

Draft UN Regulation on DCAS — Outline

I. General

Background

- GRVA adopted at its 9th session in February 2021 the terms of reference for the Task Force on Advanced Driver Assistance Systems (ADAS).
- The Task Force (TF) focuses on Advanced Driver Assistance Systems (ADAS), and shall address the simplification of UN Regulation No. 79 and if needed, develop a new ADAS UN Regulation with a focus on ADAS systems up to of level 2 (as defined in ECE/TRANS/WP.29/1140).
- The TF on ADAS agreed to start developing a new UN Regulation.

What to be covered in a new UN Regulation?

(ADAS-03-07, updated)

- To address ADAS in general with a focus on systems combining longitudinal and lateral support on a sustained basis:
 - To provide a safety net (minimum requirements) for any ADAS especially the ones can't be approved today.
 - To consider combinations of lateral and longitudinal assisted driving systems.
- To introduce a comprehensive approach to Driver Control Assistance Systems (DCAS) performance/assessment:
 - Performance requirements applicable to any combination of lateral and longitudinal motion control assistance (UN R R79 focused on steering system). Strong emphasis on driver engagement in vehicle operation and HMI.
 - More comprehensive compliance assessment methods compared to those in UN R 79 (where specific tests are developed for each use case).
 - Aligned with discussions in FRAV/VMAD on generic requirements/ assessment for ADS.
- Without prejudice to possible more detailed requirements on some ADAS in other regulations such as the ones currently covered in UN R 79

Continuous assistance – primarily designed to reduce the workload while driving, these systems are still beneficial for road safety (ADAS-06-10)

Key contributors to road traffic accidents:

- Speeding
- Too little distance
- driver disengagement from the driving task
- Human limitations
- Wrong judgement

The use of continuous assistance could encourage the driver to:

- Keep an appropriate distance to other road users
- Drive at the permitted speed
- React to potential hazard preventatively
- Judge situations correctly

And thereby contribute to overall road safety, provided appropriate measures are taken to ensure drivers properly monitor the system and the environment.


New industry-requested ADAS use cases: a few examples (ADAS-08-04)

Main requests by the industry:

- Allow operation in a larger set of operational environments
- Allow more dynamic control
- Allow system-initiated manoeuvring
- Allow so called “hands-off” systems

Use Case
Assisting changing lanes in a non-highway environment

Description
Assisting the driver in performing a lane change in urban or inter-urban scenarios (e.g. changing from one lane to another at a fork/intersection)



ODD
Domain:

- Urban
- Inter-urban


Speed:
< [70]km/h

Assumed driver supervision/involvement:

- Hands-on lateral control

Use Case
Assisting Driving through roundabouts

Description
Assisting the driver in driving through a roundabout



ODD
Domain:

- Urban
- Inter-urban

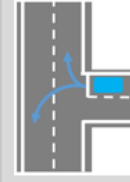
Speed:
< [70]km/h

Assumed driver supervision/involvement:

- Hands-on lateral control

Use Case
Assisting Turning at an intersection

Description
Assisting the driver in turning at an intersection



Specifics:

- With/without traffic lights

ODD
Domain:

- Urban
- Inter-urban


Speed:
< [70]km/h

Assumed driver supervision/involvement:

- Hands-on lateral control

Use Case
Driving around obstacles being in the driving lane

Description
Assisting the driver in following a driving path around obstacles, which are blocking the current driving lane.
(this is not an emergency situation)



Specifics:

- the adjacent lane may be used by traffic moving in the same or in the oncoming direction

ODD
Domain:

- Urban
- Interurban


Speed:
Usually in urban scenarios <[50]km/h
In inter-urban environments < [100]km/h

Assumed driver supervision/involvement:

- Hands-on lateral control

Use Case
Changing Lanes, initiated by the system

Description
Assists the driver in performing lane changes when deemed reasonable



ODD
Domain:

- Highway
- Multilane roads without oncoming traffic

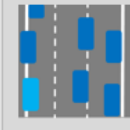
Speed:
No restriction

Assumed driver supervision/involvement:

- Hands-on lateral control

Use Case
Forming an emergency corridor

Description
Assisting the driver in the formation of a corridor for emergency vehicles at low speed



Specifics:

- With/without crossing of lane markings

ODD
Domain:

- Highway
- Multilane roads without risk of oncoming traffic

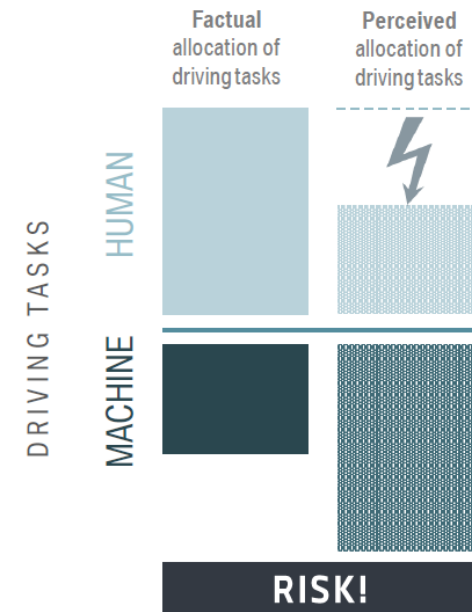
Speed:
< [30]km/h

Assumed driver supervision/involvement:

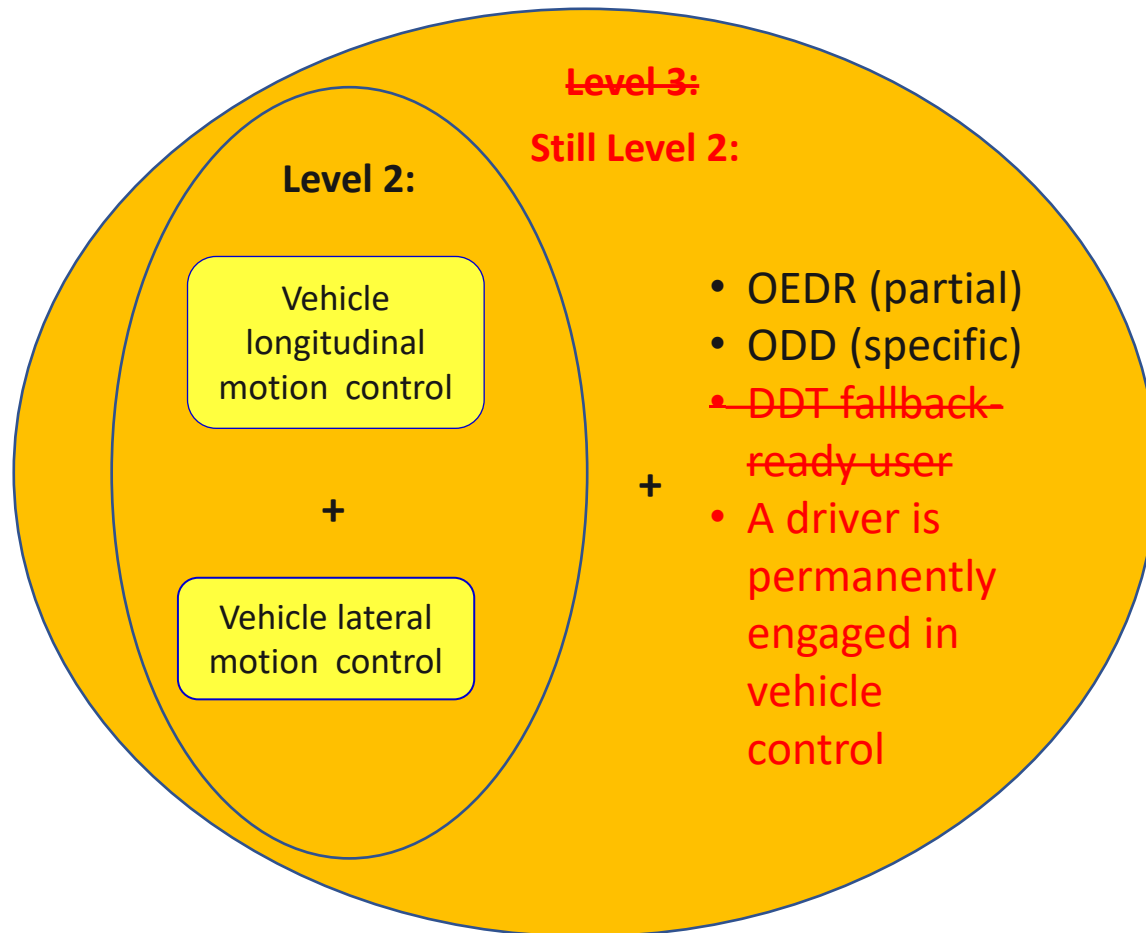
- Hands-on lateral control

Safety issues (ADAS-15-04)

