PROJECT of the PEGASUS FAMILY

VERIFICATION VALIDATION METHODS

Final Event 21 / 22 November 2023

Demonstrator: Scenario Database

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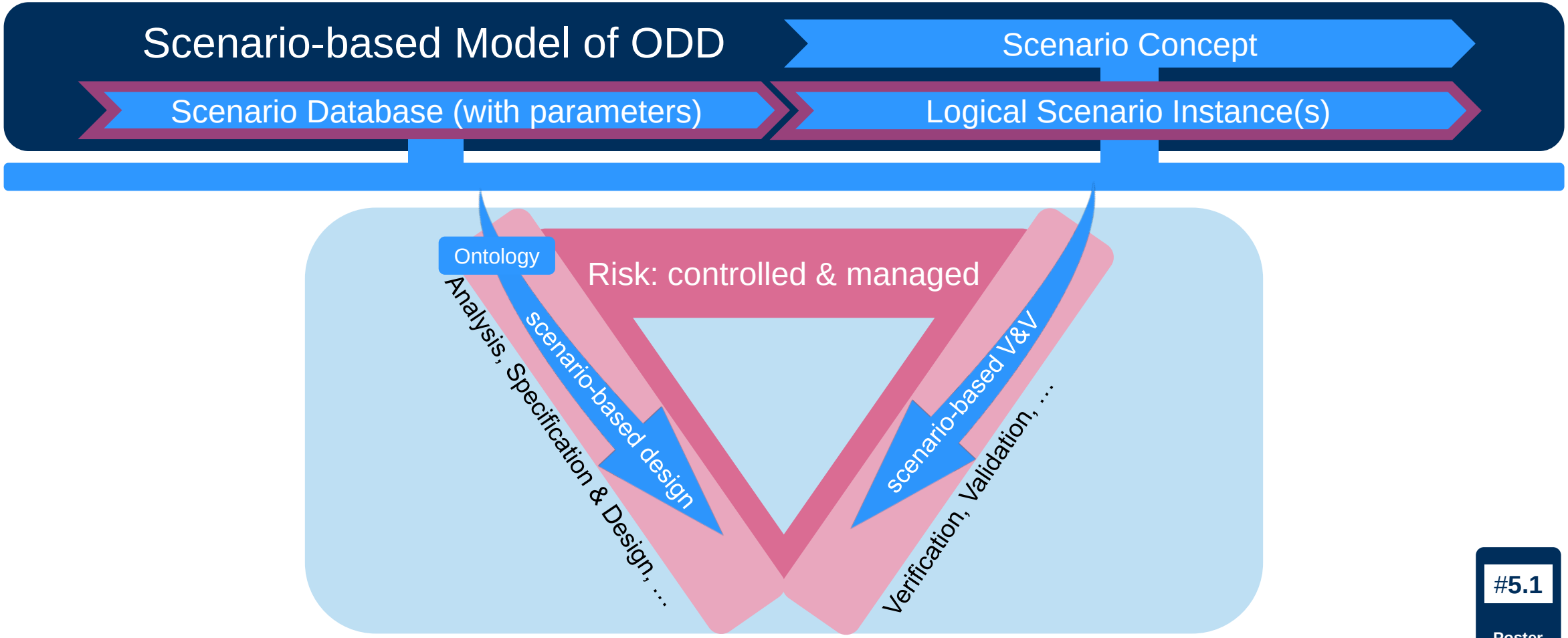
Supported by:

