

ASAM OpenX Overview

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North America



The OpenX portfolio so far...

OpenSCENARIO

- Dynamic scene description

OpenDRIVE

- Static road network

OpenCRG

- Detailed Road surface description

Open Simulation Interface

- Interface for environmental perception of AD functions

OpenLABEL

- Labels and labelling format for objects & scenarios

OpenODD

- ODD definition format

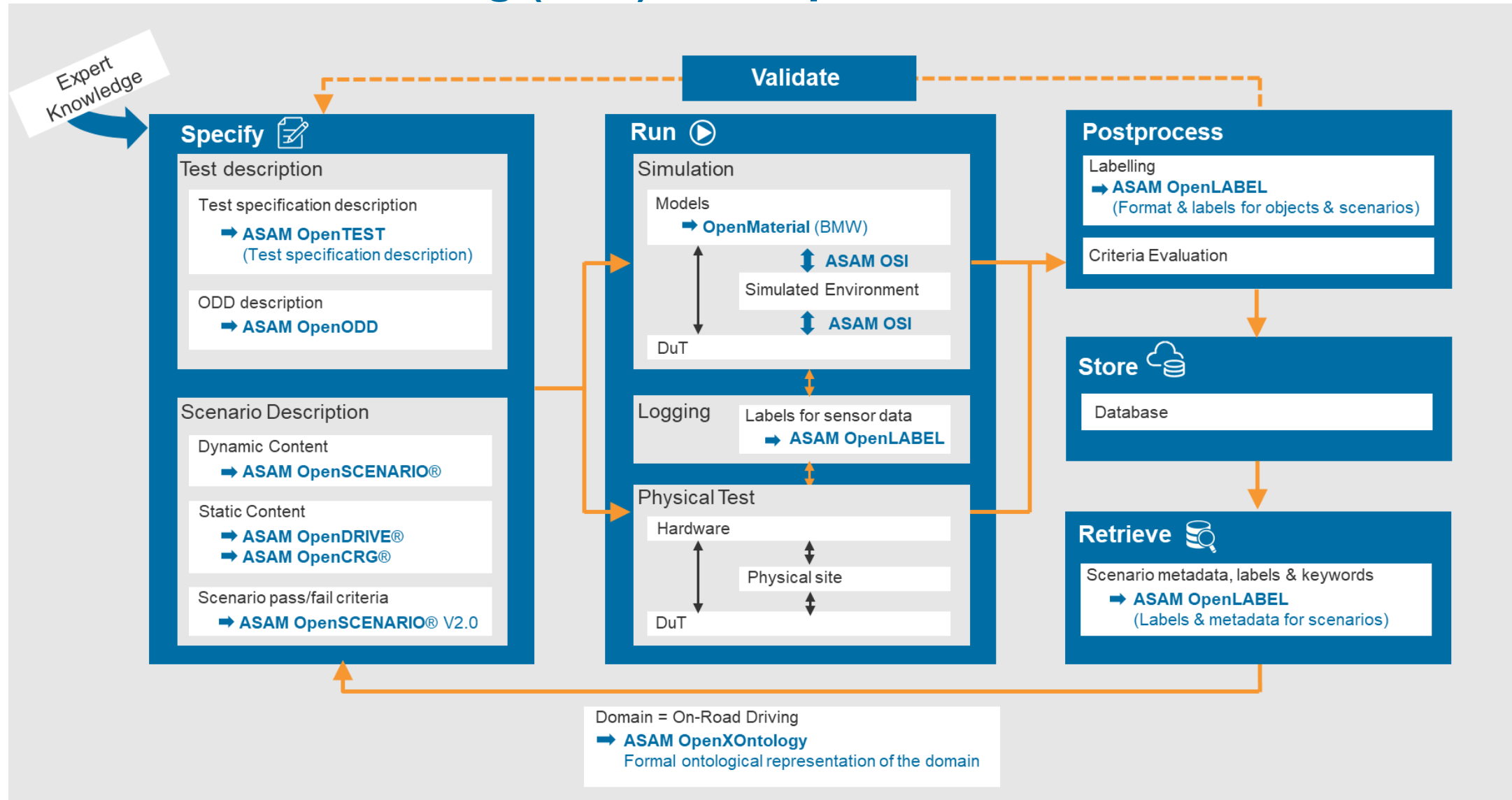
OpenXOntology

- Extendable domain ontology for on road driving

[OpenTest]

- TBD...

Scenario-Based Testing (SBT) with OpenX



Latest project developments...

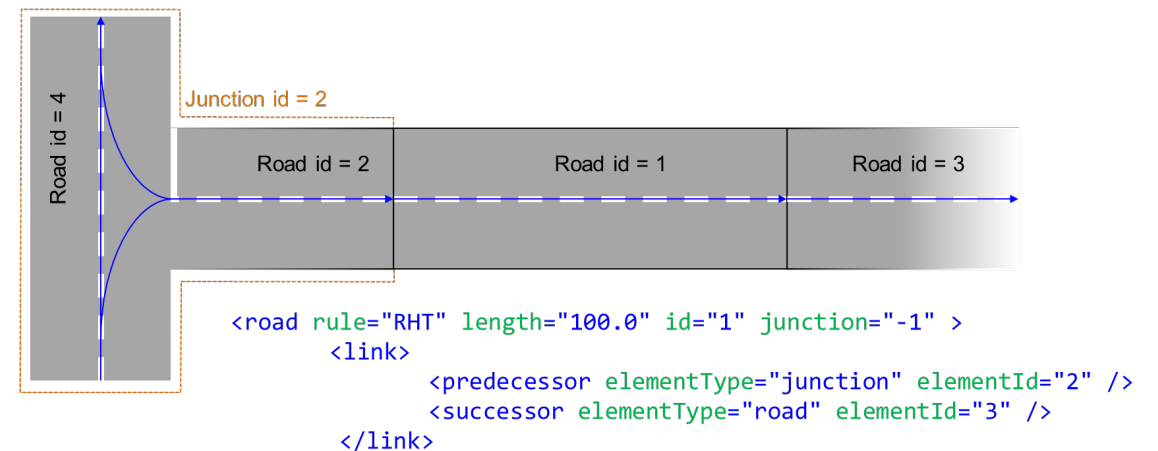
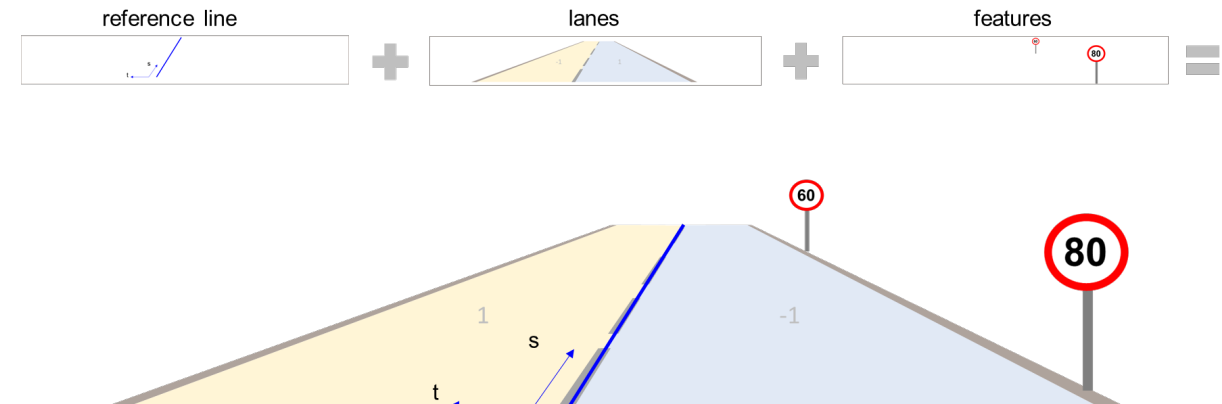
1. OpenDRIVE
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9. OpenTest...

