

Clarification of the boundaries between ADAS and ADS

Revision 3

A follow-up to the exchange between CPs
and the discussion at the 11th GRVA session
concerning the distinction between ADAS and ADS

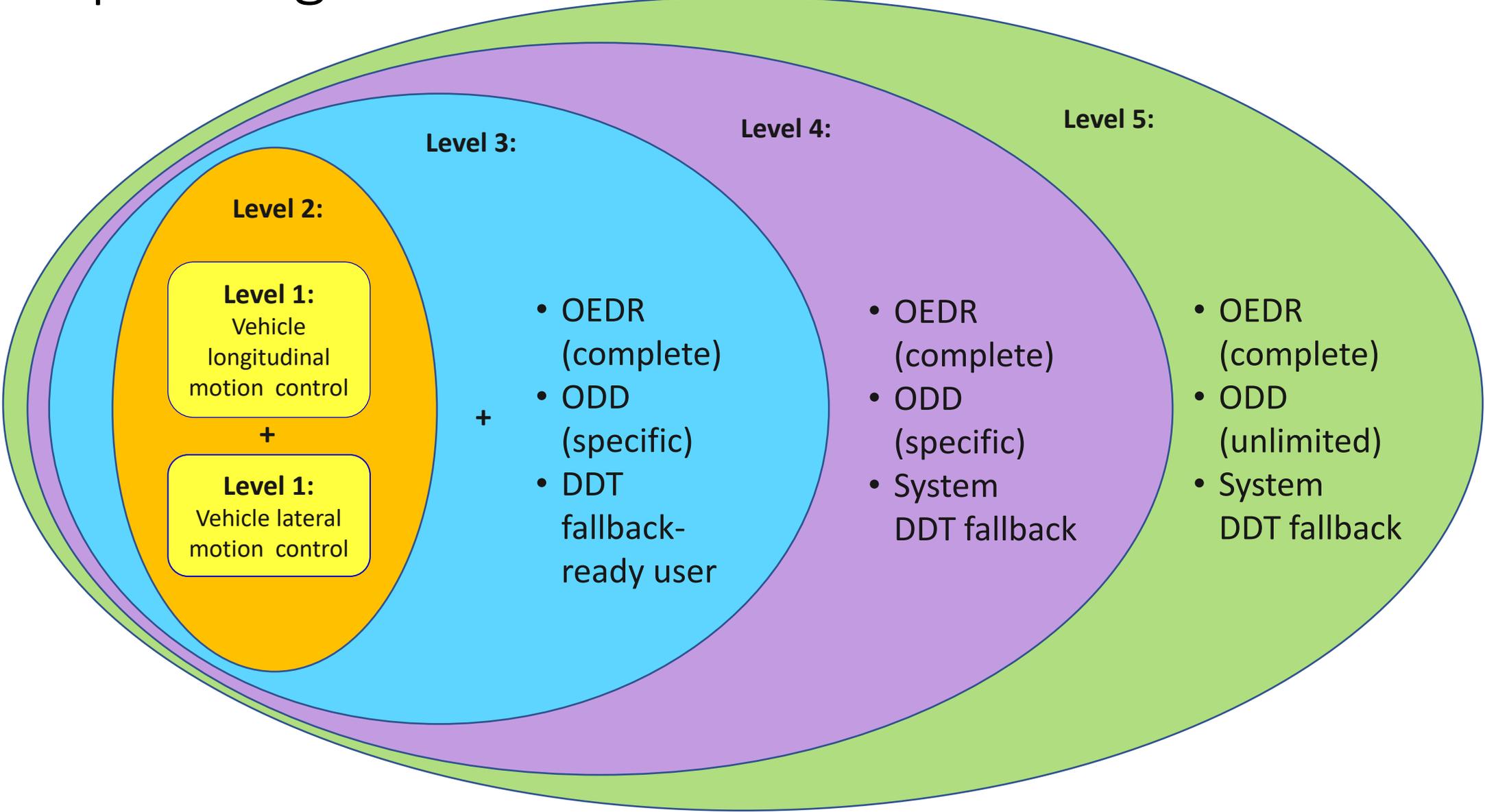
Objectives

- To recall and confirm the distinction between ADAS and ADS
- To confirm the scope of the new UN Regulation being drafted by the TF on ADAS (“to identify the animal”)
- To distinguish the systems to be under the attention of the TF on ADAS with those under the attention of the IWG on FRAV
- To confirm the regulatory approach (“to define how the cage for the animal should look like”)

