ASAM OpenSCENARIO

Introduction and Project Overview

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2019-03-27
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ASAM
Association for Standardization of
Automation and Measuring Systems

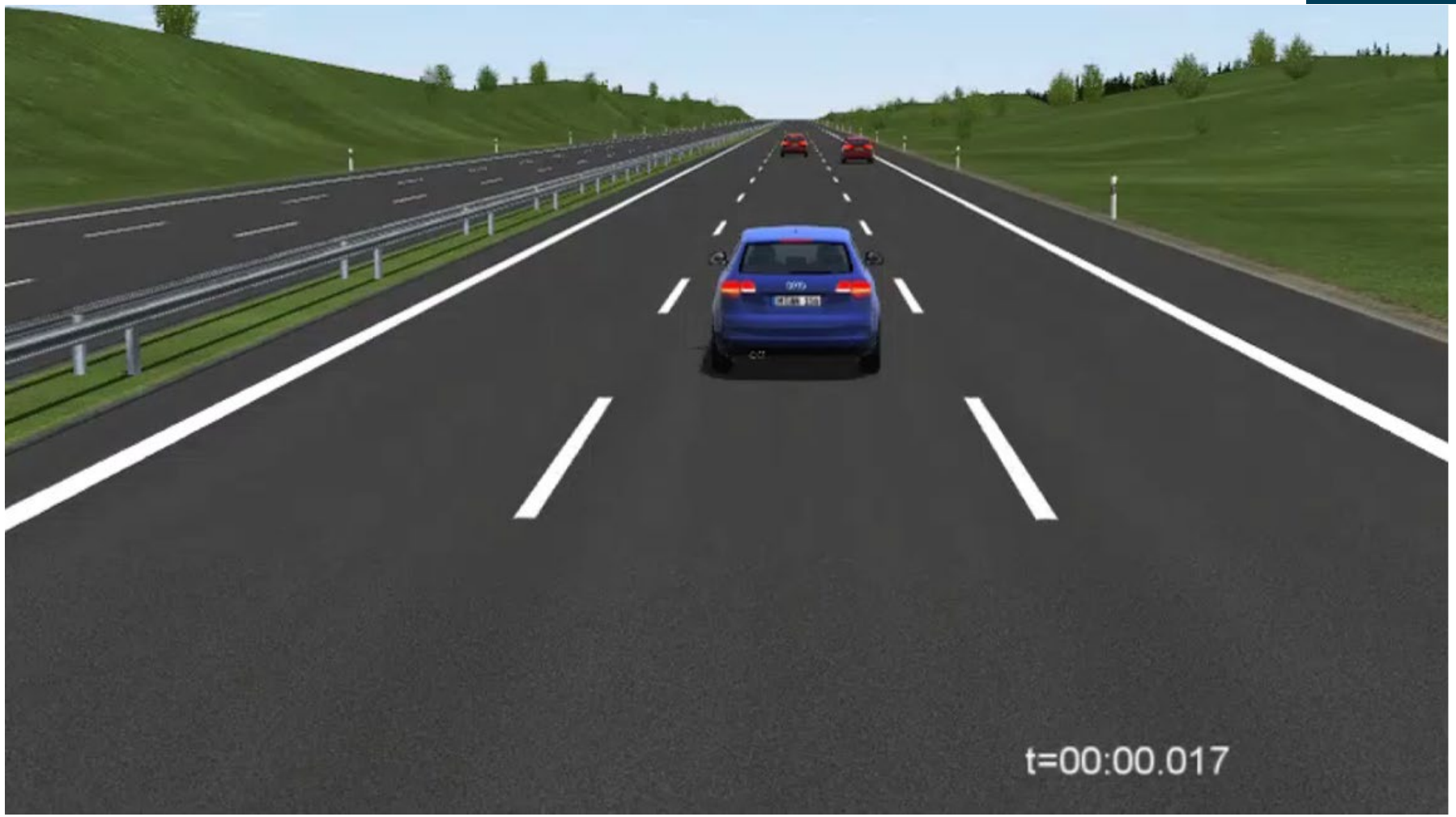
What is OpenSCENARIO?