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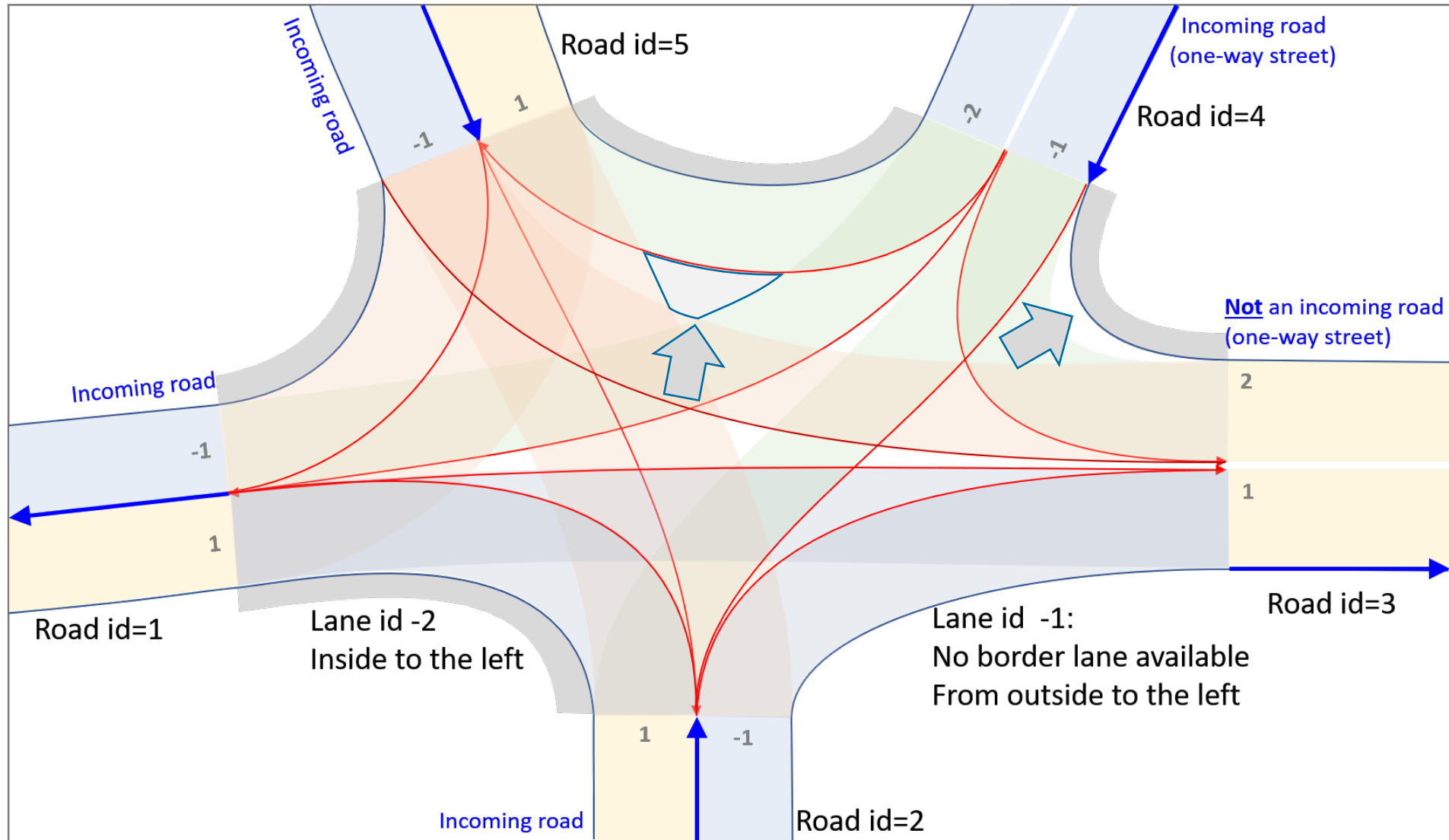
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ASAM OpenDRIVE

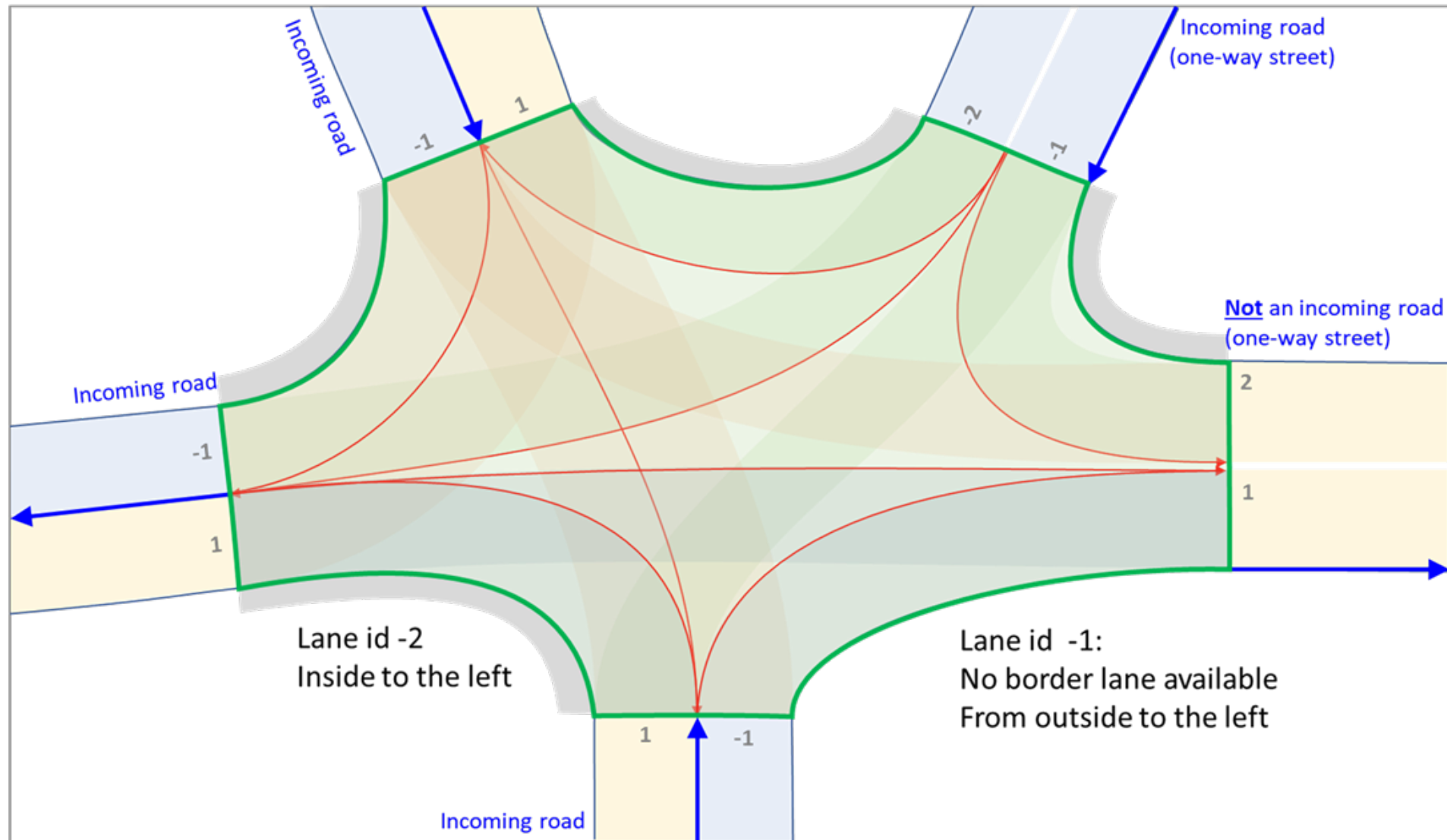
- OpenDRIVE: Open Dynamic Road Information for Vehicle Environment
- File format for the **description of road networks**.
- Used for simulators in the area of
 - Drive simulation
 - Traffic simulation
 - Sensor simulation
- Based upon XML and a hierarchical data model.
- Basic elements:
 - Roads
 - Junctions
 - Controller
- Not covered: entities acting on or interacting with the road network.



