ASAM – Open Standards
Proposal Workshop ASAM OpenMaterial

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Höhenkirchen

ASAM Association for Standardization of Automation and Measuring Systems

Where do we stand today in our projects?

>400 participants

>200 unique companies

9 Standardisation projects
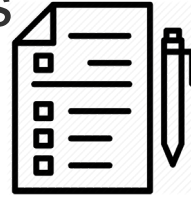
2 Concept projects

1 Study group

3 Proposals being prepared

9 Releases in 2022

1 Ongoing ideation

6 Office employees supporting projects

ASAM

Ongoing standardisation efforts…

SOVD	ODS	OpenSCENARIO
Communication with SDVs	*Test data management*	*Description of dynamic content*

XIL	OTX	OpenDRIVE
Communication between test automation tools and test benches	*Definition of test procedures*	*Description of logical road networks*

OSI	OpenTestSpecification	OpenODD
Interface for the environmental perception of AD functions	*Hollistic test specification*	*Specification of ODDs*

MDF		OpenLabel
Storage of measurement data		*Data structure for labels & tags*

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OpenSCENARIO

OpenSCENARIO Differentiation Statement

ASAM OpenSCENARIO®

OpenSCENARIO 1.x

- XML schema for describing scenarios with synchronized maneuvers of vehicles, pedestrians, and other traffic participants
- Supports specifying precise trajectories with capability to parameterize and vary their properties
- Structured format that can be validated, edited, imported, and exported by simulation tools and content editors
- Tuned to support trigger-action scenario descriptions
- Optimized for simple machine parsing and processing
- Primary use case: predictable highly precise scenarios that may be used with external test specification for V&V

OpenSCENARIO 2.x

- Domain specific programming language for describing test scenarios of synchronized maneuvers of vehicles, pedestrians, other traffic participants and ADS function control
- Supports specifying scenario intent at a higher level of abstraction along with KPIs, checks, & coverage metrics
- Built-in abstract road descriptions
- Designed to enable exploration of scenario/functionality space to identify potential unknowns
- Optimized for composability to maximize scenario reuse
- Designed as V&V programming language
- Enables higher level of automated test generation at scale
- Primary Use case: Large scale V&V

The differentiation between the two standards is by their primary use cases. A primary use case describes the main use case for which the standard is intended and a key consideration behind many design decisions. The primary use case is not exclusive, the standards may be (and are) used for a wide variety of additional use cases, with overlap, but these are not specified here.
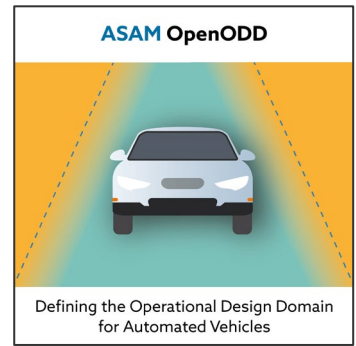
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Roadmap

- The two versions, 1.x. and 2.x, shall be developed as two separate standards, with no formal migration nor convergence required by ASAM.

- Continued alignment of the two standards is encouraged but is subject to project participant interests and is not required by ASAM. This will be driven by the market/members and is not part of the formal roadmap of ASAM OpenSCENARIO.

OpenODD

What is an ODD in the context of OpenODD?

A machine and human readable format for representing a defined Operational Design Domain that is measurable and verifiable

A list of attributes and values, based on a taxonomy or ontology
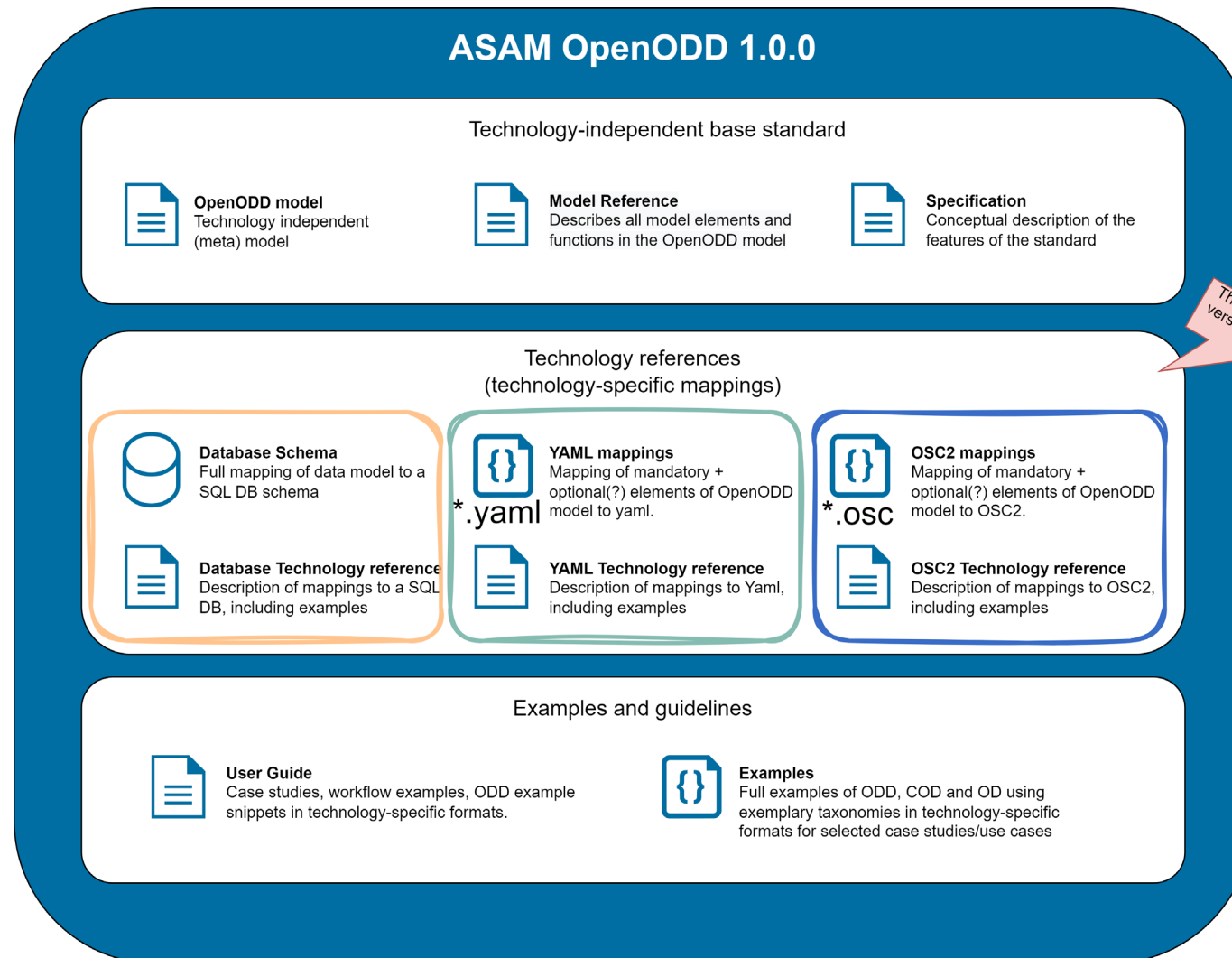
```
weather
    temperature:single(-20..40) [°C]
    rain
    light:(droplet_size:single,
        density:single) ((0..1),
        (0..1k)) ([mm^3], [1/m^3])
```