Federal Ministry for Economic Affairs and Climate Action

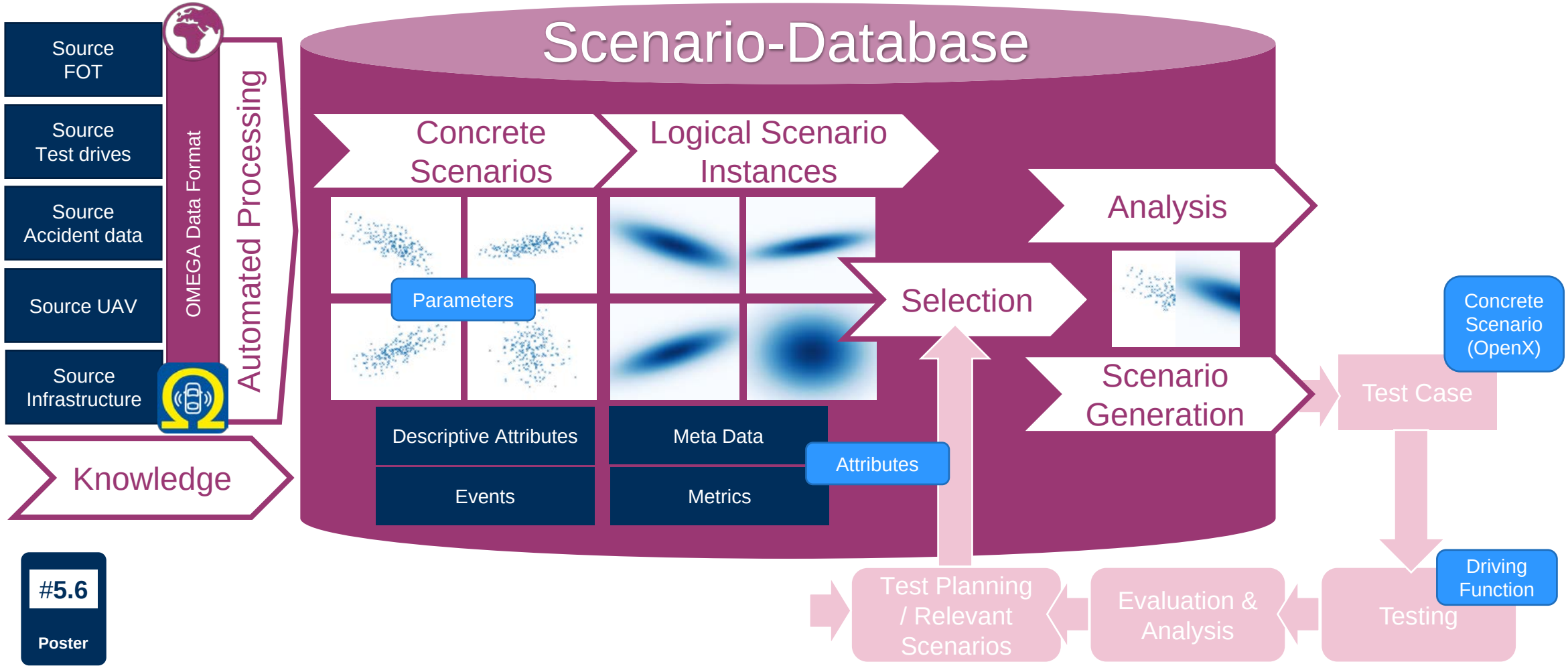
on the basis of a decision by the German Bundestag

Scenario-based Development and Verification & Validation of ADS



#5.1
Poster

Insight View of Scenario Databases



#5.6
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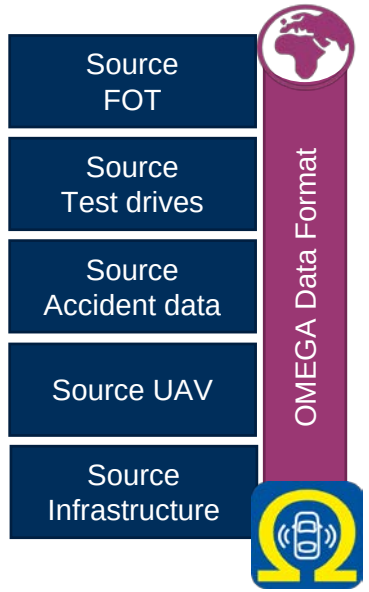
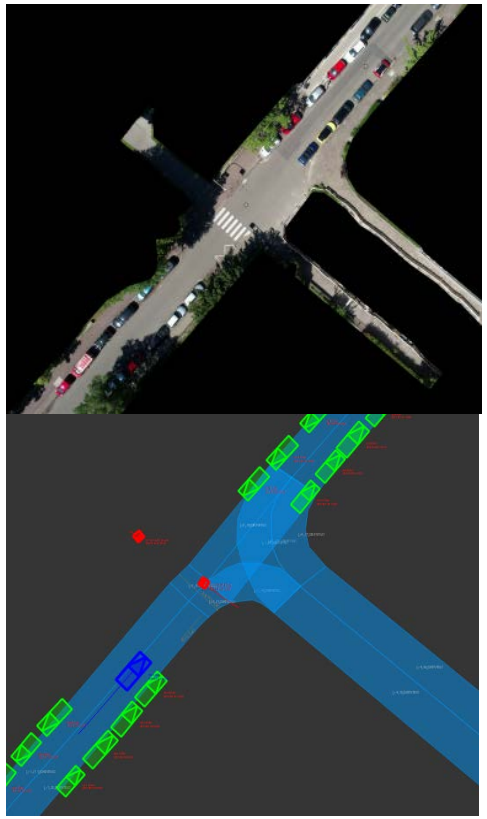
Data: Omega Format

- → Diverse Data Needed: Combining Different Data Sources

- Data Format realizing 6-Layer Model and A.U.T.O. Ontology
- Unifying Map and Object-list based Trajectory Data in a hierarchical Format
- Enabling automated algorithms for scenario extraction
- Exchanged with a working group of UN ECE 157