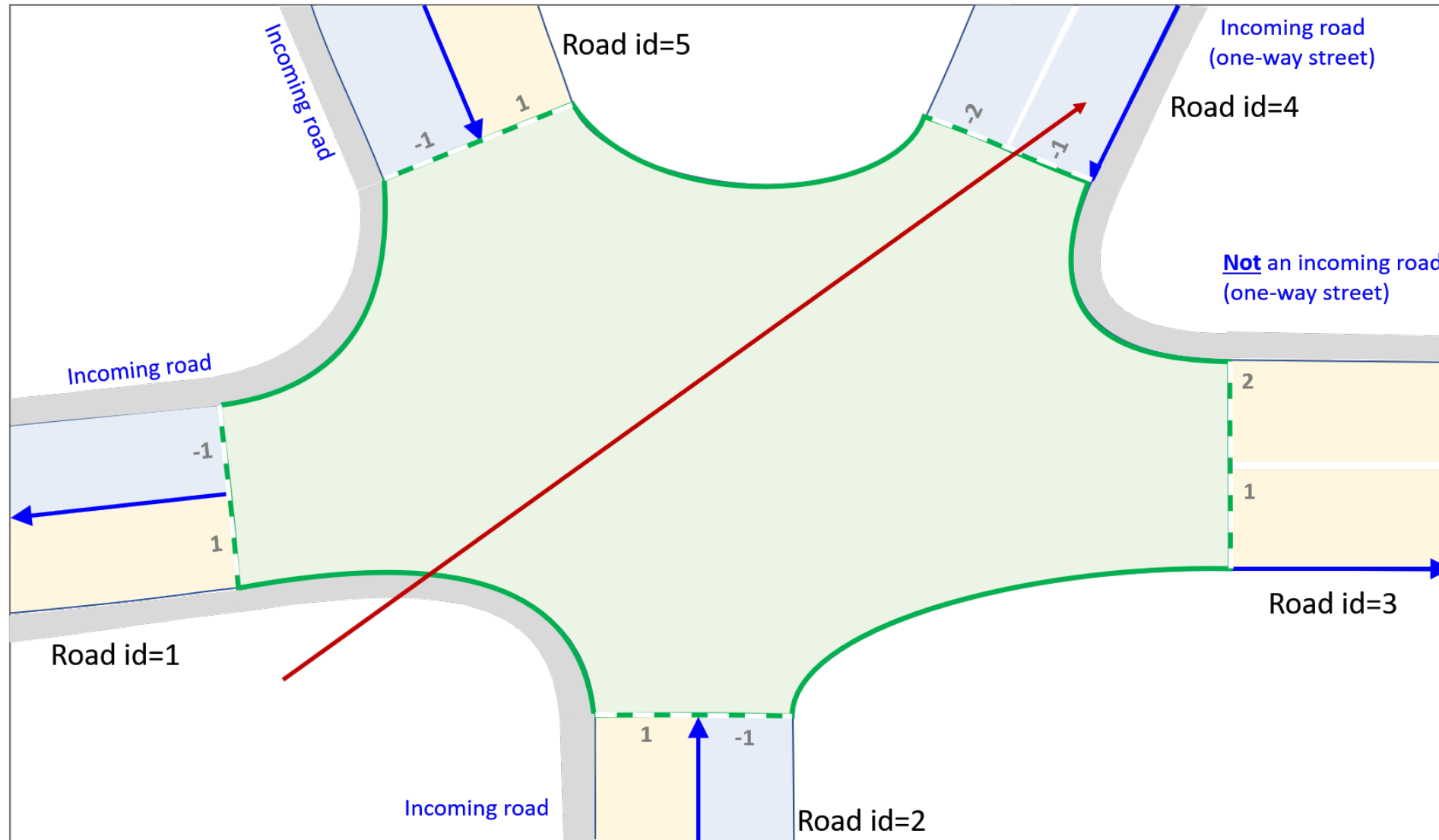
OpenDRIVE: Junction Modeling



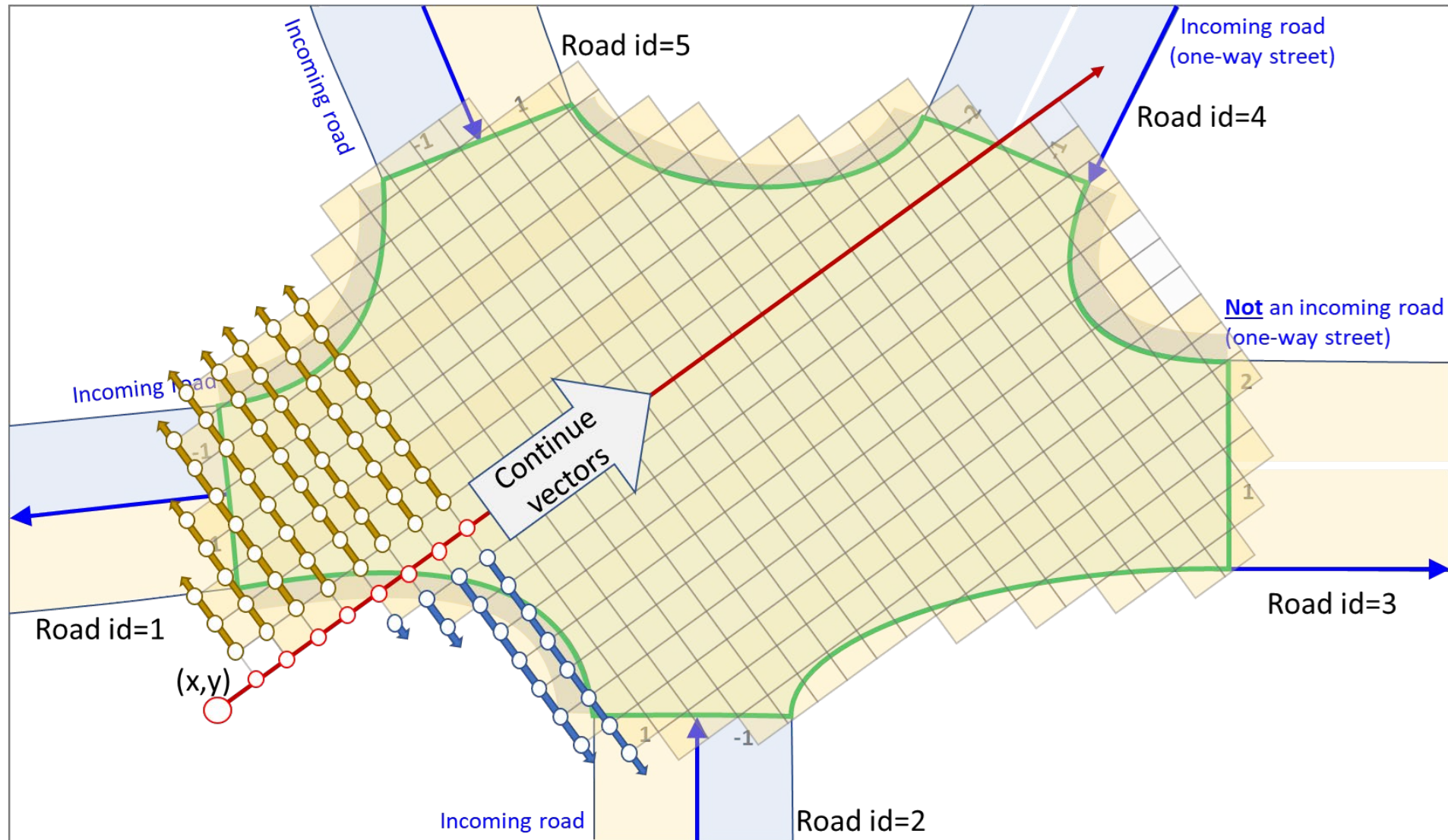
OpenDRIVE Concept: Junction Border



OpenDRIVE Concept: Junction Road



OpenDRIVE Concept: Junction Grid



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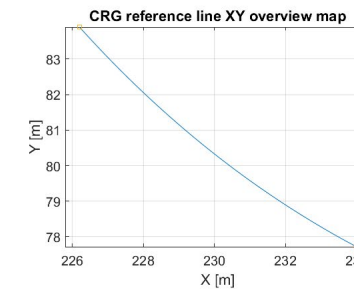
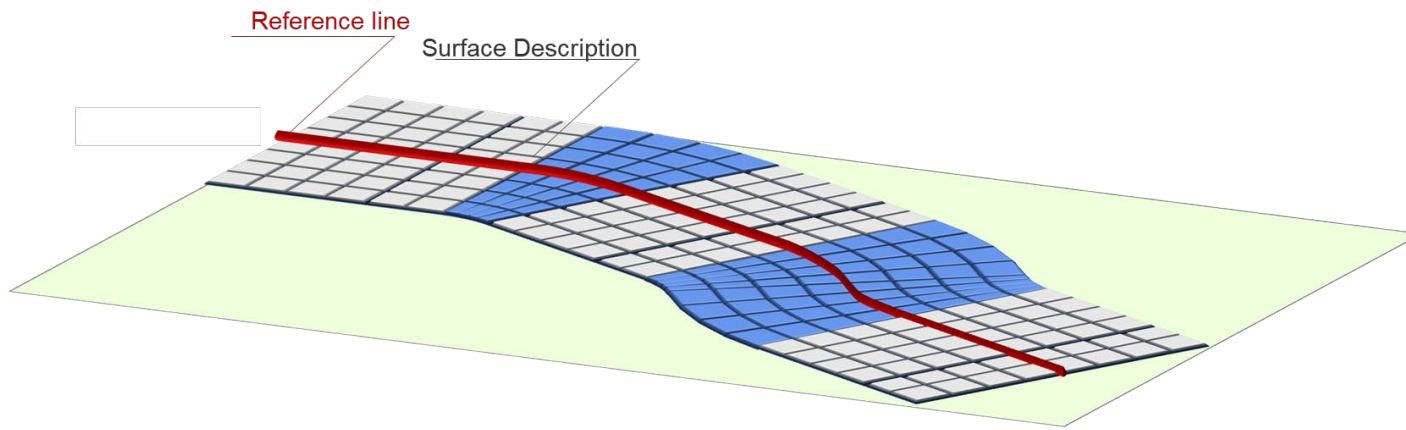
Introduction to OpenCRG

OpenCRG

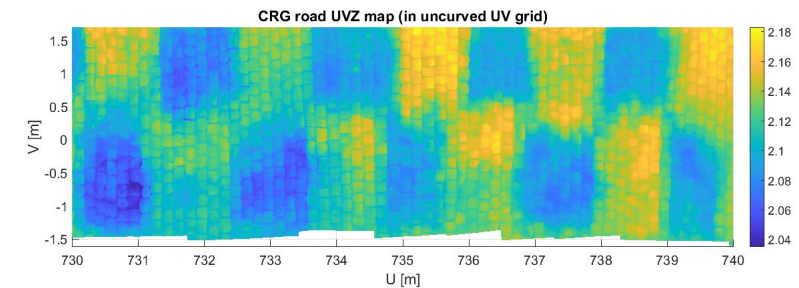
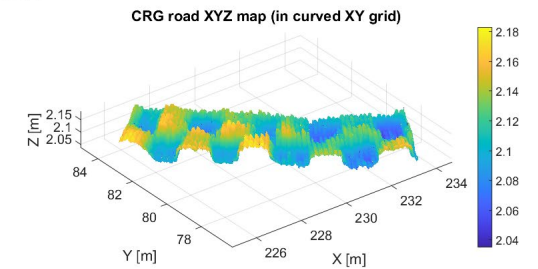
- CRG = "Curved Regular Grid,,
 - Developed by Daimler AG
 - open source C-API for data handling and evaluation
 - open source MATLAB® API for data manipulation and generation

Usage

- Vehicle dynamics
- Tire simulation
- Driving simulation (Combination with OpenDRIVE !)
- Vibration simulation



