Platforma dSPACE pro testování automobilových systémů v reálném čase

Tomáš Fridrich; fridrich@humusoft.cz

www.humusoft.cz, www.dspace.com, www.understand.ai

Autonomous Driving – typical approach

Record real world data

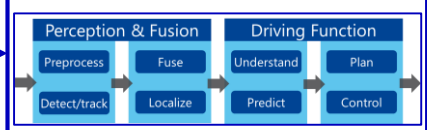
Data base with real world data

Train/validate DNNs

Real world and simulation must be brought together

Data base with simulation scenarios

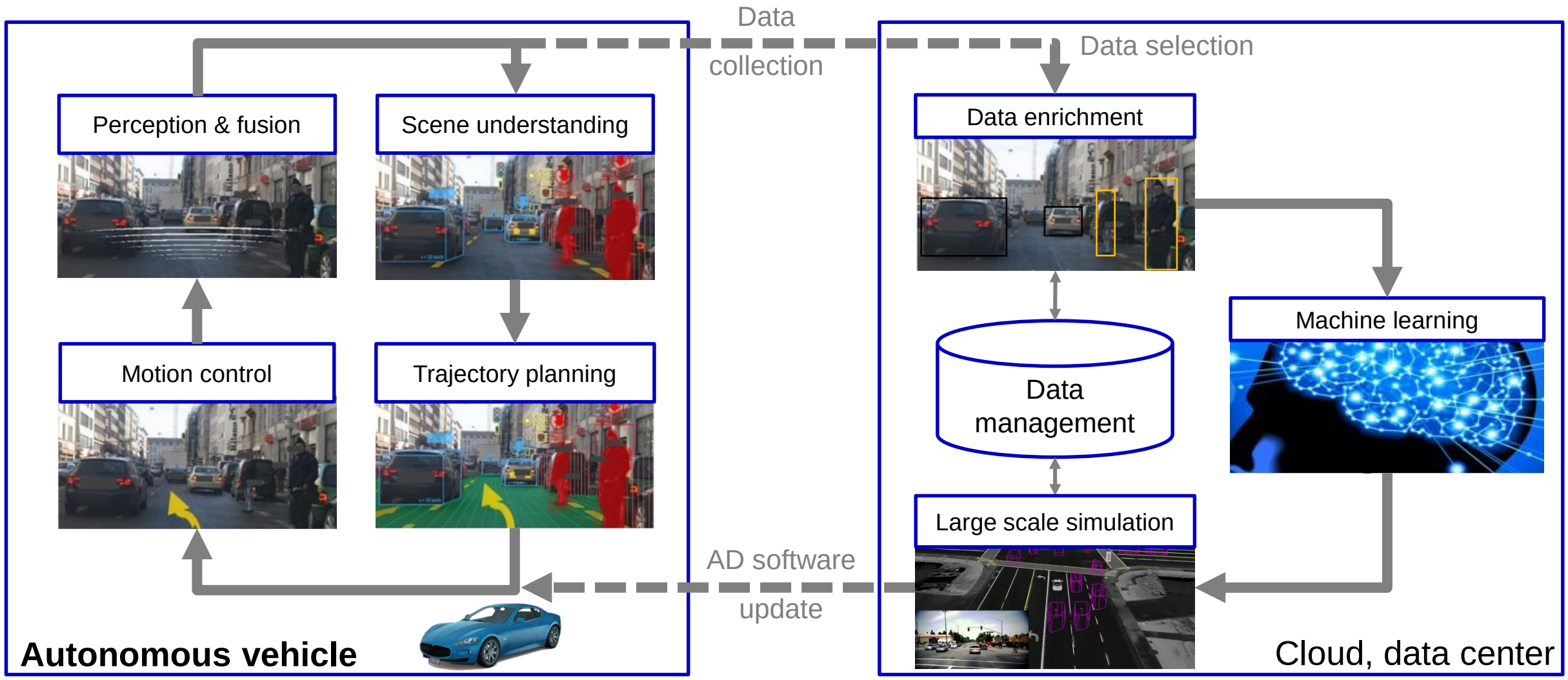
AD software



Perform large scale simulations

Update AD software

Data driven development



Managing so much data is extremely expensive

Real driving tests are costly (equipment, people, time …)

AUTONOMOUS VEHICLE SENSORS		
Sensor type	**Quantity**	**Data generated per sensor**
Radar	4-6	0.1-15 Mbit/s
LIDAR	1-5	20-100 Mbit/s
Camera	6-12	500-3500 Mbit/s
Ultrasonic	5-16	<0.01 Mbit/s
Vehicle motion, GNSS, IMU	-	<0.1 Mbit/s

Total bandwith can reach up to **40 Gbit/s (~19TB/h)**

Source: Stephan Heinrich, Flash Memory Summer 2017 Santa Clara, CA

100 000 km / 40 km/h avg speed / 19 TB/h = ~ 50 PB

According Nvidia volume of data required to teach AI differ between 200 – 600 PB

Source: https://developer.nvidia.com/blog/training-self-driving-vehicles-challenge-scale/