- “L2 systems cannot become L3 systems by just further extending the ODD and performance” – Schuster (BMW), 2022 SafetyWeek
- “The driver needs to be able aware of the allocation of driving task all times!” – Raisch (BMW), 2022 SafetyWeek
- System should be robust “enough” that it does not bring the vehicle to safety critical situation
- “Added functionality can exacerbate driver misunderstanding about system limitations” - IIHS
- “Risky situations can develop if the vehicle starts to move or performs a complex maneuver before the driver is ready” - IIHS
- “Unexpected system behavior takes time for a driver to react to”



Identifying risks with level 2 systems



There are two main risks with a level 2 system:

1. The system is so poor that the operator (driver) is constantly intervening to prevent catastrophic outcomes, and/or
 2. The system is so good that the operator (driver) ceases to provide proper supervision (up to and including driver unresponsiveness).
- In the first case, the system requires so much driver intervention that it impairs driver operation of the vehicle.
 - In the second case, the system is so reliable that the driver may not be available to intervene when needed.

The regulatory objectives should ensure that:

- The system provides stable control under the use conditions for which it is designed;
- The system has safeguards to guarantee that the driver is always ready to intervene;
- The system enables smooth transactions with the driver with safeguards to manage problematic transactions.

Agreed DCAS Key Principles

1. **“Driver” refers to a human being driving a vehicle.**
 - 1.1. A DCAS does not replace the driver (ADS); a DCAS assists the driver (ADAS).
 - 1.2. A DCAS does not change the driver’s responsibilities for control of the vehicle.
2. **A DCAS is a driver-operated vehicle system.**
 - 2.1. A DCAS must prevent reasonably foreseeable risks of driver misuse or abuse.
 - 2.2. A DCAS must have means to evaluate continuous driver involvement in and supervision of the vehicle operation.
 - 2.3. A DCAS do not aim to permit driver activities other than driving in addition to those permitted for manual driving.
 - 2.4. A DCAS must provide sufficient information to enable the driver to supervise its motion-control assistance.
3. **A DCAS assists the driver via sustained lateral and longitudinal motion-control support.**
 - 3.1. The DCAS support must not adversely impact road safety.
 - 3.2. The DCAS support must not adversely impact driver control over the vehicle behavior.
4. **The availability of a DCAS to the driver is constrained by defined system boundaries.**
 - 4.1. The manufacturer must describe the system boundaries.

II. DCAS UN R & UN R 79 Scope Separation

DCAS Definition

- “*Driver Control Assistance System (DCAS)*” means the hardware and software collectively capable of assisting a driver in controlling the longitudinal and lateral motion of the vehicle on a sustained basis.

Applicability of UN R 79 / draft DCAS UN R for various system configurations

System Configuration	UN R 79	Draft DCAS UN R
ACSF-B1 + manual longitudinal control	YES	NO (only Level 2)
ACSF-B1 + manual longitudinal control + Hands off	NO	NO (anything beyond R 79 needs to be L2)
ACSF-B1 + ACC	YES	YES (but Level 2 requirements)
ACSF-B1* + ACC * Lateral accelerations > 3m/s ²	NO	YES (but Level 2 requirements)
ACSF-B1 + ACC + Hands-off	NO	YES (but Level 2 requirements)

For this case, an equivalent level of safety needs to be ensured!

General principles on the scope and separation of the draft DCAS UN R and UN R 79 (1/3)

The obvious:

1. L1 lane keeping and lane change systems continue to be approved to UN R 79 ACSF B1 and ACSF C, and can be used together with an ACC
2. Features of the draft DCAS UN R - section 6 have to be approved to DCAS UN R (because they are in conflict with UN R 79)

What about the rest of the systems:

- Requirements between UN R 79 and the draft DCAS UN R applicable to lane keeping and driver initiated lane change will not be identical, because the draft DCAS UN R is deliberately drafted to cover more operating domains and apply to different types of systems.
- But the draft DCAS UN R should ensure an equal level of safety compared to the provisions established in UN R 79, although potentially achieved through other means.
- To achieve such an equal level, the provisions of the draft DCAS UN R shall be matched with those of UN R 79. Even, the relevant provisions of UN R 79 could be used for the draft DCAS UN R as well. *The drafting is ongoing to achieve this.*

General principles on the scope and separation of the draft DCAS UN R and UN R 79 (2/3)

Consequences:

1. An ACSF that can only be operated as L2 hands-on and without any advanced features has to be approved to UN R 79 (this ensures consistency for existing systems and the driver's experience with them);
2. Sustained lane keeping and driver-initiated lane change that are activated together with advanced DCAS features can be either approved to UN R DCAS, or UN R 79 if they meet the UN R 79 ACSF requirements, by the manufacturer's declaration, to ensure a consistent safety argumentation for all parts of the system.
3. If the system can be configured that sustained lane keeping and driver initiated lane change can operate without any of the specific features implemented in the vehicle, this mode of operation is still covered by UN R DCAS and shall fulfill the provisions of UN R DCAS.

General principles on the scope and separation of the draft DCAS UN R and UN R 79 (3/3)

The concept of scope separation

The essential concept remains to eliminate both 'double-testing' and incompatibilities in technical provisions, at the same time keeping UN R 79 unchanged for those parties which might only apply UN R 79. This would also help to simplify the scope of the draft DCAS UN R:

- Functions approved to UN R R79 shouldn't have to also be approved to (or meet the technical requirements of) DCAS UN R;
- Functions approved to DCAS UN R shouldn't also have to be approved to (or meet the technical requirements of) UN R 79;
- Contracting Parties which do not apply DCAS UN R should still be able to require compliance with UN R 79 in-full.

Realization

The proposal for amendments to UN R 79 is presented in GRVA-17-07.

III. DCAS UN R Construction

Content of the draft DCAS UN Regulation (1/2)

Introduction	← Detailed explanation of the nature of DCAS and regulatory consequences
1. Scope	
2. Definitions	
3. Application for approval	← Common content with other UN Regulations
4. Approval	← Common content with other UN Regulations
5. Specifications	
6. Requirements for Specific DCAS Features	
7. Monitoring of DCAS operation	← Provisions for in-service monitoring and reporting (post-type approval compliance assessment pillar)
8. System Validation	← General provisions regarding compliance assessment with reference to annexes dedicated to system validation
9. System Information Data	← Provisions requesting specific data to be submitted by manufacturers in the approval process
10. Requirements for Software Identification and Cyber Security	← Provisions stipulating manufacturers' actions in case of software update

Content of the draft DCAS UN Regulation (2/2)

11. Modification of vehicle type and extension of approval	← Common content with other UN Regulations
12. Conformity of Production	← Common content with other UN Regulations
13. Penalties for non-conformity of production	← Common content with other UN Regulations
14. Production definitively discontinued	← Common content with other UN Regulations
15. Names and addresses of the Approval Bodies	← Common content with other UN Regulations
Annex 1 – Communication	← Common content with other UN Regulations
Annex 2 - Arrangements of approval marks	← Common content with other UN Regulations
Annex 3 (plus appendixes) – Audit	← Provisions regarding compliance assessment by means of auditing manufacturers' documentation
Annex 4 - Physical Test Specifications for DCAS Validation	← Provisions regarding compliance assessment by means of track and public road testing
Annex 5 - Principles for Credibility Assessment for using Virtual Toolchain in DCAS Validation	← Provisions to be applied in case of using simulation in compliance assessment process