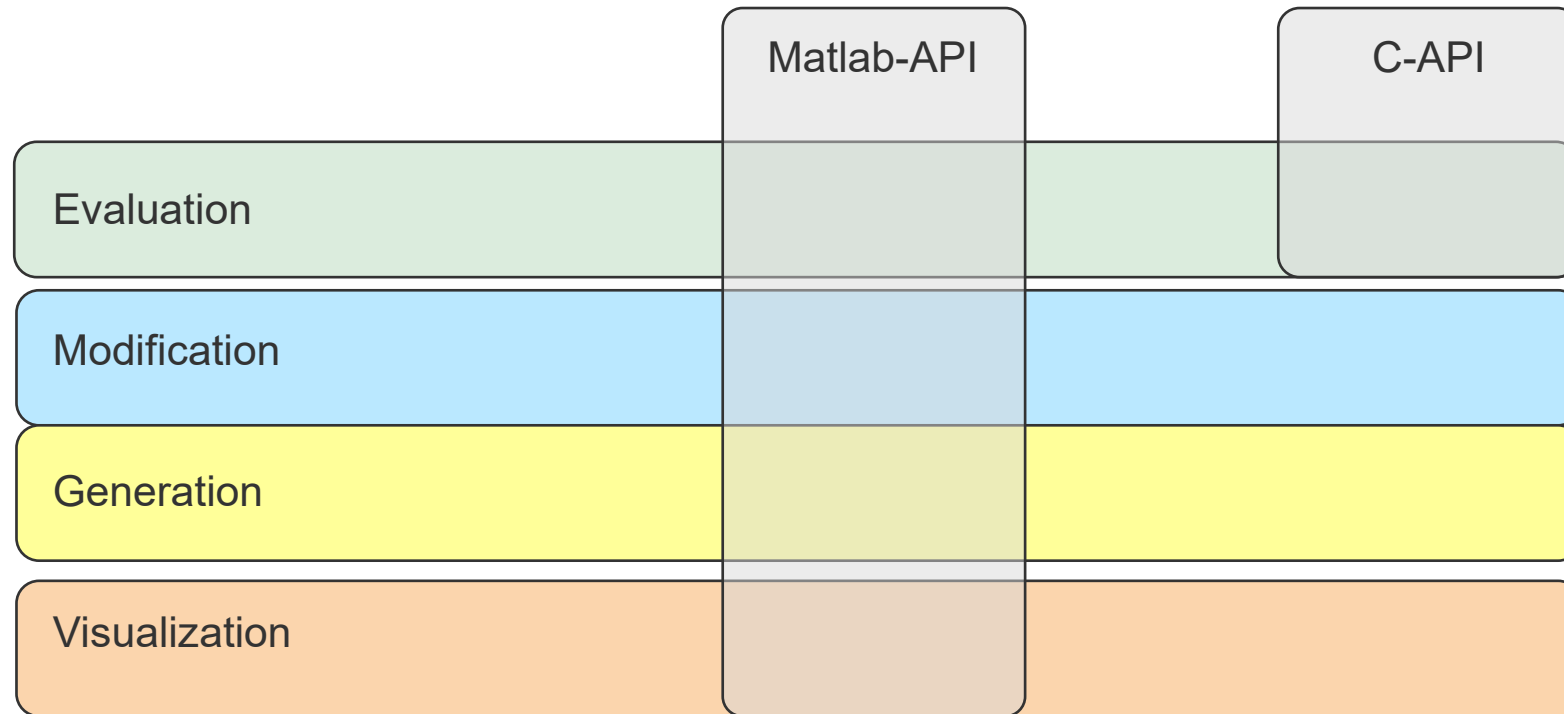
CRG road surface



belgian_block-txt-double.org

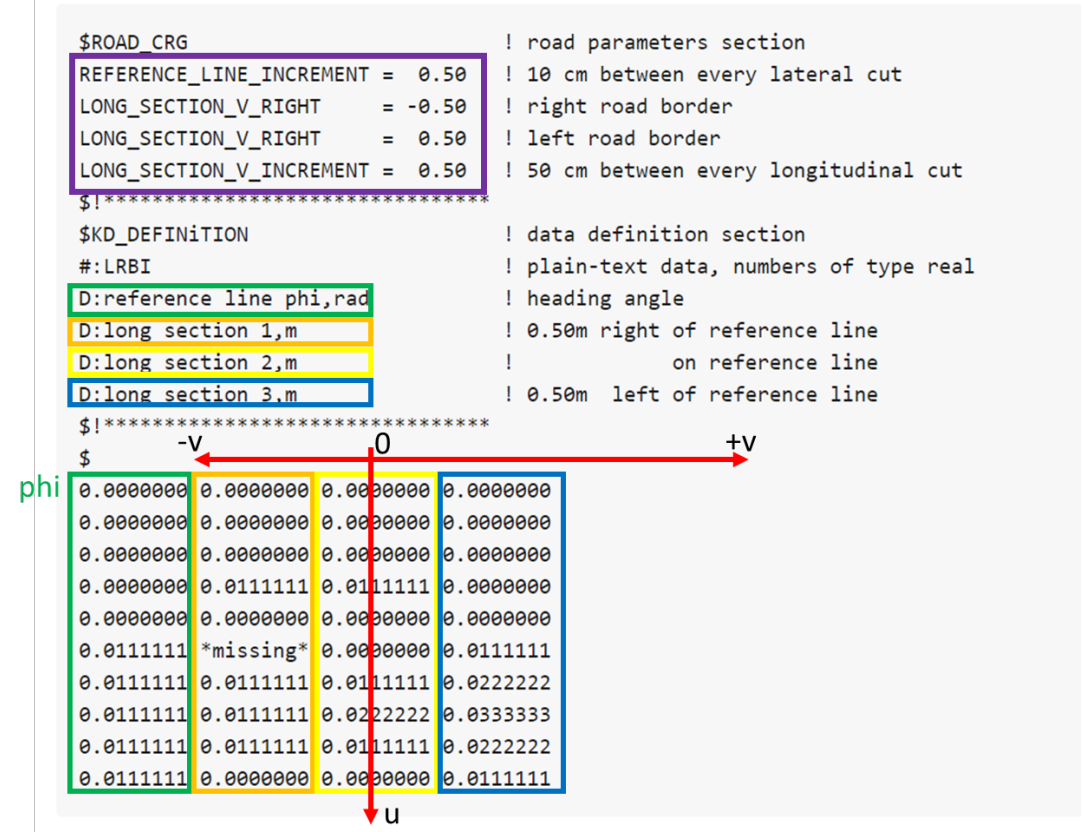
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ASAM OpenCRG: Matlab API, C-API



File Format OpenCRG

- The OpenCRG File Format looks like the following:
- The dimensions of the sections is defined on the top
- Options for the road sections are defined in the green box
 - heading
 - Banking
- Each long section has an individual column



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OpenSCENARIO V1.x

- V1.1 Releasing in March 2021
- Significant extensions and clarifications in user guide based on feedback
- Very active discussion and collaboration on issues
- > 100 issues under active discussion!

```
<parameter name="$x0" unit="m" type="continuous">  
  <distribution>  
    <uniformDistribution lowerLimit="-2" upperLimit="2"/>  
  </distribution>  
</parameter>
```

Early concept of parameters in OSC 1.1

- Some highlights:
 - Runtime clarifications
 - Interactions between an Action, an Entity and a Controller.
 - Parameters, distributions & expressions
 - Deterministic & statistical distributions (e.g. normal, poisson, uniform, lists, etc.)

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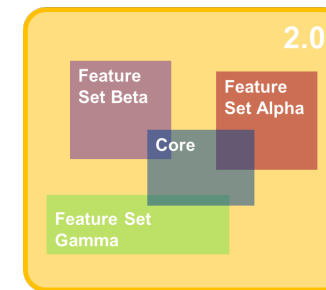
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OpenSCENARIO 2.0

- V2.0 Releasing Summer 2021
- DSL for scenario descriptions (concrete <-> abstract)
- Domain Model for the domain addressed by the DSL → closed-loop system testing for automotive functions
- Guidelines on using OpenSCENARIO 2.0 in different scenario-driven workflows
- Fully compatible with V1.x versions
→ “The runtime behavior of scenarios converted from 1.x to 2.0 will be the same”

OpenSCENARIO 2.0 – Feature Subsets

- Implementation of a new standard with such a large scope is not instantaneous
→ Iterative support in existing tooling
- See e.g. OSC 1.0
- Modular language support through feature subsets
- Allow for **clearly delineated, partial** support for the specification