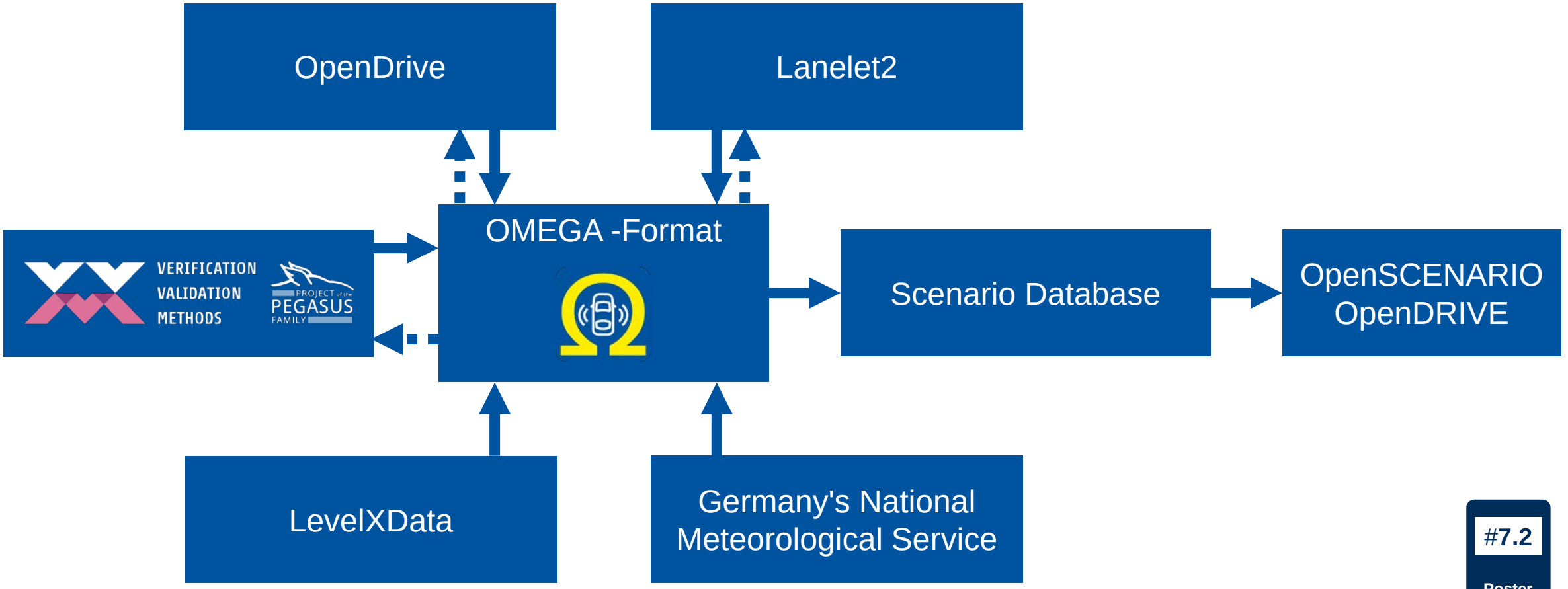
Pegasus Format

OMEGA-Format

Common Data Format

#7.2
Poster

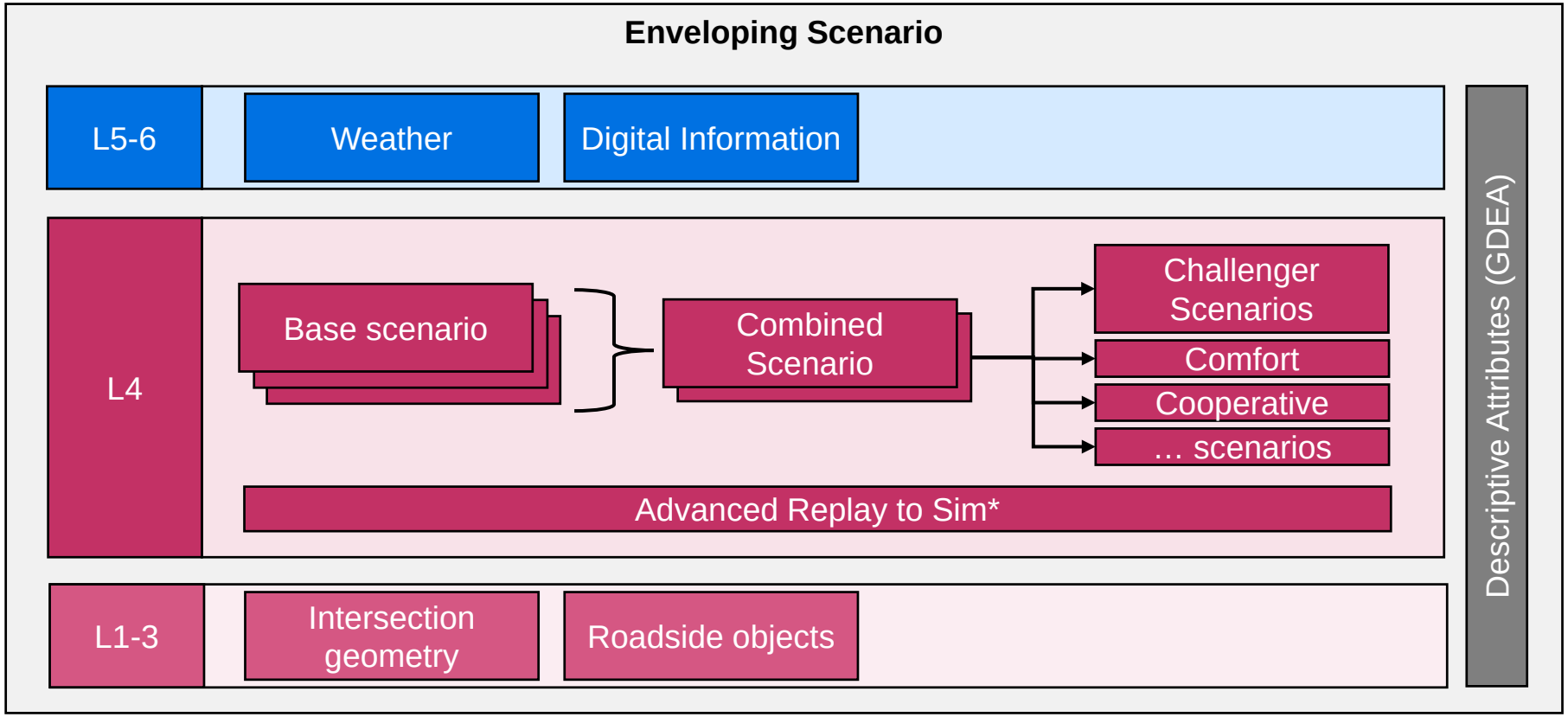
Omega Format - Converters to and from Established Formats



#7.2
Poster

Scenario Concept to Structure Traffic

- Scenario concept to structure traffic area
- Base Scenarios encompass the ODD (realization of core scenarios)



#5.4
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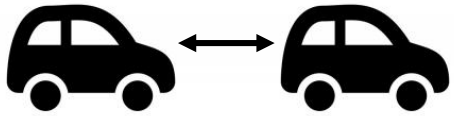
Base Scenarios

