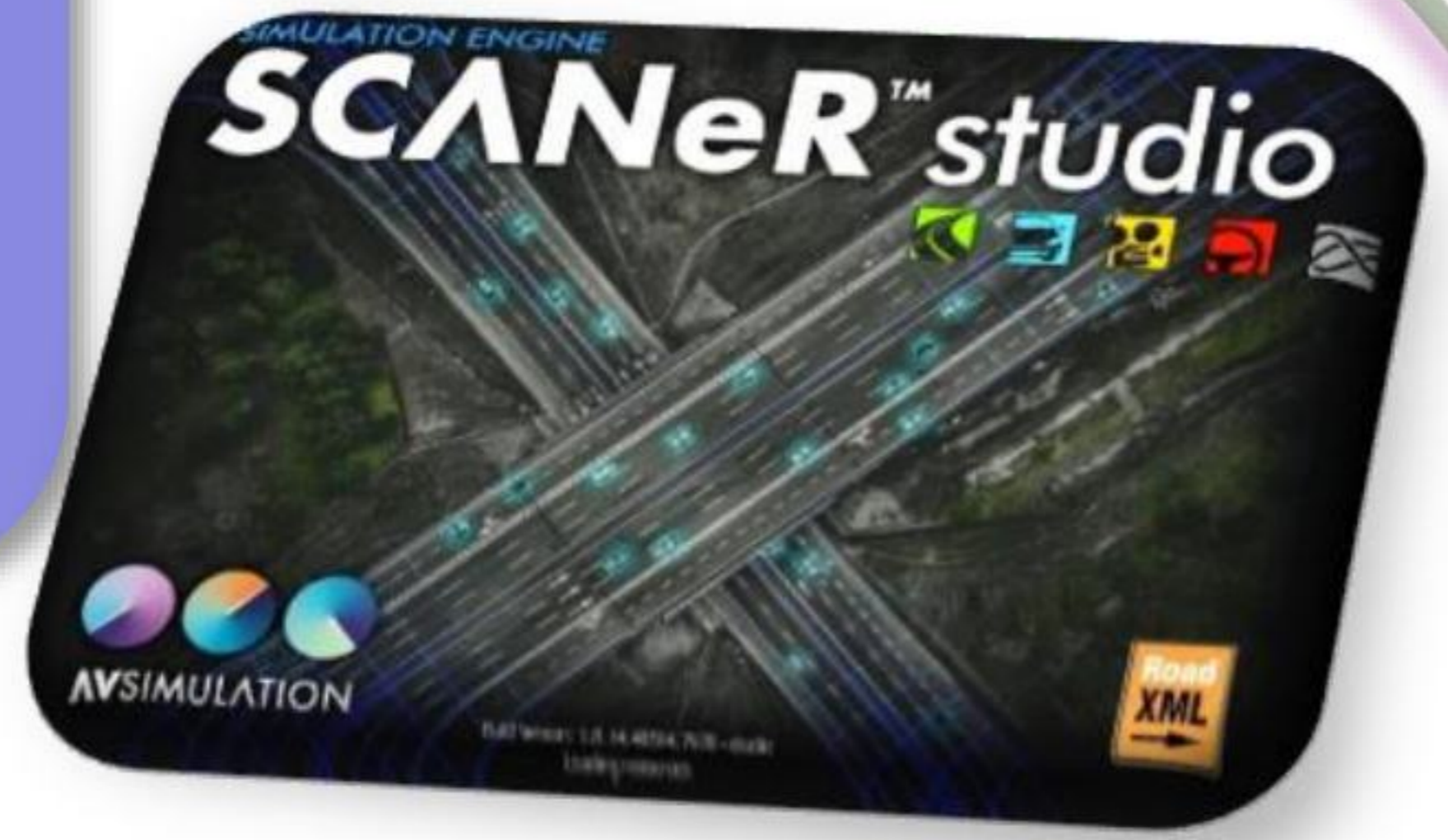
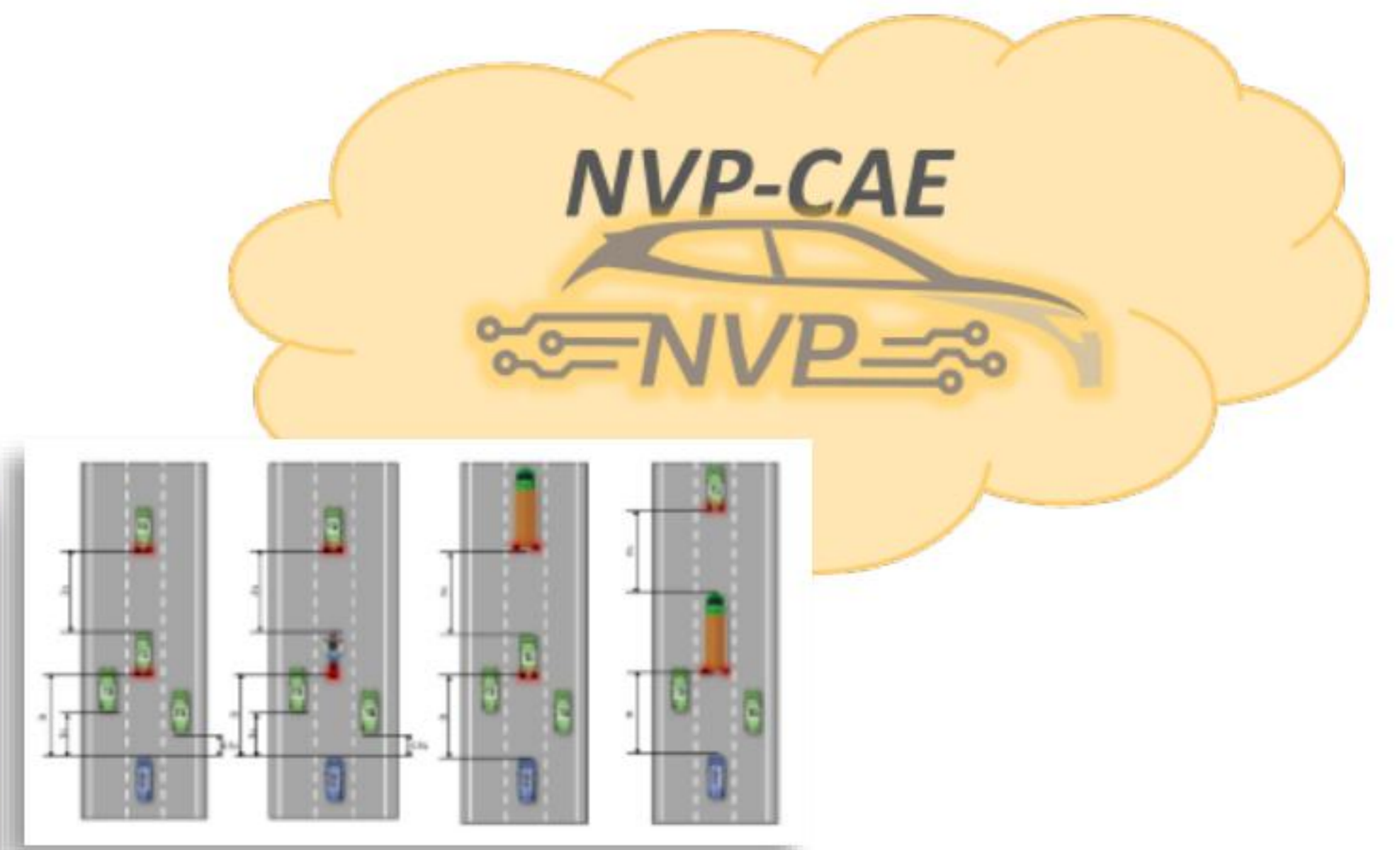
SCANeR as an orchestrator of various simulation means for various use-cases