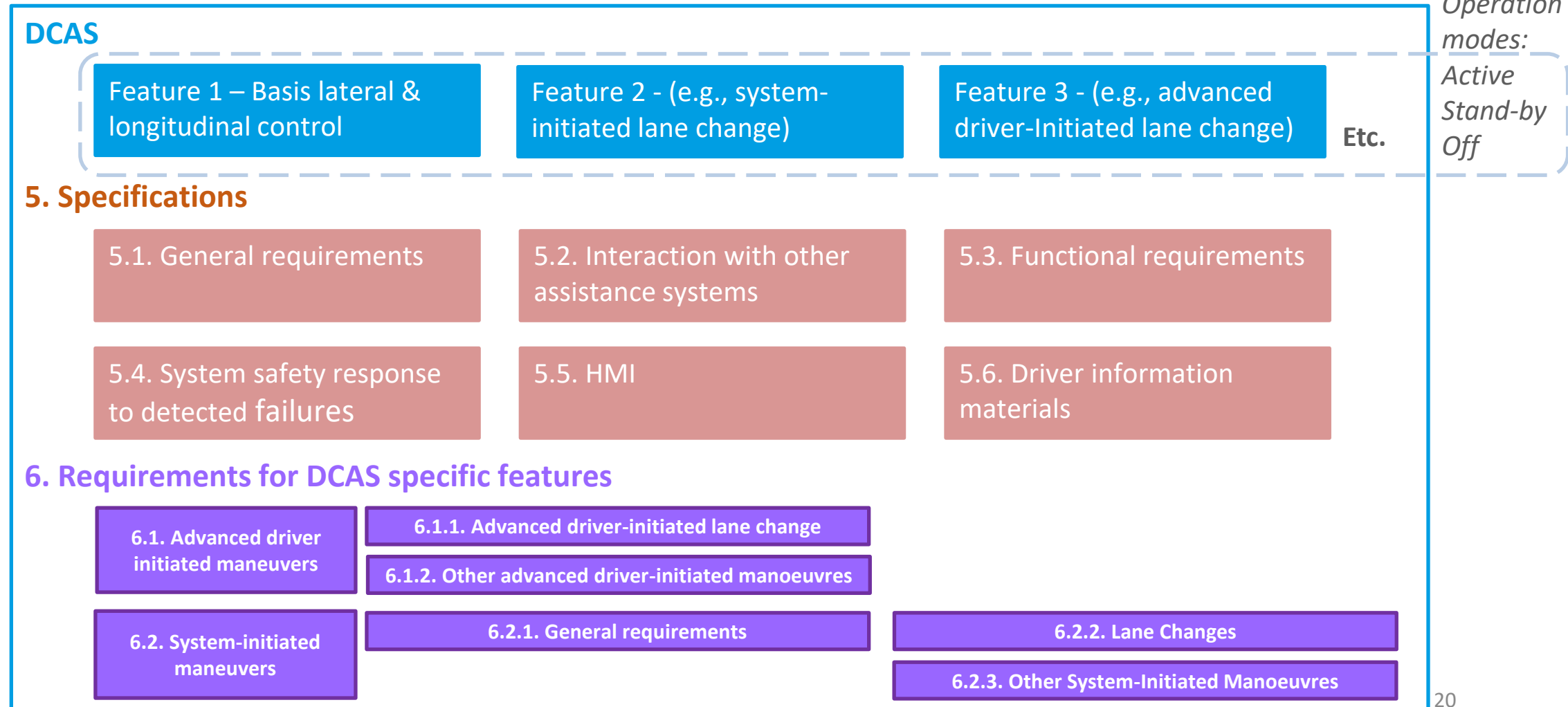
Language of requirements (ADAS-23-04)

The availability of DCAS, and their capability to assist, are constrained by the defined system operational boundaries. This impact of system boundaries on the system's ability to fulfil certain requirements, and the nature of how certain requirements can be assessed, is reflected by the language of requirements:

- Some requirements are expected to always be met, including in all relevant tests. These provisions are phrased as “the system shall...”.
- Some requirements are such that whilst the system is generally expected to fulfil them, either this might not be appropriate or achievable under the specific circumstances, or external disturbances may still lead to a varying output. These provisions are phrased as “the system shall aim to...”.
- Some requirements are difficult to verify by assessing system performance directly and are more readily verified by assessing the design of the system, for example by analyzing its control strategies. These provisions are phrased as “the system shall be designed to...”.

DCAS to be assessed as a L2 system comprising of a number of features

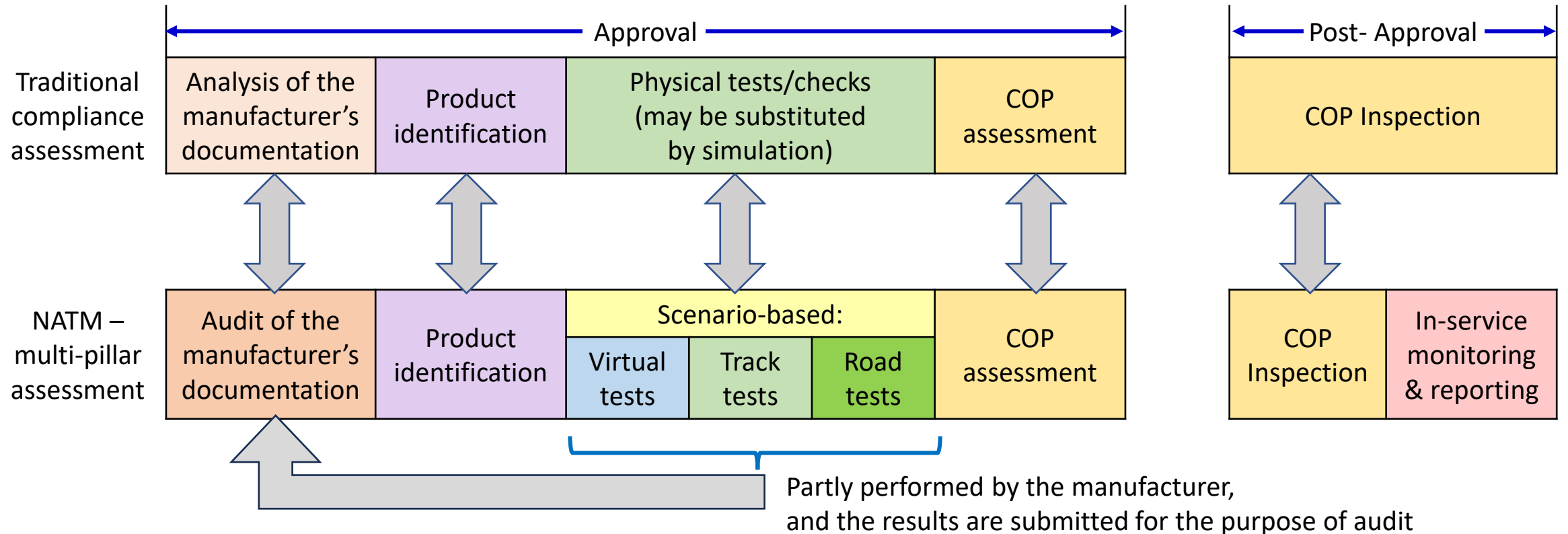
- “(DCAS) Feature” means a specific DCAS capability providing assistance to the driver in defined traffic scenarios, circumstances and system boundaries.



An approach to DCAS Validation (ADAS-17-03)

- Due to DCAS operation in multiple domains, to ensure safe operation in all domains, for DCAS validation, “multi-pillar” techniques have been implemented, as they have been elaborated by the IWG on VMAD as the New Assessment Test Method (NATM):
 - The multiple assessment techniques compensate uncertainties related to operational cases that are not assessed directly and thus cover DCAS multiple operational cases that should be assessed;
 - Extensive assessment through multiple pillars allows a deep assessment of the manufacturer’s design (e.g., functional safety, controllability, driver engagement strategies) and allows for system flexibility to dynamically handle environments.
 - This in turn avoids requiring the definition of specific limit values. Appropriate behavior and control is verified in test scenarios;
 - In addition, the manufacturer will be required to monitor and report on system performance following entry into service;
 - The enhanced assessment techniques are not new; they are already known and implemented in other areas: this would ensure easier implementation of those in the DCAS UN Regulation; We implement synergy of these techniques.