Overview and History

A Standardized Format for Driving Scenarios

PEGASUS RESEARCH PROJECT

SECURING AUTOMATED DRIVING EFFECTIVELY.



Video by courtesy of Vires VTD

PEGASUS

http://www.pegasus-projekt.info/en/home

Supported by:

Federal Ministry for Economic Affairs and Energy

on the basis of a decision by the German Bundestag

Moving to more Complex Scenarios

Video by courtesy of BMW

New Requirements:

- More complex road networks
- More complex interactions
- Composition of multiple complex interactions (scenes & scenarios)
- Complex Inner City Traffic Scenarios
- Reviewability & Analyzability
- Regulatory Bodies
- International Harmonization
- …

OpenSCENARIO goes to ASAM

Internationalization & Harmonization

ASAM

OpenSCENARIO Migration to ASAM

Goals

- Ensure **long-term stable home** for OpenScenario
- Draw more **international participation**
- Increase **harmonization** across **OpenX** and **related standards** and **standards bodies**
- Retain **open** and **free access** to standards
- Retain and ensure **high speed** of **evolution**

OpenSCENARIO Migration to ASAM

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- **Pegasus & ASAM OpenSCENARIO Kick-Off**

OpenSCENARIO Migration to ASAM

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OpenSCENARIO Migration to ASAM

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- **ASAM OpenSCENARIO Concept Project Kick-Off**
  2019-04/05 @ ASAM Höhenkirchen
  (Expected: ~30-50 Companies)

Proposal Workshop Outcome

Features & Requirements for OpenSCENARIO

Features

F001	Maneuver Model	: 122
F008	High-Level Maneuver Descriptions	: 119
F003	Traffic Model	: 50
F007	Parameter Stochastics	: 44
F002	Driver Model	: 42
F004	Environmental Condition Model	: 30
F009	Replay of Recorded Scenarios	: 27
F010	Automatic Parameter Calculation	: 18
F005	Infrastructure Event Model	: 14
F006	Vehicle Dynamics	: 14
F011	Additional Meta Data for Parameters	: 10
F012	Language Constructs for Localization	: 7

Requirements

TABLE: ISSUE DESCRIPTIONS

ID	Title/Description
R001	Avoid Different Ways to Model
R002	Define Elements as 'Mandatory' Only When Absolutely Needed
R003	Maintain Independence and Open Linking Between Standards.
R004	Define Three Levels of Control for Ego Vehicles.
R005	Allow Tool-Vendor Specific Extensions.
R006	Allow Definition of Feature Subsets
R007	Define Semantics to Enable Reproducibility and Single Interpretation. (Workshop phrasing was: Well Defined Semantics Requirement)
R008	Allow both Open-loop and Closed-loop Simulation by the Same Maneuver Descriptions. (Workshop phrasing: Maneuver Description Shall be Suitable for Open-loop and Closed-loop Simulation)
R009	Define Parameter Boundaries
R010	Synchronize Maneuvers and Events
R011a	Allow Definition of Success Criteria for Individual Maneuvers, and for Full Scenarios and Tests – DUT criteria
R011b	Allow Definition of Success Criteria for Individual Maneuvers, and for Full Scenarios and Tests – non-DUT criteria
R012	Allow Textual Editing of the Format. (Workshop phrasing was: Suitability for textual editing)

