INTERACTION BETWEEN NEW ASSESSMENT TEST METHODS

Draft Proposal – Version 2.3

Definitions

['*Traffic scenarios'* are representations of specific real-world situations that exercise and challenge the capabilities of an ADS to safely operate in a given operational design domain (ODD).]

'Test case specification' are the detailed specifications of what must be done by the tester to prepare for the test.

'Test methods' is a structured approach to consistently derive knowledge about the ADS by means for executing tests, e.g. virtual testing in simulated environments, physical, structured testing in controlled test facility environments, and real-world on-road conditions.

New Assessment Test Method (NATM) Approach

The goal of the NATM is to provide clear direction for validating the safety of an ADS in a manner that is as repeatable, objective and evidence-based as possible, whilst remaining technology neutral and flexible enough to foster ongoing innovation in the automotive industry.

Therefore the NATM includes not only test methods but also an aggregated analysis (e.g., an audit) to assess whether an ADS meets the functional requirements appropriate for its ODD. The NATM should assess whether the data gathered by an ADS designer, a manufacturer or a 3rd party provide a sufficient basis to conclude that relevant safety risks were addressed appropriately.

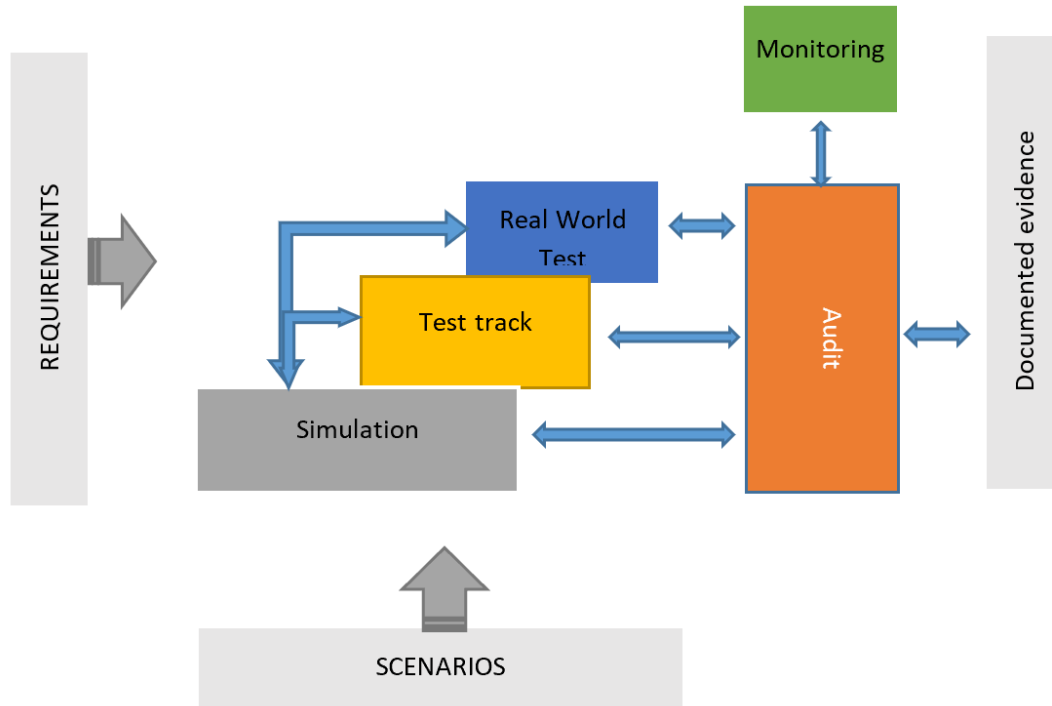**How Traffic Scenarios are applied to each Test Method**

A single traffic scenario or test method is not enough to assess all functional requirements applied to an ADS.

The functional requirement being assessed will have an impact on what test method is used as some may be better suited than others. For instance, traffic scenarios assessing:

- Path planning and control may be best examined using virtual testing because a large number tests may be carried out faster than real time to support efficient scenario coverage,
- HMI or fall back response could be more appropriately assessed via track test because the performance can be fully assessed in a discrete number of physical tests and the assessment would benefit from higher levels of fidelity,
- Interaction with other road users via real world testing where the behaviour of other road users may not be precisely represented virtually, and
- Perception may be assessed through real world evaluation or by specific virtual testing techniques using pre-recorded sensor data

Manufacturers should provide documentation that demonstrates how the functional requirement has been assessed across foreseeable traffic scenarios, recognizing that the VMAD traffic scenario database will serve as a minimum baseline only, on which manufacturers should apply their own scenarios as necessary to assess each functional requirement.

In addition, the NATM should define a set of mandatory physical tests that should be used to demonstrate compliance to specific functional requirements.

How the NATM is carried out

The NATM aims to ensure a comprehensive assessment of ADS functional/operational safety leveraging the strengths and compensating for the weaknesses across the various methods. The methods complement one another avoiding excessive overlaps or redundancy to ensure an efficient and effective validation strategy.

In general, the NATM consists of methods which Include audit, virtual tests, track tests and real world tests. Performance data that is used in the NATM will be generated by various test methods. These tests methods may be done in parallel as they will likely be used to test different functional requirements. Though in general there is a logical sequence from simulation via track testing to real-world testing, there may be deviations for specific situations.