Feature subsets in OSC 2.0

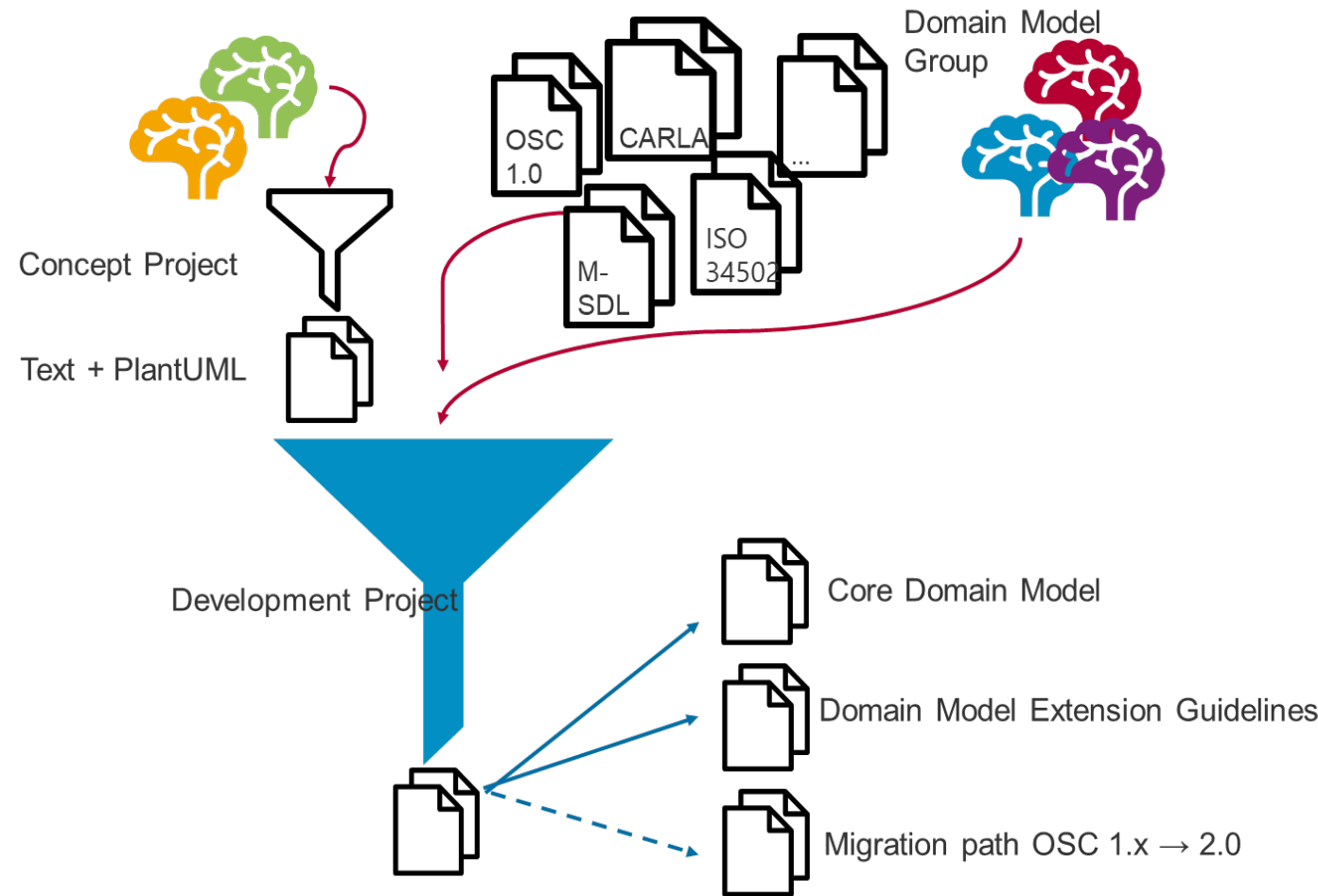
Source: OSC 2.0 Project meeting
(Michael Kluge)

OpenSCENARIO 2.0 – Ensuring a shared Understanding

- Implementer Forum
 - Goal: ensure a shared understanding of how the language is used to describe scenarios as it develops
 - Define a set of benchmark/reference scenarios
 - Members of the forum describe a set of reference scenarios based on their understanding of the current draft of the OSC 2.0 language.
- Clearly defined, high-level workflows that use OpenSCENARIO 2.0, some examples currently in progress:
 - Creation of a Specification Scenario
 - Discussion with Stakeholders
 - Executing a scenario in a simulation toolchain
 - Test Automation using logical files
 - Scenario-based Testing using OpenSCENARIO
 - Currently a set of 9 workflows that demonstrate the different approaches to testing in use in the industry

OpenSCENARIO 2.0 – Domain Model

- OpenSCENARIO targets the **domain of closed-loop system testing for automotive functions**.
- A domain model provides the semantics for the **terms that are used in the Language component** of OSC 2.0”
- Entities are “actual things in the domain. These can be activities, events, conditions and information, as well as physical objects”
- **Goal: clear and unambiguous definitions of all key entities,**



A unifying approach to defining a domain model for OSC 2.0

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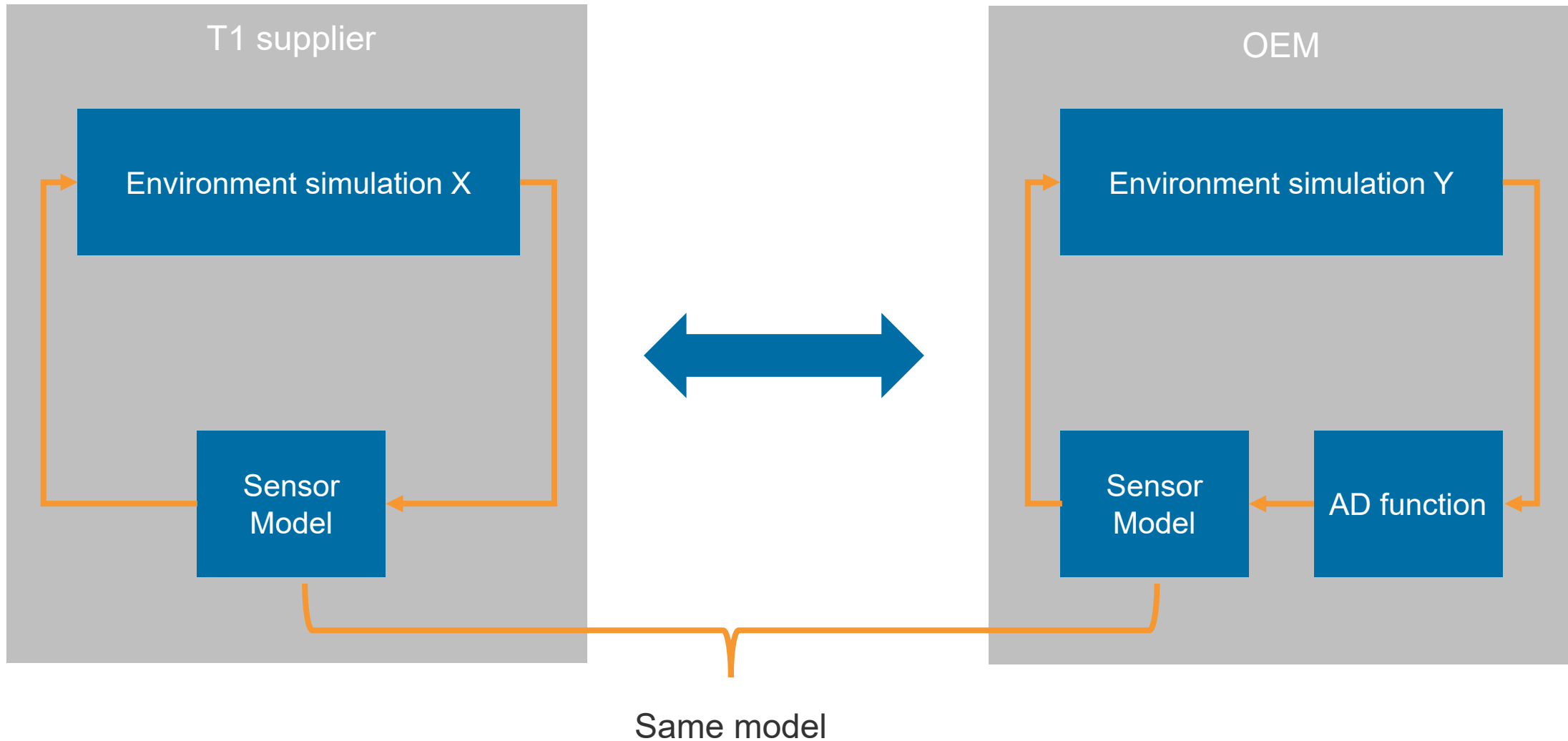
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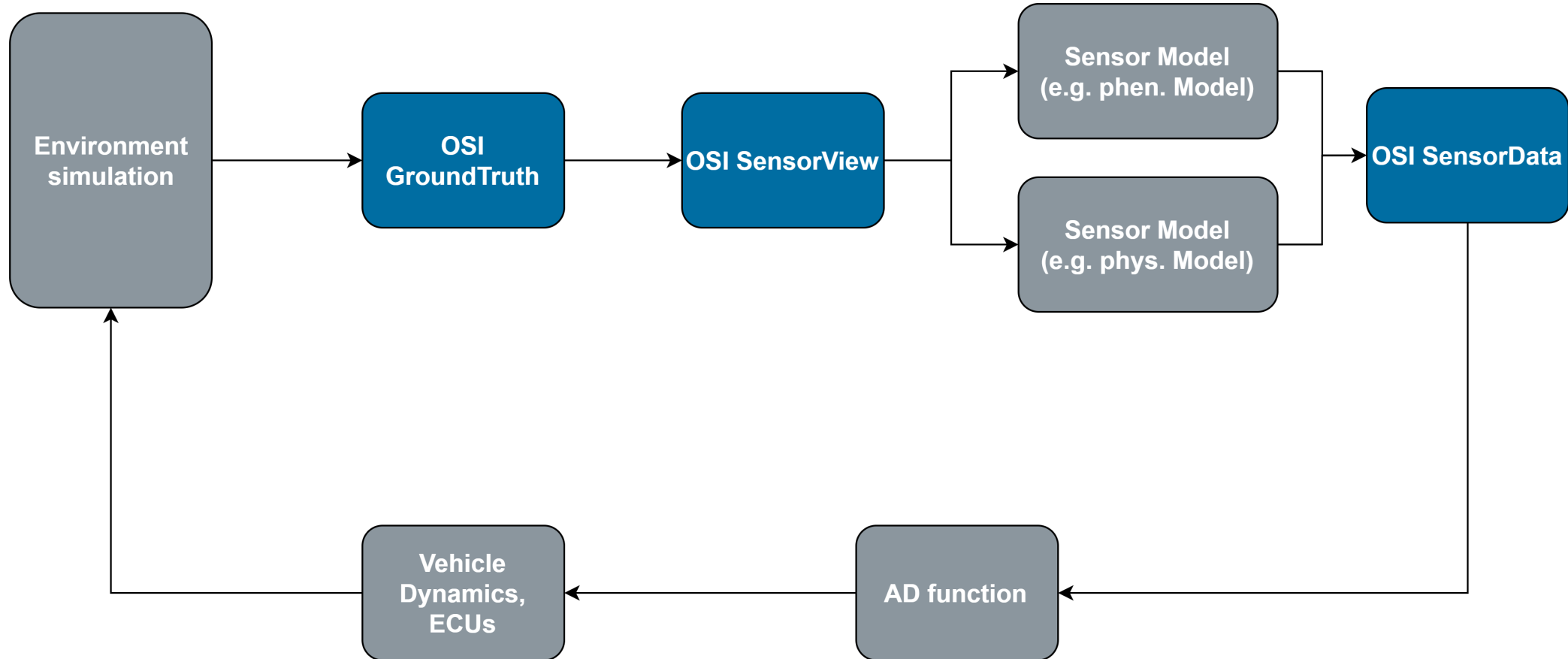
What is OSI