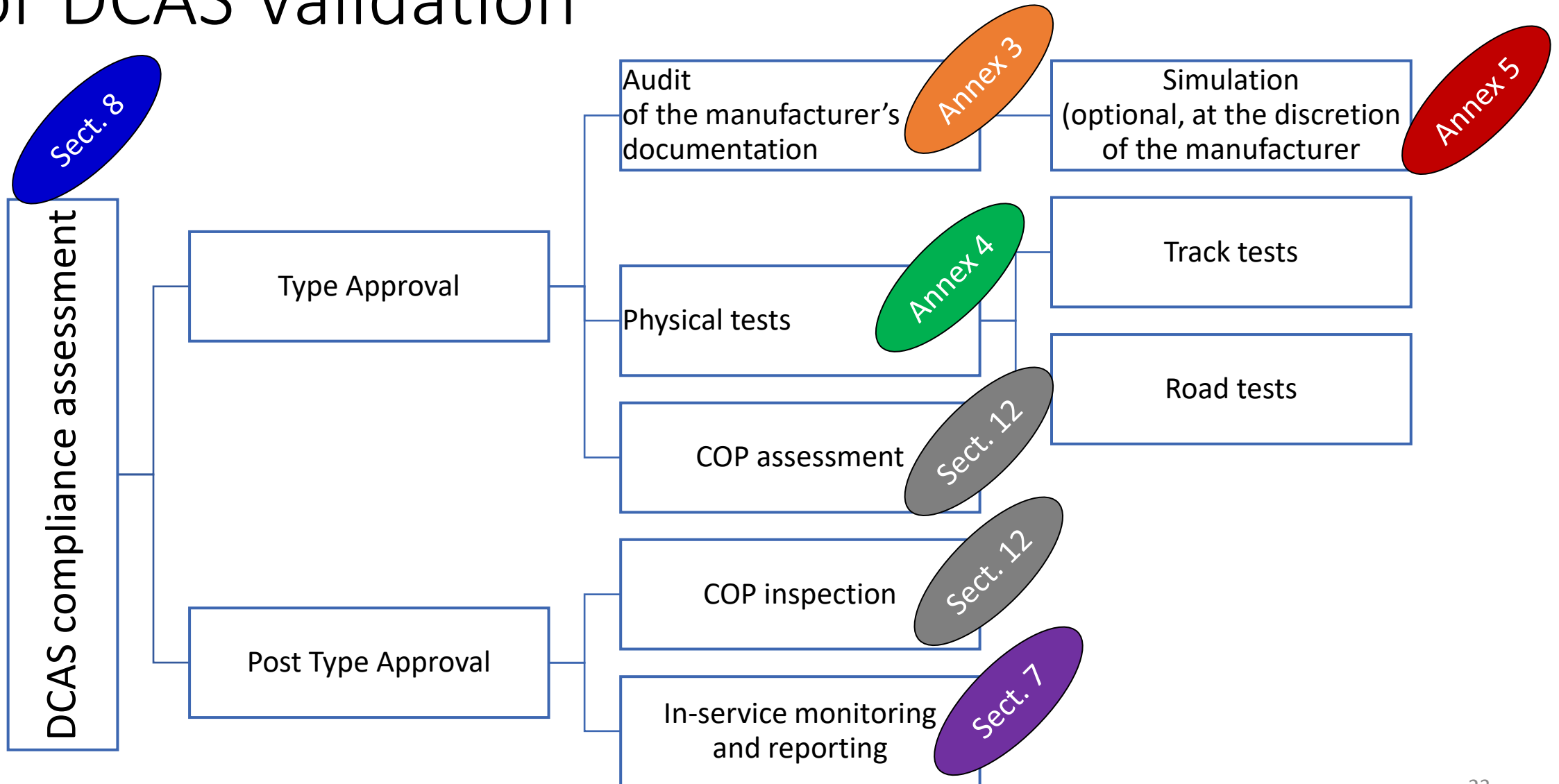
1958 Agreement Compliance Assessment Chart



The NATM elements are more comprehensive compare to those of traditional compliance assessment.

The width of the cells is not time-scaled.

Proposed Multi-Pillar Techniques for DCAS Validation



IV. Specifications (Requirements)

Section 5 – 5.1. General Requirements

- Driver must remain engaged (Re.: 5.5.4.2.)
- Manufacturer shall implement strategies to ensure mode awareness and avoid driver overreliance (Re.: 5.5.4.)
- Manufacturer shall take effective measures to guard against reasonably foreseeable misuse by the driver
- Driver must be able to override or deactivate at any time (Re.: 5.5.3.4.)
- Must be equipped with emergency safety systems (UN Regulation Nos. 131, 152, 179 and 130)

Section 5 – 5.2. DCAS interaction with other vehicle assistance systems

- DCAS operation shall not suppress or deactivate other emergency assistance systems
- Transitions between DCAS and other assistance or automation systems, prioritization, suppression and deactivation to ensure nominal and safe operation shall be described to the TAA.

Section 5 – 5.3. Functional Requirements Outline

- Detailed manufacturer description of detection capabilities and system boundaries of system and features, as well as other equipped systems
- Assess and respond to surroundings as required to implement intended functionality
- Adapt behaviour to surrounding traffic conditions by avoiding disruption of the flow of traffic
- Use longitudinal and lateral motion to maintain appropriate distances from other road users
- Other relevant vehicle systems may be activated (e.g. wipers, heating, indicators)
- Control strategy shall aim to reduce risk of collision and ensure controllability (per 5.3.6)

Section 5 – 5.3. Functional Requirements

5.3.1. System detection capabilities to be described by the manufacturer

5.3.2. The system shall be able to assess and respond to its surroundings according to its functionality, within the system boundaries

5.3.3. The system may activate relevant vehicle systems when necessary (e.g., direction indicators)

5.3.4. The manufacturer's control strategy shall [aim to] reduce the risk of collision and the system shall aim to ensure controllability by the driver

5.3.5. Response to system boundaries

5.3.6. Controllability

Section 5 – 5.3.5. Response to system boundaries

- Detected boundaries when switched on
- Detailed description of system boundary conditions for each system and feature (considering Annex 3 Appendix 3)
- Describe behaviour and impact on system performance when beyond boundaries
- Declare means of identification of system boundaries
- Notify driver when system boundary is exceeded and terminate assistance in predictable and controlled way. Strategy described.
- Warning when approaching of a system boundary

Section 5 – 5.3.6. Controllability

- System shall aim to ensure that control actions by the system including, but not limited to those resulting from failures and/or reaching system boundaries remain controllable. This must take into account the driver's potential reaction time.
- System shall implement strategies relevant to the system's intended operational design, within defined system boundaries to be assessed by the TAA, e.g.:
 - Limiting system steering output
 - Adjusting position in the lane of travel
 - Road type and attribute determination
 - Other road user behaviour determination
 - Driver monitoring used

Section 5 – 5.3. Functional Requirements (cont-d)

5.3.7. System dynamic control

- 5.3.7.1. Lane keeping
- 5.3.7.2. Lane change
 - 5.3.7.2.1. General
 - 5.3.7.2.2. Driver-initiated lane-change assistance
- 5.3.7.3. Driver unavailability response

5.3.8. Longitudinal control

- 5.3.8.1. Deceleration and acceleration
- 5.3.8.2. Speed limit compliance assistance
- 5.3.8.3. Safe headway assistance

Section 5 – 5.3.7.1. Lane keeping

- Shall keep a stable position in its lane of travel within its boundary conditions. Lateral acceleration values to be specified by the manufacturer.
- Only permitted higher lateral acceleration than 3.0 m/s^2 provided
 - the system provides visual information to the driver on the upcoming driving situation/manoeuvre which may induce higher values
 - System adapts vehicle speed to upcoming changes in road curvature
 - System ensures driver is engaged confirming visual attention
- Leaving the lane to form an access corridor for emergency and enforcement vehicles allowed
 - If system only leaves its current lane of travel when this is required and allowed according to national traffic rules
 - System to ensure sufficient lateral and longitudinal distance to road boundaries, vehicles and other road users
 - Return completely to original lane of travel once situation requiring intervention transpired