SAE J3016:2021, Table 1

	Level	Name	Description	DDT		DDT fallback	ODD
				Sustained lateral and longitudinal motion control	OEDR		
The driver performs part or all of the DDT / The driver performs all of the DDT, the driving automation system assists the driver							
TF on ADAS Driver support	1	Driver assistance	The sustained and ODD-specific execution by the driving automation system of either lateral or longitudinal vehicle motion control subtask, while the driver performs the remainder of the DDT.	Driver and system	Driver	Driver	Limited
	2	Partial driving automation	The sustained and ODD-specific execution by the driving automation system of both lateral and longitudinal vehicle motion control subtasks, while the driver completes OEDR subtask and supervises the driving automation system.	System	Driver	Driver	Limited
An automated driving system (ADS) performs the entire DDT (while engaged)							
IWG on FRAV Automated driving	3	Conditional driving automation	The sustained and ODD-specific performance by an ADS of the entire DDT with the expectation that the DDT-fallback ready user is receptive to ADS-issued requests to intervene, as well as to DDT performance-relevant system failures in other vehicle systems and will respond appropriately.	System	System	Fallback-ready user, who becomes the driver during fallback	Limited
	4	High driving automation	The sustained and ODD-specific performance by an ADS of the entire DDT and DDT fallback without any expectation that the user will need to intervene.	System	System	System	Limited
	5	Full driving automation	The sustained and unconditional (not ODD-specific) performance by an ADS of the entire DDT and DDT fallback without any expectation that the user will need to intervene.	System	System	System	Un-limited

The automation system performance depending on SAE J3016 automation levels hierarchy



The key elements to distinguish between levels 1-2 and 3-5

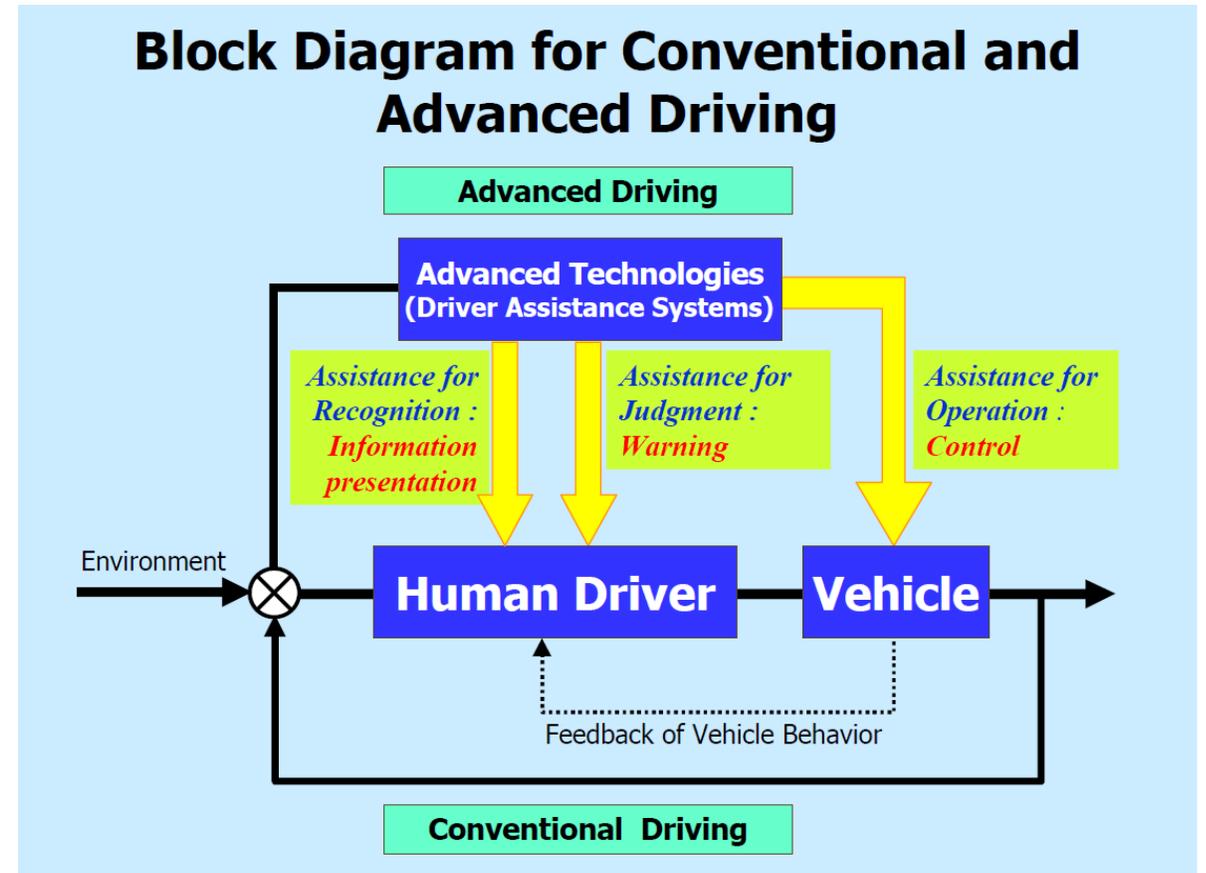
- Assisted driving (there is a human driver):
 - Requires a driver operating the vehicle, including all its subsystems.
 - The driver refers to a human being qualified to operate the motor vehicle.
 - The driver performs OEDR regardless of the system capabilities.
- Automated driving (there is no human driver when the system is in operation):
 - Does not require a driver operating the vehicle.
 - The system may be designed to transfer control to a fallback user, but it can in any case fallback to an automated response as needed.
 - The system performs the entire DDT, including the entire OEDR.
 - The system shall cope any traffic situation (within ODD).
- The comparison between SAE Level 2 & Level 3 (ECE/TRANS/WP.29/1140) is given in the Appendix to this presentation.