- Holistic Driving Scenario Concept for Urban Traffic
- Concepts describing abstract characteristics of traffic
- Combination of concepts defines base scenario

Individual concepts

- *Road user type*
- Intersection maneuver

*



Bilateral concepts

- Intersection conflict
- Longitudinal state
- Relative direction
- Traffic area change

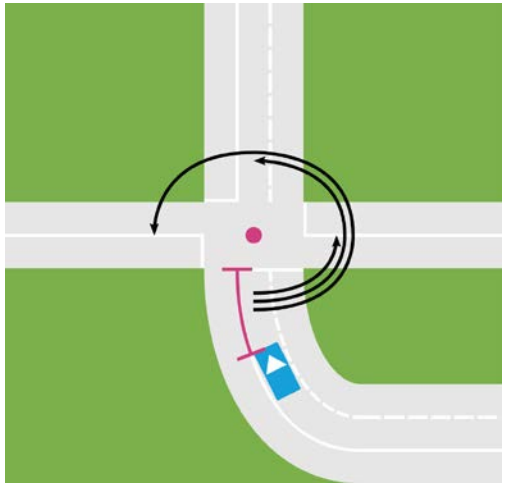
*

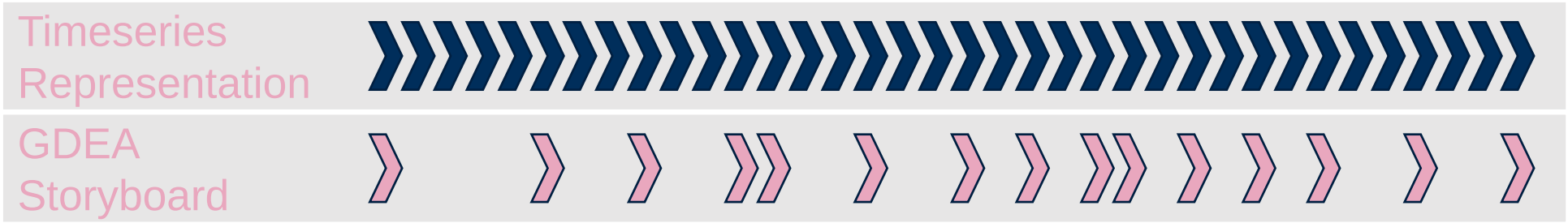
Global concepts

- *Traffic flow*
- *Traffic type*

General Descriptive Entity Attributes (GDEA)