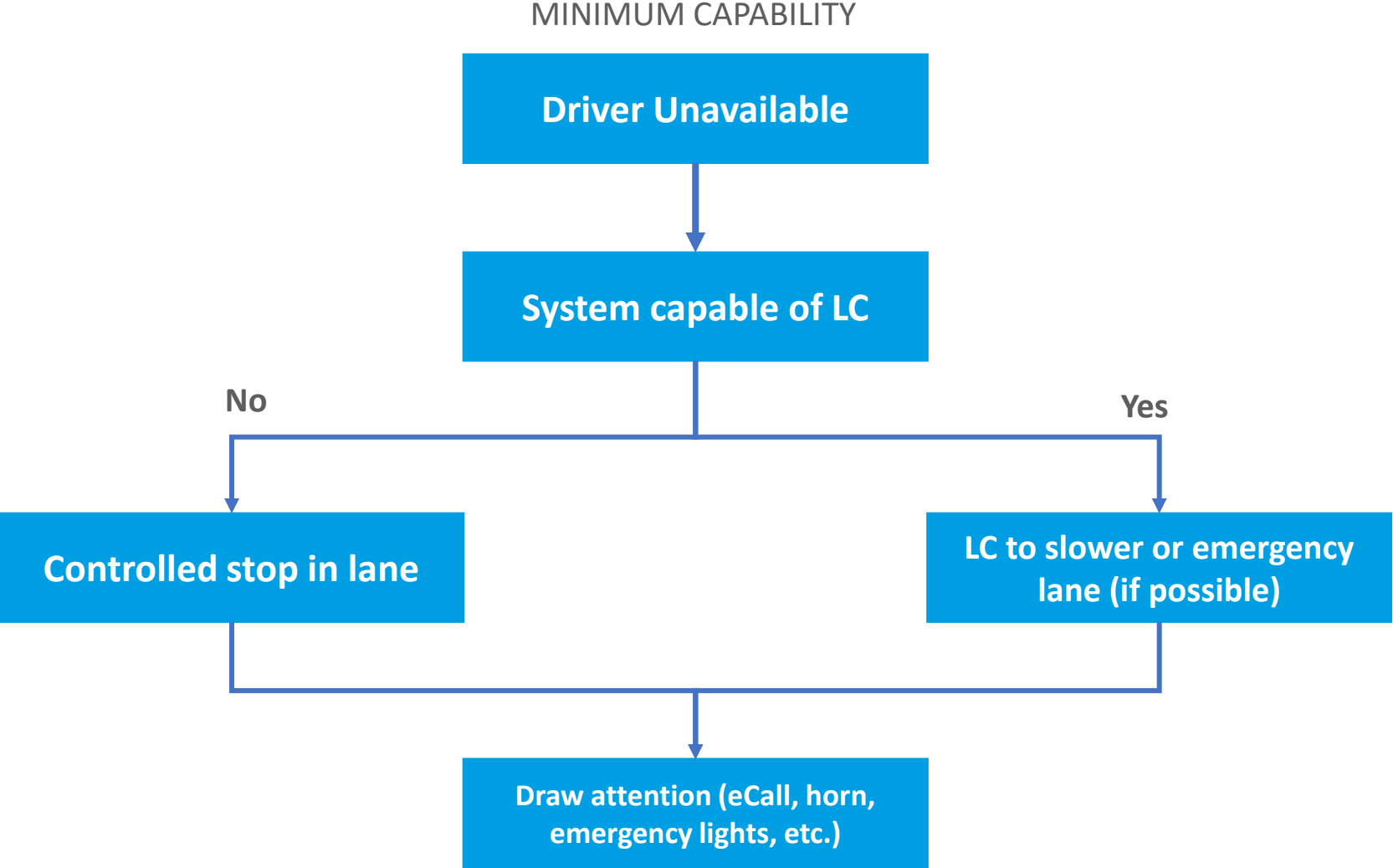
Section 5 – 5.3.7.2. Lane change

- Sufficient notice to be provided to the driver. Compliance with requirements in 6.1.1 and 6.2.2 mandated.
- Lane change requirements largely aligned with recent approaches in R79

Section 5 – 5.3.7.3. Driver unavailability response

- When driver is determined to be unavailable following an engagement warning cascade, slow down and aim to remain in the lane of travel. Avoid deceleration demand of greater than 4.0 m/s^2 until coming to a stop. Hazard lights activated
- Manufacturer to implement strategies to draw external attention to the emergency situation (e.g. emergency call, horn use)
- Higher deceleration values are permitted for very short durations, e.g. as haptic warning
- If equipped with a lane change system, aim to perform lane changes towards a slower or emergency lane if capable of doing so, accounting for surrounding traffic and road infrastructure.
- Alternatively, compliance with RMF or additional response strategies can be evidenced.

Driver unavailability response chart



Alternative (e.g. RMF) or more complex strategies permissible to account for varied use cases

Section 5 – 5.3.8.1. Deceleration and acceleration

- System acceleration or deceleration shall remain controllable for surrounding traffic, unless increased levels of deceleration are required to ensure safety of the vehicle and/or surrounding road users. To be declared.

Section 5 – 5.3.8.2. Speed limit compliance assistance

- Aim to detect the applicable speed limit in current lane of travel
- Continuously display system-determined speed limit
- Aim to follow the system-determined speed limit or driver-speed limit, whichever is lower
- Control not to exceed the speed limit, provide a means to override
- Any assisted deceleration should be controllable
- When the driver overrides and exceeds a system-determined speed limit, provide optical warning
- When override ends, system resumes control based on last system-determined speed limit or driver-set speed.
- Alternatively, evidence compliance with national regulations for speed limit control systems. To be declared.

Section 5 – 5.3.8.3. Safe headway assistance

- System aims to make driver comply regulatorily defined headway according to national traffic rules
- For M1 & N1, requirement fulfilled if either:
 - A visual warning is provided upon first activation during a run cycle that the headway configuration is set to $<[2]$ s
 - Visual warning is provided when system detects that the headway to the road user ahead is too short/shorter than necessary for safe operation

Section 5 – 5.4. System safety response to detected failures

- Detection of electrical and non-electrical failure conditions affecting safe operation
- If a failure affects safe operation of a system/feature, control assistance of given system/feature to be terminated in safe manner according to safety concept
- Manufacturer to take measures to ensure failures must remain controllable for the driver
- System to switch “off” if failure affects the entire system upon termination of assistance, coupled with optical and audible failure warning signal. Gradually reduce control assistance if capable of doing so and inform the driver.
- If failure affects specific features, system operation is permitted to continue if remaining features are unaffected
- Notice to driver when a system or feature affected by a failure is attempted to be switched “on” or “activated” by driver.