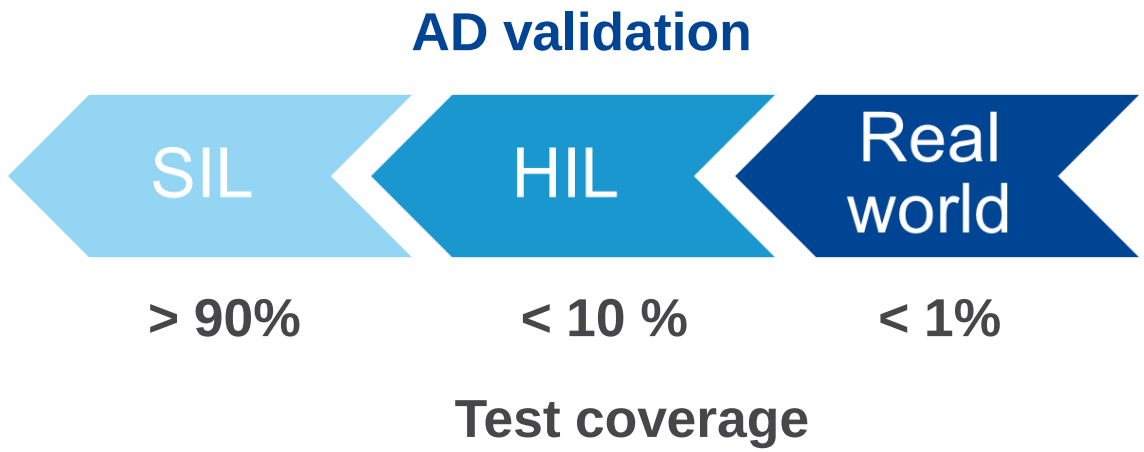
Autonomous Validation – The problem…

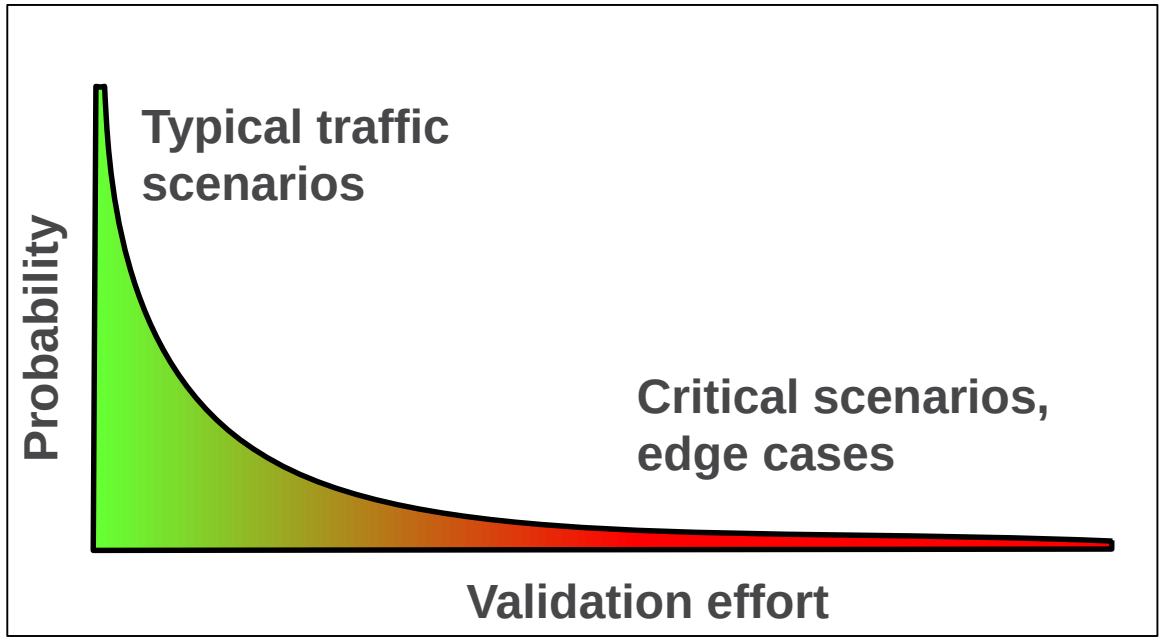
Realism of complexity in simulation

Creating thousands of simulation scenarios efficiently

Critical traffic scenarios and edge cases

Key: Effective Scenario-based Testing





Autonomous Driving – The solution …

Bringing the complexity of the real-world into AV simulation

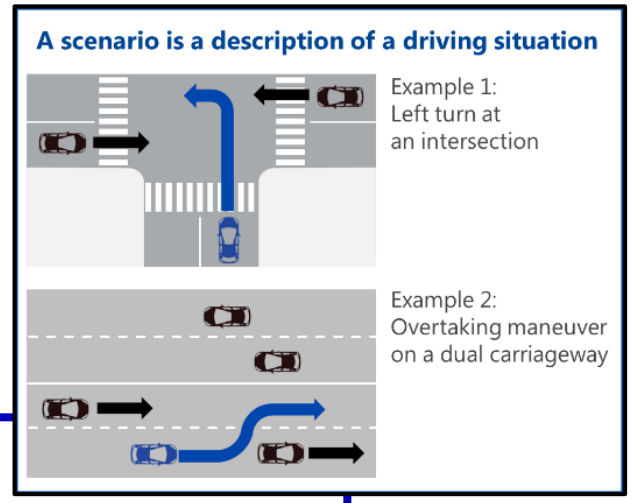
Autonomous Driving – typical approach

