

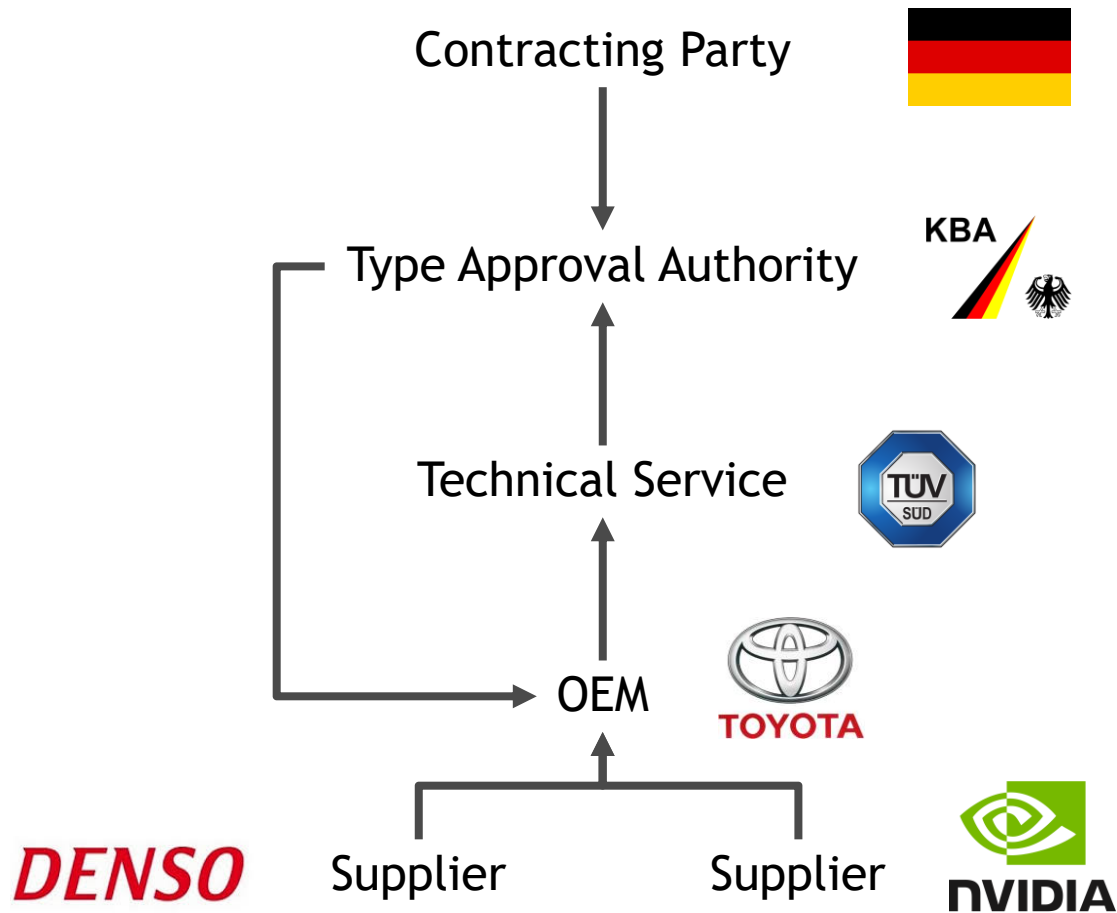


# CERTIFICATION OF AVS

07 January 2020

# TYPE APPROVAL

## Summary



A mechanism that enables manufacturers to demonstrate compliance to technical requirements defined in regulations.

Harmonizes performance and test procedures across countries around the world

Prerequisite for market access.

Reduces non-tariff barriers

# TYPE APPROVAL

## UNECE

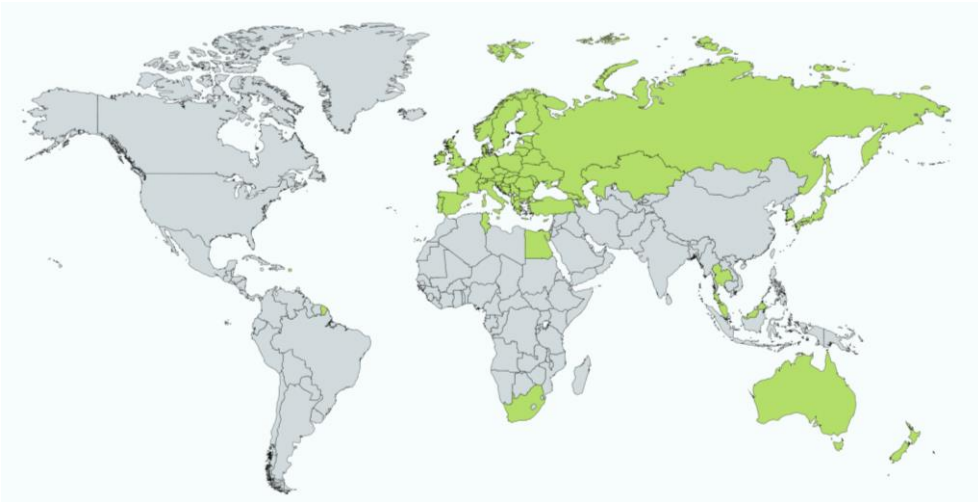
Mandatory fitment / compliance to specific regulations is dependent upon the market.

