



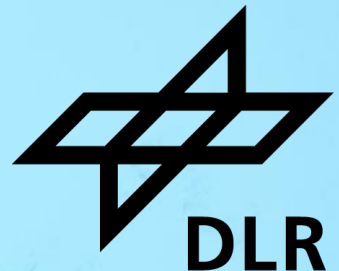
V&V4NGC

Methoden, Prozesse und Werkzeugketten für die
Validierung & Verifikation von Next Generation Car

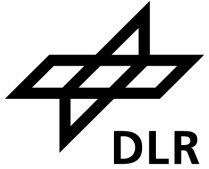
TOP 1: Ergebnisrückblick (Projektleitung)

V&V4NGC | Abschlussevent | 20.11.2025

Dr. Kim Grüttner (SE), Julia Jupe-Weinauer (SE)



V&V4NGC - Motivation



- The **commissioning and reliable operation** of automated vehicles require **methods and tool chains for model-based development, validation and verification**.
- Today's V&V techniques are primarily aimed at the design phase (what and how must be tested before a vehicle can be put into operation?).
 - **Challenge:** Today's methods scale poorly with the increasing complexity of new driving functions and the context (ODD = Operational Design Domain) in which they are to be used.
 - **Approach:** Use information from the field for continuous improvement (updates) and validation & verification during the entire product life cycle with the help of digital twins.
 - **Opportunity:** This also enables the future use of learning algorithms (AI).
- Various simulators and V&V frameworks already in use at DLR.
 - **Challenge:** Often complex, non-transparent tool dependencies. Makes reuse, expansion and transfer difficult.
 - **Approach:** Modular simulation framework (NGC simulator) with interfaces to coordinated V&V tool chains that build on each other.
 - **Opportunity:** Development of a V&V toolkit based on the NGC simulator for future use in the DevOps cycle.

"V&V4NGC enables the verification and validation of new driving functions for highly automated vehicles during development and during operation."

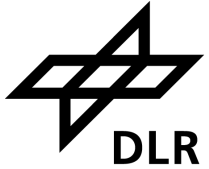


Source:

https://www.reddit.com/r/teslamotors/comments/nq2hse/tesla_model_3_display_bug_showing_constant/



V&V4NGC - Objectives



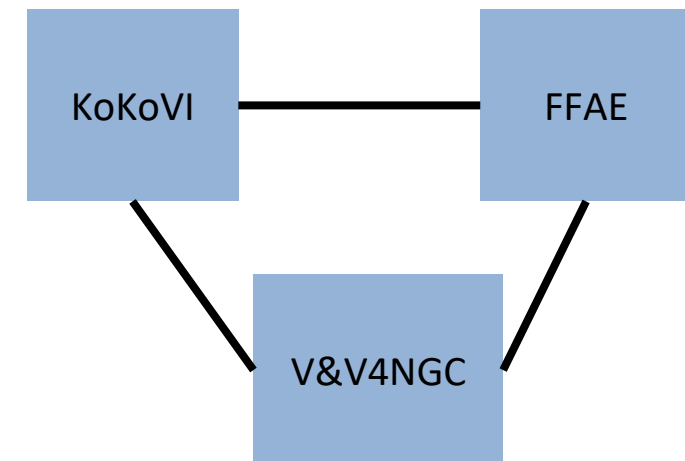
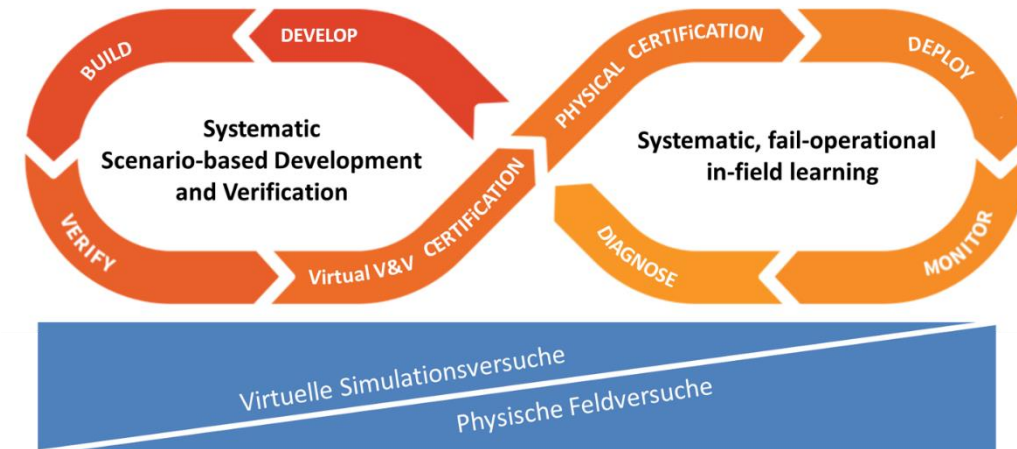
1. Development of a **mixed virtual/physical simulation environment** for the NGC concept and all future vehicle concepts
 - a) for **continuous design**,
 - b) for **continuous verification and validation**,
 - c) up to the **virtual certification**of automated driving functions and fully automated road vehicles. As part of the **HGF field of action "Validation and verification"**, tool chains are to be established to achieve objectives 1a) - c).

2. **Application and evaluation** of the methods and tools researched in the project, as well as tool chains in use cases of the two projects KoKoVI and FFAE.

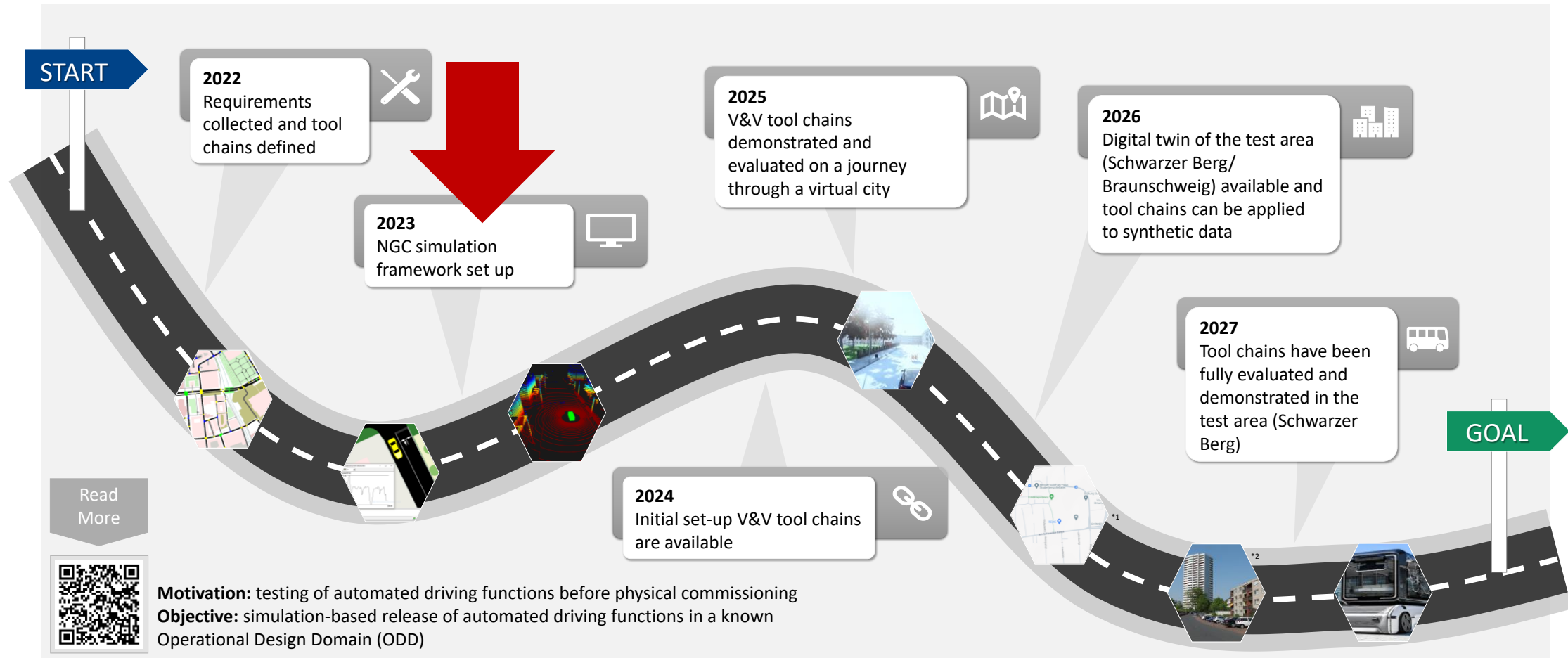
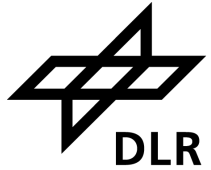
To this end, the development and maintenance of interfaces and synergies between the projects should be continuously coordinated throughout the course of the project.