Record real world data

Data base with real world data

Interesting scenarios

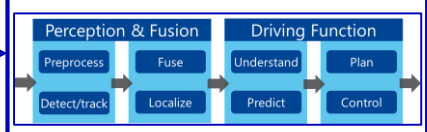
Generate logic scenarios



Train/validate DNNs

Data base with simulation scenarios

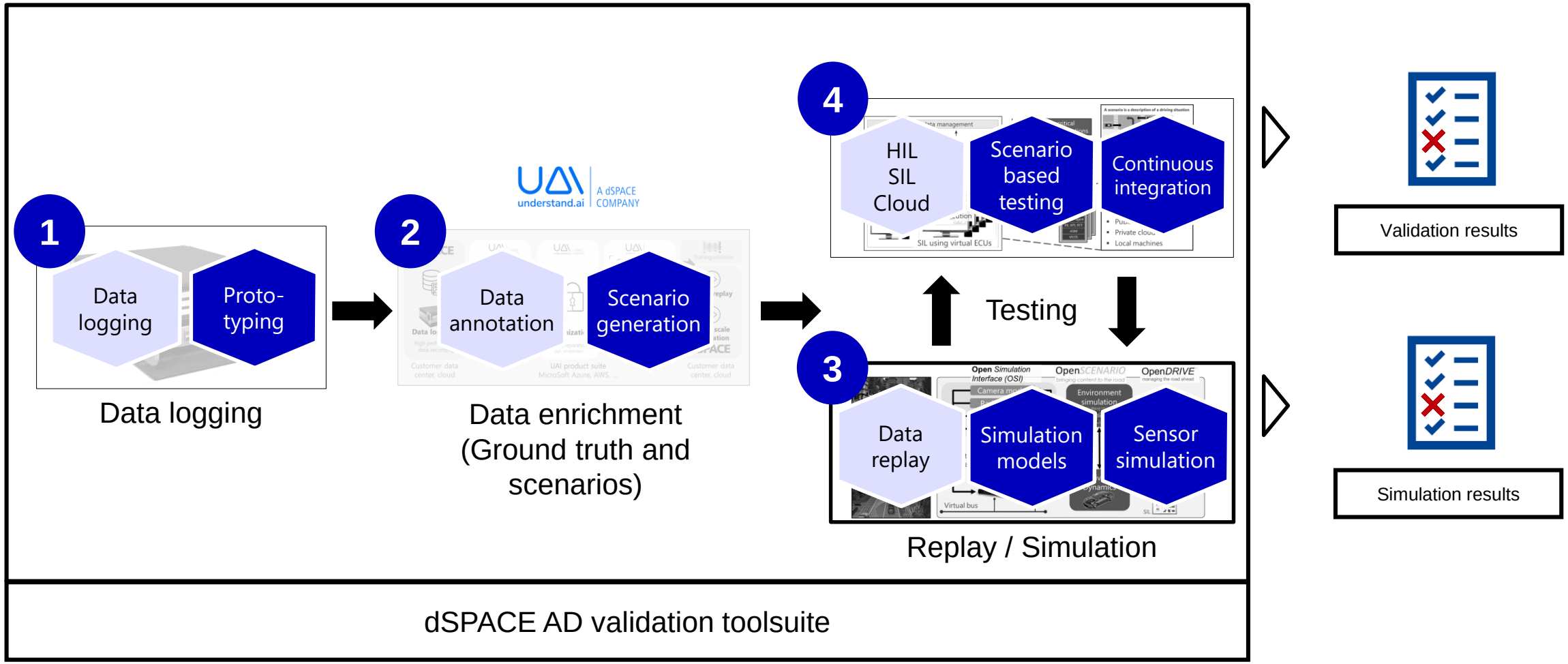
AD software



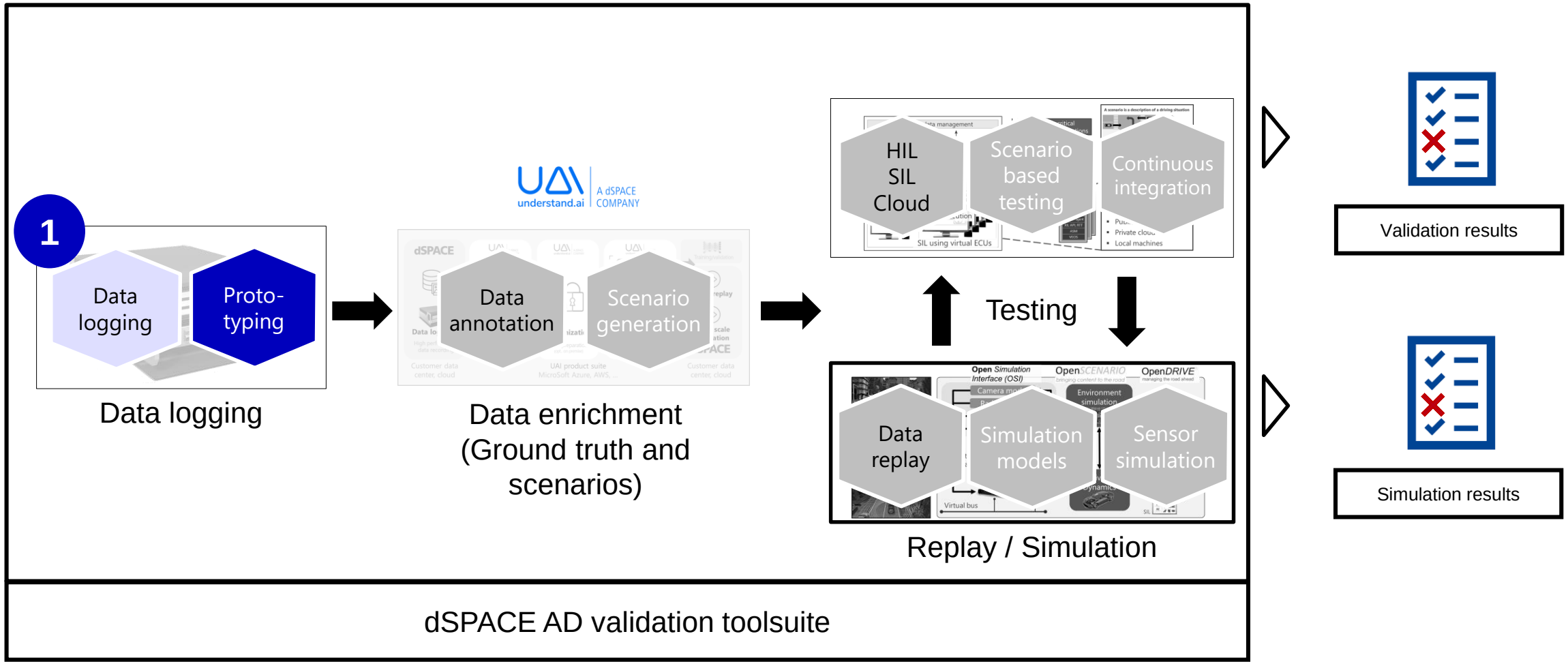
Update AD software

Perform large scale simulations

Integrated AD validation toolsuite for data-driven development