UNECE Regulations are recognized globally.

OEMs / Suppliers must demonstrate compliance to UNECE regulation in order to obtain a type approval.

### UNECE Regulations

*1958 Agreement*



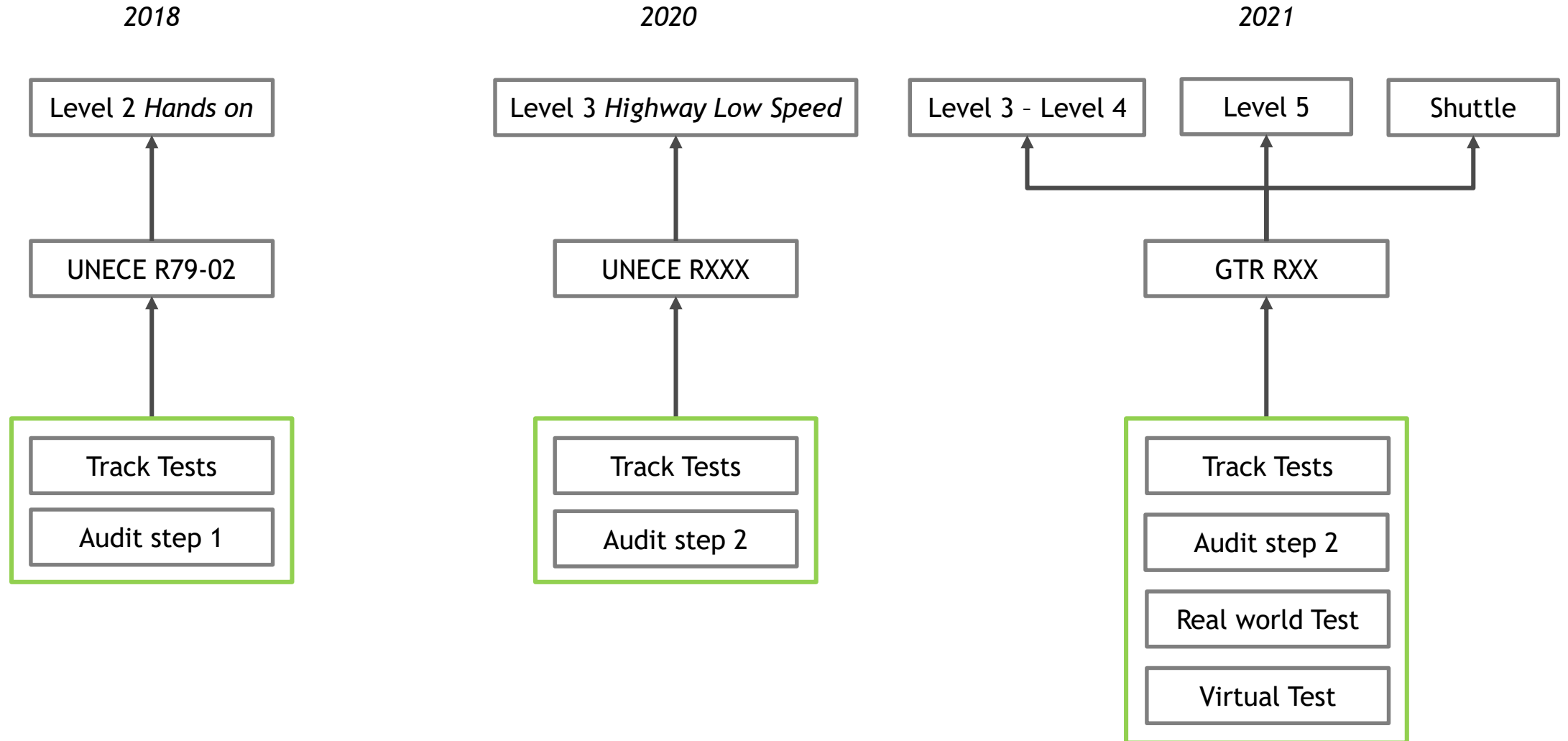
### Global Technical Regulation

*1998 Agreement*



# TYPE APPROVAL

## AD Regulations



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## UNECE Working Groups

UNECE Working Groups:

- Functional Requirements for Automated Vehicles (FRAV)
- Validation Methods for Automated Vehicles (VMAD)

Both groups are working closely to develop a framework that will define the functional requirements and the relevant assessment methods for automated/autonomous vehicles (SAE level 3-5).