3. **Connectivity of research results in industrial third-party funded projects and possibly spin-offs..**

The methods, tools and tool chains are to be aligned with industrially relevant issues and show their usability and effectiveness with the help of suitable demonstrators. This is the main focus in Phase II (2026 - 2027).

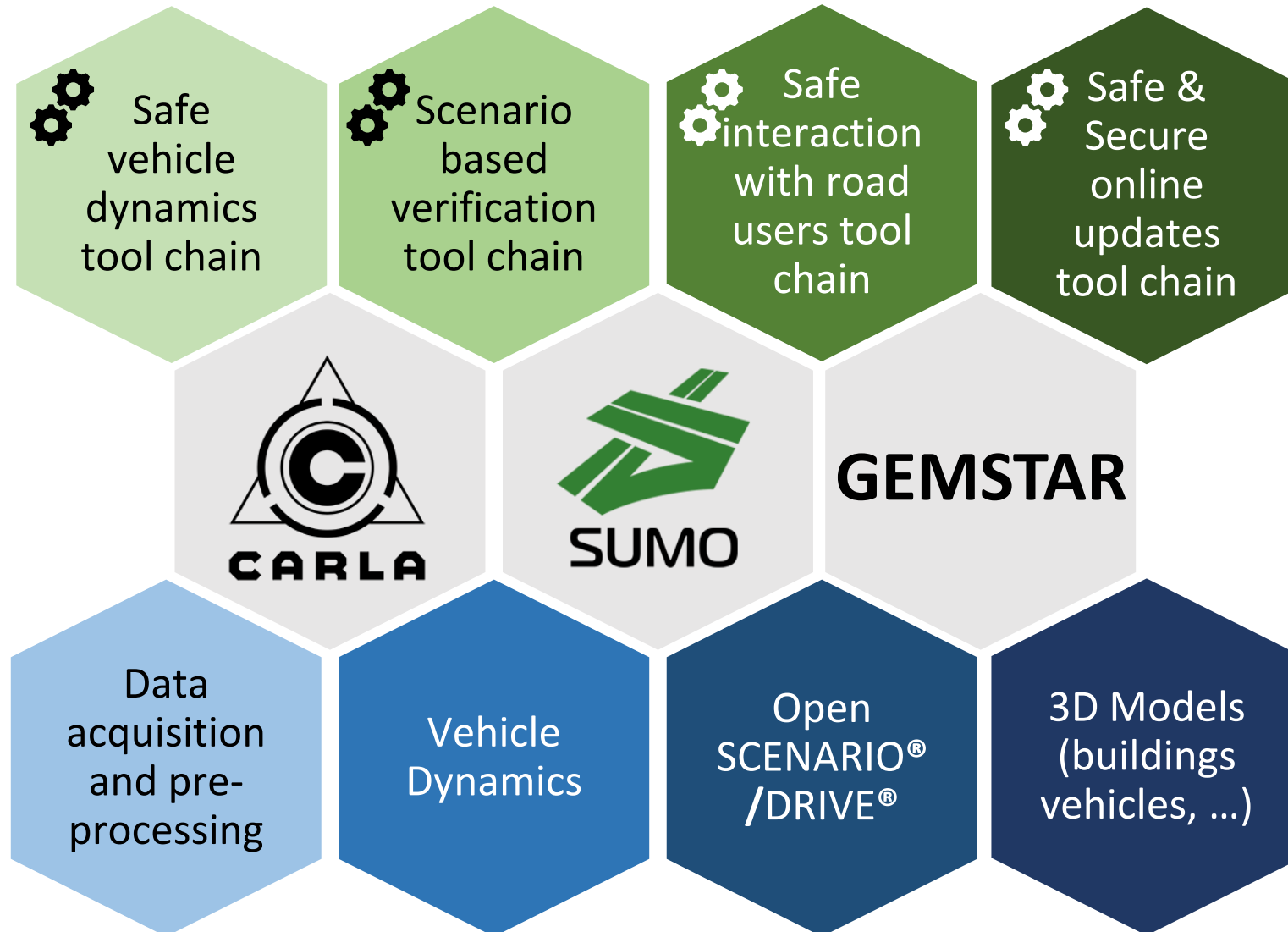


V&V4NGC – Our roadmap towards simulation based V&V for future automated vehicles

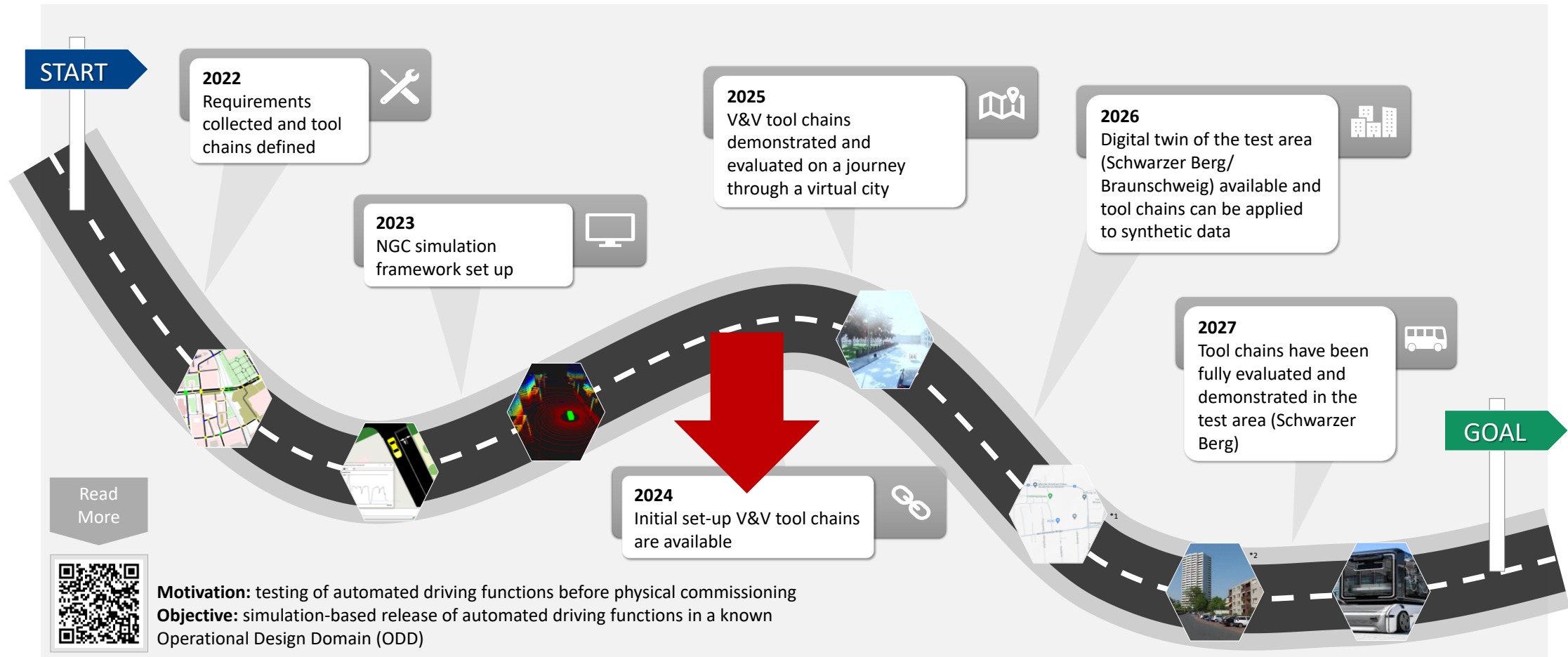


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2023: NGC simulation framework set up