Integrated AD validation toolsuite for data-driven development



Data logging - AUTERA

Flexible Configuration with 6 General Purpose Slots

For BUS-/Network-Card, GPU and Data Logging Extension

>50 Gbit/s bandwith

Up to 32TB data Storage (64 TB planned)

High END GPU/FPGA support

Unique performance of data logging and data replay in terms of bandwidth and synchronization

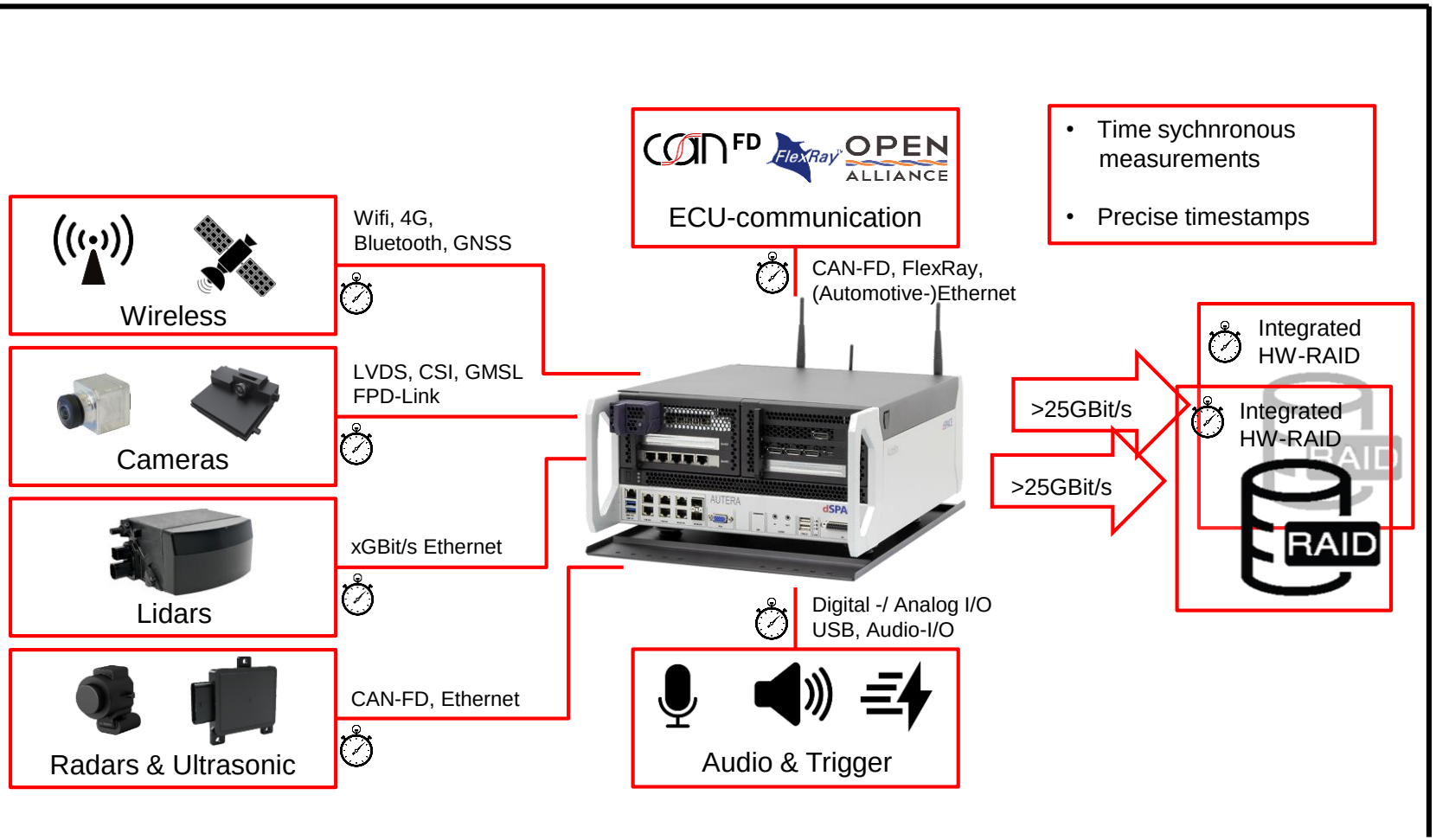
Easy-to-scale if you need more bandwidth or sensor interfaces