- OSI: Open Simulation Interface
- An interface (messaging format) for the environment perception of automated driving functions in virtual scenarios
- ASAM's first completely open source standard → Includes open source development! (MPL 2.0 License)
- <https://github.com/OpenSimulationInterface>

Original Motivation

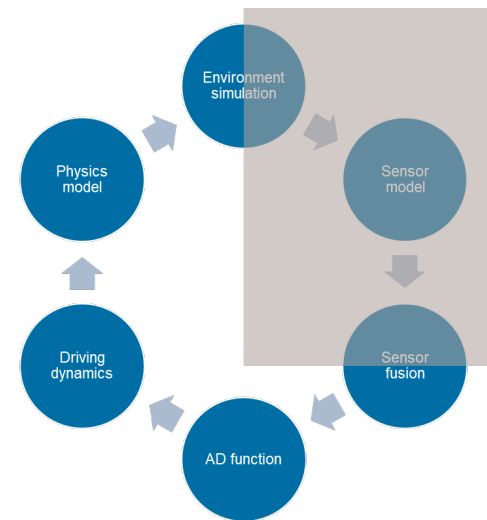


The OSI Logical Flow

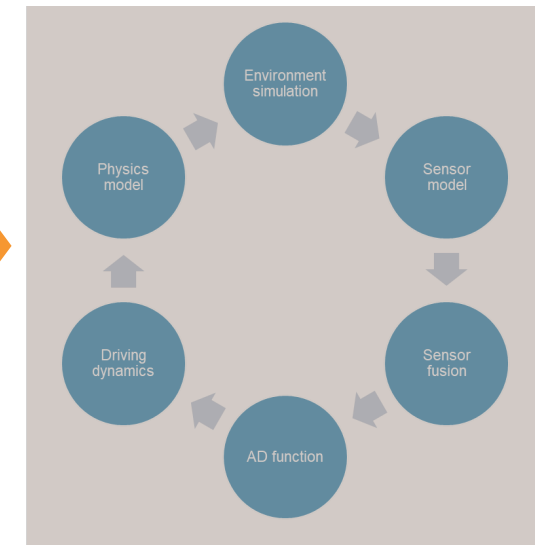


OSI: Looking Forward

- Support for more detailed sensor models → Stochastic & physics based sensor models
- More interfaces, e.g. for:
 - Individual traffic participants
 - Driving simulator frameworks
 - Agent models (e.g. driver model)
- V2X communication
- Increased performance for real time simulation – Google Flatbuffer, data traffic reduction, delta encoding
- OpenX ID management - uniform and unique ID management for all OpenX standards



Current scope



Scope for 2021...

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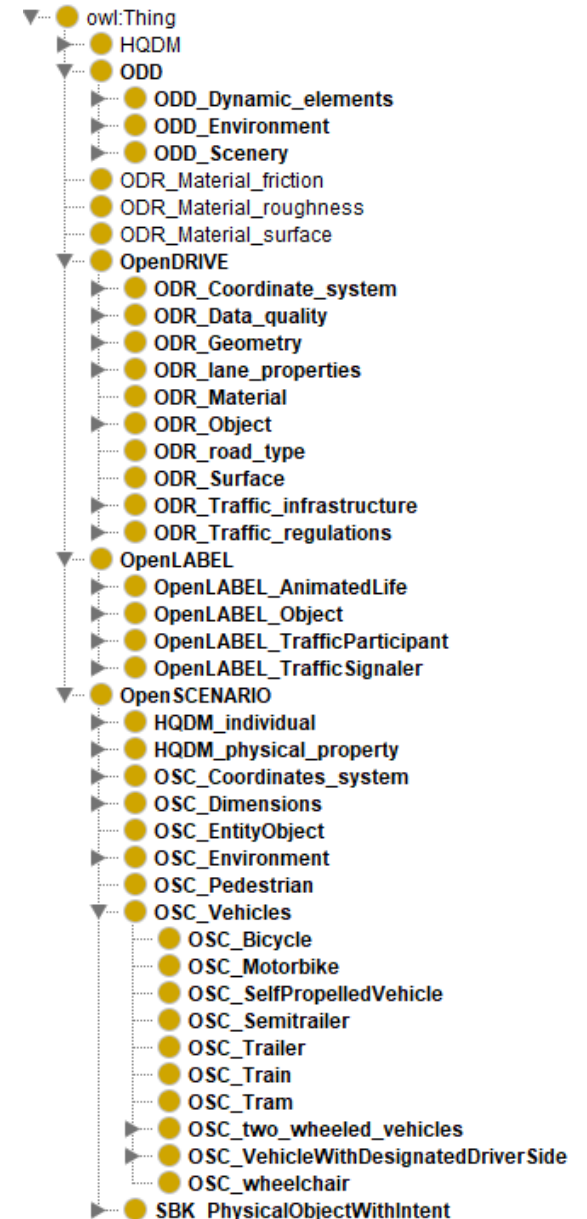
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OpenXOntology

- First version will cover domain addressed by OpenX standards
- Minimal working example of ontology to be released for public review by Q1 2021
- Includes:
 - Guidelines on usage with other OpenX standards, e.g.:
 - Using the ontology to check OpenSCENARIO scenario descriptions
 - Using the ontology for object labels in OpenLabel
 - Extension guidelines – how to extend the ontology

Current status:

- Transferring domain content from OSC, OpenLabel, OpenDRIVE & OSI
- HQDM standard likely to become foundation for ontology structure
- Collaboration with OSC 2 Ontology WG – Identifying use cases for an ontology in OSC 2.0
→ Checking scenario descriptions



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ASAM OpenLABEL

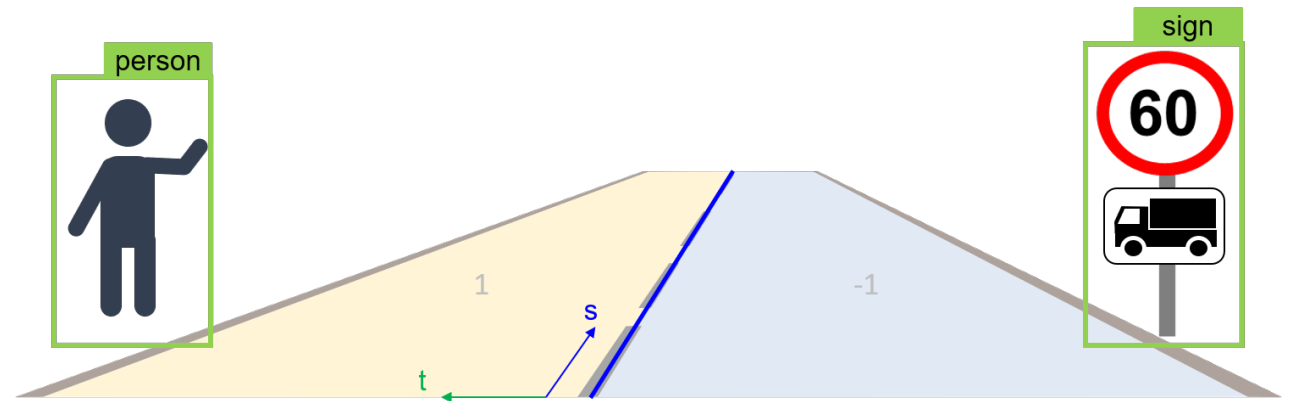
new Standard initiative

The ASAM OpenLABEL Concept Project will provide the basis for the Standard development of OpenLABEL 1.0.