+

Boundary definition

ASAM OpenODD deliverables

ASAM OpenODD 1.0.0

Technology-independent base standard

OpenODD model
Technology independent (meta) model

Model Reference
Describes all model elements and functions in the OpenODD model

Specification
Conceptual description of the features of the standard

These are separately versioned to the base standard.

Technology references (technology-specific mappings)

Database Schema
Full mapping of data model to a SQL DB schema

Database Technology reference
Description of mappings to a SQL DB, including examples

*.yaml

YAML mappings
Mapping of mandatory + optional(?) elements of OpenODD model to yaml.

YAML Technology reference
Description of mappings to Yaml, including examples

*.osc

OSC2 mappings
Mapping of mandatory + optional(?) elements of OpenODD model to OSC2.

OSC2 Technology reference
Description of mappings to OSC2, including examples

Examples and guidelines

User Guide
Case studies, workflow examples, ODD example snippets in technology-specific formats.

Examples
Full examples of ODD, COD and OD using exemplary taxonomies in technology-specific formats for selected case studies/use cases

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OpenTestSpecification

Concept Project ASAM OpenTestSpecification

TEST METHOD	TEST ENVIRONMENT								
	MODEL-IN-THE-LOOP	SOFTWARE REPROCESSING	CLOSED-LOOP SIL	HARDWARE REPROCESSING DATA REPLAY	CLOSED-LOOP HIL	VEHICLE-IN-THE-LOOP (VIL)	DRIVER-IN-THE-LOOP (DIL)	PROVING GROUND	OPEN ROAD TESTING FIELD MONITORING
REQUIREMENTS-BASED TEST (FUNCTIONAL TEST) *Software architectural design/Specified functionality*	**More details 5.2.2** Requirements-based testing MIL	**Test of ADAS/AD software via open loop** e.g. detection quality	**More details 5.2.1** Use cases Requirements-based test SIL		**More details 5.2.1** Requirements-based testing on closed-loop HIL	**More details 5.2.7** Requirements-based testing vehicle-in-the-loop		**Testing in a controlled proving ground environment** e.g. testing of the complete ADAS function in real-world conditions	**Testing of the ADAS/AD functions under real-life use cases in the field** e.g. shadowing
INTERFACE TEST *Software unit implementation/ Hardware – software interface specification*			**Software integration tests** e.g. test of interfaces for communication between ...	**More details 5.2.6** Hardware reprocessing Data replay	**Higher-level integration tests** e.g. testing of bus communication between ECUs	**Testing of complete ADAS/AD effect chain on system level** e.g. interaction			
FAULT INJECTION *Testing of safety mechanism/ Robustness*	**More details 5.2.3** Fault injection on MIL	**Evaluation of robustness** e.g. robustness against pixel faults	**Verification of safety mechanisms** e.g. out of range e.g. testing robustness of software calibration	**Verification of safety mechanisms including hardware** e.g. testing robustness	**Testing of safety mechanisms with integrated system** e.g. electrical failure simulation like short to ground e.g. testing of robustness against vehicle tolerances		**Validation of overall system behavior** e.g. testing of controllability	**Verification of overall system performance** e.g. testing of safety	
RESOURCE USAGE PERFORMANCE TEST *Sufficiency of resources/ Hardware architectural design*					**Testing of the vehicle network performance** e.g. sleep and wake				
SCENARIO-BASED TEST *Validation of real-life use cases/SOTIF validation*	**Validation of control components** e.g. testing of ADAS/AD effect chain in modeling environment		**More details 5.2.8** Scenario-based testing SIL Closed loop		**Validation of electronics integration** e.g. testing the overall system behavior in challenging scenarios	**Validation on system level** e.g. complete system reaction to the most challenging scenarios	**Validate interaction of driver with safety-relevant vehicle function (HMI, ADAS, active chassis systems), confirm controllability classifications from hazard analysis and risk assessment**	**More details 5.2.5** Scenario-based testing on proving grounds	**More details 5.2.4** Scenario-based open road testing