Maximum flexibility to adapt to different sensor interfaces, buses and Networks

Easy-to-use and fast data upload with AUTERA upload station

Prepared for online data selection with AI algorithms and GPU power to log “only the interesting scenarios”

Data logging - AUTERA



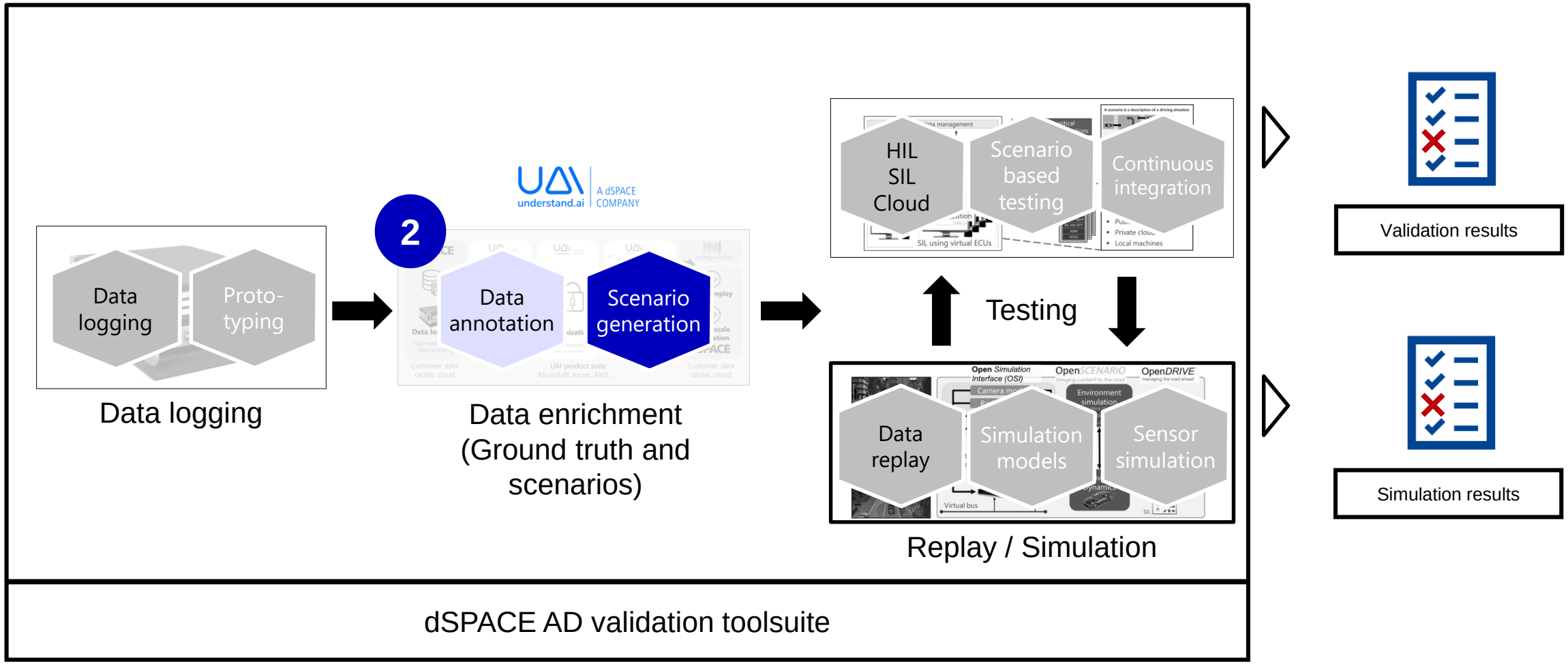
Open Linux base System
50 Gbps+ sustained data throughput

