Preliminary Input: Certification of Automated/Autonomous Driving Systems

WP.29 IWG ITS/AD session, Geneva
16 November 2017
The concept and building blocks for certification of automated/autonomous driving systems that are discussed in this presentation could be applied both under a type approval or self-certification regime.

A regulation for certification of automated/autonomous driving systems could also be designed as a Global Technical Regulation (GTR) under the 1998 agreement.

As usual, application of a regulation under a self-certification regime requires precise descriptions of the procedures and tests to be applied by the manufacturer.

In a first step, the intention of this presentation is to start the discussion of suitable building blocks and regulation structure.
Example whole vehicle type approval: IWVTA or EC-WVTA

Safety
- Braking UN-R13H
- Lighting UN-R48
- Steering UN-R79
- Frontal Impact UN-R94

Environment
- Emissions UN-R83
- Noise UN-R51
- Energy consump. UN-R101

Other
- Anti Theft UN-R116
- Engine power UN-R85

Automated/Autonomous Driving Systems UN-Rxxx *

* Under discussion if all aspects should be included in a single future Regulation or if –at least for some aspects - a modular split into several Regulations is appropriate
Possible Building Block of a Certification Process

- **classical physical certification test**
  - exactly defined
  - worst case

- **real world test drive**
  - analogous to RDE

- **process-oriented audit**
  - annex for complex electronic systems (e.g. UN R-13H, R-79)
    - ISO 26262
    - simulation tools

- **manufacturer’s declaration**
  - in the sense of general product safety responsibility
    - e.g. NHTSA FAVP* in the sense of „self-assessment“

*Federal Automated Vehicles Policy
Challenges/Premises for a Suitable Approach

- It is important to consider that WP.29 is aiming at regulating the use of new technologies some of which are not available on the market yet
  - lack of experience should not be neglected and tackled with reasonable strategies

- It will be difficult to regulate each and every topic in detail from the early beginning
  - need to prioritize the different topics
  - start with a first set of requirements and develop further as the technology evolves

- Technology for Automated/Autonomous Driving Systems will continue to evolve rapidly over the next years
  - need a flexible structures that can be applied to the different kinds of L3-L5 systems
  - “function by function-approach” that would frequently require formal updates/ upgrades of regulations is not practical

- Need to find a pragmatic way that on the one hand leaves “controlled” flexibility for industry and authorities and on the other hand defines reasonable requirements/principles to ensure a safe evolution of the new technology over the next years
  - structure should allow to add output of research initiatives and lessons learnt at a later stage
Concept for a Structure of a Regulation Automation Level 3*-Level 5

Use-Cases: Urban, Highway, Interurban, [Parking] for automation levels 3*, 4 and 5
Requirements address vehicle behavior in road traffic and further general safety requirements

<table>
<thead>
<tr>
<th>Physical Certification Tests</th>
<th>Real World Test Drive</th>
<th>Audit</th>
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</thead>
<tbody>
<tr>
<td>Dedicated, reproducible worst-case tests for specific scenarios that cannot be guaranteed to occur in real world test drives</td>
<td>Test drive to assess the vehicle’s standard behavior in public road traffic, compliance with traffic laws and maneuvers according to defined checklist</td>
<td>OEM provides e.g.: - Safety concept / functional safety strategy - Simulation and development data to verify vehicle behavior in edge cases - Manufacturer’s self declarations - etc.</td>
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<tr>
<td>+ Objective performance criteria</td>
<td>+ Limited testing efforts</td>
<td>← pros/cons: see RWTD</td>
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<tr>
<td>– Significant testing efforts</td>
<td>- Subjective influence on judgments</td>
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<td>– Transfer of requirements into reproducible tests technically difficult or likely to result in remarkable functional restrictions</td>
<td>- Requires highly skilled and qualified test house/certification agency to appropriately assess systems</td>
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* If not covered by UN-R 79 ACSF – ACSF results for highway could also be transferred afterwards
Overview: Contents and Methods for Verification