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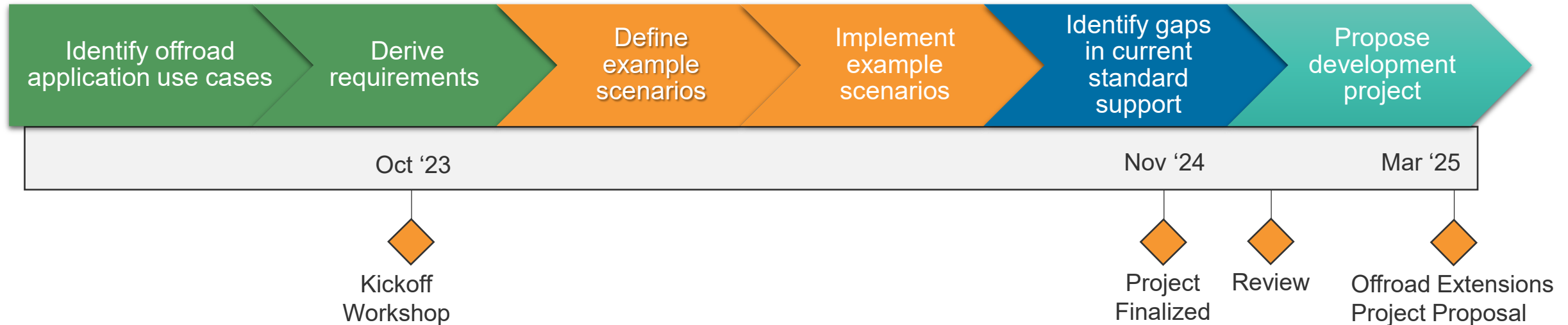# Concept Project ASAM OpenTestSpecification
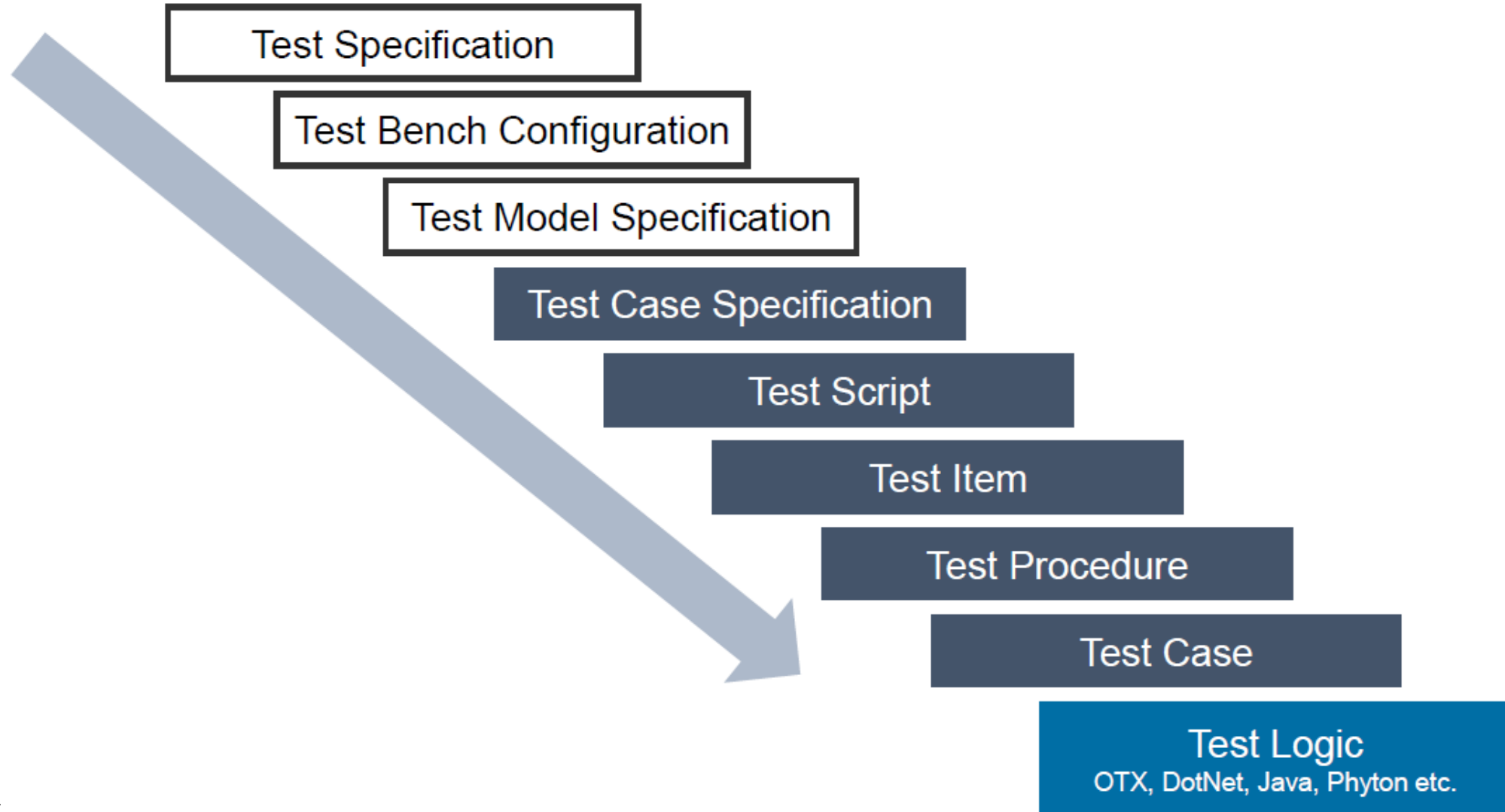
Offroad Challenges

- Complex 3D terrain
- Sensor modeling and surface materials (including link between appearance and physical characteristics)
- Object representation
  - Vegetation and other natural obstacles
  - Meshes, materials, physics
- Representation of the subsurface
  - Soil strength, density, temperature, water content
  - Effects on mobility
- Vehicle-terrain interaction and material dynamics
  - Mud and water spray
  - Mud and snow deformation
  - Accumulation of material on vehicles
- Weather conditions
- Occlusion of sensors
  - Mud, snow, dirt in the air and on camera lens

Concept Project ASAM OpenX in Offroad Applications

GOAL

- Evaluate the need for extensions to existing standards or development of new standards to support modeling and simulation of (a) vehicle mobility in off -road conditions and (b) earth moving for digging, loading, and hauling

| Identify offroad application use cases | Derive requirements | Define example scenarios | Implement example scenarios | Identify gaps in current standard support | Propose development project |