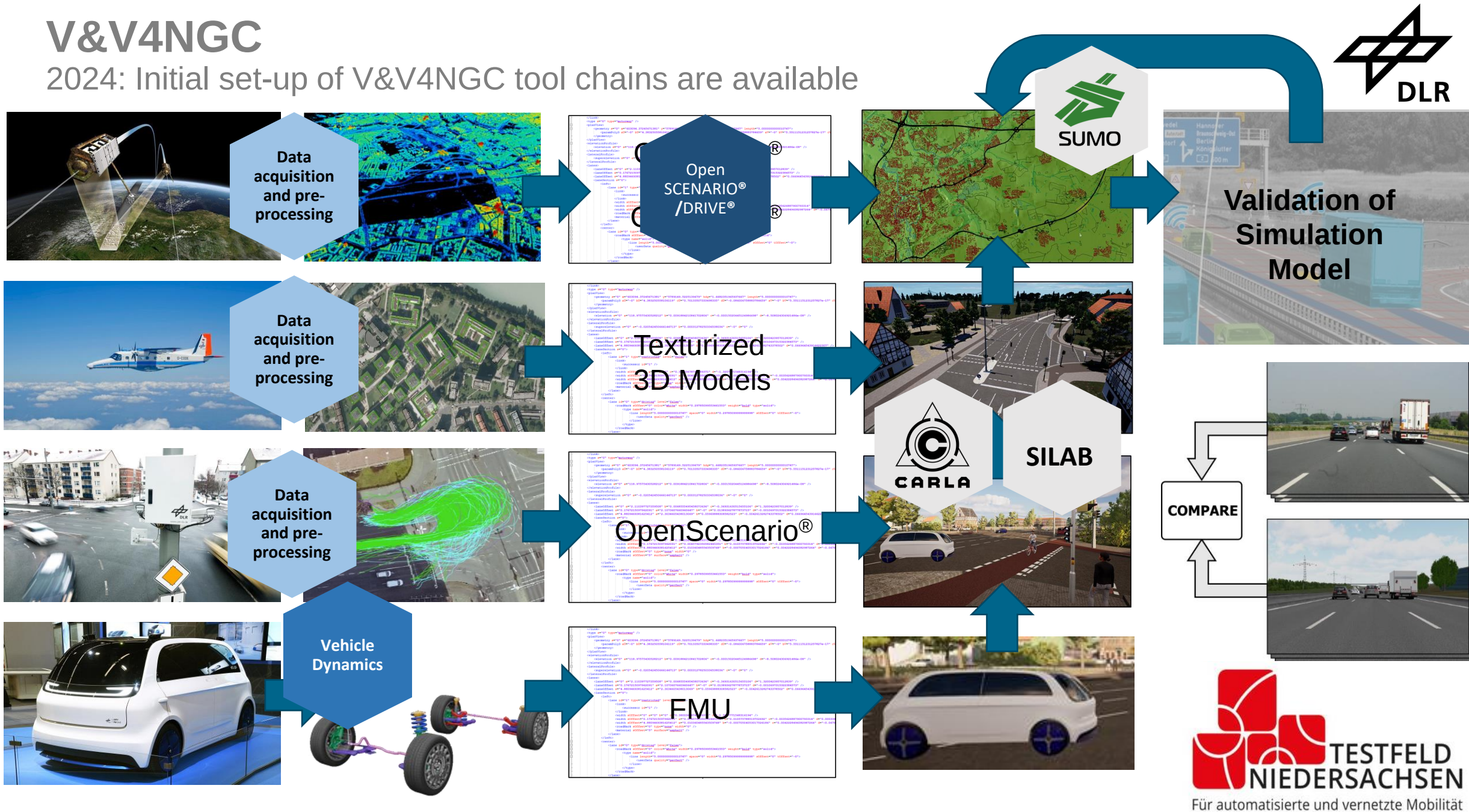


V&V4NGC – Our roadmap towards simulation based V&V for future automated vehicles



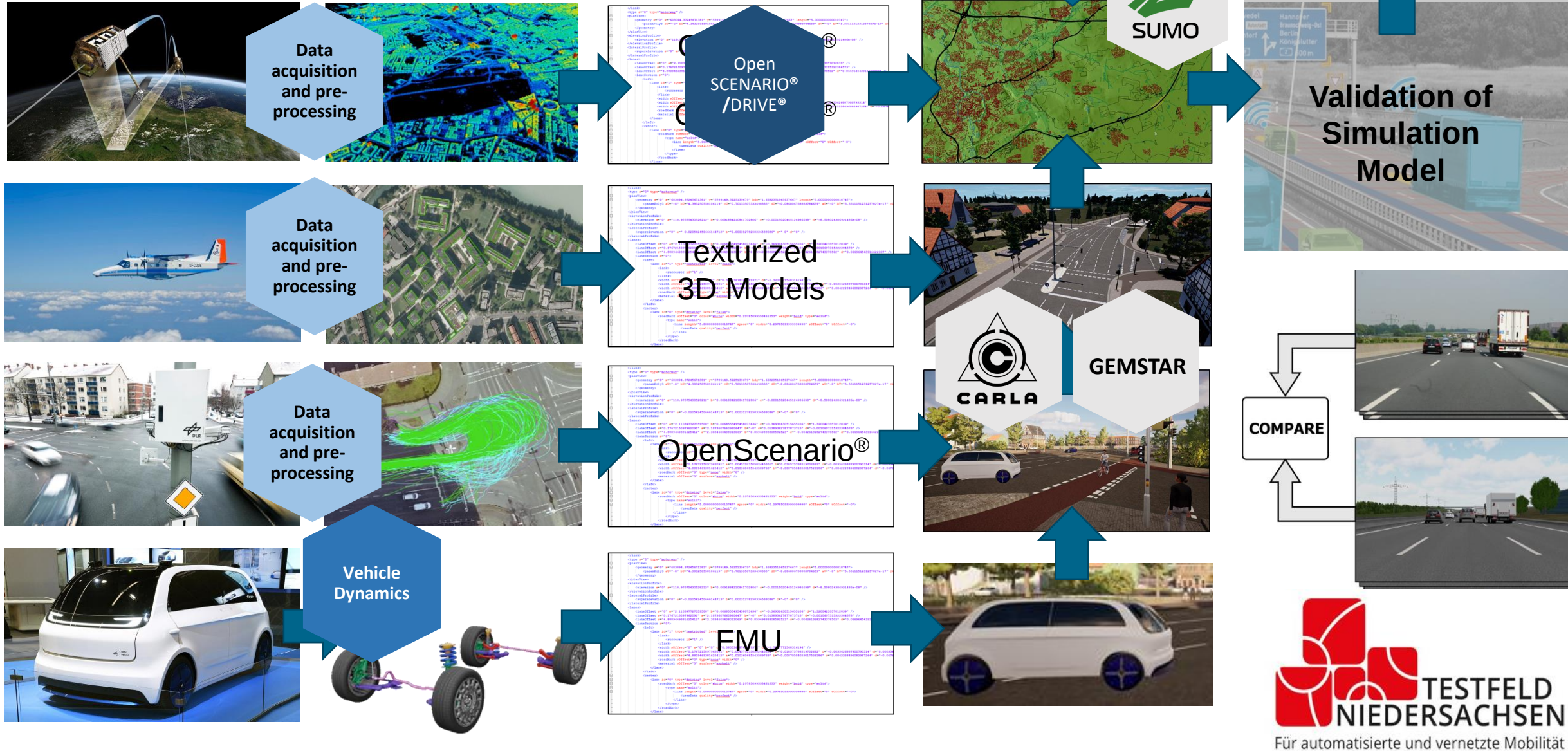
V&V4NGC

2024: Initial set-up of V&V4NGC tool chains are available



V&V4NGC

2024: Initial set-up of V&V4NGC tool chains are available