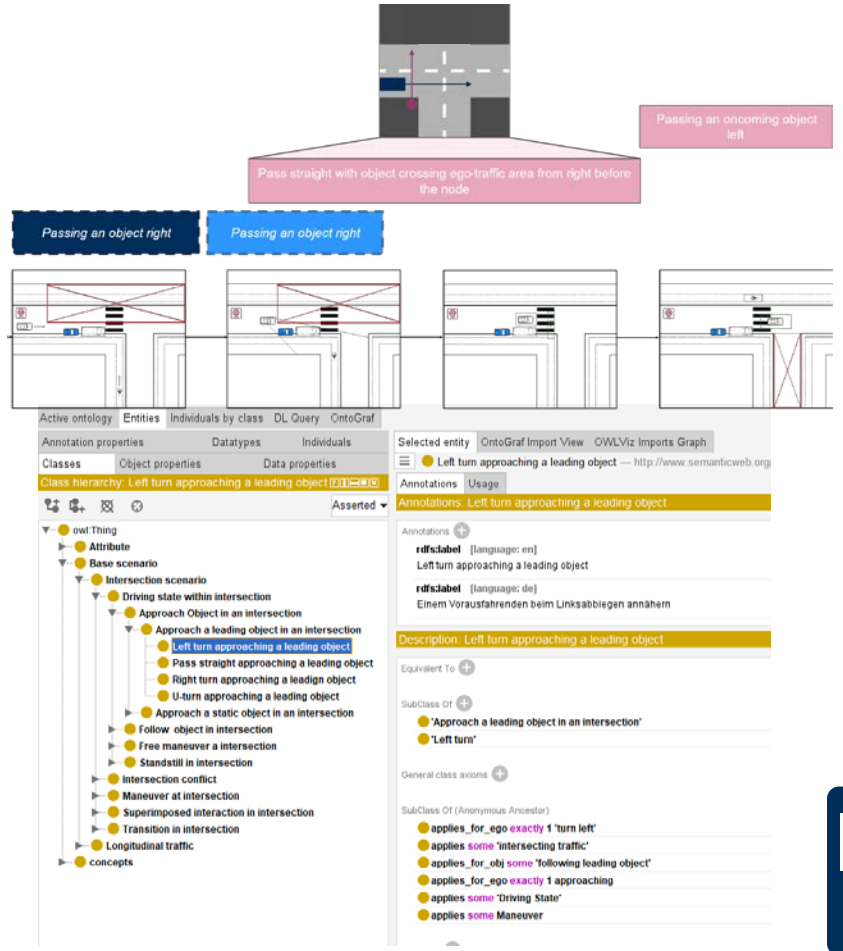
- Goal: Enable granular search beyond scenario definition
- Abstract ex-post description from the perspective of an entity (ego)
  - Complete trajectories are considered known
  - Representation of a “Reference”
- Abstraction of time series as a sequence of events (storyboard)
  - Occlusion (entering the field of vision of ego)
  - Passing of object
  - lane change
  - …





Scenario Identification and Attribute Calculation

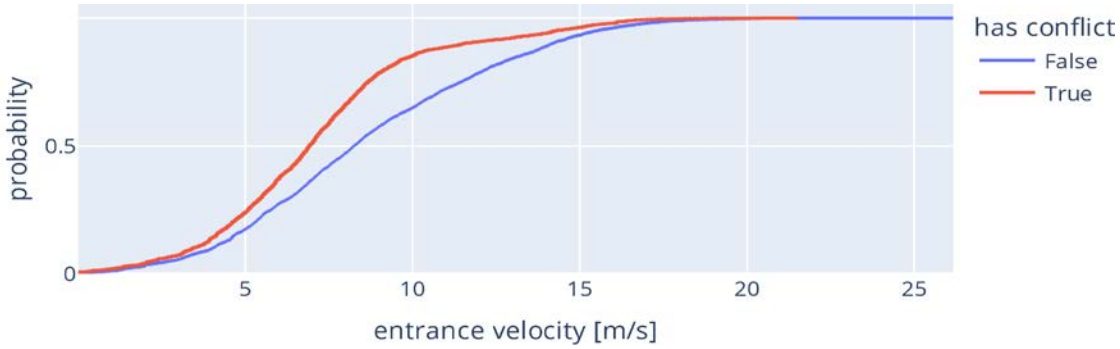
- Explicit Knowledge
  - 6-Layer Model
  - The Automotive Urban Traffic Ontology
  - Holistic Urban Driving Scenario Ontology
- Identify Scenarios and their Parameters
- Attributes:
  - Infrastructure Abstraction
  - Metrics
    - Occlusion
    - TTC, THW, PET, …
    - Dynamics Statistics