Oct '23 — Kickoff Workshop

Nov '24 — Project Finalized

Review

Mar '25 — Offroad Extensions Project Proposal

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Upcoming topics

Describing and Certifying Proving Grounds with the help of ASAM standards

Collaboration along the workflow

How it works – on OD(D) level
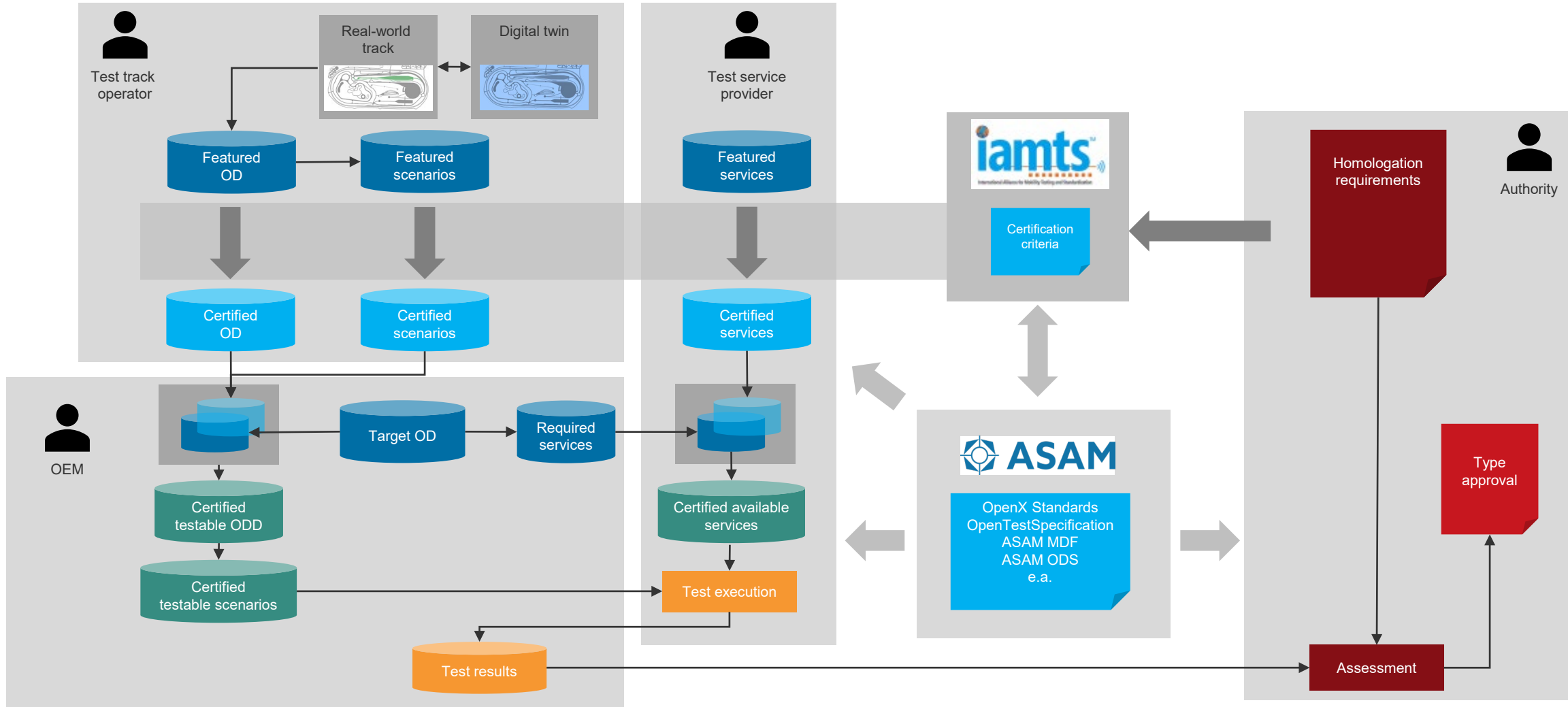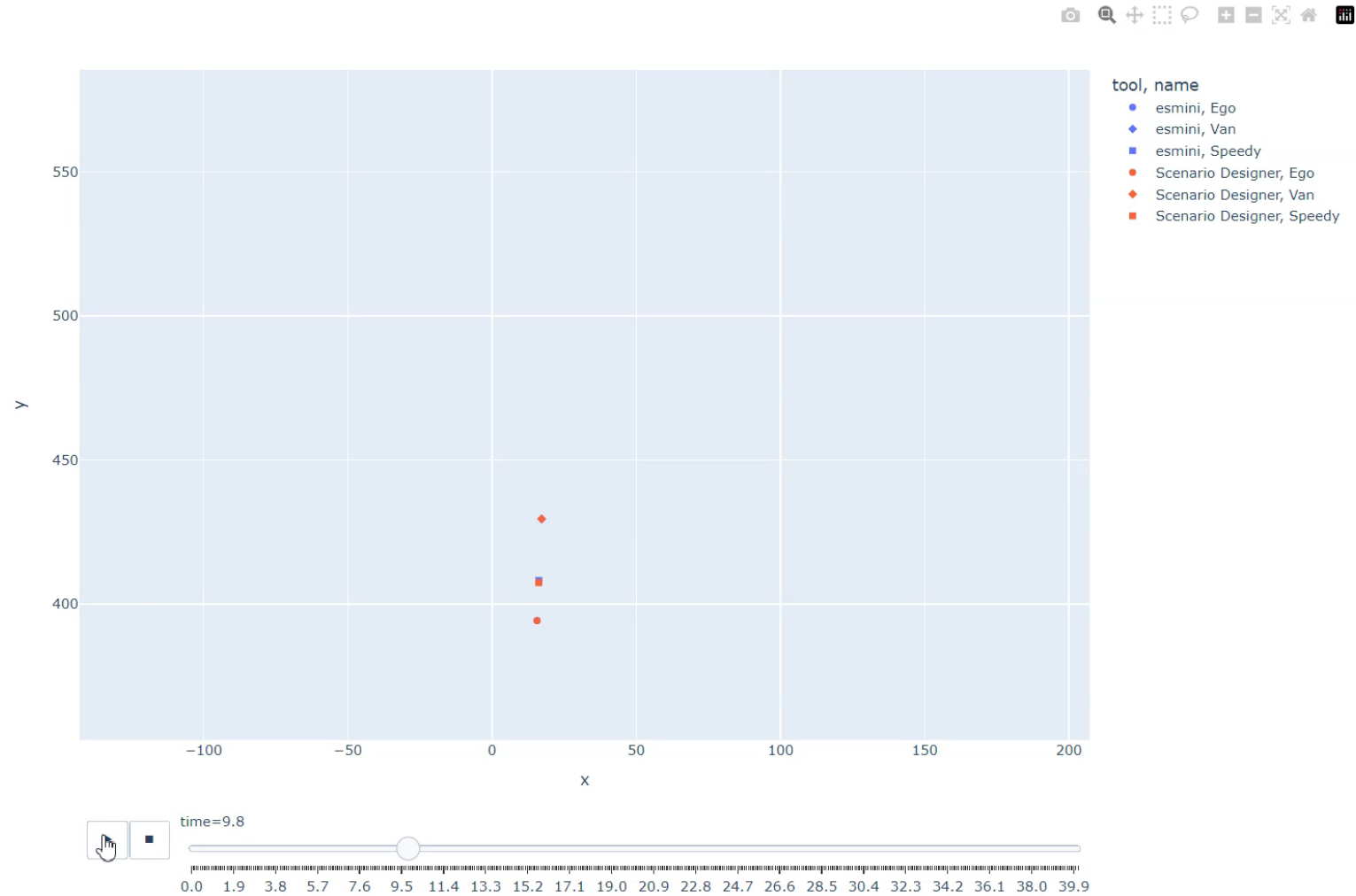
OpenMaterial
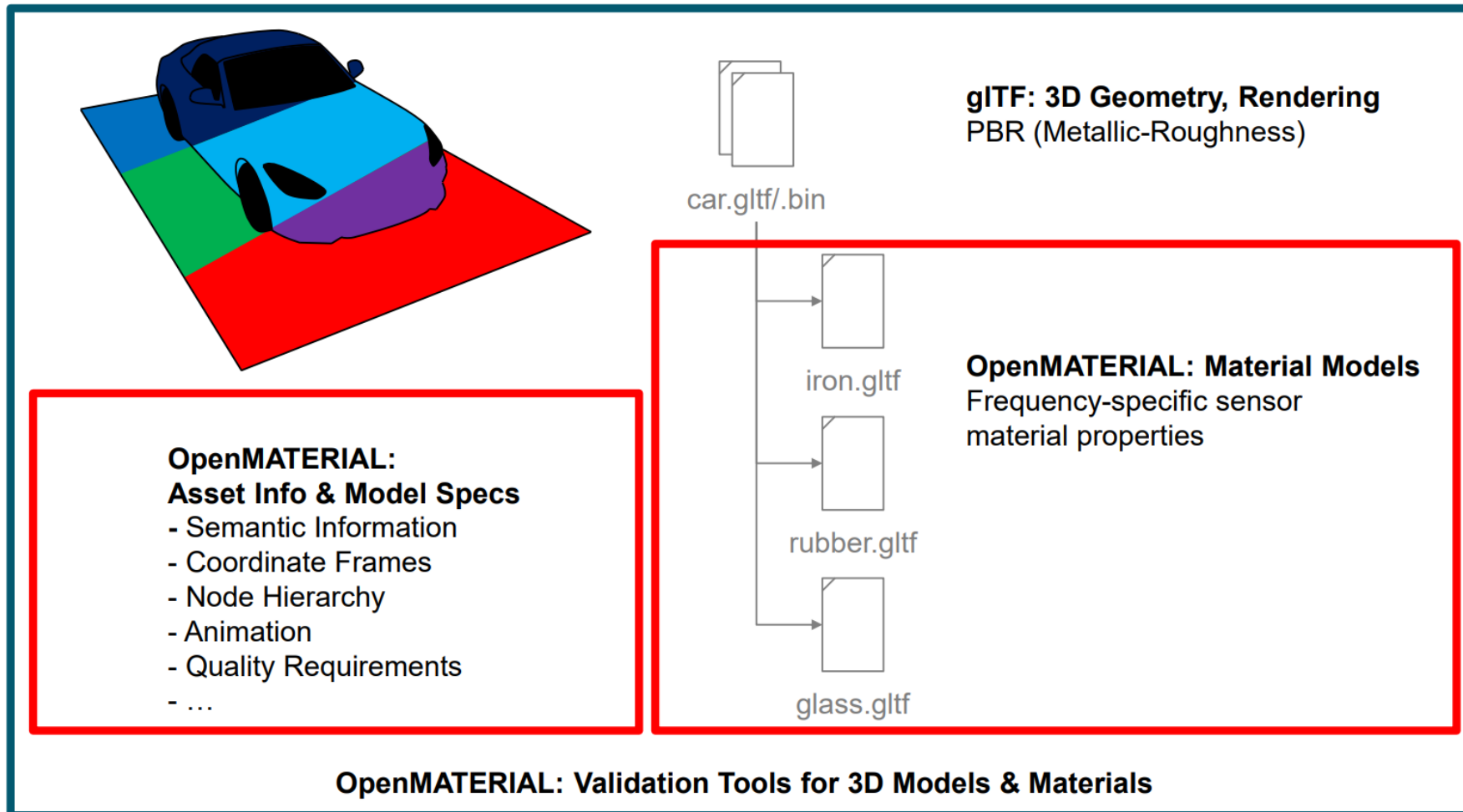
Quality Checker