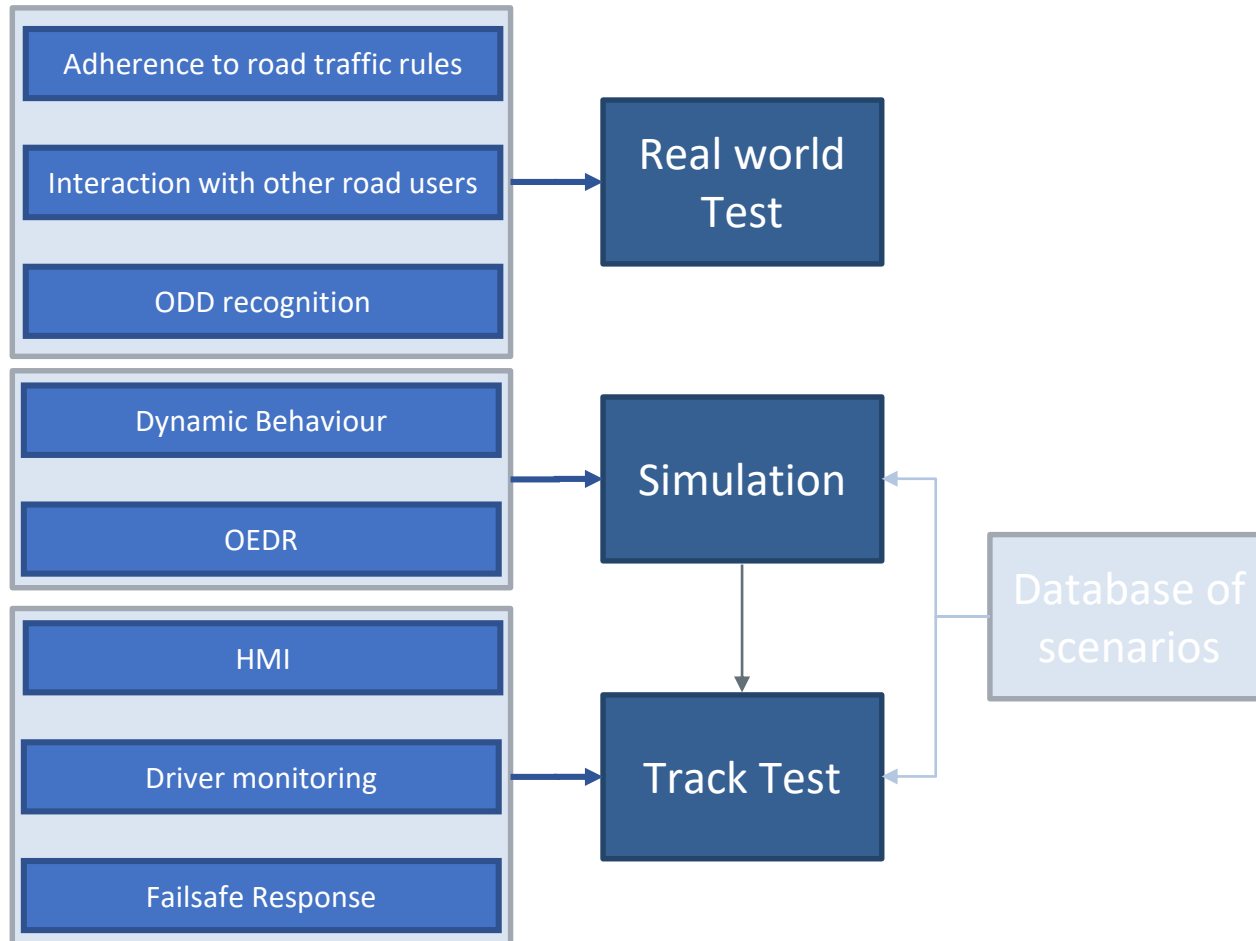
The deadline for completing the work is Q1 2021.

The requirements will be applicable to both the 1958 and 1998 Agreements. Guidelines adopted / amended by each CP and region, based on the work, with regulation to follow after more experience. Existing guidelines incl: EC, CAN, US, J, AUS, CHN, WP.1, SaFAD, etc.