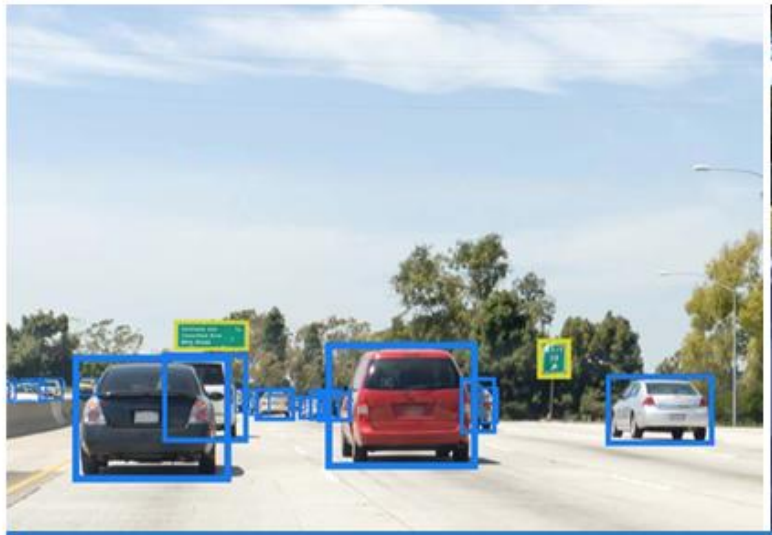
Fast adaptation to new sensor types and Other communication interfaces

Precise time synchronization and time Stamping between all bus, network and Sensor interfaces

Import of communication description For buses to reduce amount of logged Bus data

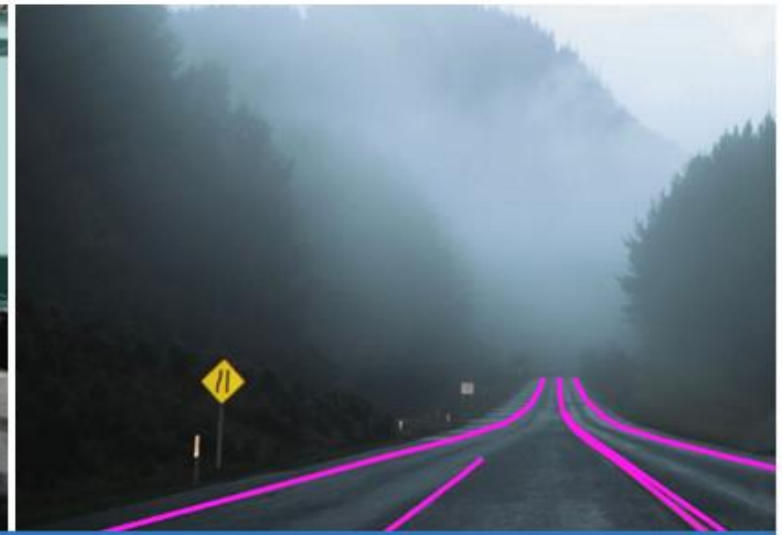
Integrated AD validation toolsuite for data-driven development