Ambiguity examples

Geometric discontinuity
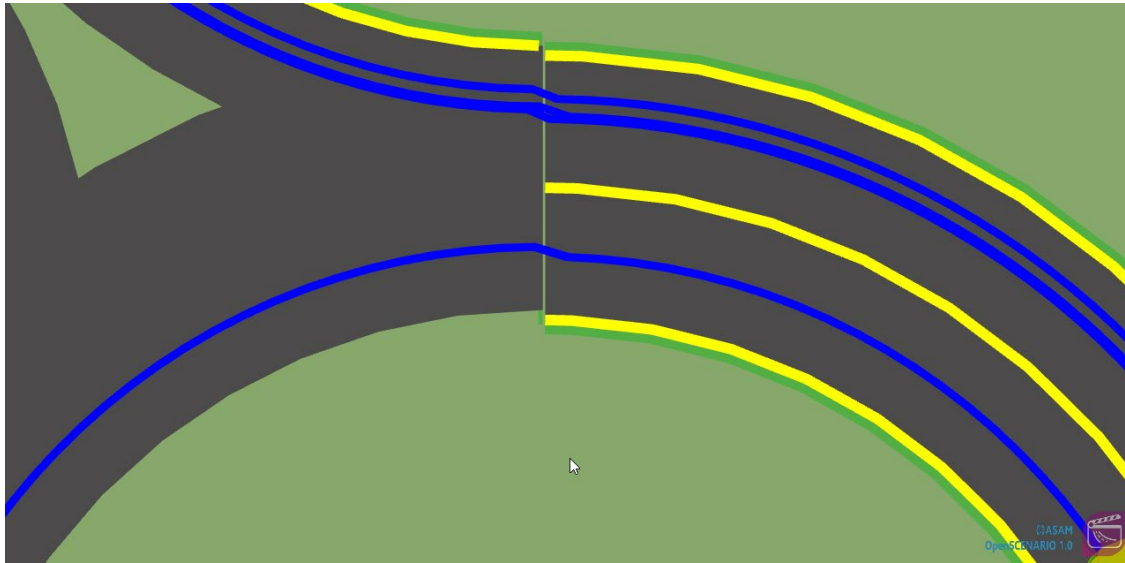
Default value misinterpretation – driving direction rules
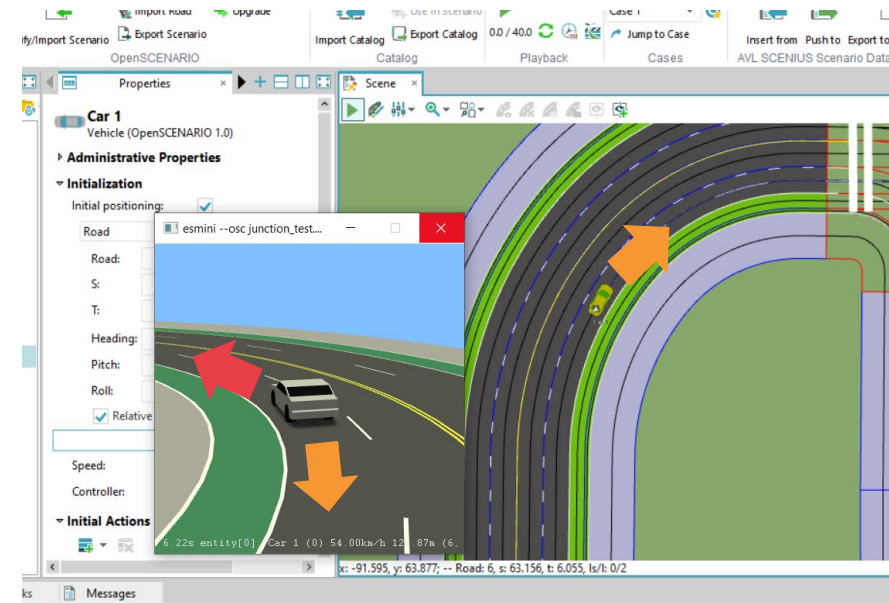
OpenSCENARIO
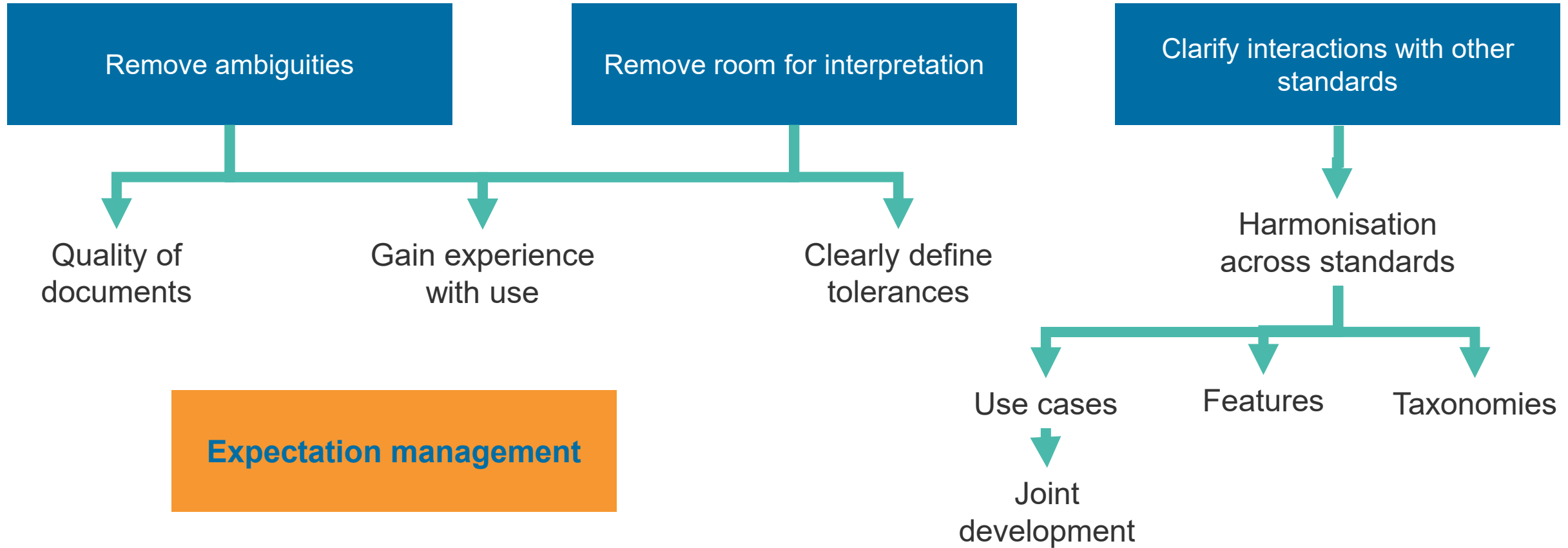
Another example: Traffic participants