# AV CERTIFICATION

## Concept

Functional Requirements (FRAV)    Assessment Methods (VMAD)



- Each assessment method has its pros and cons and can be used to assess certain functional requirements.
- A database of scenarios can be used to provide a list of scenarios that are tested in simulation and on track.
- The majority of scenarios will be tested in simulation.
- Simulation results are validated by comparing the performance of the ADS on a test track – this will be done on a small subsection of scenarios.

# AV CERTIFICATION

## Concept

- Scenarios are generated from accident data (critical scenarios) and real-world data (nominal scenarios).
- Scenarios should be applicable to simulation and track tests. Real world scenarios are not applicable as very difficult/impossible to ensure real world conditions match the scenario.
- Scenarios will be defined in a standardized scenario description language (OpenScenario2.0, OpenDrive etc)
- Ideally these scenarios are to be held in an international database
- The curator of the scenarios are yet to be defined - this depends on the owner of the database (OEMs, individual Governments (TAAs), EU, UNECE etc)
- Manufacturers will provide evidence through simulation results that the ADS meets the functional requirements in those scenarios.
- The simulation tools used by the OEM will not be defined but the methods for validating those tools may be defined.

# AV CERTIFICATION

## Scenario Database

GTR RXX

### International/common database of scenarios?

Requiring physical track tests to be defined in regulation for all ADS / ODD combinations is not feasible and would require continuous updating. It is therefore understood that scenarios assessing dynamic driving should be assessed by simulation and be derived from:

- Crash data
- Theoretical / top down risk assessment
- ADS development knowledge / experience
- Synthetically generated scenarios from key parameter variation
- Engineered scenarios (functional safety / safety of the intended function)

The level of risk can be reduced by ensuring the quality of the scenario coverage whilst also validating the performance of the system in these known scenarios. With sufficient coverage it can be expected that the system would react effectively in those remaining and unknown scenarios.

Manufacturers will be required to test by simulation the ADS in all scenarios relevant to the ODD that are defined in a database.



# AV CERTIFICATION

## Scenario Databases

Existing databases incl:

- **DRIVE SWEDEN** - Sweden
- **MUSICC** - Multi-User Scenario Catalogue for Connected and Autonomous Vehicles - United Kingdom
- **MOSAR** - Méthodes et Outils pour la conception et la validation de Systèmes Autonomes Robustes (includes scenarios library for AD design and validation - France
- **PEGASUS**: Project for the Establishment of Generally Accepted quality criteria, tools and methods as well as Scenarios and Situations - Germany
- **SAKURA** - Safety Assurance Kudos for Reliable Autonomous Vehicles - Japan

Ideally there will be a common international database of scenarios which OEMs must demonstrate performance against. However considering the aggressive timeframe and the difference in scenarios across different territories. As a first step the framework may require OEMs / CPs to develop their own databases, whilst demonstrating the tools used ensure sufficient scenario coverage and described in a standardized SDL. After more experience all databases can be merged.

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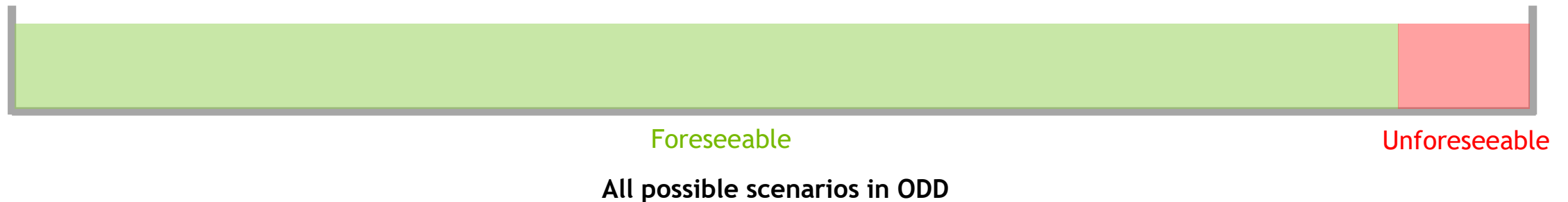
GTR RXX

## Assessment of Safety Concept

When in automated driving mode the vehicle shall not cause any traffic accidents that are rationally foreseeable and preventable.

Foreseeable scenarios are derived from;

- Accident data
- Theoretical / top down risk assessment
- ADS development knowledge / experience
- Synthetically generated scenarios from key parameter variation
- Engineered scenarios (functional safety / safety of the intended function)



# AV CERTIFICATION

GTR RXX

## Assessment of Safety Concept

When in automated driving mode the vehicle shall not cause any traffic accidents that are rationally foreseeable and preventable.

Of those foreseeable scenarios, the ADS must perform better than a 'reference driver'.

By applying the reference driver model to those foreseeable scenarios it is possible to determine which are preventable and which are unpreventable.

The driver model is still up for debate (human driver, skilled human driver, driver without faults etc)