Although initially, the manufacturer makes the determination, whether the system operates as an ADS or as an assisted driving system, we should assess the system based on its functionality and ability to keep the driver engaged. The challenge is to define the criteria for such an assessment.

What is “ADAS”?

(ADAS-01-05 – R.E.3, ITS-12-04 (2006))

- “ADAS (Advanced Driver Assistance Systems) have been developed to support drivers and enhance road safety. Among the products on the market are warning systems to advise of a safety hazard; control systems to improve the ease of control during normal driving and help avoid accidents and/or mitigate the crash severity in critical situations”.
- “ADAS can be classified into three categories: information provision, warning, and control”.



Scope of the new UN Regulation (based on ADAS-03-06)

ADAS	New ADAS use cases to be addressed by the TF on ADAS [in a new UN Regulation]		Remark
	Yes	No	
1. ADAS providing information support only			Subject to consideration by GRSG
a. ADAS providing useful information (e.g., traffic sign recognition)		x	
b. ADAS providing safety-critical warnings (e.g., collision warning)			
2. ADAS influencing the dynamic driving task performed by a human driver			
c. ADAS providing momentary intervention during potentially hazardous situations (e.g., AEBS)		x	
d. ADAS providing assistance in operating a vehicle on a sustained basis (e.g., Adaptive Cruise Control)			
i. ADAS assisting in both longitudinal and lateral vehicle control	x		
ii. ADAS designed as backup function in the case of driver's inability (e.g., RMF)		x	RMF is addressed in UN R 79.
ADS (not ADAS) performing the entire dynamic driving task (i.e., replacing the human driver) – driving automation levels 3, 4 and 5		x	Subject to consideration by the IWG on FRAV

What we consider as "DCAS"*

* DCAS provide longitudinal and lateral vehicle motion control on a sustained basis. Considering the case of vehicles equipped with separate lateral-only and longitudinal-only systems, the presence of both would place the vehicle under the DCAS UN Regulation since DCAS refer to any combination of technologies that results in a vehicle equipped with hardware and software designed to assist the driver via sustained longitudinal and lateral control.

Definition of DCAS

On one hand, DCAS are driver assistance systems (ADAS).