What's wrong?

A **pedestrian** in OSC 1.x and a **vehicle** in OSI.
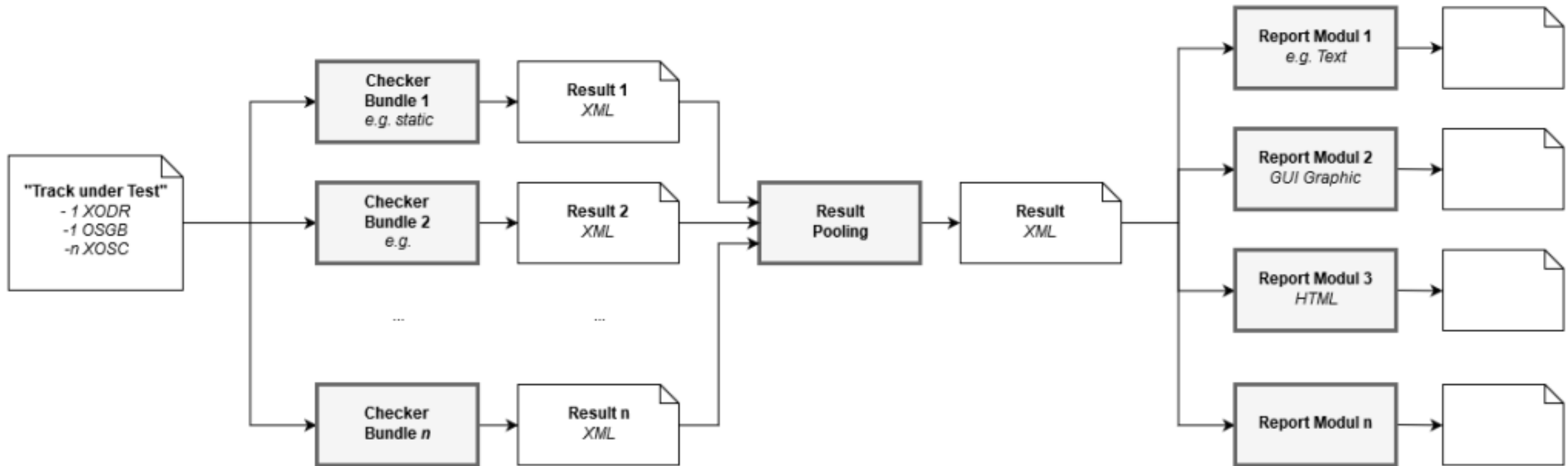

Truck or **car with trailer** in OSC 1.x?
Luxury_Sedan with Trailer in OSI?

Slide credit: Jakob Kaths, Vector

Mitigating the differences

ASAM Checker & Validation Tooling

Upcoming topics

SCDL	OpenMaterial	ASAM Quality Checker	Offroad
Formal notation for ISO26262 safety concepts	*Description of material properties & 3D model data structures*	*Checking & validation framework for ASAM standards*	*Application of OpenX in other domains*