V&V4NGC

2024: Initial set-up of V&V4NGC tool chains are available



Safe
vehicle
dynamics
tool chain



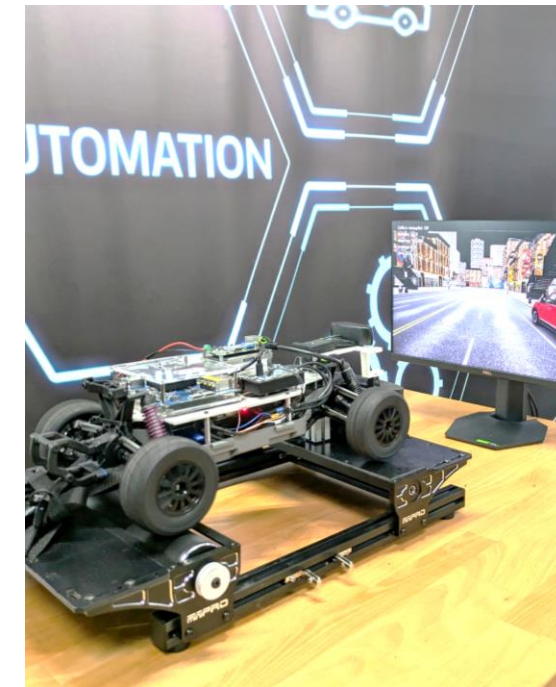
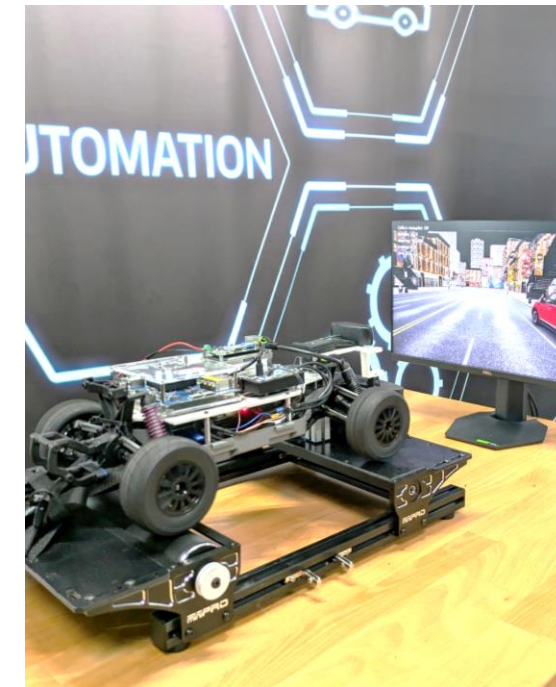
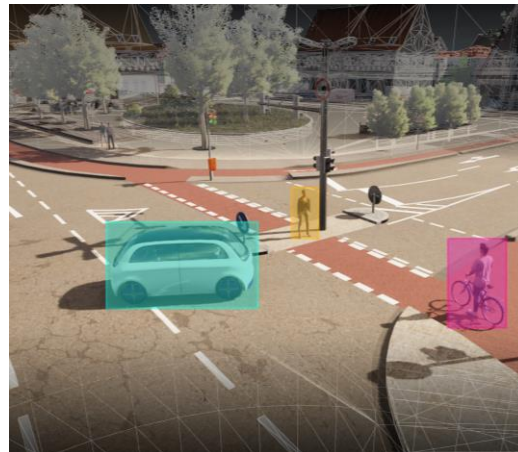
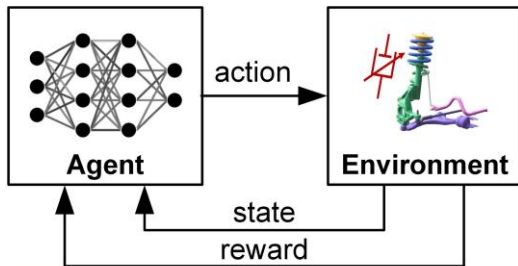
Scenario
based
verification
tool chain