Section 5 – 5.5. HMI

5.5.1. System modes of operation

5.5.2. General requirements

5.5.3. Activation, deactivation, driver override)

5.5.4. Driver information, driver engagement and warnings to the driver

5.5.4.1. System messages and signals

5.5.4.2. Driver state monitoring and warning strategies



5.5.4.2.1. Driver disengagement monitoring

5.5.4.2.2. General requirements for driver disengagement warnings

5.5.4.2.3. Types of warnings

5.5.4.2.4. Disengagement detection and re-engagement support

5.5.4.2.5. Assessment of motoric disengagement

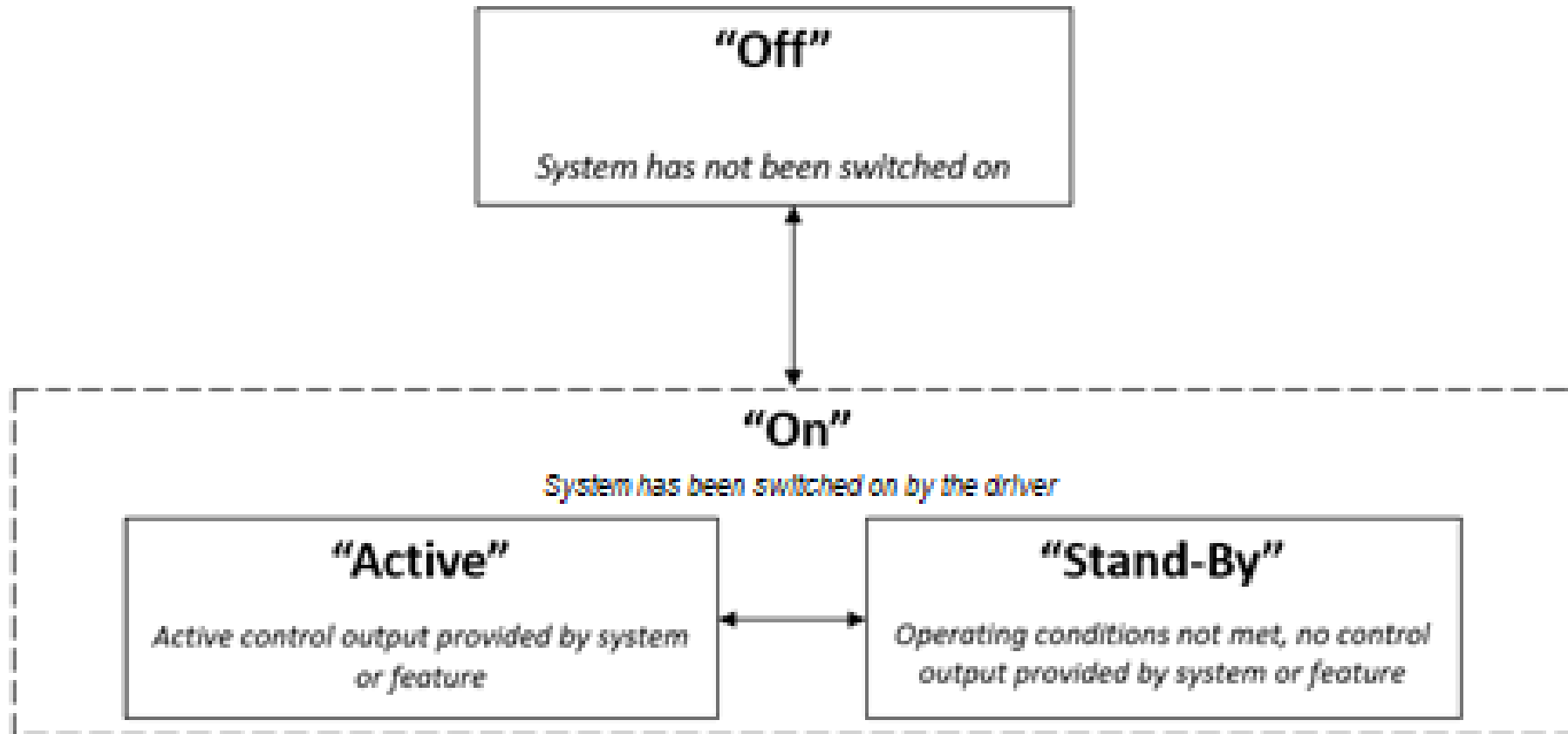
5.5.4.2.6. Warning escalation sequence in the event of motoric disengagement

5.5.4.2.7. Assessment of visual disengagement

5.5.4.2.8. Warning cascade in the event of visual disengagement

5.5.4.2.9. Repeated or prolonged driver disengagement

Section 5 – 5.5.1. Modes of operation



Section 5 – 5.5.3.2. System activation

- “Off” to “On” only upon a deliberate action by the driver
- “Active” only if:
 - Driver’s in the seat and safety belt is fastened
 - System is able to monitor driver’s engagement with the driving task
 - No failure affecting the safe operation of the system has been detected
 - System has not detected to be outside of system boundaries
 - Other safety systems are operational

Section 5 – 5.5.3.3. System deactivation

- System can be switched off at any time. When switched off, system to go “off”
- If preconditions for activation are no longer met, the system or features shall no longer generate control output by transitioning to “stand-by” or “off”
- Automatic deactivation upon a standstill following an emergency intervention.

Section 5 – 5.5.3.4. Driver override

- May remain “active” when a driver overrides provided priority is given to the driver’s input
- Input to the braking control higher than system-generated deceleration or by maintaining the vehicle in standstill, to override longitudinal control function
- Accelerator input shall temporarily revert longitudinal control assistance to “stand-by” until end of override
- Steering input shall override the steering action. Effort necessary shall not exceed 50 N. May allow minor lateral corrections.

Section 5 – 5.5.4.1. System messages and signals

- Inform the driver on system status, request of the driver to perform a specific action, system boundaries, detected failures, intended driver-confirmed or system-initiated manoeuvres (or sequence)
- Signals to be clear, timely and noticeable. Not lead to confusion.
- Use combination of visual, audio and/or haptic feedback
- Messages and signals should be prioritized if offered in parallel. Safety-relevant messages and signals to be prioritized. Explained by manufacturer
- Messages and signals to encourage driver understanding of intended system control outputs
- System messages to be unambiguously distinguishable from messages by other assistance or automation systems equipped on the vehicle
- Aim to visually communicate deactivation reason
- Inform driver on availability of features, and inability to activate a given feature.
- [May take into account potential impairments of users]

Section 5 – 5.5.4.1.11. System messages and signals for system-initiated manoeuvres

- System to visually inform the driver about upcoming manoeuvres [at least 3 seconds] ahead of their initiation. System to
 - Inform the driver ahead of time about the sequence of manoeuvres that are upcoming
 - Inform the driver of system intent at a given point in time (e.g. notice that system is changing speeds to perform a lane change)
- Any notice to clear and easy to understand
- Messages and signals aim to avoid driver complacency and misuse

Section 5 – 5.5.4.2. Driver state monitoring and warning strategies (1/2)

- System to be equipped with the means to detect driver disengagement depending on the assistance provided, driving and environmental conditions
- Monitor physical [and/or] visual disengagement using appropriate criteria
- If driver detected to be disengaged, warning to be provided
- Warning shall guide driver about the required actions to resume appropriate engagement
- If the driver continues to be disengaged, the warning shall be escalated. Remains on as long as driver is disengaged or until system deactivation
- Continued disengagement triggers unavailability response
- Repeated or prolonged driver disengagement may lead to inability to reactivate the system for the start/run cycle

Section 5 – 5.5.4.2. Driver state monitoring and warning strategies (2/2)

The system shall monitor driver attentiveness according to all of the following criteria:

- The driver's gaze and/or head movement is confirmed as primarily directed towards the currently driving task relevant area (e.g., road ahead, relevant mirrors or relevant direction of travel).
- The driver's distraction or drowsiness..
- The driver is providing motoric input to the vehicle controls (e.g. steering control input, pedal application, control switch operation, etc) appropriate for the current driving situation.

The driver shall be considered to be attentive if any of the above criteria are met. The manufacturer may declare additional criteria. All criteria used to assess the driver's general attentiveness shall be evidenced and demonstrated by the manufacturer to the satisfaction of the Type Approval Authority.

Section 5 – 5.6. Driver information materials

- Manufacturer must provide clear and easily accessible information (e.g. documentation, video, website materials) instructing the driver on DCAS operation
- Materials should explain responsibility, limitations and how warnings should be interpreted
- Documentation and educational materials not to describe system in a manner that would mislead customer about the capabilities/limits
- Information to be legible for a non-technical audience
- Example information points:
 - Safety benefit of DCAS
 - How DCAS exerts dynamic control assisting the driver
 - System Boundaries
 - Driver Engagement Detection
 - HMI elements
 - Etc.