ANNEX I

High level summary of Traffic Scenarios and Test Methods

How Traffic Scenario are Stored

- VMAD will develop a common international database of traffic scenarios which entities use to validate the safety of an ADS through various test methods.
- Given the challenges that may be posed when developing an international database (e.g., scenario priorities, development, consolidation, geographic attribution, administration, financing, operation), as a first step manufacturers or individual Contracting Parties may need to develop their own databases.
- With this in mind, if each database defines traffic scenarios in a standardized Scenario Description Language (SDL) e.g. ASAM OpenX format[1], in the future with more experience these databases can be consolidated into a one internationally recognized database of traffic scenarios.
- The development of an international database of traffic scenarios is a desirable result of, and not a prerequisite to, the development of detailed requirements and performance tests to determine ADS safety.

How Traffic Scenarios are Described

- Traffic scenarios in general should be described in a way which allows application across multiple assessment types (virtual test, track test and real-world testing). A common dictionary of terms may be required to describe scenario elements, parameter ranges for elements, and units of measure.
- Entities should make use of functional, logical and concrete scenario abstraction layers as suggested by Canada in VMAD-05-18, to effectively structure the traffic scenarios.
- The level of abstraction may be more appropriate for specific test methods. For stance, functional/logical scenarios may be more suited for real-world, whereas concrete scenarios can be derived from the logical ones for testing more specific cases in virtual testing and tracks test.

How Relevant Traffic Scenarios are Defined

An Automated Driving System (ADS) feature[2] must be able to safely perform the Dynamic Driving Task (DDT) within its Operational Design Domain (ODD).

The ODD description is used to determine which traffic scenarios are used to assess the ADS feature's ability to meet the functional requirements.

Relevant traffic scenarios within an ODD can be derived from:

- Accident data
- Real world data

---

[1] https://www.asam.net/index.php?eID=dumpFile&t=f&f=2049&token=86c6617b9c8b8517e115f889451ad4d60b43d650

[2] https://wiki.unece.org/download/attachments/92013888/FRAV-03-05-Add.2.docx?api=v2

- Functional requirements as defined by FRAV
- Engineered scenarios e.g. ISO 26262 (functional safety) and PAS/ISO 21448 (Safety of the Intended Functionality)
- Expert scenarios

Tools for the evaluation of traffic scenario coverage and representativeness should be developed, including the definition of suitable key performance indicators (KPIs).

Audit:

- The Audit Pillar will serve to assess both the robustness of organizational processes/strategies and the safety of product, whereas the other pillars will only serve to assess the safety of product. Elements of the Audit are:
    o Assessment of the robustness of Safety Management System,
    o Assessment of the (identified) hazards and risks for the system,
    o Assessment of the Verification strategy (e.g. verification plan and matrix) that describe the validation strategy and the integrated use of the pillars to achieve the adequate coverage
    o Assessment of the level of compliance with requirements achieved through an integrated use of all pillars, including consistency between the outcomes of one pillar as input for another pillar (forward and backward) and adequate use of scenario's. This level of compliance concerns both new vehicles as vehicles in use.
- Depending on the moment in the process, the audit may incorporate results from the Simulation, Track test and Real-World test. The manufacturer is responsible to provide the relevant information for each of these assessments.
- Depending on the legislative regime, assessment of the level of compliance may be (partly) derived from third parties. The auditor is responsible to evaluate this information on completeness, reliability and compliance, as well as the adequate documentation of the conclusions.

In-service safety: operational feedback

- One purpose of operational feedback is to ensure that the initial safety demonstration in the audit phase before the market introduction is confirmed in the field and that new unknown and unsafe scenarios are managed by the manufacturer.
- The other purpose would be to share learnings derived from incidents and near-miss analysis to allow the whole community to learn from operational feedback, fostering continuous improvement of both technology and legislation.

Virtual Testing:

- The purpose is to determine the system's ability to meet functional requirements during a wide range of complex and critical driving conditions. Apart from that, virtual testing enables an appropriate coverage of traffic scenarios.
- The outcome of these tests are used to support the assessment

UNECE VMAD 07-XX

- The virtual testing type (e.g. SIL, HIL, VIL etc) and the level of fidelity should be addressed when considering the overall contribution to the assessment.
- The data generated through virtual testing should be validated by physical tests (track and real world data).

Track Test:

- The purpose is to determine the system's ability to meet functional requirements during nominal and critical driving conditions.
- The data generated during the test can also be used for validation of manufacturers virtual testing data.
- The outcome of these tests are used to support the assessment
- The track tests will be carried out with high levels of fidelity in a discrete number of scenarios.
- Common test case specifications should be defined such that tests can be repeated and reproduced regardless of the entity conducting the assessment.
- Track tests should be carried out in ideal/ good conditions. The extent to which it can be used is limited due to environmental constraints as a track environment may not be able to replicate certain conditions in which the ADS is designed to operate.

Real World Test:

- The purpose is to confirm the system's ability to meet certain functional requirements during nominal driving conditions, interacting simultaneously within a complex traffic environment with many other road users, as well as its natural behavior in real world traffic.
- The outcome of these tests are used to support the assessment
- The real world test should contain an appropriate range of traffic scenarios and/or driving maneuvers.