On the other hand, DCAS are driving automation systems of level 2*.

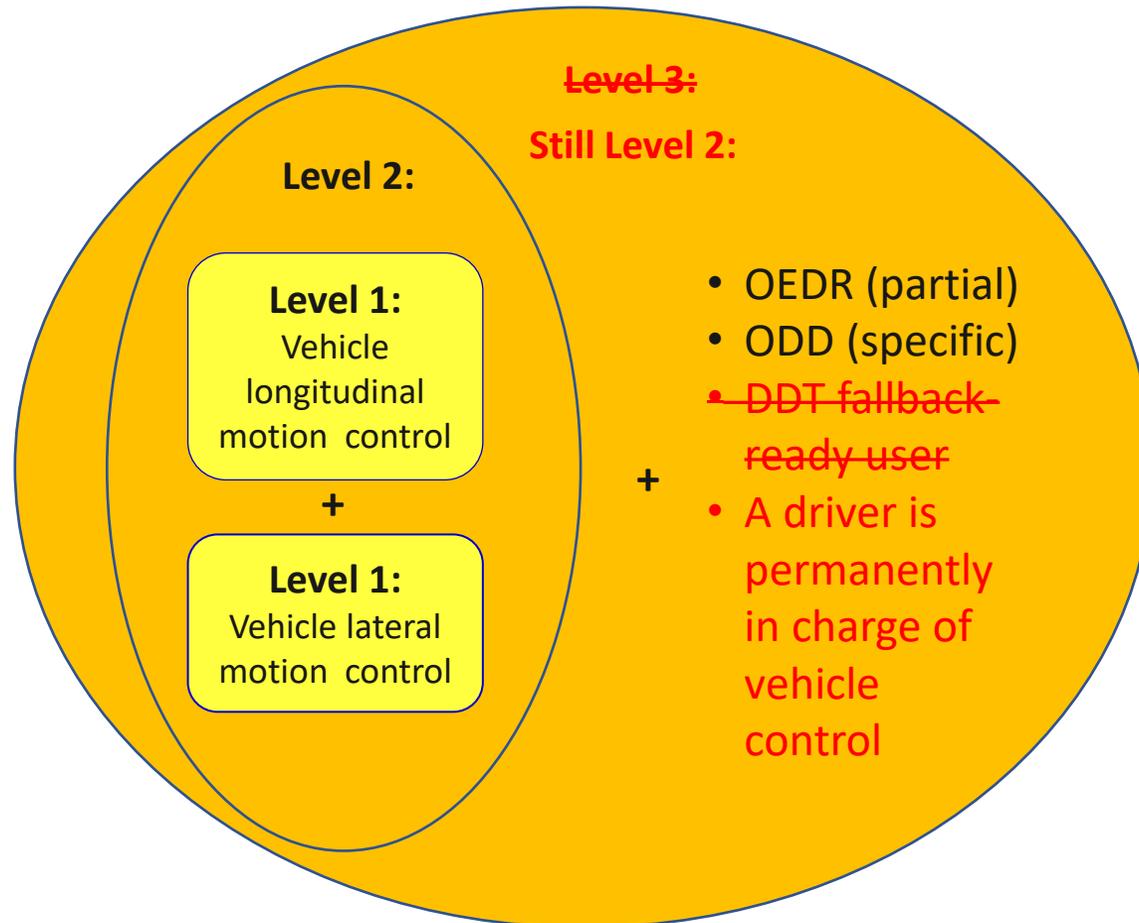
Hence:

- DCAS (Driver Control Assistance Systems), which are a subset of ADAS, mean hardware and software collectively capable of assisting a driver in controlling the longitudinal and lateral motion of the vehicle on a sustained basis, and which requires the driver to be permanently engaged and to monitor the environment, and vehicle/system performance.

* DCAS may not provide longitudinal and lateral vehicle motion control at the same time. Providing either only longitudinal or only lateral control temporarily degrades automation level from 2 to 1.

