

Quality Assurance Framework

OpenDRIVE 1.8 Kickoff Meeting 06/Sep/21



We transform automotive mobility.

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A VOLKSWAGEN GROUP COMPANY

Agenda

// High-level requirements

// Architecture / Workflow

// Details about Checker Bundles and Reporting

// Related Projects

High-level requirements

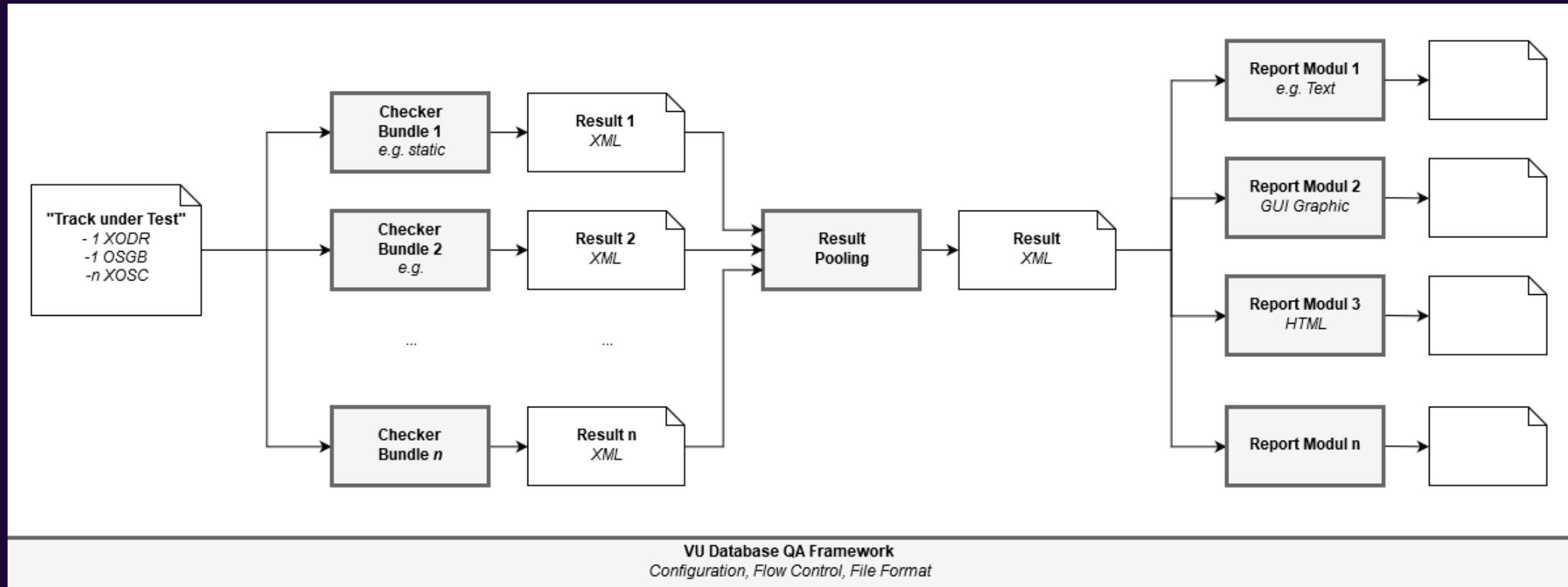
Where do we come from?

- Possibility to include common ASAM rule sets
- Implement/Include own checker in any programming language
- Use in local and server based environments
- Run static file checks and dynamic tests (observe the simulation behavior)
- Parameterize the checks
- Traceability of issues to the XML source code and into visualization
- Human and machine readable results

One reporting approach for all use cases

Architecture / Workflow

Combining executables with standardized interfaces



Additional configuration GUI / Runtime

Checker Bundle

Executable including one or more Checkers – using one parser/sharing code

Simple call

```
>> checker_bundle track.xodr [-o1 -o2 ...]
```

Configured from GUI

Much more options (e.g. reporting level, parameter)

```
>> checker_bundle configuration.xml
```

```
<Checker checkerId="roadIdChecker" description="Checks validity of ...<br/><Issue description="Road with id=5 invalid" issueId="2" level="1"><br/><Locations description="Roadid is defined multiple times"><br/><XMLLocation xpath="/OpenDRIVE/road[@id='5']"/><br/><RoadLocation roadId="5" s="0.0" t="0.0"/><br/></Locations><br/></Issue><br/></Checker>
```

Output

XML based result file checker_bundle.xqar

Any programming language possible!