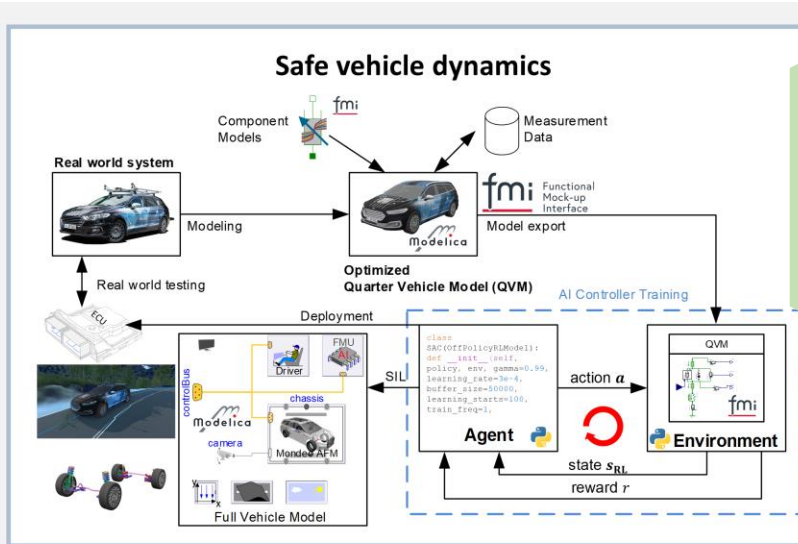
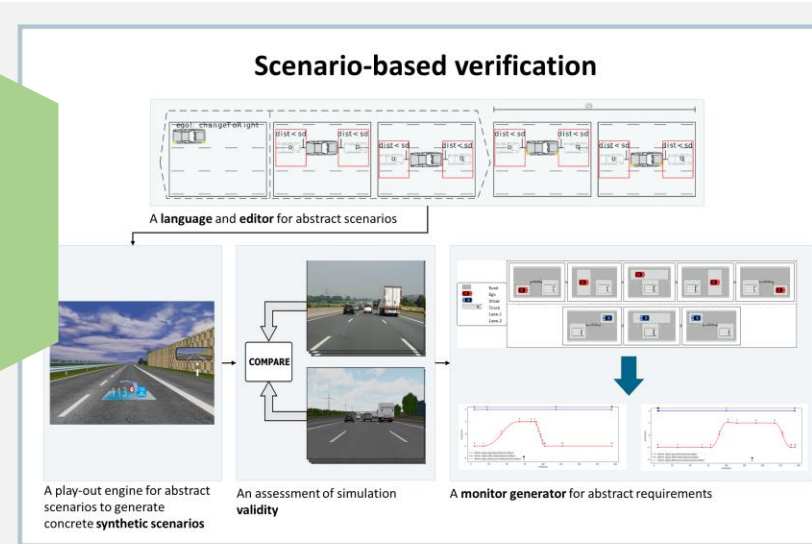
Safe
interaction
with road
users tool
chain



Safe &
Secure
online
updates
tool chain

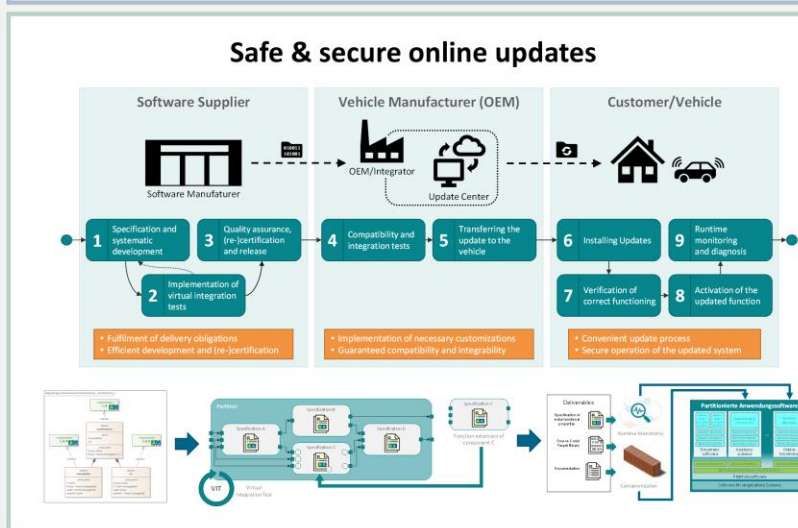
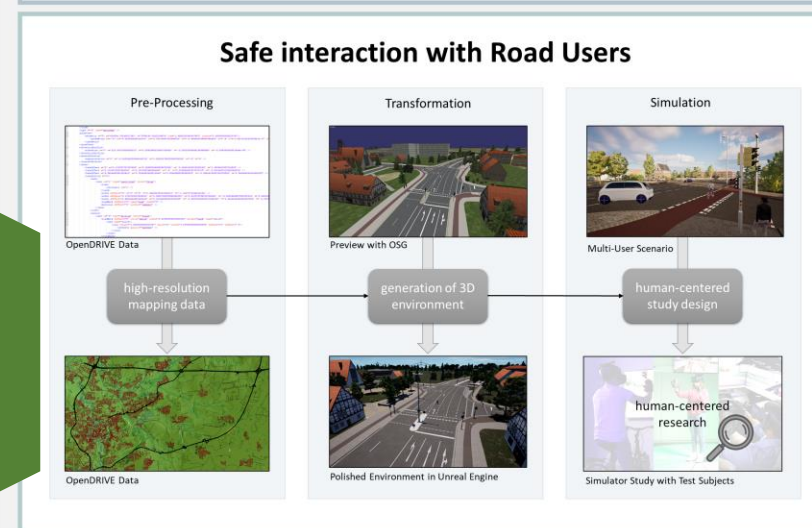