Example for Feature Complexity

F008: High-Level Maneuver Descriptions

Current Situation

200 lines of XML code in OpenSCENARIO

Example for Feature Complexity

F008: High-Level Maneuver Descriptions

Current Situation

200 lines of XML code in OpenSCENARIO

Proposals

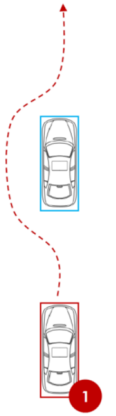
INTUITIVE HIGH-LEVEL DESCRIPTION LANGUAGE

```
Scenario SimpleOvertaker:

  Act Overtaking:
    @init:
      CreateVehicle(Ego,EgoProto,xyz=0m|0m|0m,speed=80km/h)
      CreateVehicle(Overtaker,OvertakerProto,xyz=0m|Ego.y-100m|0m,speed=100km/h)
    @Distance(Ego,Overtaker) <= 30m % OnceOnly:
      LaneChange(Overtaker,lane=-1,model=Sinusoidal(time=5s))
    @DistanceAfterPassing(Ego,Overtaker) >= 5m % OnceOnly:
      LaneChange(Overtaker,lane=+1,model=Sinusoidal(time=5s))

  Prototypes:
    EgoProto: Vehicle(geometry="mycar.obj",color="blue")
    OvertakerProto: Vehicle(geometry="traffic.obj",color="red")

  Resources:
    Map: OpenDrive("OpenDriveMap.xodr")
```

Acts

Triggers

Actions



Example for Feature Complexity

F008: High-Level Maneuver Descriptions

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Proposals

Clear (example)

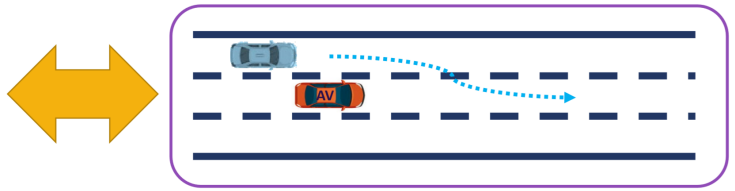
```
scenario ego::cut_in_and_slow is {
  car1: car;     // The other car
  side: av_side;  // Car1 starts on this side of the ego
  stretch: stretch {.lanes >= 2; .length in [120..250] * meter};

  do serial {

    get_ahead: phase(duration: in [1..5] * second) {
      p1_ego: ego_car.drive {+drive_on(stretch)};
      p1_car1: car1.drive {
        +behind(ego_car, at: start);
        +ahead_of(ego_car, [5..10] * meter, at: end);
        +on_side_of(ego_car, side);
        +faster_than(ego_car);  }};

    change_lane: phase(duration: in [1..5] * second) {
      p2_ego: ego_car.drive;
      p2_car1: car1.drive {+change_to_lane_of(ego_car); }};

    slow: phase(duration: in [1..5] * second) {
      p3_ego: ego_car.drive;
      p3_car1: car1.drive {+slow_down([10..15] * kph); }};
};
```



Example for Feature Complexity

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Proposals

OSC Code Extensions

Definition in OSC

- New Section in XOSC File
- Backward compatible
- Languages (Proposal)
  - Python
  - C/C++ via shared Libraries

```
<?xml version="1.0" encoding="utf-8"?>
<OpenSCENARIO>
  <FileHeader>
  <!--Parameter Section-->
  <ParameterDeclaration>
  <!--Catalogs Section-->
  <Catalogs>
  <!--Roadnetwork Section-->
  <RoadNetwork>
  <!--Entities Section-->
  <Entities>
  <!--CodeEntities Section-->
  <CodeEntities>
      <CodeEntity name="Ego" type="python3" filepath="./driverSimple.py">
          <ParameterDeclaration>
              <Parameter name="InitPosX"        type="double" value="20.0"/>
              <Parameter name="InitPosY"        type="double" value="6.25"/>
              <Parameter name="InitOrientation" type="double" value="0.0"/>
              <Parameter name="InitVelocity"    type="double" value="4.0"/>
          </ParameterDeclaration>
      </CodeEntity>
      <CodeEntity name="RightLaneDriver" type="cdll" filepath="../../bin/driverSimple.dll">
          <ParameterDeclaration>
              <Parameter name="InitPosX"        type="double" value="30.0"/>
              <Parameter name="InitPosY"        type="double" value="2.75"/>
              <Parameter name="InitVelocity"    type="double" value="3.0"/>
              <Parameter name="Width"           type="double" value="1.8"/>
              <Parameter name="Length"          type="double" value="4.8"/>
          </ParameterDeclaration>
      </CodeEntity>
  </CodeEntities>
  <!--Storyboard Section-->
  <Storyboard>
</OpenSCENARIO>
```