Focus on the HOW to label → Labeling formats for objects of interest and scenario data

The project is divided into 4 work packages:

1. Annotation Format
2. Labeling Methods
3. Taxonomy -> linked to OpenXOntology
4. Scenario Labels



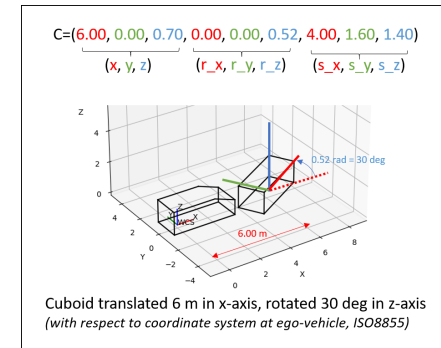
Concept paper releasing November 2020
Standard development project starting Dec. 2020

ASAM OpenLabel

WP1: Annotation Format

```
1 {  
2   "openlabel": {  
3     "metadata": {  
4       "annotator": "John Smith",  
5       "file_version": "0.1.0",  
6       "schema_version": "1.0.0",  
7       "comment": "Annotation file produced manually",  
8     }  
9   }  
10 }
```

WP2: Labeling Methods

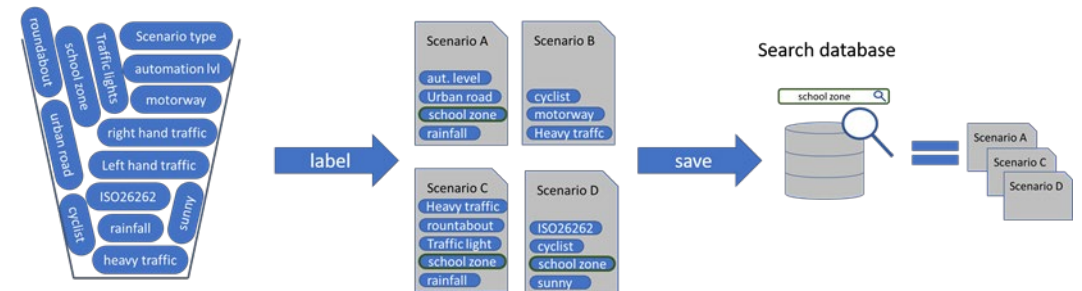


WP3: Taxonomy



The elements of the taxonomy shall be used as labels within OpenLABEL. The Taxonomy can be found within the OpenXOntology

WP4: Scenario Labeling



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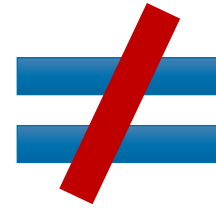
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OpenODD

- Concept Project started on 9th September 2020
- Runs until August 2021
- Standardized format for definition of Operational Design Domains (ODDs)
- [Proposal link](#)
- Deliverables include:
 - Attributes for ODD definition
 - KPIs for determining whether a scenario, actor or action is within a given ODD
 - Investigation into using ODDs for safety analysis (uncertainty, rare risks, etc.)
 - Usage guide

Why is ODD important?

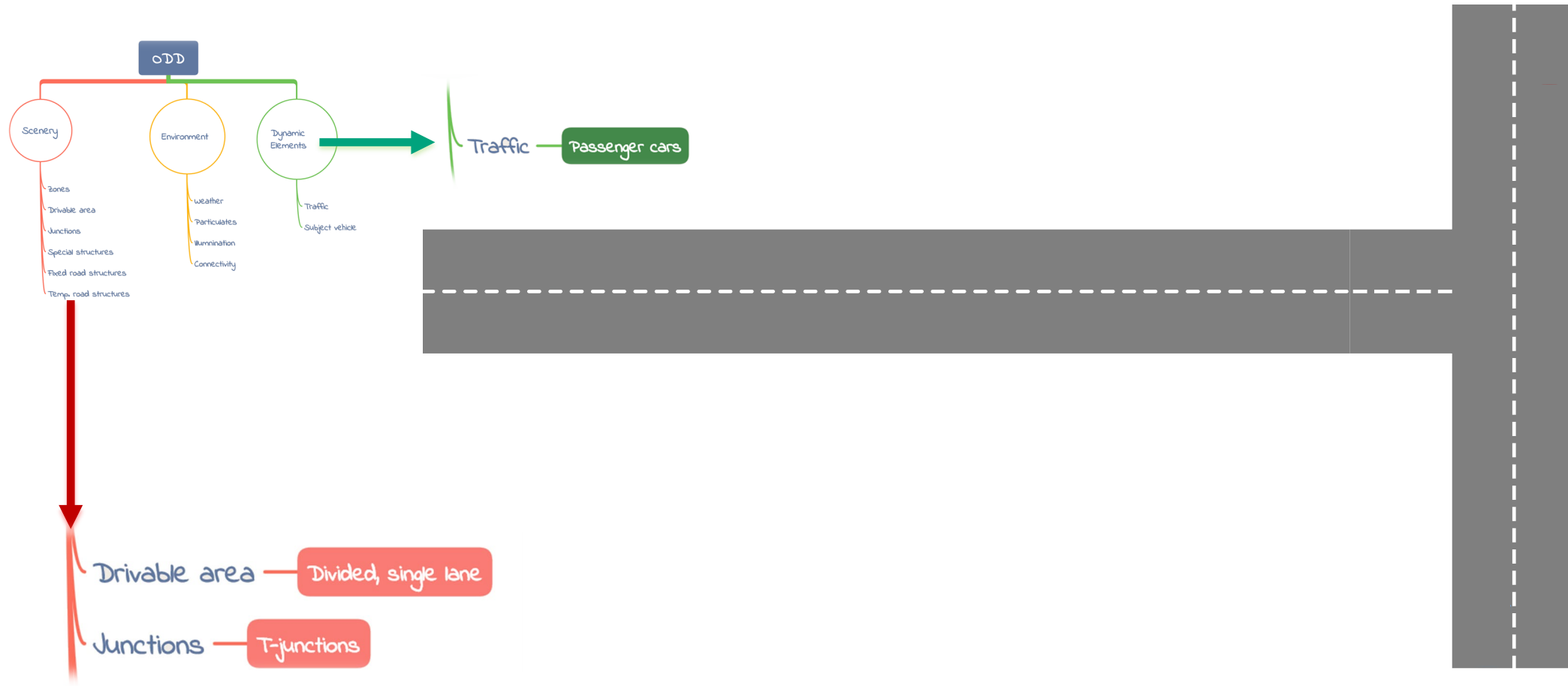


Operational Design Domain

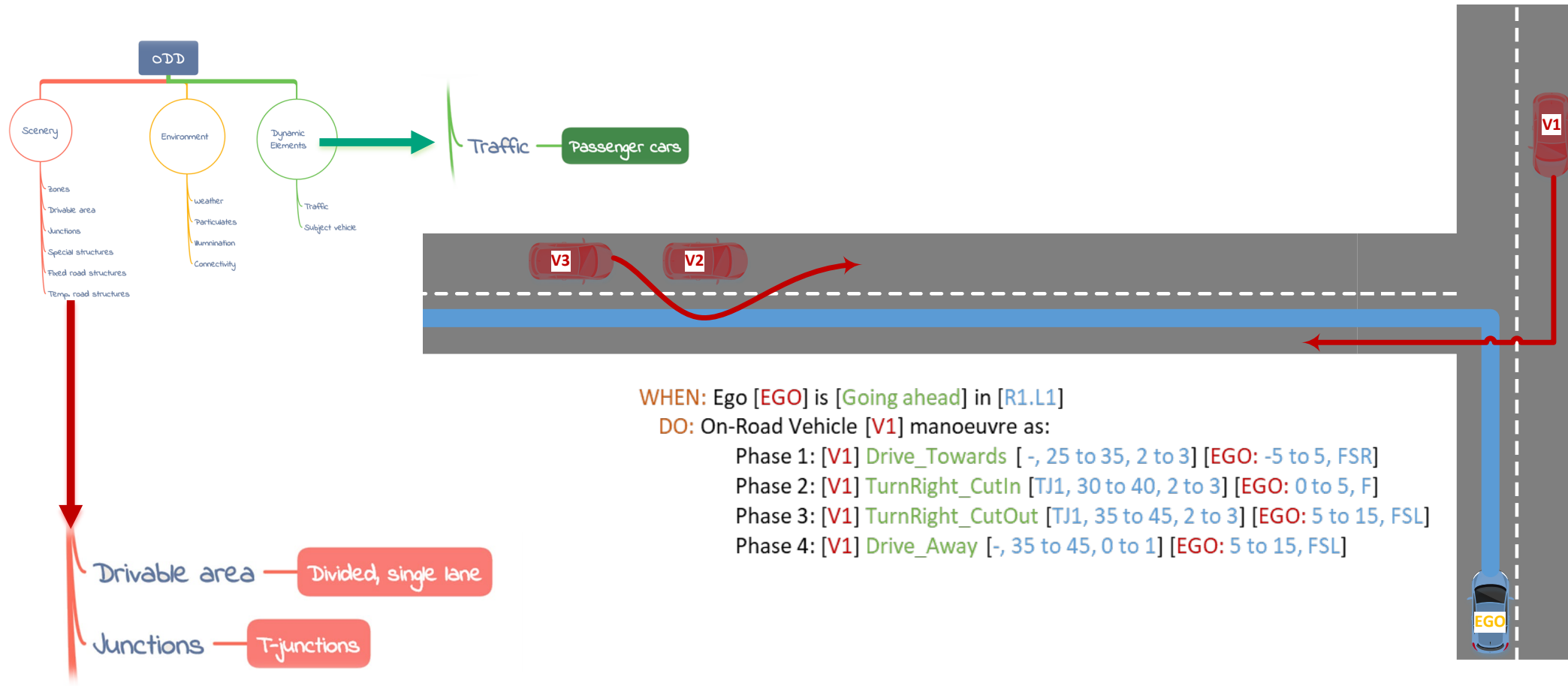
“Operating conditions under which a given driving automation system or feature thereof is specifically designed to function, including, but not limited to, environmental, geographical, and time-of-day restrictions, and/or the requisite presence or absence of certain traffic or roadway characteristics.”