Scenario based verification tool chain



Safe vehicle dynamics tool chain

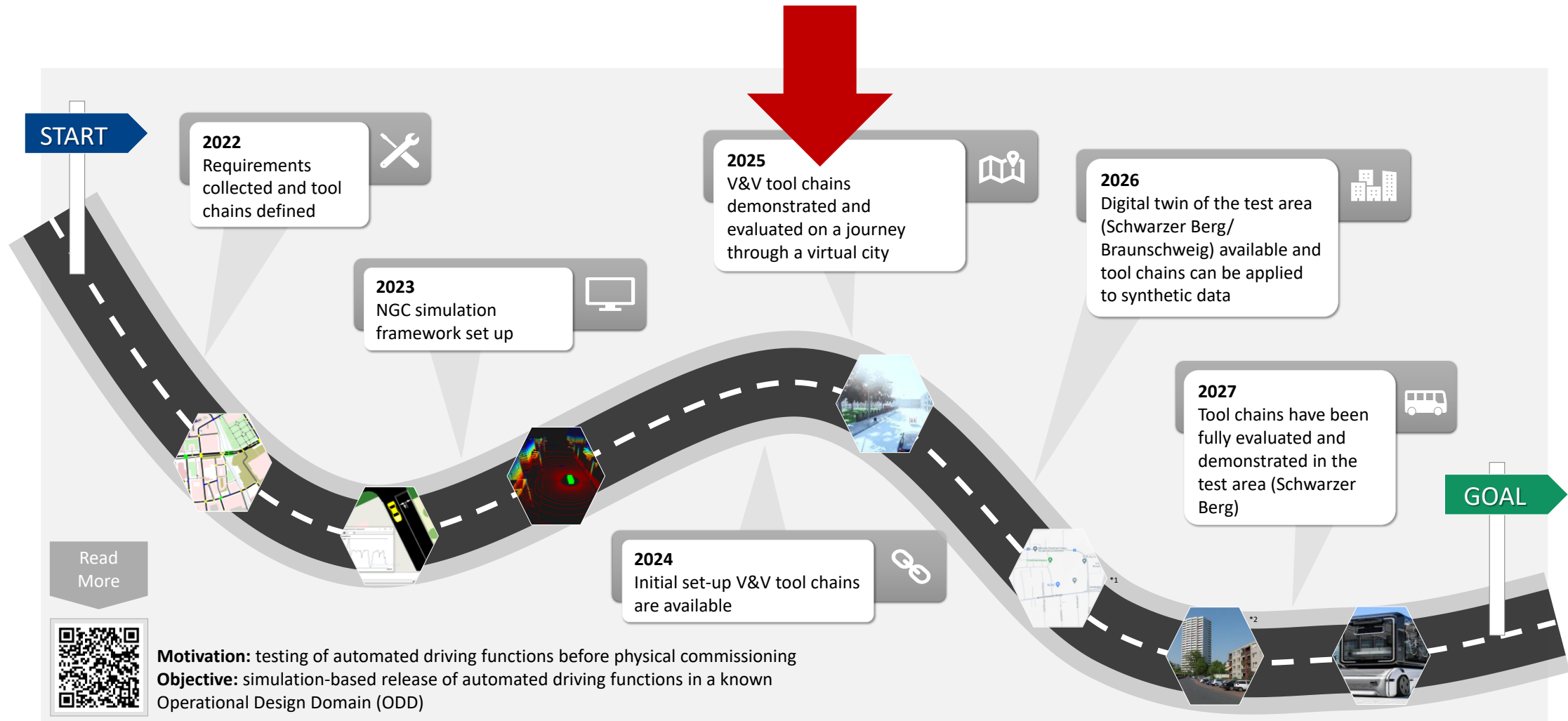
Safe interaction with road users tool chain



Safe & Secure online updates tool chain



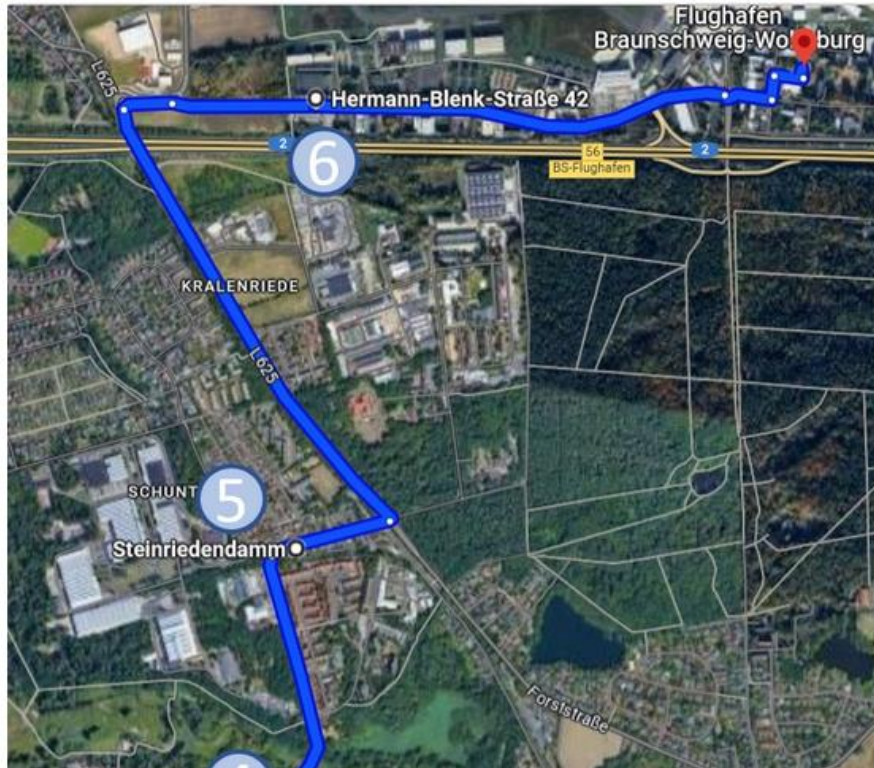
V&V4NGC – Our roadmap towards simulation based V&V for future automated vehicles



V&V4NGC

2025: V&V tool chains demonstrated and evaluated on a journey through a virtual city

Please, start reading from the bottom upwards (Brunswick central station is in the south of the map).



6 Hermann-Blenk-Straße 42

TC3.3 Failure Predictor for Maintenance

Just before the vehicle reaches its destination at the airport, a warning light suddenly starts blinking. Because the vehicle has accumulated many kilometers over the past years, the shock absorbers have suffered quite a bit and are slowly approaching a state in which vehicle safety is no longer guaranteed. The vehicle indicates that the journey can still be completed without hesitation, but automatically schedules an appointment at the repair



TC1.1 OSTAR (1/2)

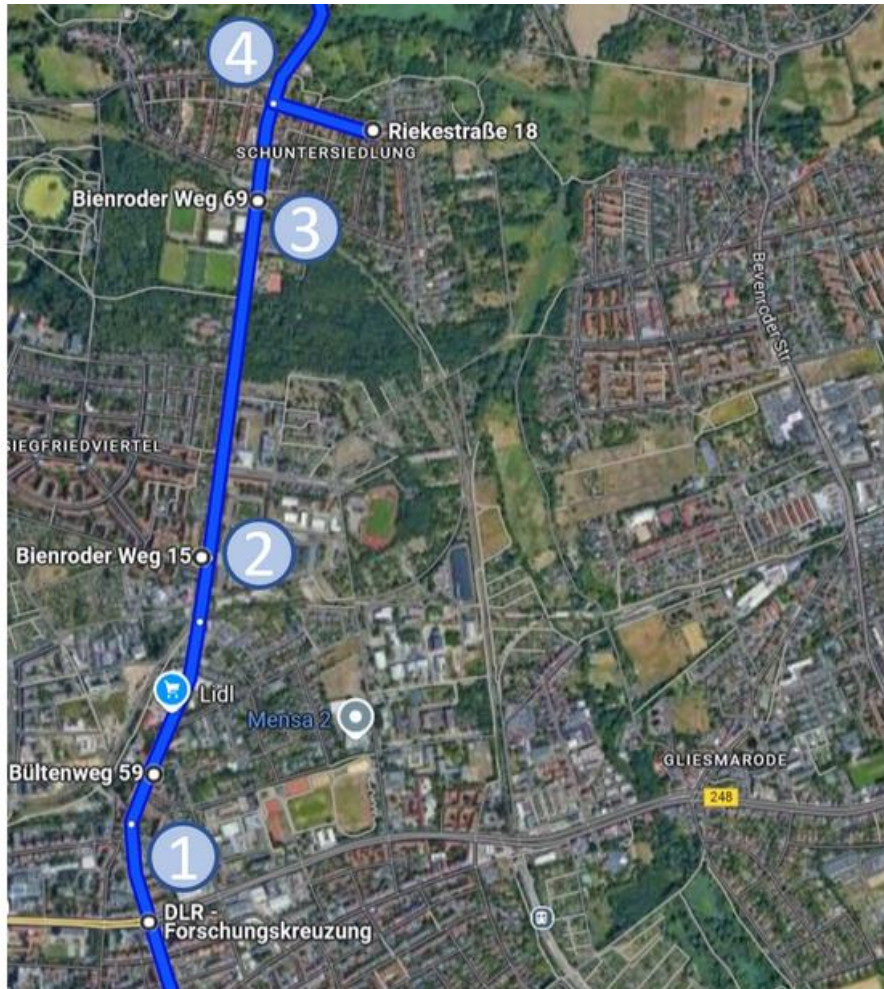
TC1.1 OSTAR (2/2)