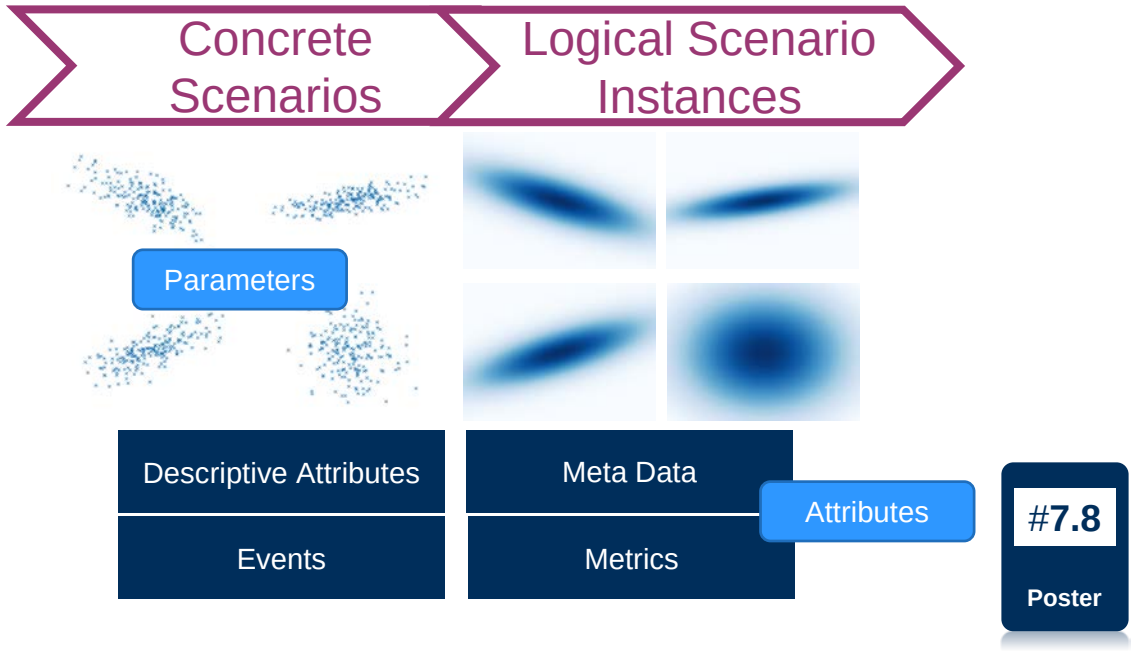


#5.5
Poster

Scenario Database – Understand the Data

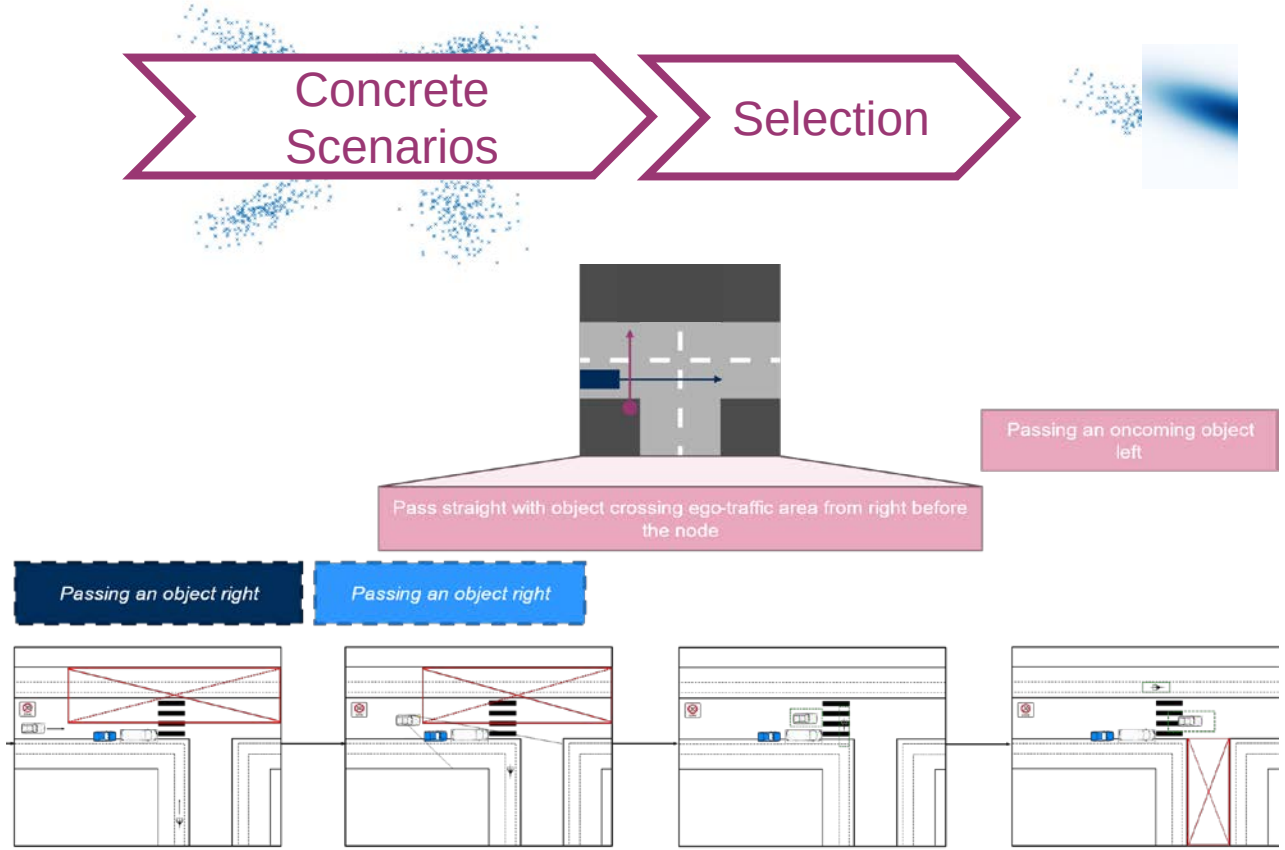
- Collection of concrete scenario
  - Logical scenarios with distributions
- Analyze available data
  - Estimating Occurrence Probability
  - Distribution of interaction partners
  - Parameter Distributions