Result Pooling

Combine results from different Checker Bundles into one result file

Inputs

checker_bundle.xqar
another_checker_bundle.xqar
(...)

Additional functionality

Calculates locations in source file from XPath

Output

XML based result file result.xqar (same format)

```
<Checker checkerId="roadIdChecker" description="Checks validity of ...>
  <Issue description="Road with id=5 invalid" issueId="2" level="1">
    <Locations description="Roadid is defined multiple times">
      <XMLLocation xpath="/OpenDRIVE/road[@id='5']"/>
      <RoadLocation roadId="5" s="0.0" t="0.0"/>
      <FileLocation column="25" row="505"/>
      <FileLocation column="25" row="1023"/>
    </Locations>
  </Issue>
</Checker>
```



Report GUI

Interactive tooling to explore checker results

- Filter issues by Checker Bundle and Checkers
- Link issues to source code
- Highlight issues in source code
- Show detailed issue description
- Plugin interface for controlling a 3D Viewer

The screenshot shows the ReportGUI application interface. On the left, there are three main sections: 'CheckerBundles' (listing 'CheckerBundle', 'Select All (2 CheckerBundles, 3 Checkers, 4 Issues)', 'ScenarioChecker (2 Checkers, 3 Issues)', and 'XoscSchemaChecker (1 Checker, 1 Issue)'), 'Checkers with issues' (listing 'Checker', 'InitPositionOnRoad (1 Issues)', 'InitPositionOverlapping (2 Issues)' (selected), and 'xoscSchemaChecker (1 Issues)'), and 'Issues' (a table with two rows). The 'Issues' table has columns for ID, Level, and Description. Row 1 (highlighted) details an 'Object init positions overlapping' issue between 'Vehicle_0' and 'Vehicle_1'. Row 2 details another such issue. The 'Description' section at the bottom provides build information: CheckerBundle: ScenarioChecker, Build date: 2021-07-08 07:40:53, Build version: 0.1.0, Description: Checks the content of an OpenSCENARIO file., Summary: Found 3 issues, Parameters: XodrFile = C:/conan/ebcd8b/1/examples/xosc_example.xodr. On the right, the 'Source' tab displays the OpenSCENARIO XML code. Two specific lines are highlighted in yellow: line 61 ('<Object name="Vehicle_0">') and line 83 ('<Object name="Vehicle_1">'). Both lines contain the comment '!-- this entity has an overlap with another ent'.

ID	Level	Description
1	●	Object init positions overlapping: object: 'Vehicle_0' with object: 'Vehicle_1' Entity Definition XPath: /OpenSCENARIO/Entities/Object[@name="Vehicle_0"] File: row=61 column=0 Init Action XPath: /OpenSCENARIO/Storyboard/Init/Actions/Private[@object="Vehicle_0"] Location: x=448.24 y=-53.62 z=0.00 heading=0.00 pitch=0.00 roll=0.00 File: row=166 column=0
2	●	Object init positions overlapping: object: 'Vehicle_1' with object: 'Vehicle_0' Entity Definition

3D Viewer Integration

The screenshot illustrates the integration of a 3D viewer into a report GUI. On the left, the 'ReportGUI' window displays a checker bundle named 'ScenarioChecker' which has found three issues. One of these issues is highlighted in yellow in the code editor on the right, which shows XML source code for an OpenSCENARIO file. The code snippet highlights a specific action where an object's initial position is not on the road. On the right, the 'FEP VU Viewer 2.7.0' window shows a 3D rendering of a road with two cars. A callout box from the 'ReportGUI' interface points to the viewer, specifically highlighting the issue related to the object's initial position.