On the next traffic intersection, a vehicle parks illegal in the lane or broke down at this undesired location. To pass this situation safely the vehicle must drive into the lane with oncoming traffic. The vehicle has been trained on these kind of potentially dangerous situations in simulations and can act accordingly.



V&V4NGC

2025: V&V tool chains demonstrated and evaluated on a journey through a virtual city



4 Riekestraße 18

TC2.1 Vehicle Automation and VRU Interaction

At this location, the driver wants to pick up a colleague and the vehicle needs to do a right turn from the main road into Riekestraße. Due to the intersection design the sensors can not safely detect vulnerable road users (pedestrians and cyclists) which can cross the road coming from different locations. Changing the road's infrastructure can help to increase safety, but it is necessary to model and simulate costly changes to the infrastructure.



3 Bienroder Weg 69

TC5 Validation of Vehicle Dynamics Controller on AI For Mobility

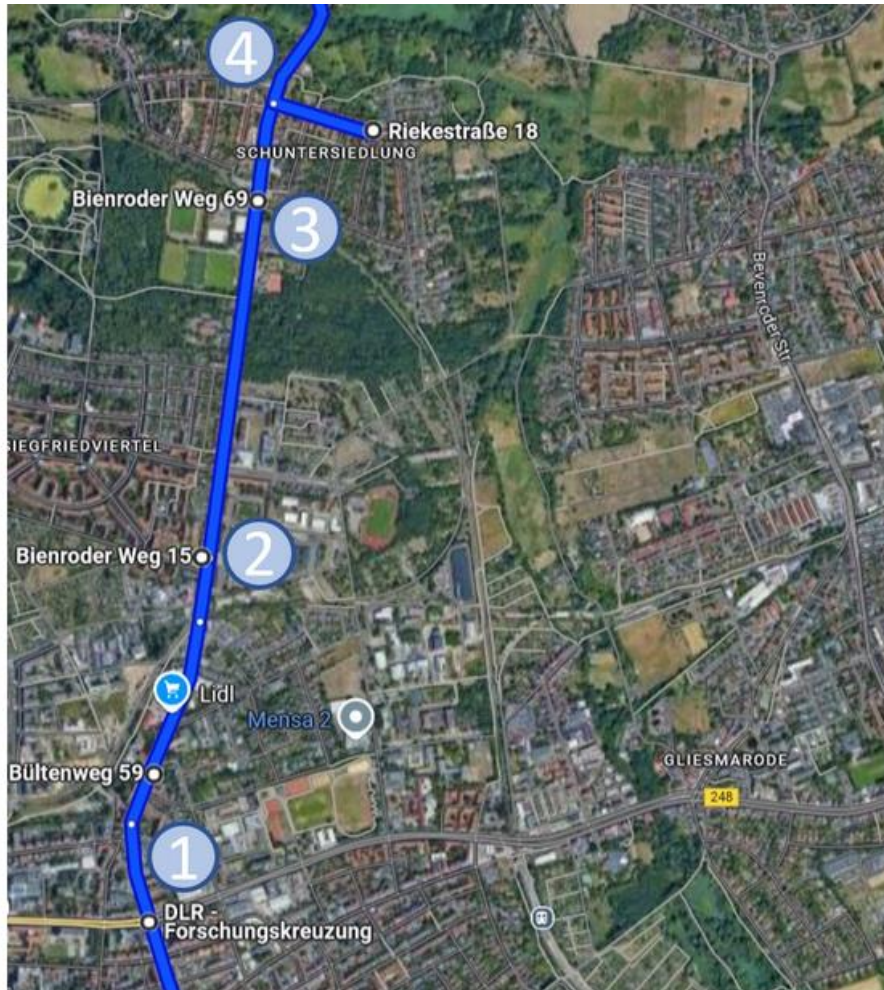
TC6 Specification and online monitoring

Another 5 minutes later the vehicle has to cross a railroad track. There are also a number of different patches of asphalt in this area which would make it quite a bumpy ride in a normal vehicle. Fortunately, the automated vehicle is equipped with an advanced vertical dynamics controller which is part of the semi-active damping system. The damping behavior is controlled by an AI-based algorithm that finds a compromise between road holding safety aspects and the comfort of the passengers in the vehicle.



V&V4NGC

2025: V&V tool chains demonstrated and evaluated
on a journey through a virtual city



2 Bienroder Weg 15

TC2.2 Virtual Tester

TC1.3 Traffic Sequence Charts (TSC)

TC3.1/2 TSC Online Monitoring

TC4 Safe Update Processes

Half-way along the route, the automated vehicle detects a small construction site which partially blocks its lane. Because it is just a two-lane road and the vehicle also detects oncoming traffic, the automation system is not allowed to conduct an overtaking maneuver on its own (ODD restriction). It informs the driver approximately 7s or 80m in advance, initiates a stopping maneuver and hands over control. The driver looks for an adequate gap and presses the "Resume" button to start the automated passing maneuver. A little later a parcel delivery truck is blocking the lane and requires yet another overtaking and handover maneuver. Data about these scenarios caused by ODD limitations is constantly reported to the support team / engineers of the OEM who work on improvements of the system. Within this scenario several tool chains of the project can be motivated.