  - …





Selection of Subset of ODD – Database Filtering

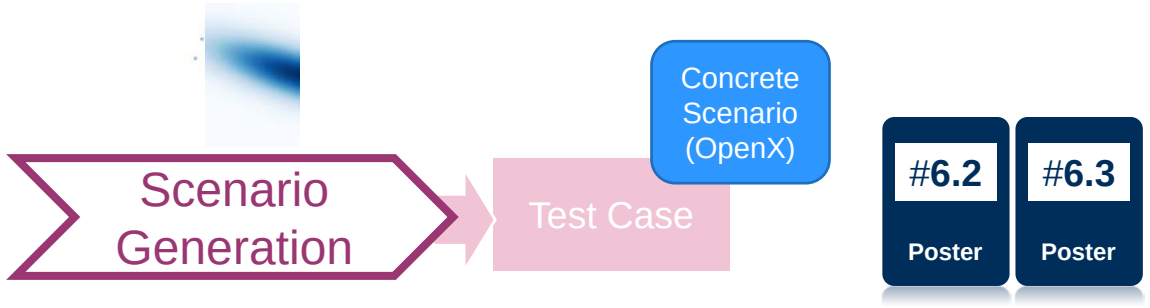
- Fine-grained selection of scenarios
- Based on Attributes and Parameters
- Type of Base Scenario
- Parameter Range
  - TTC range
  - Precipitation
  - Number of intersection arms
- Sequence of Scenarios
  - Define Sequence through query graph