ReportGUI

File

CheckerBundles

- CheckerBundle
 - Select All (2 CheckerBundles, 3 Checkers, 4 Issues)
 - ScenarioChecker (2 Checkers, 3 Issues)
 - XoscSchemaChecker (1 Checker, 1 Issue)

Checkers with issues

Checker

- InitPositionOnRoad (1 Issues)
- InitPositionOverlapping (2 Issues)
- xoscSchemaChecker (1 Issues)

Issues

ID	Level	Description
0	!	Object init position isn't on road. Entity Definition Xpath: /OpenSCENARIO/Entities/Object[@name='Vehicle_2'] File: row=105 column=0 Init Action Xpath: /OpenSCENARIO/Storyboard/Init/Actions/Private[@object='Veh... Location: x=-378.70 y=-34.50 z=0.00 heading=0.00 pitch=0.00 roll=0.00 File: row=202 column=0
1	!	Object init positions overlapping: object: 'Vehicle_0' with object: 'Vehicle_1'. Entity Definition Xpath: /OpenSCENARIO/Entities/Object[@name='Vehicle_0'] File: row=61 column=0 Init Action Xpath: /OpenSCENARIO/Storyboard/Init/Actions/Private[@object='Veh... Location: x=448.24 y=-53.62 z=0.00 heading=0.00 pitch=0.00 roll=0.00 File: row=166 column=0
2	!	Object init positions overlapping: object: 'Vehicle_1' with object: 'Vehicle_0'. Entity Definition Xpath: /OpenSCENARIO/Entities/Object[@name='Vehicle_1'] File: row=83 column=0 Init Action Xpath: /OpenSCENARIO/Storyboard/Init/Actions/Private[@object='Veh...

Description

```
CheckerBundle: ScenarioChecker
Build date: 2021-07-08 07:40:53
Build version:
Description: Checks the content of an OpenSCENARIO file.
Summary: Found 3 issues
Parameters: XodrFile = C:/conan/209fe0/1/examples/xosc_exa...
           mple.../xodr_examples/ramp.xodr
           XoscFile = C:/conan/209fe0/1/examples/xosc_exa...
```

Source

```
</Action>
<Action>
  <Longitudinal>
    <Speed>
      <Dynamics shape="step"/>
      <Target>
        <Absolute value="0"/>
      </Target>
    </Speed>
  </Longitudinal>
</Action>
<Private object="Vehicle_2">
  <Action>
    <Position>
      <!-- (#0) Object init position isn't on road. -->
      <World x="378.699" y="-34.4968" z="0" h="0" p="0" r="0" s="0" t="0" u="0" v="0" w="0" x2="378.699" y2="-34.4968" z2="0" h2="0" p2="0" r2="0" s2="0" t2="0" u2="0" v2="0" w2="0" x3="378.699" y3="-34.4968" z3="0" h3="0" p3="0" r3="0" s3="0" t3="0" u3="0" v3="0" w3="0" x4="378.699" y4="-34.4968" z4="0" h4="0" p4="0" r4="0" s4="0" t4="0" u4="0" v4="0" w4="0" x5="378.699" y5="-34.4968" z5="0" h5="0" p5="0" r5="0" s5="0" t5="0" u5="0" v5="0" w5="0" x6="378.699" y6="-34.4968" z6="0" h6="0" p6="0" r6="0" s6="0" t6="0" u6="0" v6="0" w6="0" x7="378.699" y7="-34.4968" z7="0" h7="0" p7="0" r7="0" s7="0" t7="0" u7="0" v7="0" w7="0" x8="378.699" y8="-34.4968" z8="0" h8="0" p8="0" r8="0" s8="0" t8="0" u8="0" v8="0" w8="0" x9="378.699" y9="-34.4968" z9="0" h9="0" p9="0" r9="0" s9="0" t9="0" u9="0" v9="0" w9="0" x10="378.699" y10="-34.4968" z10="0" h10="0" p10="0" r10="0" s10="0" t10="0" u10="0" v10="0" w10="0" x11="378.699" y11="-34.4968" z11="0" h11="0" p11="0" r11="0" s11="0" t11="0" u11="0" 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Open Soure Contribution

What's in the contribution?

Included

- Configuration GUI
- Checker Bundle for XML Schema
- Result Pooling
- Text Report Module
- Interactive Report GUI
- C++ Library for reading/writing configuration and result XML format

Not Included

- Internal Checker Bundles (due copyright issues)
- Internal 3D Viewer

Buildable for Windows and Linux

Related Projects

- <https://github.com/esmini/esmini>
 - possibly base for 3D Viewer
 - RoadManager library
- <https://github.com/pyoscx>
 - Python parser for OpenDRIVE / OpenSCENARIO
- [VIRES OdrManager Light](#)
 - OpenDRIVE parser and function to process content
- <https://github.com/RA-Consulting-GmbH/openscenario.api.test>
 - OpenSCENARIO API (including checkers for XOSC)

Thank you!