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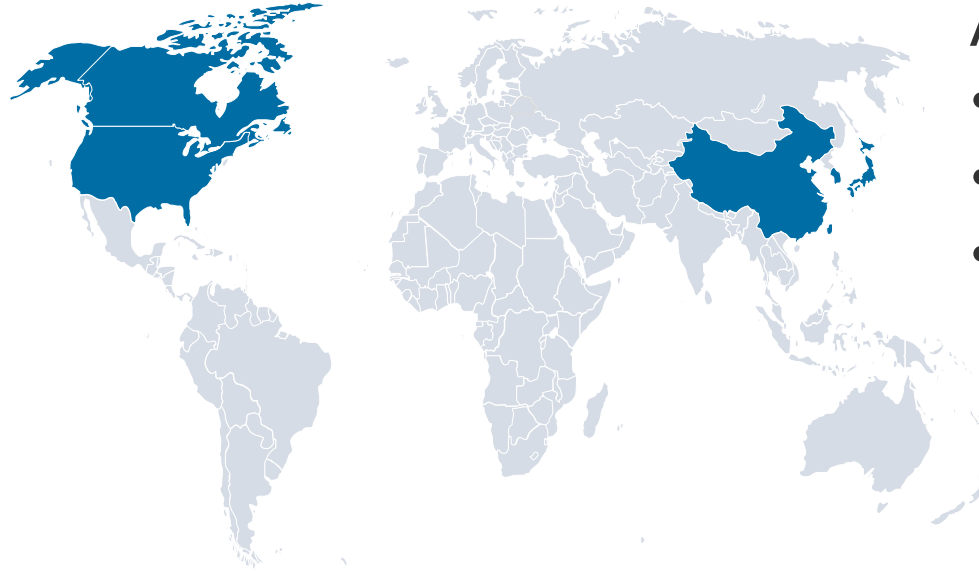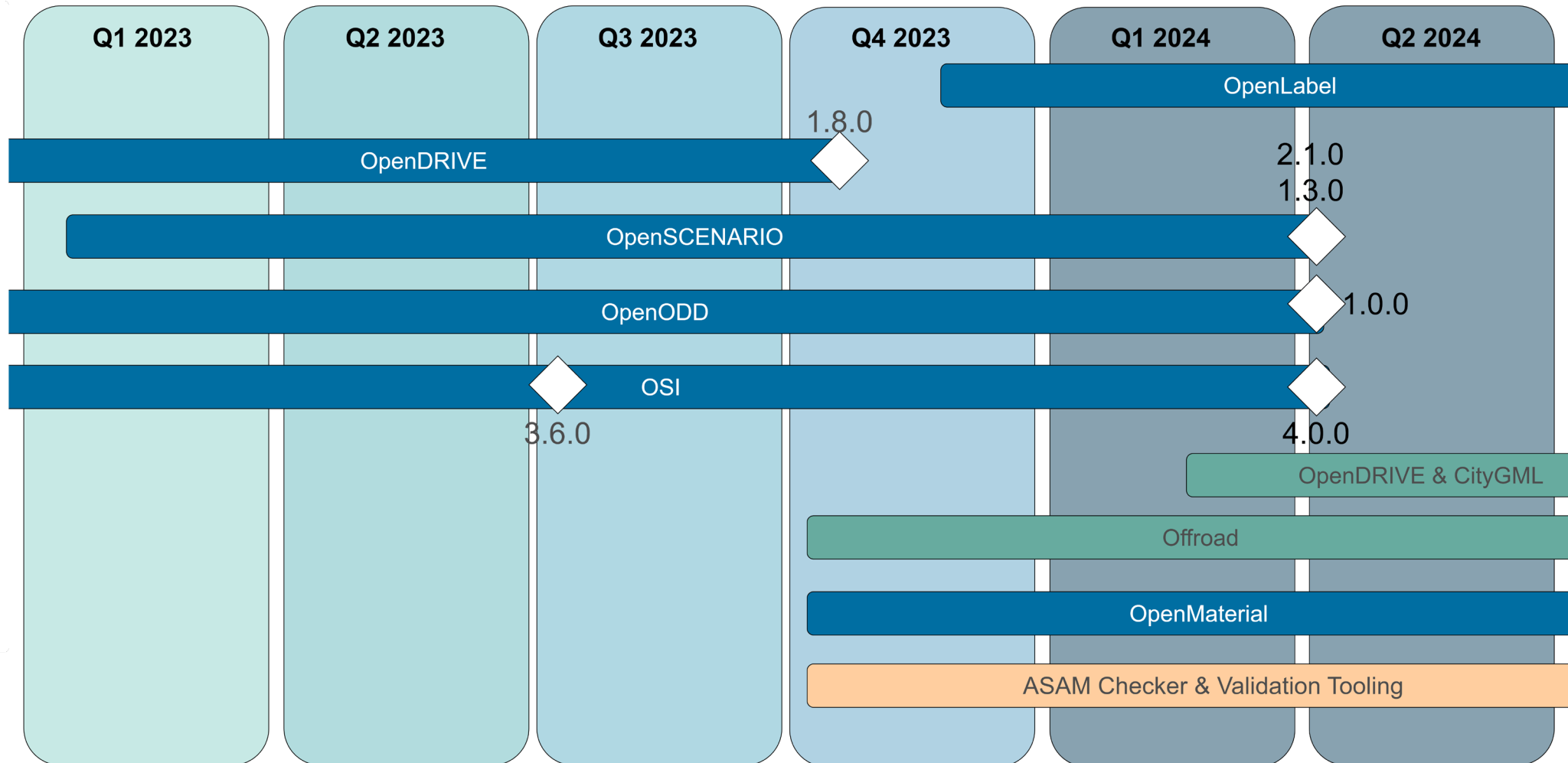
What else?