<table>
<thead>
<tr>
<th></th>
<th>Physical testing (defined, test track/lab)</th>
<th>Real world driving test</th>
<th>Audit by test house/certification agency</th>
<th>Self declaration by manufacturer</th>
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<tbody>
<tr>
<td><strong>General system requirements</strong></td>
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<tr>
<td>HMI (internal and external)</td>
<td>X</td>
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<td>Driver monitoring</td>
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<td>Transition scenario</td>
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<td>Minimum risk maneuver</td>
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<td>Functional safety</td>
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<tr>
<td>Data storage</td>
<td>X</td>
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<tr>
<td>Cybersecurity</td>
<td></td>
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<td>X</td>
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<td>OTA-updates</td>
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<td><strong>Vehicle behavior on the road</strong></td>
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<tr>
<td>(a) Basic capabilities of the vehicle</td>
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<td>X</td>
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<td>(b) Test scenarios for physical testing</td>
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<tr>
<td>(c) Real world test drive</td>
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<td>(d) Repository of test cases</td>
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* If not covered by a separate UN-Regulation (under discussion, see also footnote slide 2)
Physical certification tests
- General idea: scenarios for which it can be guaranteed that they can be tested in the real world driving test need not be replicated as physical tests.

Real world driving test
- 30-60 minutes in realistic traffic environment for use case: highway, urban, inter-urban
- Checklist with mandatory plus optional traffic situations to be filled out by Test House/Certification Agency

Audit
- General requirements and safety concepts
Traffic rules (code of the road)
- Verification of compliance during real world driving test for the country in which test is performed
- Verification of all implemented traffic rules (other designated countries for application) during audit

Environmental conditions (Weather and Lighting)
- Verification during audit: review of manufacturer’s strategies and testing

Extended repository of test cases
- For simulation and real test data collected during development phase
- Verification during audit
Main Concepts (3 of 3)

Use-case specific flexibility
- If the manufacturer can provide evidence that certain requirements are not relevant due to the foreseen use-case, the respective requirements are not applicable

Flexible regulation structure
- Allows to foresee placeholders that can be worked out at a later state (e.g. rural roads/interurban)
- Allows to add results of other research initiatives (e.g. scenario data base approach)
Development of a Regulation structure and some content has been started by OICA

The draft structure consists of 6 annexes with the following initial content:

1. **General System Safety Requirements***
   - HMI (internal and external)
   - Driver monitoring
   - Transition scenario
   - Minimum risk maneuver
   - Functional safety
   - Data storage
   - Cybersecurity
   - OTA-updates

*If not covered by a separate Regulation (under discussion, see also footnote slide 2 and 6)
Vehicle behavior on the road is reflected by the following Annexes:

2. Special requirements in highway traffic
3. Special requirements in urban traffic
4. Special requirements in interurban traffic
[5. Special requirements in parking scenarios]
6. Special requirements to show adherence to national/regional traffic rules

- Each of these Annexes contains the following paragraphs:
  1. Overall capabilities
  2. Physical Tests
  3. Checklist for test drive (use-case specific)
  4. Extended repository of test cases

- OICA can offer walkthrough of working document in the near future when more matured and broader consensus has been reached within OICA
How to Structure the Work

- As multiple topics are affected by automated/autonomous driving systems, the work on a certification regulation should in a first step be organized directly under WP.29 (analogue to UN-R 0 IWVTA) \(\Rightarrow\) an assignment to different GRs with different reporting lines should be avoided as the context is likely going to be lost.

- Consider Lessons Learned from the IWG ACSF when organizing the future work \(\Rightarrow\) e.g. use the benefit of temporary small experts group/working packages to efficiently prepare proposals on specific items; see also slide 4.

- In the long run, aspects of connected and automated/autonomous driving may be transferred to a newly established dedicated GR-Group \(\Rightarrow\) needs to be staffed with sufficient resources.

- Collaboration between the WP.1 and WP.29 relevant groups is key in the process of exchanging knowledge and approaches in regulating automated and autonomous driving functions.