Example

Example for Feature Complexity

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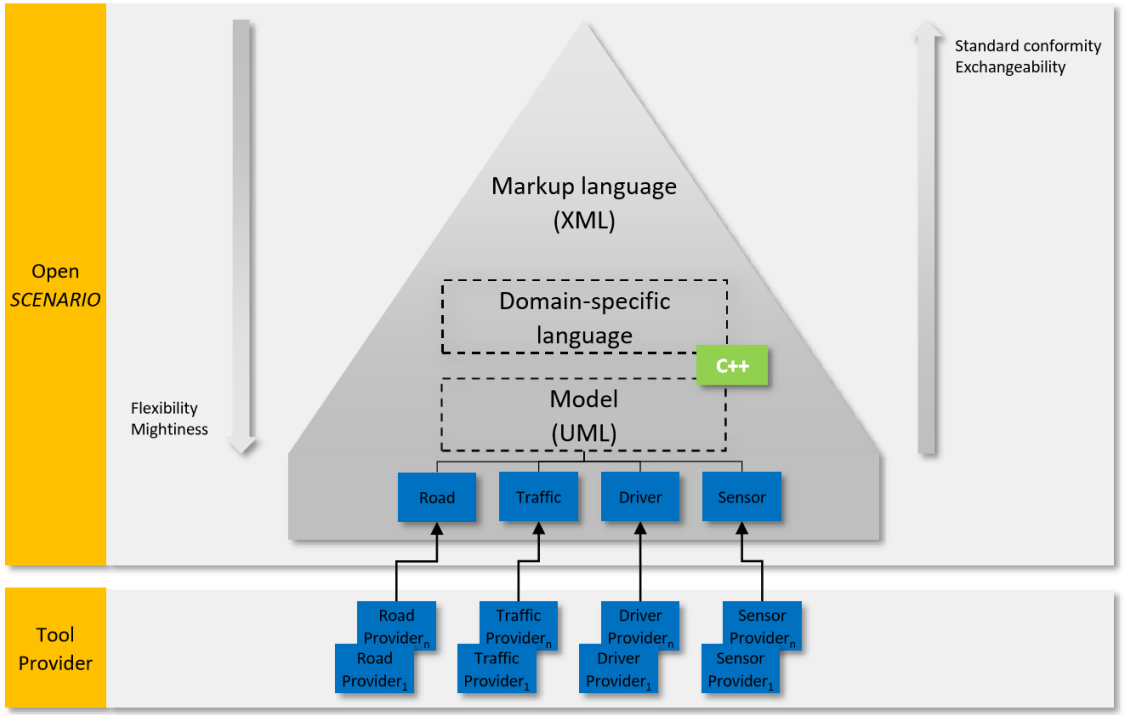

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Proposals

- Need for more expressive & composable language to address new, complex inner-city scenarios
- Readability and maintainability are of greater concern to communicate precisely with domain experts

- Proposals include:
  - High-Level Domain-Specific Language (Descriptive & Constraint-based Semantics)
  - More expressive UML data model
  - Interfaces to General Purpose Languages