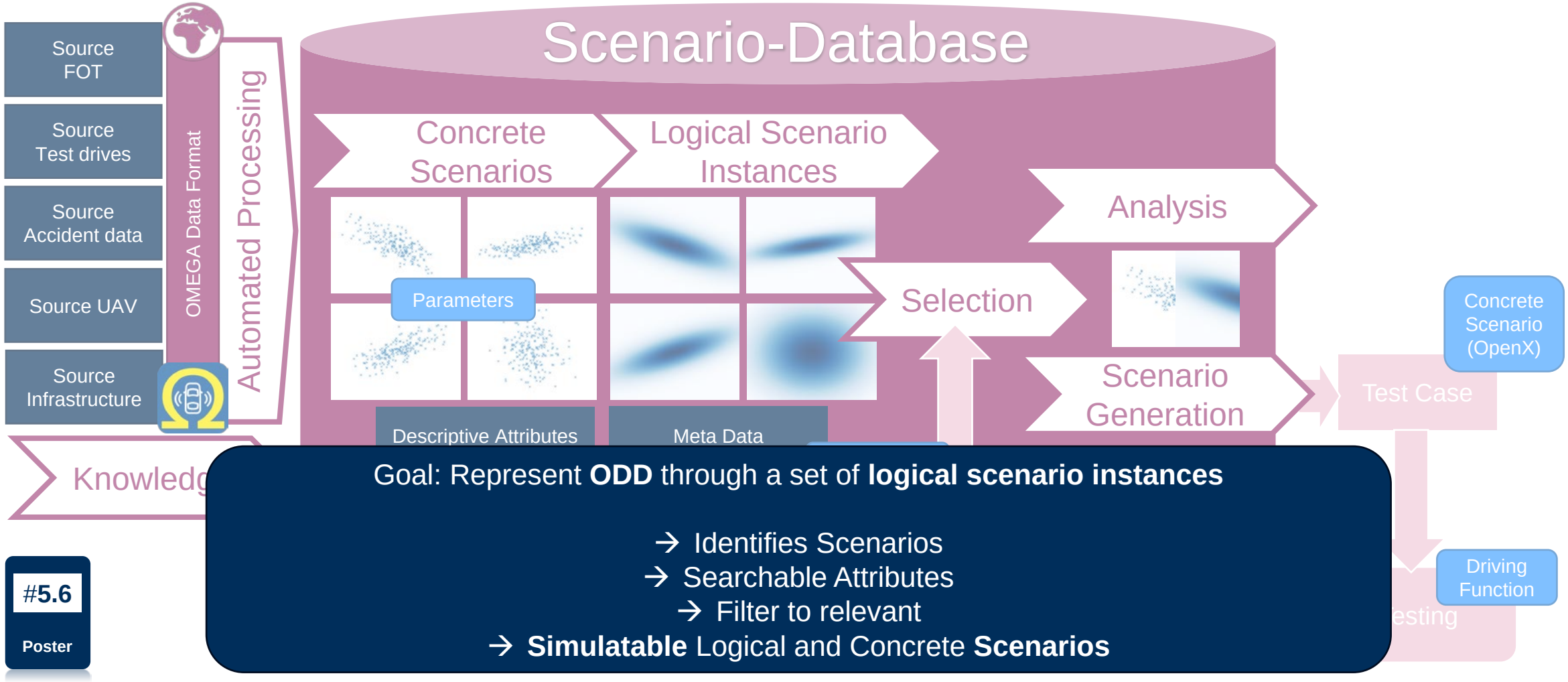
Simulation

- Acquire concrete scenarios from logical scenario instances
- Directly use concrete scenarios

- Different Levels of Abstraction
  - Replay to Sim
  - Advanced Replay to Sim
  - Base Scenario
  - Combined Scenarios (Sequence of Base Scenarios)
- Target Output: ASAM OpenSCENARIO/DRIVE
  - OpenPASS
  - esmini



Scenario Databases



VERIFICATION
VALIDATION
METHODS

Thank you!

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PROJECT of the PEGASUS FAMILY

VDA LEITINITIATIVE

A project developed by the VDA Leitinitiative
autonomous and connected driving

Supported by:

Federal Ministry
for Economic Affairs
and Climate Action

on the basis of a decision
by the German Bundestag

Relevant contributions

[1] M. Scholtes, L. Westhofen, L. Turner, K. Lotto, M. Schuldes, H. Weber, N. Wagener, C. Neurohr, M. Bollmann, F. Körte, J. Hiller, M. Hoss, J. Bock, and L. Eckstein „6-Layer Model for a Structured Description and Categorization of Urban Traffic and Environment“, IEEE Access, 2021.

[2] H. Weber, C. Glasmacher, M. Schuldes, N. Wagener, and L. Eckstein „Holistic Driving Scenario Concept for Urban Traffic“, IEEE Intelligent Vehicles Symposium, 2023.

[3] C. Glasmacher, H. Weber, M. Schuldes, N. Wagener, and L. Eckstein „Generation of Concrete Parameters from Logical Urban Driving Scenarios Based on Hybrid Graphs“, VEHITS, 2023.

[4] C. Glasmacher, M. Schuldes, H. Weber, N. Wagener, and L. Eckstein „Acquire Driving Scenarios Efficiently: A Framework for Prospective Assessment of Cost-Optimal Scenario Acquisition“, IEEE Intelligent Transportation Systems Conference, 2023.

[5] M. Scholtes, M.Schuldes, H. Weber, N. Wagener, M. Hoss and L.Eckstein „OMEGAFormat: A Comprehensive Format of Traffic Recordings for Scenario Extraction“, Uni-DAS FAS Workshop, 2022.