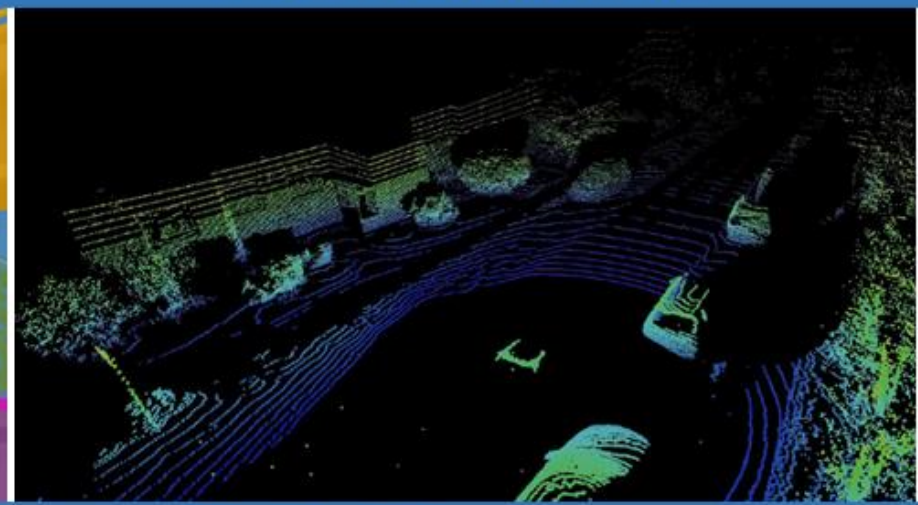
2-D Bounding Box Annotation

3-D Cuboid Annotation

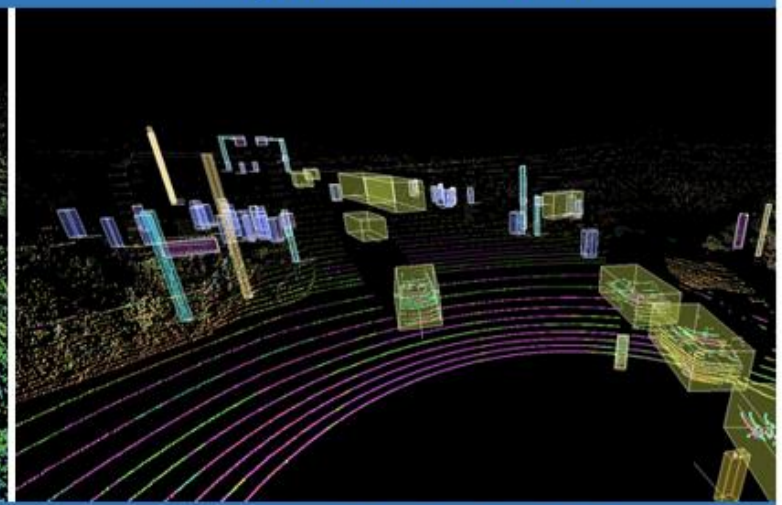


Polyline Annotation

Semantic Segmentation

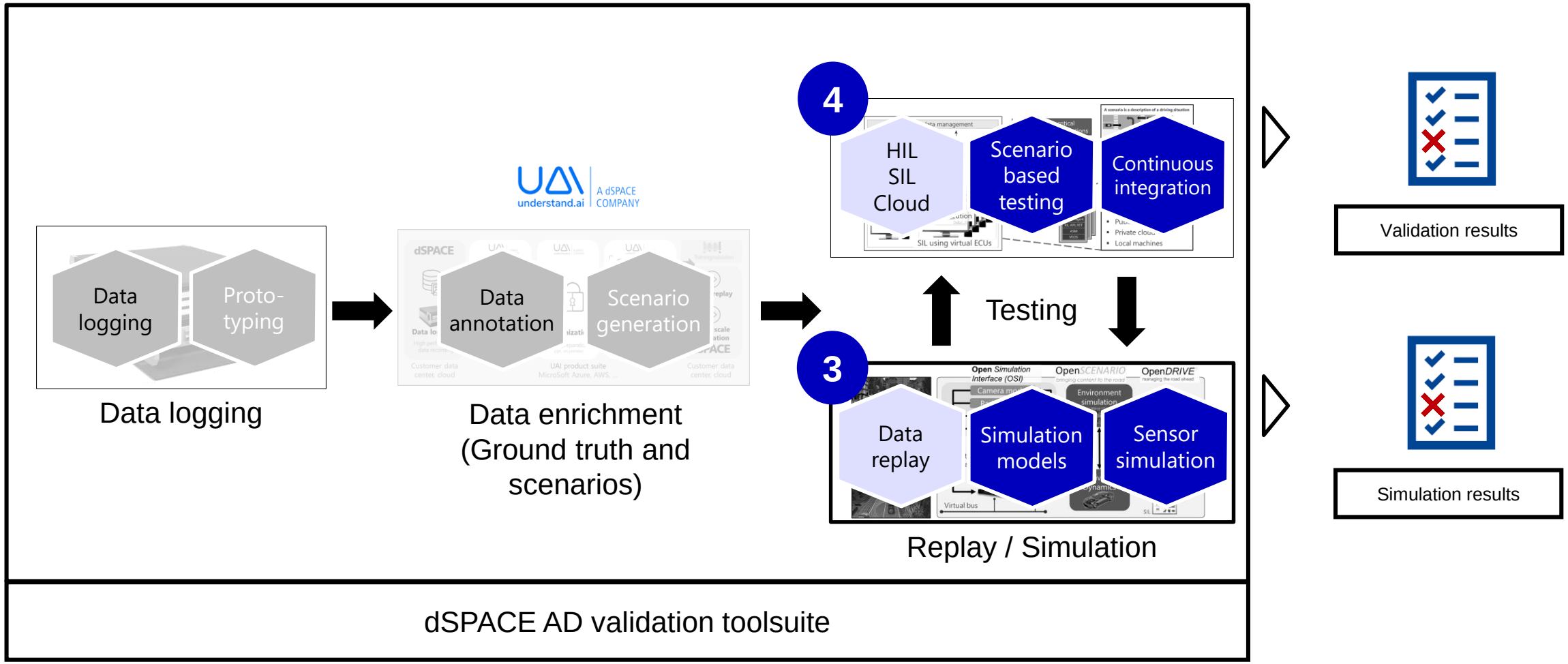


3-D Lidar/Radar Segmentation



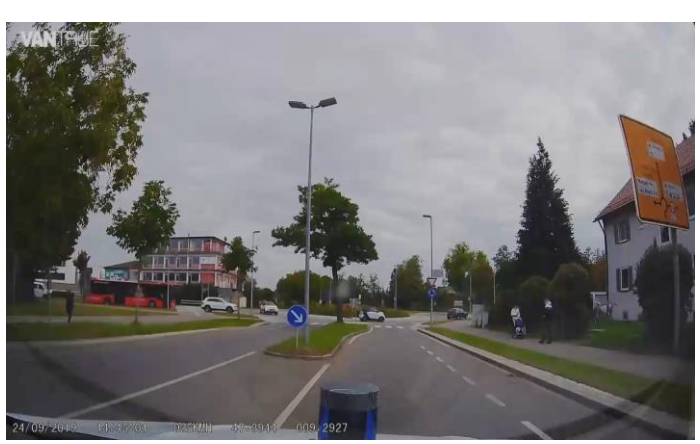
3-D Lidar/Radar Cuboids

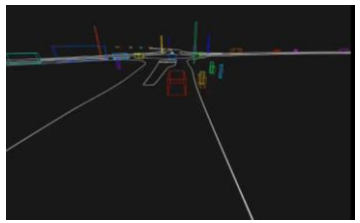
Integrated AD validation toolsuite for data-driven development