- Interplay with maneuver model and other features is key

- Clear need for architectural and feature-specific concepts

Project Structure for OpenSCENARIO

Handling the Complexity of Features and Number of New Participants

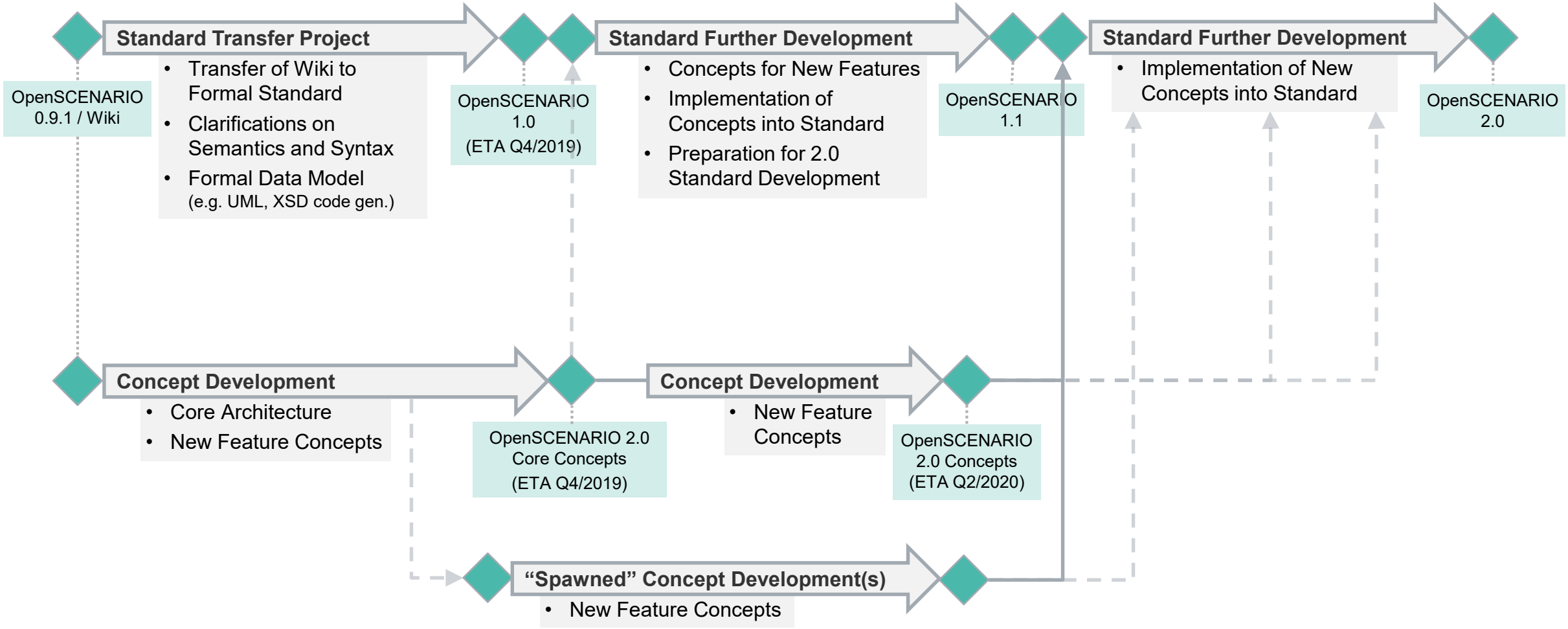
ASAM OpenSCENARIO Transfer Project

- Stabilize current format OpenSCENARIO 0.9.1
- Transfer to ASAM formal standard
- Clarify and tighten definitions
- Move definitions to formal UML-based data model
- Expand documentation to aid understanding and implementation quality
- Review and Publish OpenSCENARIO 1.0