Virtual Reality
 Animated mockup
 Design review immersive visualisation of product (Perceived Quality)
 Ergonomics assessment
 Vehicle architecture validation
 Upstream architecture



Massive simulation (MIL/SIL)
 AD/ADAS Validation, Correlation and Optimization by massive simulation
 [ToBe] Certification



with constraint: INTEROPERABILITY and TRACABILITY



Driver In the Loop
 Early validation and Tire requirements writing ,
 Ride & Handling subjective evaluation & optimization
 Lighting design and validation
 HMI design and validation



Vehicle In the Loop
 Tuning and Certification activities ("Dangerous" UC)
 AD/ADAS design and validation using VIL on track

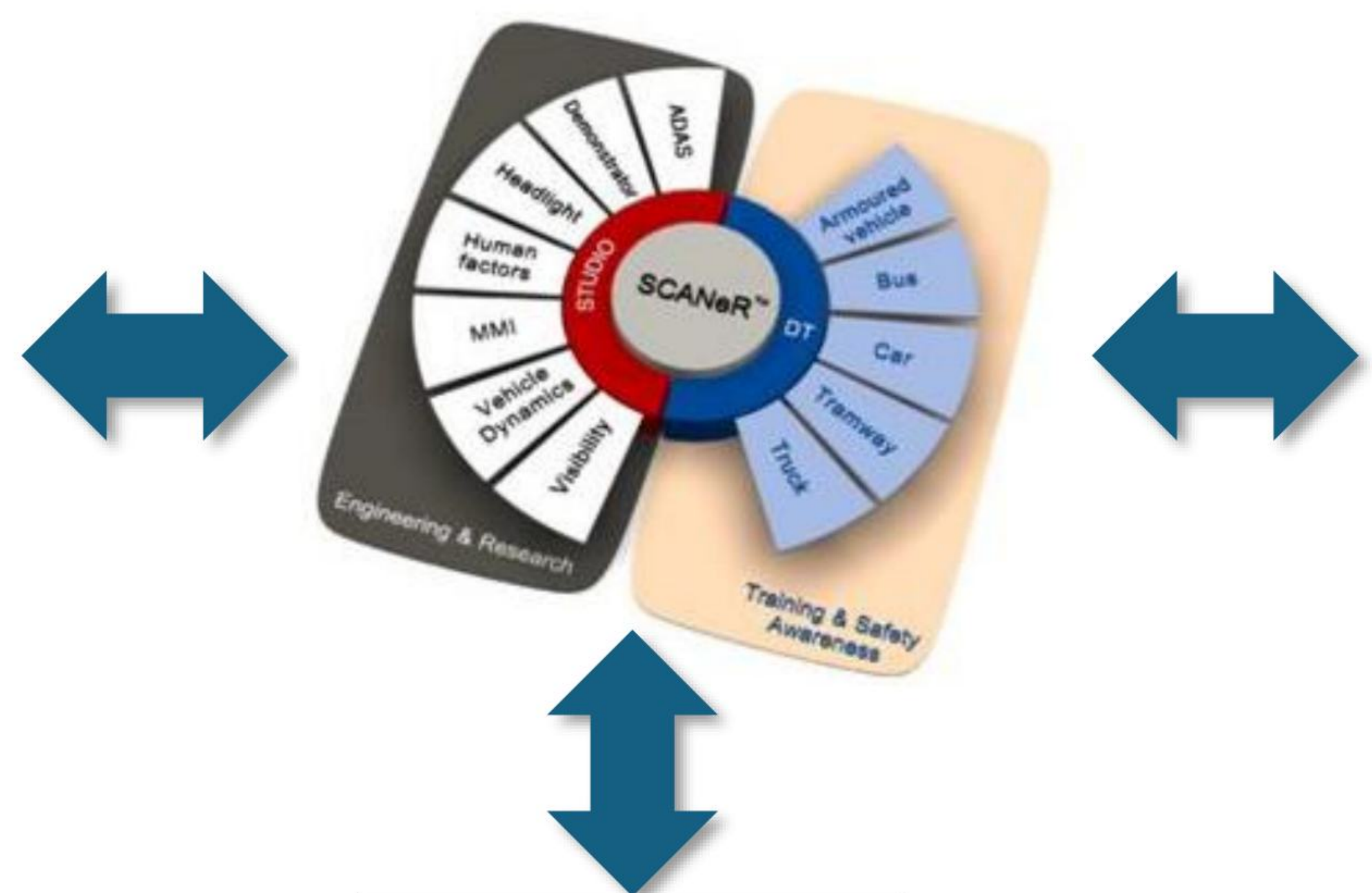


Hardware In the Loop
 Validation of Physical part





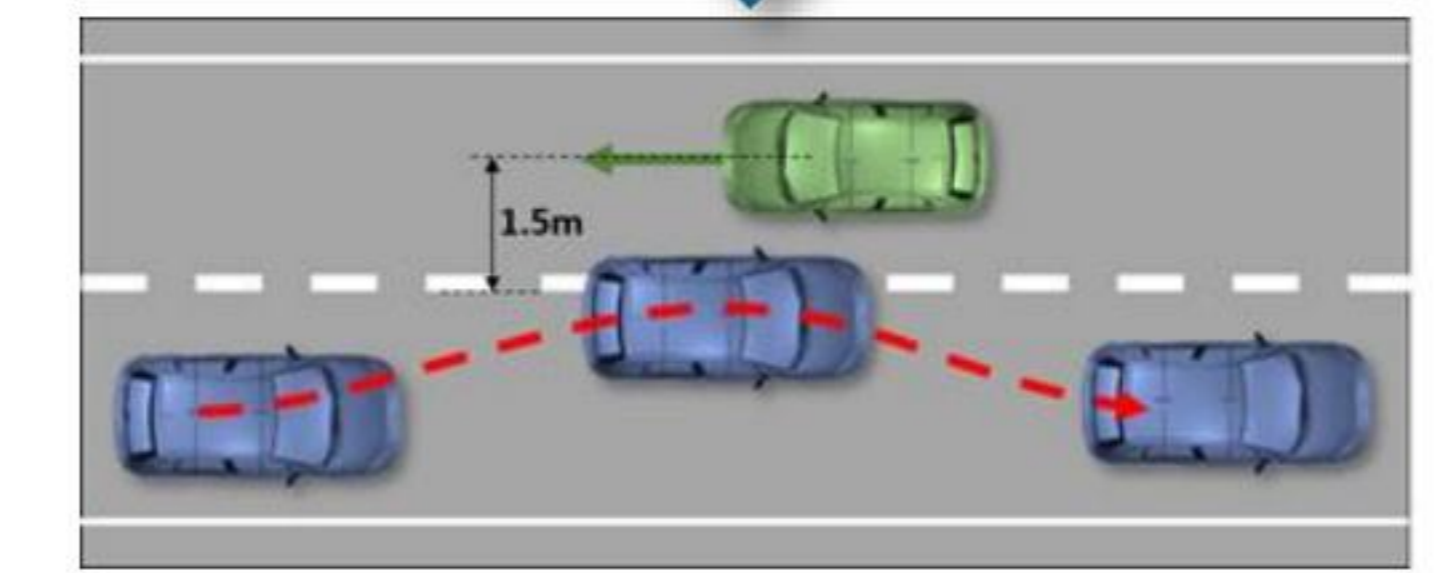
DIL : Real driver, Immersive environment & Vehicle Virtual twin



Vehicle Virtual Twin MIL/SIL/HIL

High performance dynamic DS :

- Motion system : 1G in X&Y / 15x15m / $\Delta t < 30ms$ / Yaw table
- Projection system : 360° / 3D (15 projectors)
- Immersive quality
- Quick mockup echange system