- SAE J3016 (2018)

Scenario mapping to ODD



Scenario mapping to ODD



Other standardisation activities

- Need for common understanding
- Need for collaboration
- Crowded landscape

Major activities

- BSI (UK): PAS 1883: ODD Taxonomy
- SAE: ORAD, AVSC: ODD Lexicon
- ISO: ISO 34503: ODD Taxonomy and definition format
- ASAM: OPENODD: simulation level ODD definition



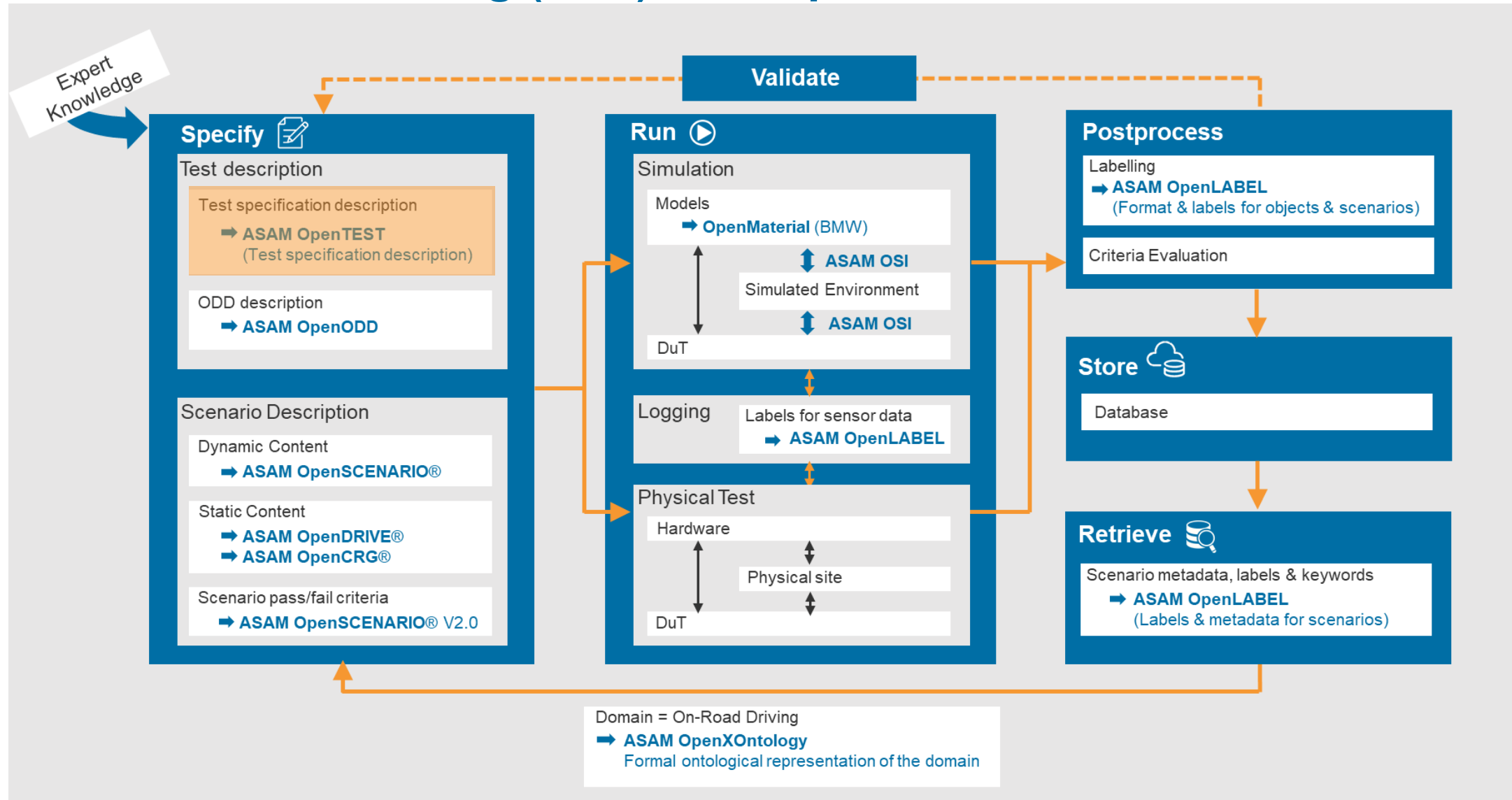
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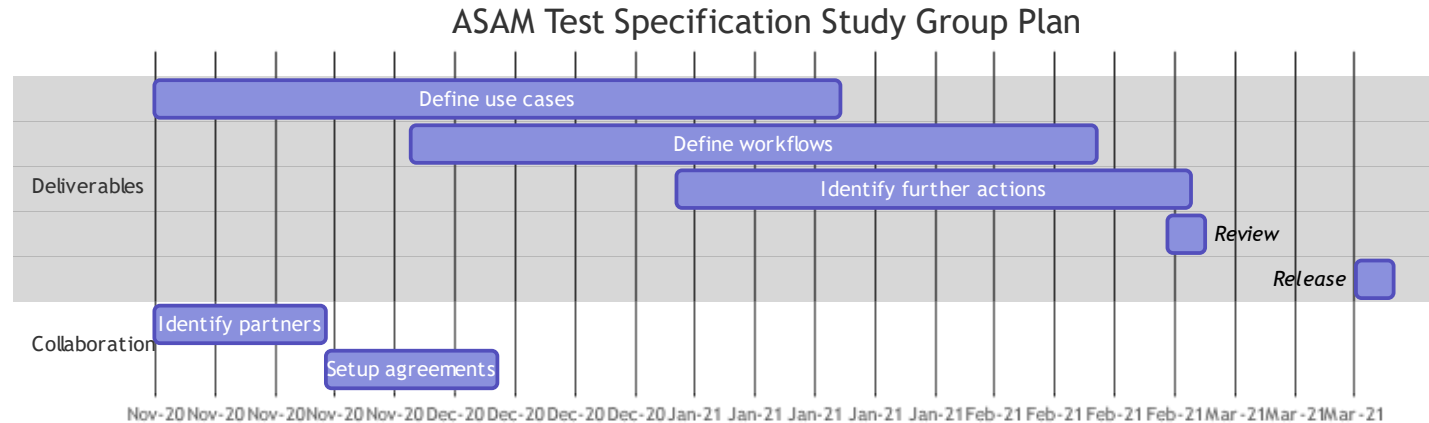
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Scenario-Based Testing (SBT) with OpenX



ASAM OpenTest Specification...



- Study group to analyse the scenario-based testing workflow
 - What is scenario-based testing?
 - Gain a better understanding of the borders between scenario & test
 - Analyse potential alignment with “classical” testing methodologies & standards
- First draft of proposal available ([repository/download](#))
→ Feedback and input welcome!
- Planned deliverables:
 1. Refined Set of Use Cases for Scenario-based Testing
 2. Set of Reference Workflows for Scenario-based Testing
 3. Gap Analysis and Recommendations on Further Actions

Other Developments in OpenX...

Harmonisation across OpenX

- Increasing need for harmonization across the OpenX projects
- Multiple steps taken @ ASAM so far...:
 - **Coordination group** – (Overview presented by Oliver Philipp)
→ high level internal and external alignment, “connect the right people”
 - **Shared project access** (chat channels and issue platform) – allow for quick communication between projects for smaller technical discussions
 - **Shared “OpenX” calendar** – all OpenX meetings open to all participants of an OpenX project
→ Quick access to discussions with other groups on relevant topics
 - **Homogenised workflows** – same workflow & structure across OpenX projects makes it easy to join other project development activities. Joint documentation via simulation wiki

Document Development for OpenX

- All ASAM OpenX Standards are now written using the AsciiDoc format and released as html
- AsciiDoc is a mature, plain-text writing format for authoring documents based on Markdown
- Main advantages:
 - Openable in any text editor
 - Focus on content not on formatting!
 - Versionable and diffable – i.e. we can tell who did what, when and where!
- Modern development platform – Gitlab (repository) and Teams (chat, file sharing, conferencing)
- Docs-as-code approach
- Modern Continuous Integration (CI):
 - Automated compilation of AsciiDoc to html format – instant download of pre-release changes
 - Automated checks:
 - To ensure contributions comply with the format
 - To ensure licensing requirements for contributions are fulfilled (OSI)
 - Commit message format and content
 - Automated changelog management

OpenX Service Providers

- Final voting last week in ASAM TSC
- Cross project alignment supported through SP participation in multiple projects
- SPs passively participating in project meetings to catch up on status
- Coming weeks – kickoff with WG leads and SPs to determine next steps.
- Next topics for ASAM Office to address:
 - Change process for content
 - Shared information architecture across OpenX
 - Improved content alignment across standards
 - Shared document structures & templates

Some closing remarks...

- Standardization enables collaboration and information exchange
 - This only happens if standards are adopted!
 - Conflicting standards from different organizations lead to confusion and lack of adoption
 - Collaboration begins with the standardization organizations
 - More collaboration and alignment amongst standardization bodies worldwide needed...
 - Aligned roadmaps
 - Joint development activities / standards
- What else can we do to assist adoption of these optional, non-regulatory standards?

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Timeline 2020 / 2021