New topics

More targeted regional efforts

And more…
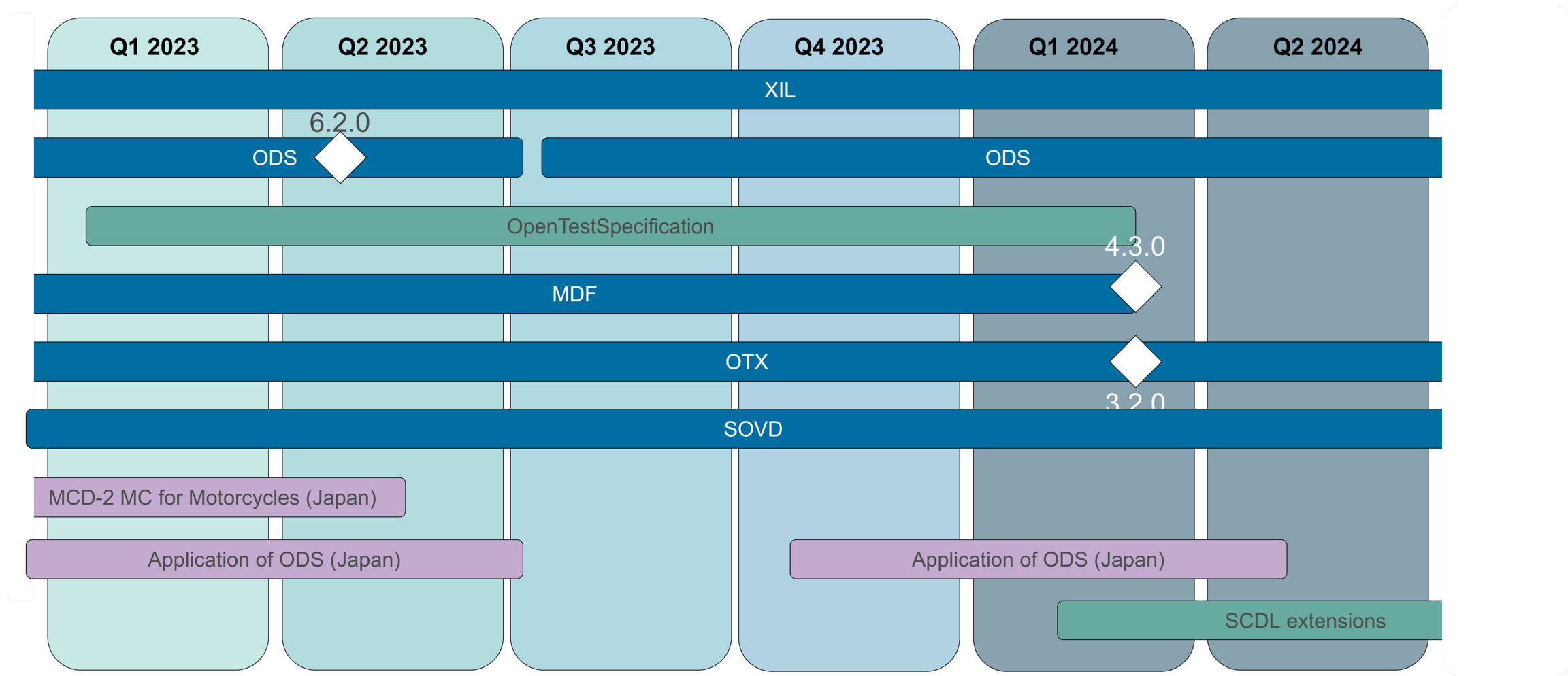- Growing the team
- Harmonisation
- Supporting research projects

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Project roadmap 2023 (simulation)
(as of 01.11.2023)

Project roadmap 2023 (all other domains) (as of 01.11.2023)

Thank you for your attention!

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◈ ASAM

Getting involved in ASAM

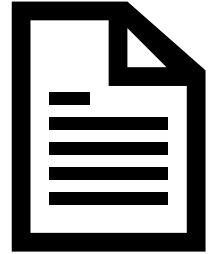# Putting ASAM into perspective

- Understand the goals & strengths of each organisation

Our main driver: leverage each organization's strengths and expertise!

Why become a member?

Access to all ASAM standards

Global community of experts

Participate in projects

„Early access" to new features
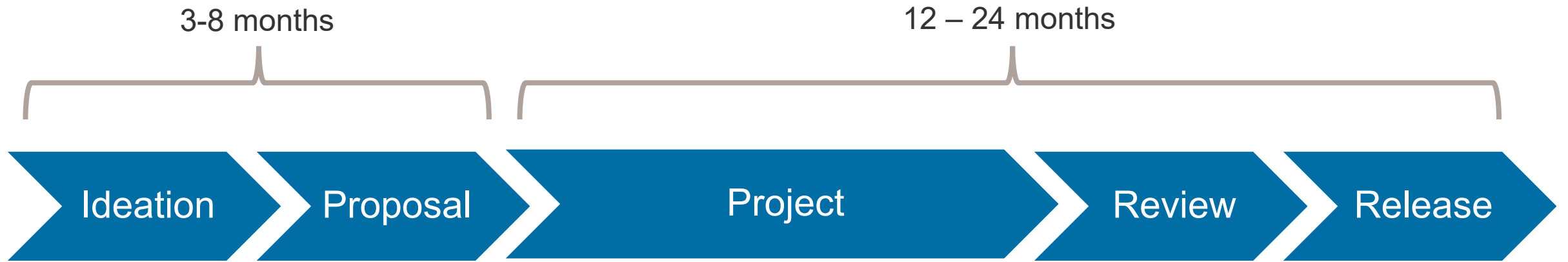
Fast, lean processes & toolchains

Ensure ASAM standards cater to your use cases & requirements

ASAM

How does a project work?

3-8 months

12 – 24 months

| Ideation | Proposal | Project | Review | Release |

All projects are **member-driven**

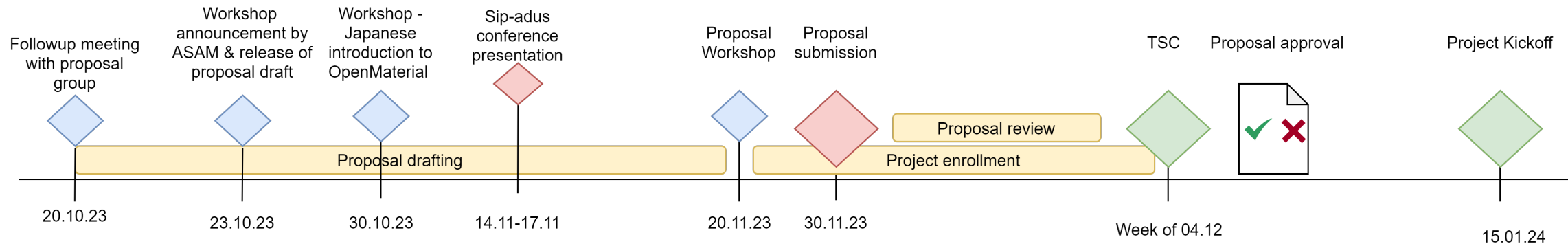Average commitment / yr **25-30 person days**

Work involves: Expert **discussion**, content **authoring**, **review**

⬡ **ASAM**

Other topics

OpenMaterial

Status

Standardized data structure for materials and 3D assets

Followup meeting with proposal group	Workshop announcement by ASAM & release of proposal draft	Workshop - Japanese introduction to OpenMaterial	Sip-adus conference presentation	Proposal Workshop	Proposal submission		TSC	Proposal approval	Project Kickoff

Proposal drafting

Proposal review

Project enrollment

| 20.10.23 | 23.10.23 | 30.10.23 | 14.11-17.11 | 20.11.23 | 30.11.23 | Week of 04.12 | 15.01.24 |

ASAM Checker & Validation Tooling

- Scope of the activity
  1. Checker framework (standard independent)
  2. Checker libraries for OpenSCENARIO XML/DSL, OpenDRIVE, OpenCRG

- Followups may address additional libraries or standards

- Project participants to define requirements towards a framework and an initial set of checks for OSC & ODR
- Software development to be performed by a service provider (framework & check implementation

All dates are preliminary! ◈ ASAM