Section 6 – Requirements for DCAS specific features

6.1. Advanced driver initiated maneuvers

6.2. System-initiated maneuvers

6.1.1. Advanced driver-initiated lane change

6.2.1. General requirements

6.1.2. Other advanced driver-initiated manoeuvres

6.2.2. Lane Changes

6.2.3. Other System-Initiated Manoeuvres

Section 6 – 6.1.1. Advanced Driver-initiated lane change

- If system designed to assist lane changes on roads where there is no physical separation, system shall implement strategies to ensure that lane change procedure is only performed where there is no oncoming traffic in the target lane
- Only permitted to perform lane changes on roads with pedestrians and cyclists if the system is able to reduce the risk of a collision with any vulnerable road user
- Time between initiation of the lane change procedure and start of the lane change is only permitted to be extended beyond [7s] where this is not in violation of national traffic rules, and there is engagement of the driver with the ongoing lane change by looking at the relevant areas of road ahead, to the side, or looking to the vehicle's mirrors.

Section 6 – 6.1.2. Other driver-initiated manoeuvres

- Relevant to manoeuvres where the vehicle selects a lane, enters into or takes a roundabout exit, leads vehicle to leave its lane of travel when this is not a lane change, leads the vehicle to take a turn, leads the vehicle to depart or arrive at a parked position, other
- System and signals for system-initiated manoeuvres applies. System to ensure driver has sufficient time to confirm.
- Request to be indicated through a visual and audible signal
- Cannot proceed if request is not confirmed. If so, continue on lane of travel or request resumption of control
- Aim to respond to vehicles, road users, infrastructure and a blocked path ahead within or to be in planned trajectory
- Aim to respond to traffic lights, stop signs, right-of-way infrastructure and restricted lanes.
- Aim to safely and cautiously navigate hillcrests where relevant for the manoeuvre
- Aim to respond appropriately to road users and infrastructure where VRUs cross the lane of travel
- Detailed activation requirements

Section 6 – 6.2.2. System-initiated lane changes

- Text adjusted from ALKS
- Consideration of adjusted parameters for the assessment of the target lane for a regular lane change, in consideration of different lane characteristics in e.g. urban environments. To be declared by the manufacturer

Section 6 – 6.2.3. Other system-initiated manoeuvres

- Similarity to driver-initiated manoeuvres
- More extensive, stringent national traffic rule compliance obligations
- More extensive detect and response requirements
- Any manoeuvre to be indicated to other traffic
- System cannot be initiated if manoeuvre would cause other road users to unreasonable decelerate/evade

Section 9 – System information data

New obligation, in addition to CEL Audit, for manufacturer to declare in detail the system and features permitting detailed assessment/verification.

Aimed to outline system characteristics

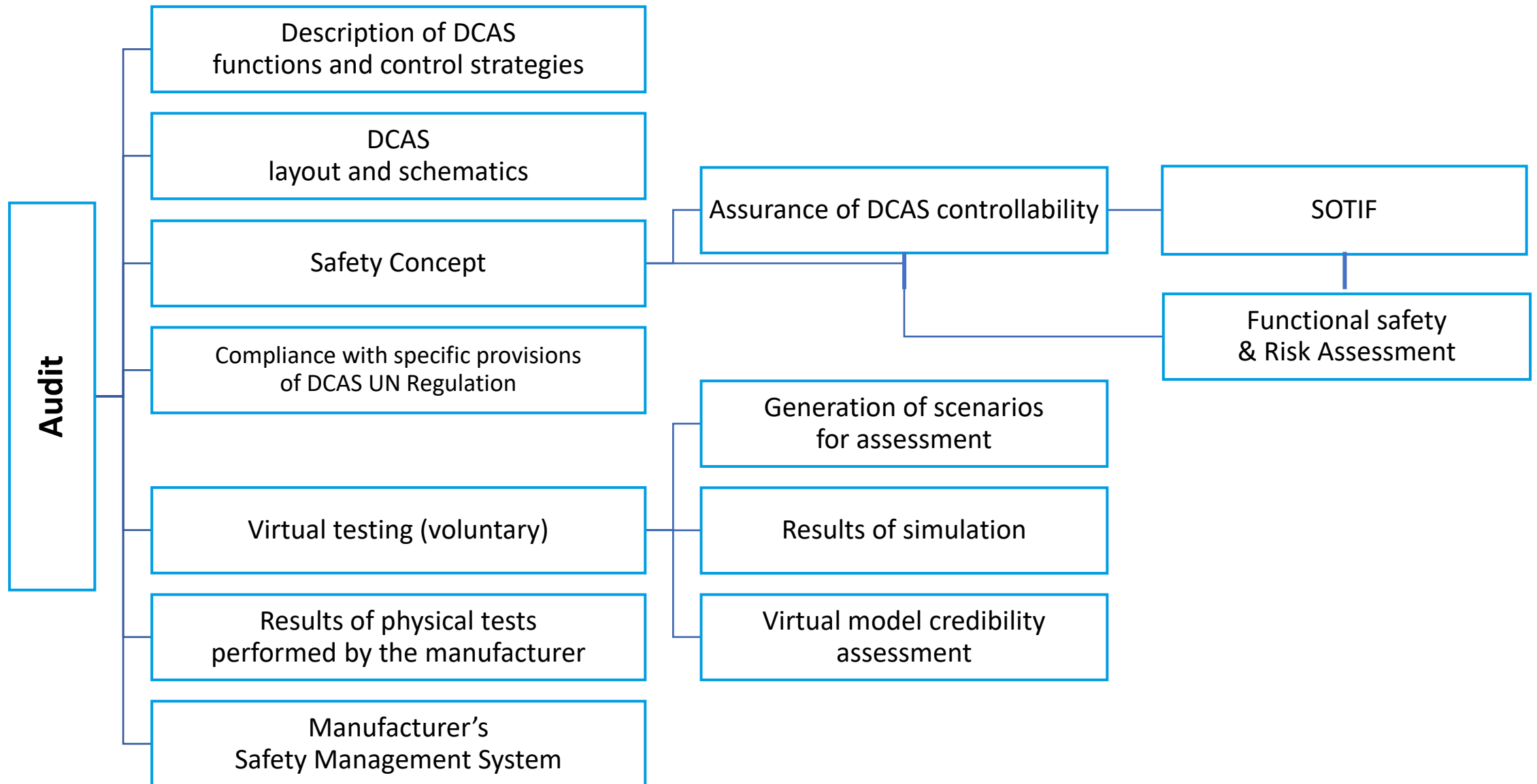
- Specific features on the system according to section 6
- Conditions for activation & system boundaries
- DCAS interaction with other vehicle systems
- Means for activation, deactivation and override
- Criteria monitored and means to determine sufficient driver engagement

Section 10 – Requirements for software identification and cyber security

- RXSWIN may be implemented, if so must comply with UN Regulation No. 156 (based on R.E.3)
- System compliance with UN Regulation No. 155 to be evidenced

V. DCAS Validation

Assessment Pillar: Audit (Annex 3)



Appendices to Annex 3

- Appendix 1 - Model assessment form for electronic systems, and/or complex electronic systems
- Appendix 2 - System design to be assessed during the audit (list of items stipulated in the main text of the Regulation, required to be submitted by the manufacturer for the purpose of audit)
- Appendix 3 - Exemplary Classification of the System Detection Capabilities and Relevant System Boundaries
- Appendix 4 – Manufacturer's declaration of system capability

Appendix 4 – Manufacturer's declaration of system capability

Aimed to outline system/feature performance to support testing.