1 DLR Forschungskreuzung

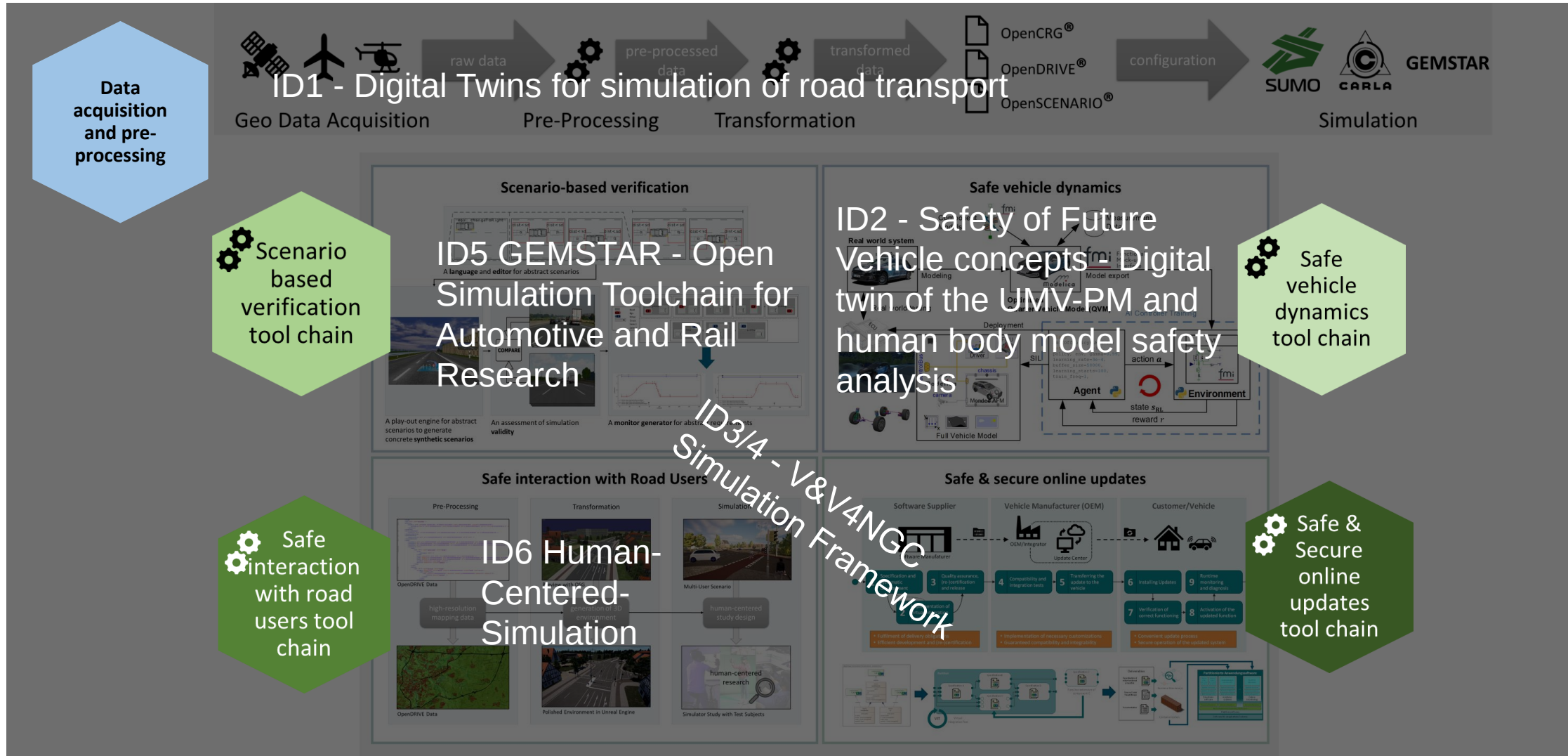
TC1.2 RdbS

After approximately 5 minutes of driving through the city, the automated vehicle approaches the AIM Research Intersection from south to north. With the traffic lights green the vehicle starts crossing the intersection while suddenly an oncoming vehicle from the north does a U-turn directly in front of our automated vehicle. The automated vehicle is forced to brake in order to avoid a collision. Afterwards, both vehicles continue driving north on the right lane, exiting the intersection.



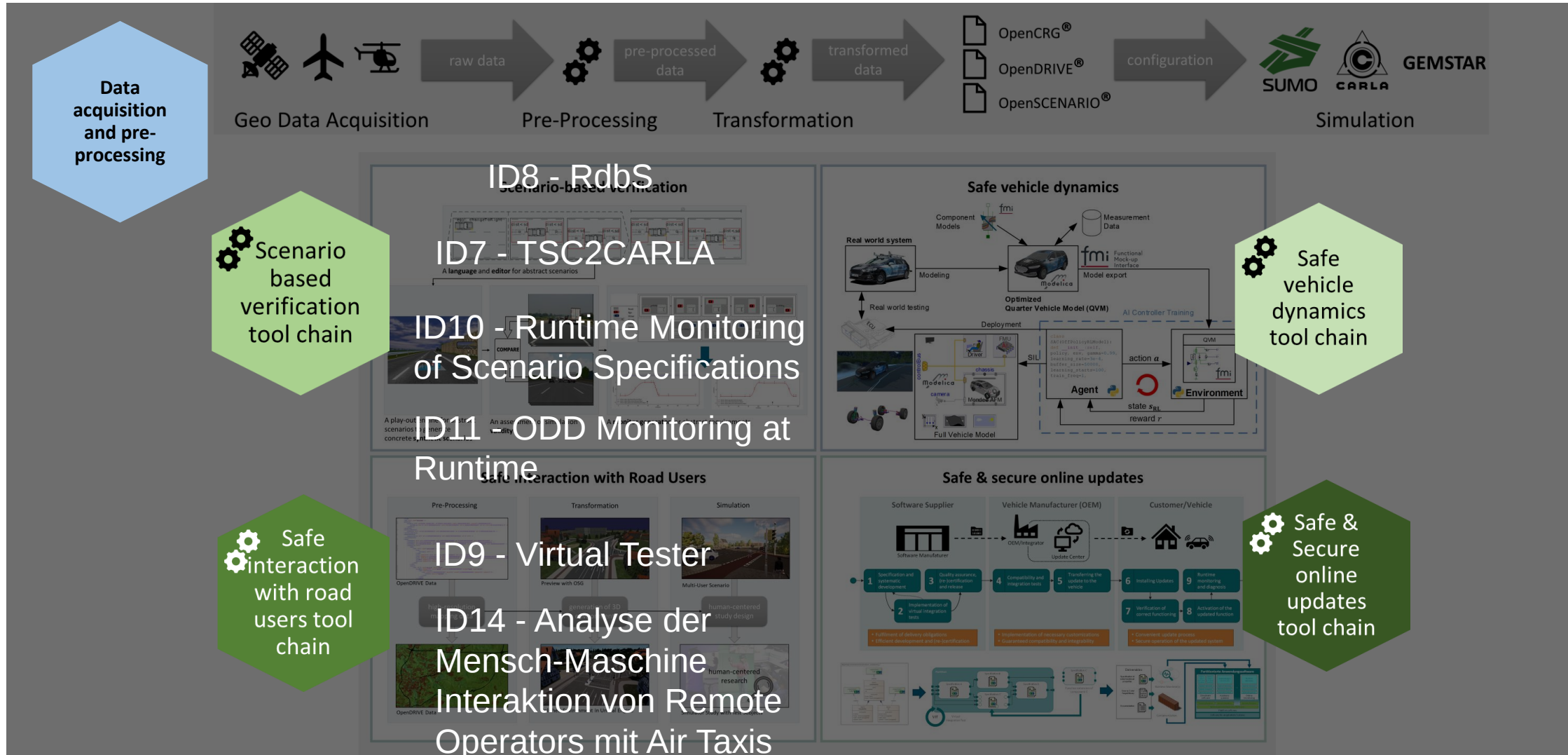
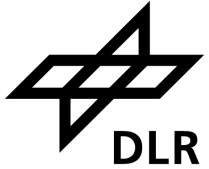
V&V4NGC: What can you see here today?

Round 1



V&V4NGC: What can you see here today?

Round 2



V&V4NGC: What can you see here today?

Round 3