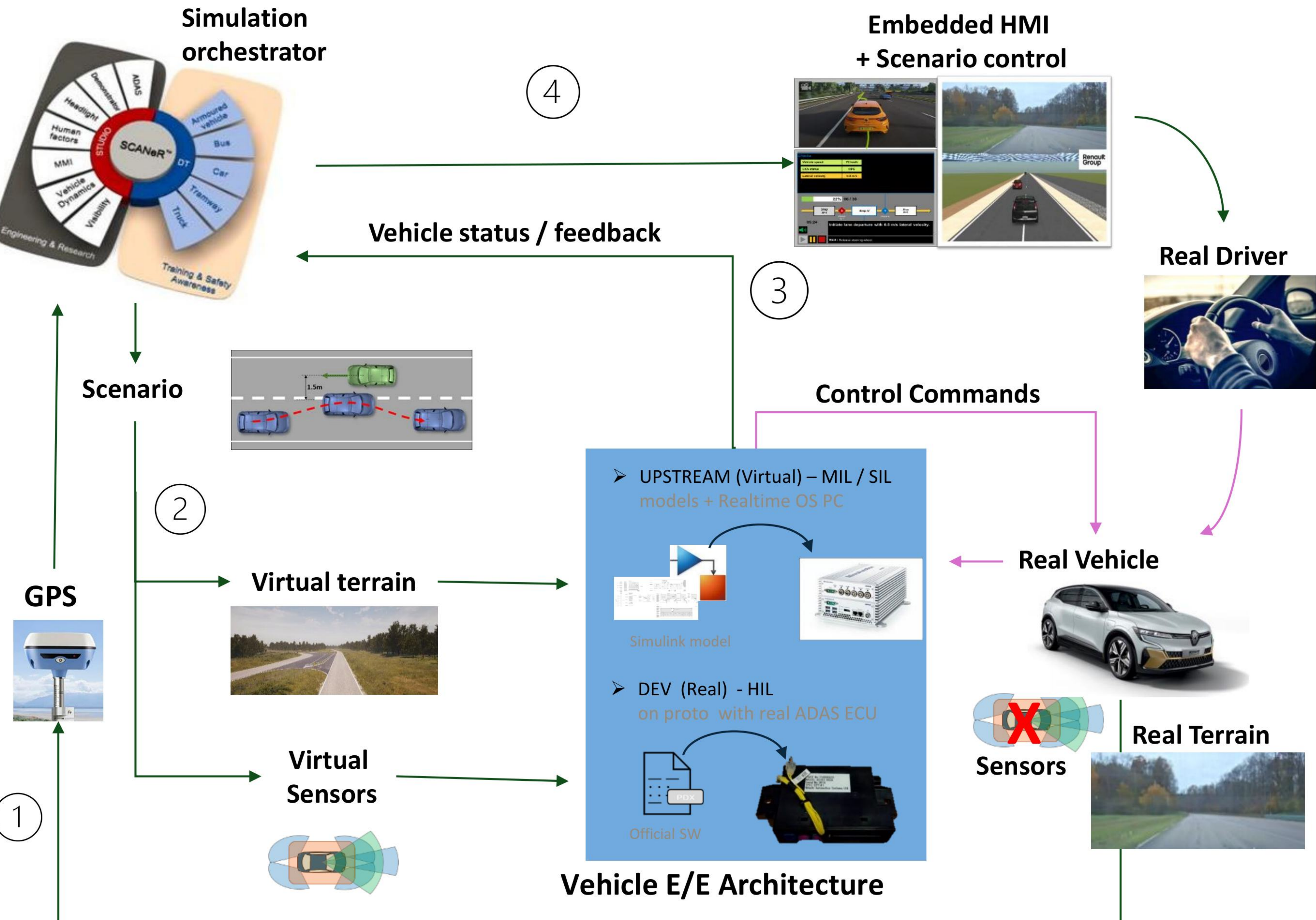
Scenario



Virtual terrain



VIL : Real car, real driver, real ground and virtual environment



Example of LSS NCAP test

LSS oncoming NCAP protocol

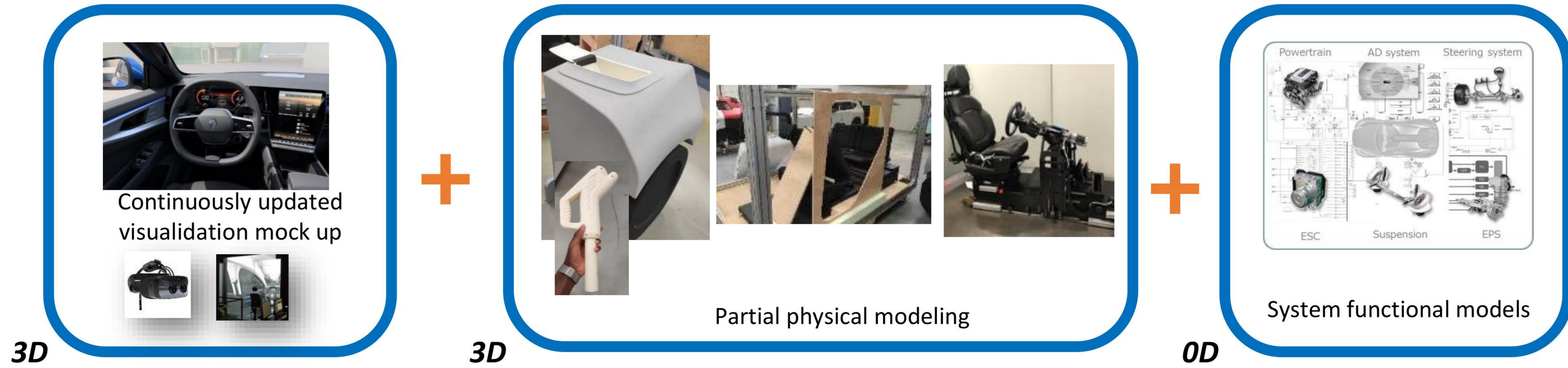
VIL SCaNeR
VIL HMI allowing to follow and operate scenario

The screenshot shows a virtual road view with a white line marking. The data dashboard includes the following information:

- © RENAULT GROUP 2021-12-03 15:42:26
- ILKA_StatusDisplay_v2: Not operational
- ILKA_StatusDisplay_v2: No display
- ILKA_AlertStatus: Left alert
- ILKA_SteeringTorqueRequestFlag: Requested
- ILKA_SteeringTorqueRequest: -10.77 Nm
- ITSA_FD...SteeringWheelAngleLaw: -3.20
- 10768
- ILKA_Cancel: 0
- ILKA_AlertL: 0
- ILKA_AlertR: 0
- offset_x: 0
- offset_y: 0
- offset_heading: 0
- ILKA_Activati: 1
- ADAS-FRCAM: 1



Immersive Virtual Twin (IVT): paradigm reality / realism



Immersive Virtual Twin

Platform Phygital VR

- **Simulate** the user experience in a contextualized environment
- **Converge** functional requirements right from the upstream phases
- **Vehicle-level** simulation (synthesis)

RAFALE - Phygital simulation platform
 XR-Innov Lab at Renault Technocenter
 REP-TDV - December 13, 2023



Some on-going challenges / open topics



- **Manage configuration (requirements, scenario catalogs, functional architecture, models...)**
 - Manage requirements , env. catalogs and models and calibration
 - MBSE / MBSI
- **Manage interoperability and continuity**
 - adaptable and scalable simulation architecture and address all « layers »
- **Manage Simulation models assembly/ distribution & realtime constraints**
 - Model optimization & reduction versus precision / correlation
 - Realtime needed for DIL / VIL platforms
 - Distribution of computing on cloud / HPC versus co-simulation and time synchronization
- **Manage simulation process and tools for regulation compliance & credibility assessment**
 - Simulation correlation and credibility
 - Transparency files / Audit / Q&A
 - Traceability

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THANK YOU