1. System's capability to respond to other road users
2. System's capability to follow the course of the lane
3. Road events which the system may recognize relevant to the given declared system boundaries and system design
4. System's ability to ensure safe operation when assisting lane changes (applicable to both driver- and system-initiated lane changes)
5. System's ability to safely perform other driver-initiated or system-initiated manoeuvres in non-highway environments without driver intervention
6. System's ability to operate in accordance with traffic rules related to a certain driver-initiated manoeuvre
7. System's ability to operate in accordance with traffic rules related to a certain system-initiated manoeuvre

Assessment Pillar: Physical testing (Annex 4)

TRACK TESTING

- Basic capabilities
- **Critical/emergency situations**
- Repeatability



PUBLIC ROAD TESTING

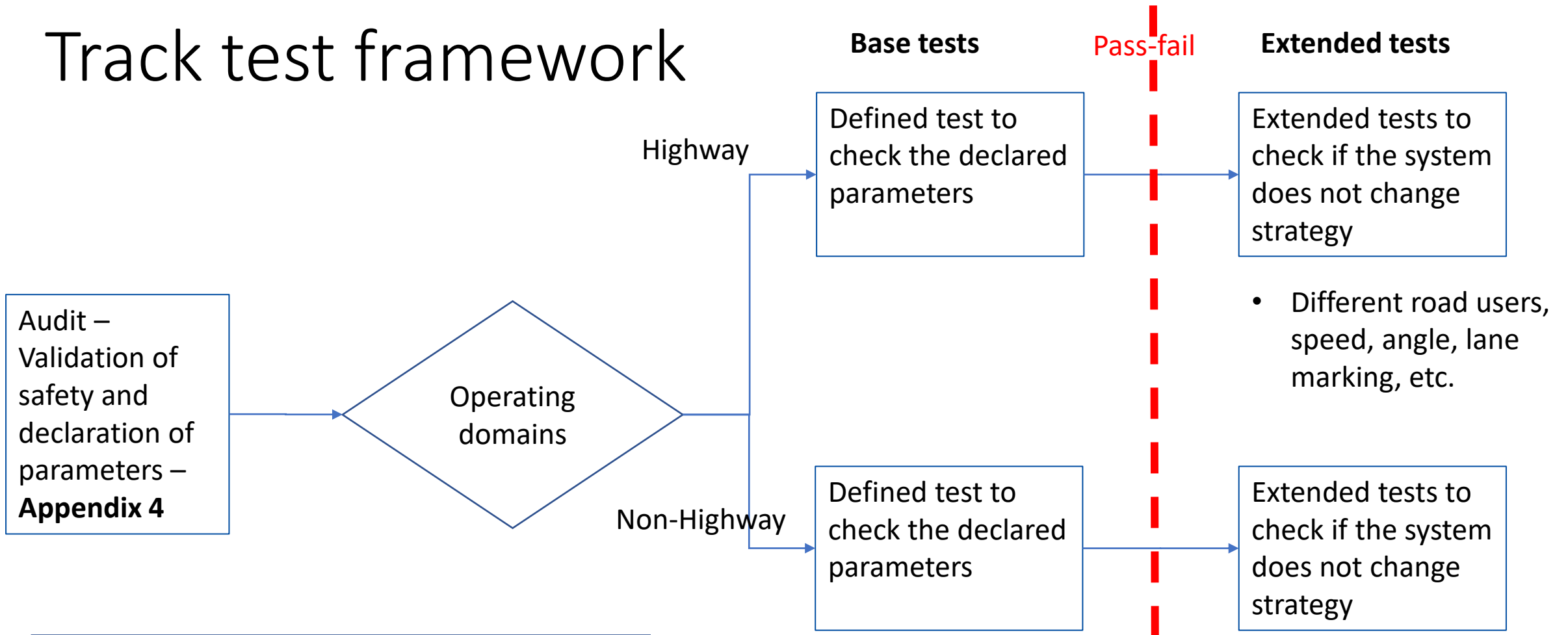
- Final verification
- **Normal operation in real world**
- Representativeness

Principles of testing (ADAS-21-05)

- Test **all relevant requirements** either through track or public road tests
- Include relevant **traffic, ODD related and failure scenarios**
- Include a variety of ODD related targets
- Scenarios with possible danger -> track
- Nominal behaviour -> public roads

- **Create a framework for the definition of pass-fail criteria**

Track test framework



Refers to Appendix 4 to Annex 3 (declaration)

Response to road users

Follow the lane / path

Road events

Specific manoeuvres

Traffic rules

“Base Test” means a test scenario where the manufacturer shall declare a threshold for the missing boundary conditions (e.g. vehicle under test speed) up to which the system is able to safely control the vehicle.

“Extended Testing” means a set of test scenarios with a combination of test design variations to verify that the system does not unreasonably change the control strategy compared to the declared value and strategy in the base test, within the declared system boundaries.

Requirements and system aspects to be tested

Requirements or system aspect to be assessed	Physical test scenario or audit	Reference in main text
Driver Information, Driver Engagement and Warnings to the Driver	Annex 3 , 4.1.1.	Paras. 5.1.1. and 5.5.4.
System Assurance of Driver Engagement	Annex 3 , 4.1.1.	Paras. 5.1.2. and 5.5.4.2
Reasonably foreseeable misuse	Annex 3, 4.1.1.	Para. 5.1.3.
System override	Annex 3, 4.1.1.	Paras. 5.1.4. and 5.5.3.4.
Equivalent performance of other safety systems (UN Regulations No. 131, No. 152, No. 79 and No. 130)	4.2.5.2.1.1., 4.2.5.2.2.1., 4.2.5.2.3.1., 4.2.5.2.4.1., 4.2.5.2.8.1., 4.2.5.2.9.1., 4.2.5.2.10.1., 4.2.5.2.11.1.	Para. 5.1.5.
Functional requirements		Para. 5.3.
Detection Ranges for lane change	4.2.5.2.5.1, 4.2.5.2.6.1.	Para. 5.3.2.
Vehicle behaviour in traffic (Avoid disruption of traffic flow, maintain appropriate distance from other road users, reduce risk of harm, deceleration/acceleration, traffic rules, headway distance)	4.3.1., 4.3.2.	Paras. 5.3.4., 5.3.5., 5.3.8., 5.3.13.1, 5.3.13.2., 5.3.13.3.
Activating relevant vehicle systems	Annex 3 , 4.1.1.	Para. 5.3.6.
Detecting and Reaching DCAS boundaries	Annex 3 , 4.1.1.	Para. 5.3.10.
Controllability	Annex 3 , 4.1.1.	Para. 5.3.11.
Lane keeping	4.2.4., 4.2.5.1.1.	Para. 5.3.12.1.
Driver-initiated lane-change assistance	4.2.5.1.2.	Para. 5.3.12.2.
Driver unavailability response		Para. 5.3.12.4.
Failure response		Para. 5.4.
DCAS operation, driver interaction and driver information		Para. 5.5.
Lane Keeping (increased lateral dynamics)		Para. 6.1.1
Driver-initiated lane change		Para. 6.2.1.
Other driver-initiated manoeuvres	4.3.3.	Para. 6.2.2.
System initiated manoeuvres	4.3.3.	Para. 6.3.
System-initiated Lane Change	4.2.4., 4.2.5.1.1.	Para. 6.3.2
Other system-initiated Lane Changes		Para. 6.3.3

Assessment Pillar: In-Service Monitoring (Section 7)

Monitoring

- Manufacturer must maintain processes to monitor safety-critical occurrences resulting from DCAS operation
- Manufacturer must notify Authority without undue delay of any severe accidents where DCAS was active, or active [x] seconds before accident, resulting in:
 - Deployment of airbags and/or restraints
 - Activation of emergency systems
- Any safety-critical occurrence within system boundaries which may impact the broader safe use of DCAS, must be investigated and notified to the Authority (incl. applicable remediations)
- Approval Authority shall have authority to request investigation results from the manufacturer [within 6 months of the occurrence or accident] subject to national rules

Periodic Reporting to the Approval Authority

List of occurrences for in-service reporting

Occurrence	Periodic Reporting once a Year
1.a. Safety-critical occurrences known to the manufacturer	X
1.b. Aggregated distance driven with Paragraph 6 features switched on or active	X
2.a. Detection of prolonged driver disengagement, resulting in a warning escalation sequence	X
2.b. Activation of an emergency system, such as a Risk Mitigation Function, due to the continuous driver disengagement	X
3.a. Detected system-level failures resulting in the unavailability of DCAS	X
3.b. Detected DCAS-deactivations without prior warning to the driver	X
3.c. Detected driver response to system deactivation	X

Assessment Pillar: Simulation (Annex 5)

- Simulation may be optionally used by manufacturers to extend evidence of compliance
- If simulation is used, the principles for credibility assessment for using virtual toolchain in DCAS validation shall be implemented.

Acknowledgements

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Thank you for your attention!