Scenario Generation service by dSPACE and understand.ai

Generating scenarios from real world measurements





Measurement data

Scenario Generation

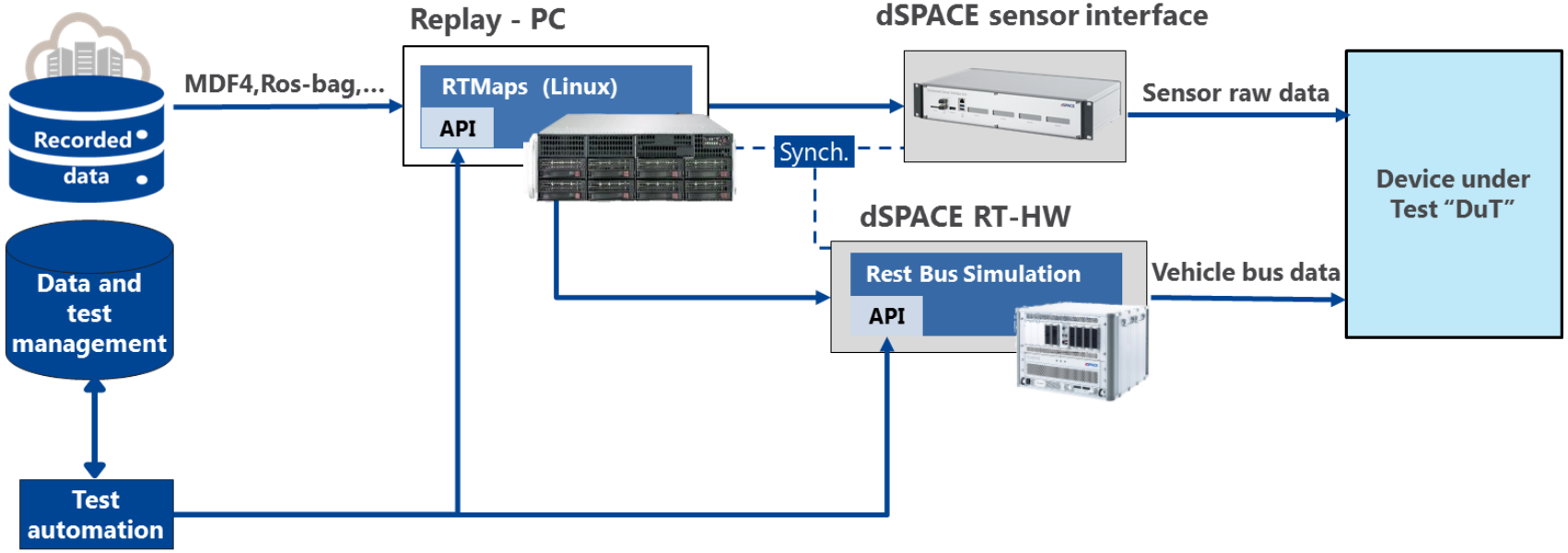
Simulation

Service generating scenario for validating ADAS/AD

Logical Scenario

Replay Scenario

Data replay HW/HIL solution



Minimal jitter due to usage of SCALEXIO real-time system

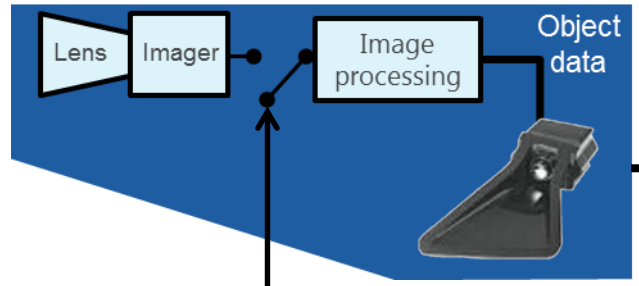
Closed loop **environment simulation up to the initial state of the recording**

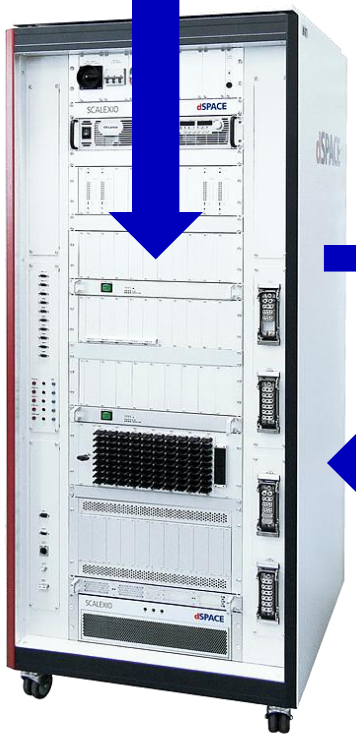
Extensive bus and sensor support with **monitoring and manipulation** features

Suitable for **electrical failure testing**

Multi-role system a single system for data replay and closed-loop simulation.

Use Case: Test functions for AD by means of HIL simulation





Sensor Simulation PC with GPU

GigE

HDMI

Environment Sensor Interface Unit

...

High-performance processing unit

Rest bus simulation

Vehicle network


With us, autonomous driving
gets more drive.