ASAM OpenSCENARIO Concept Project

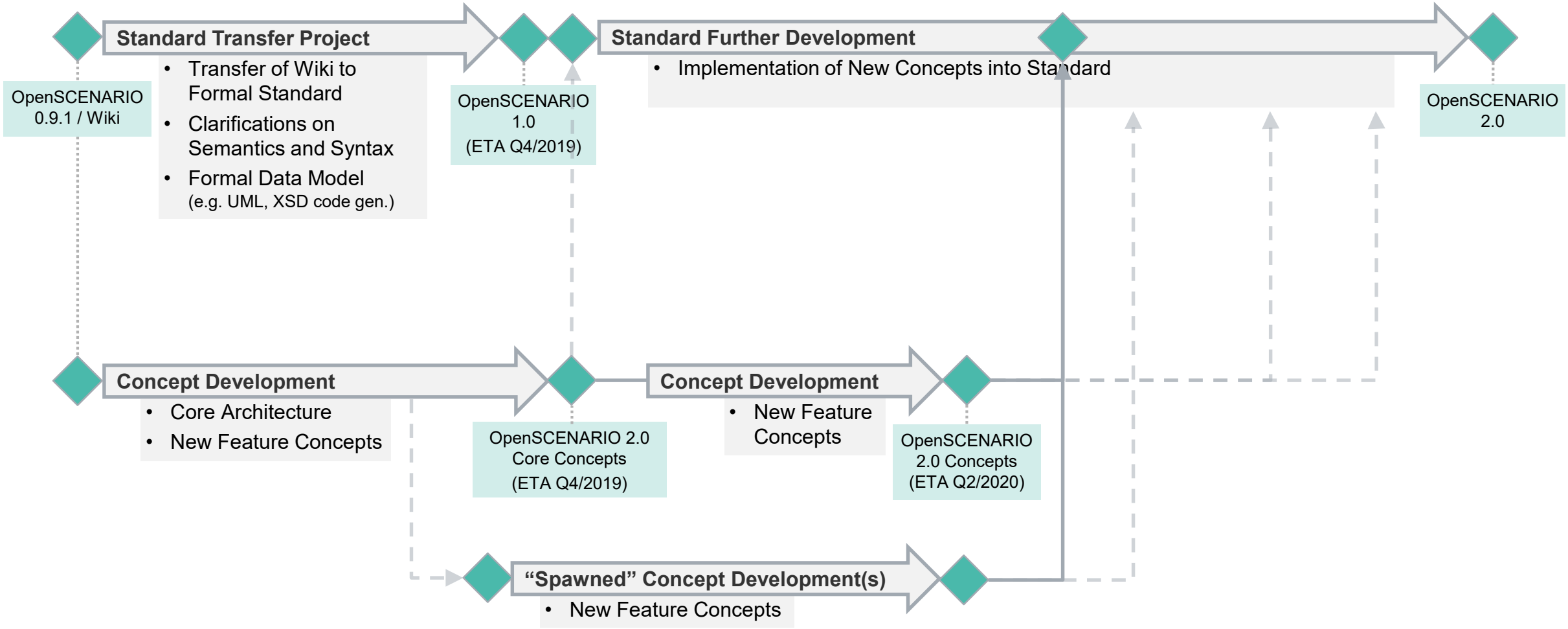
- Address features and requirements from proposal workshop that can not be easily met through simple extensions of OpenSCENARIO 1.0
- Derive core architectural concepts based on features and requirements
- Derive feature concepts for all features
- Derive migration path from OpenSCENARIO 1.x to OpenSCENARIO 2.0
- Prepare standardization of OpenSCENARIO 2.0
- Provide input to OpenSCENARIO 1.x where possible

ASAM OpenSCENARIO Roadmap – Parallel Concept Development



ASAM

ASAM OpenSCENARIO Roadmap – Parallel Concept Development



ASAM

ASAM OpenSCENARIO – Next Steps

What is up ahead for ASAM OpenSCENARIO?

- ASAM OpenSCENARIO Transfer Project has started its work:
  Next Workshop on 2019-04-11/12

- ASAM OpenSCENARIO Concept Project about to start:
  Registration Phase closes on 2019-04-12 -> Please register!
  Initial On-Site Workshop planned for 2019-04-29/30 @ ASAM Höhenkirchen

- ISO TC22 / SC33 / WG9 liaison to be established (in progress)

- ASAM OpenSCENARIO Tool / Implementation Project(s) to be defined once needed

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