We observe expansion of performance for driving automation systems of SAE Level 2

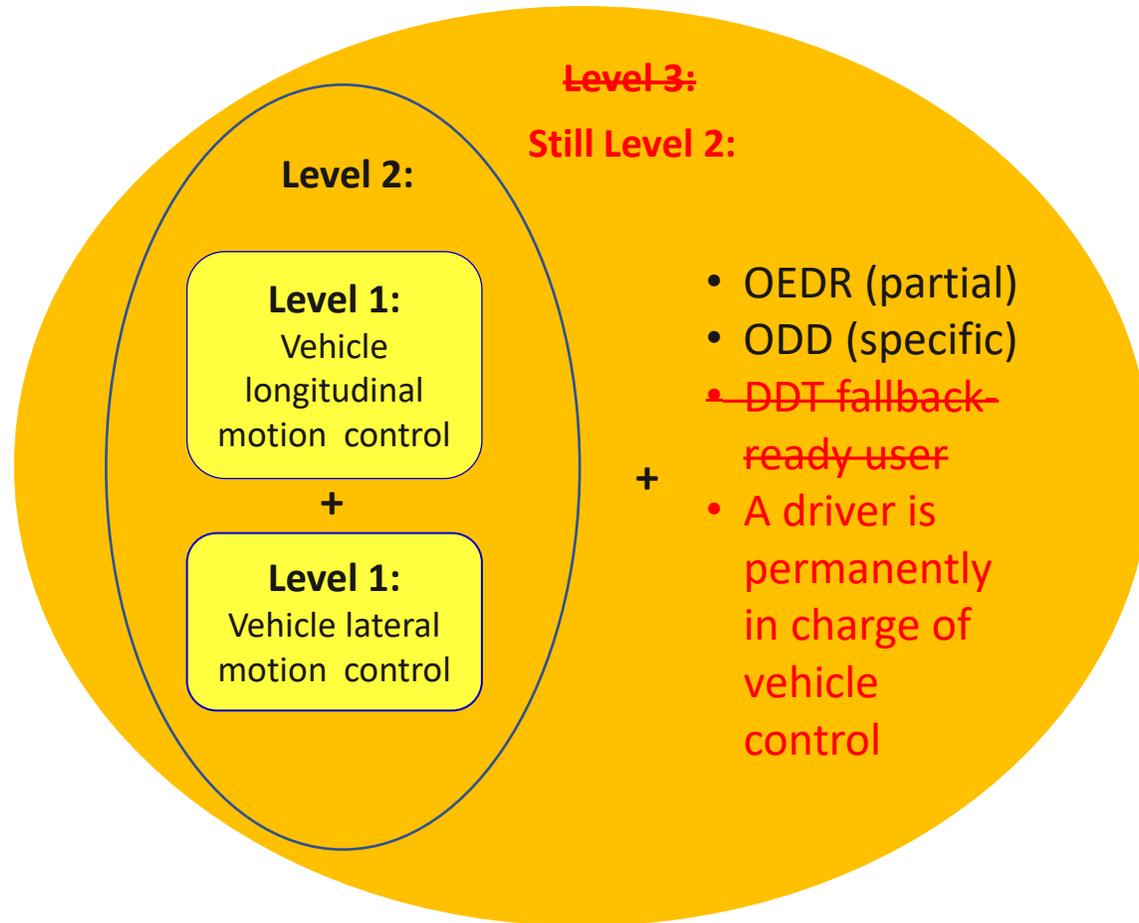
What is called “Level 2+” in slang. Is this the animal we are looking for?



- At Level 2, the driver is no longer always actively controlling the vehicle motion, but the driver is still operating the vehicle, including the Level 2 system.
- The system must provide OEDR sufficient to maintain sustained stable control of longitudinal and lateral motion of the vehicle under the driver’s supervision.
- Because of the trust risk, the system must ensure that the driver continues to operate the vehicle, including monitoring the performance of the system.

Note: One may conclude that the system of level 2 is a combination of level 1 systems for longitudinal and lateral control. Not necessarily, as the level 2 system may be designed as a single integrated one (refer to the DCAS definition).

Expansion of performance for driving automation systems of SAE Level 2



Why cannot the system be treated as SAE Level 3?

- Very limited OEDR and ODD of the system do not allow to perform the entire DDT.

How much limited?

- These parameters are uncountable.

What is the key characteristic feature of such a system?

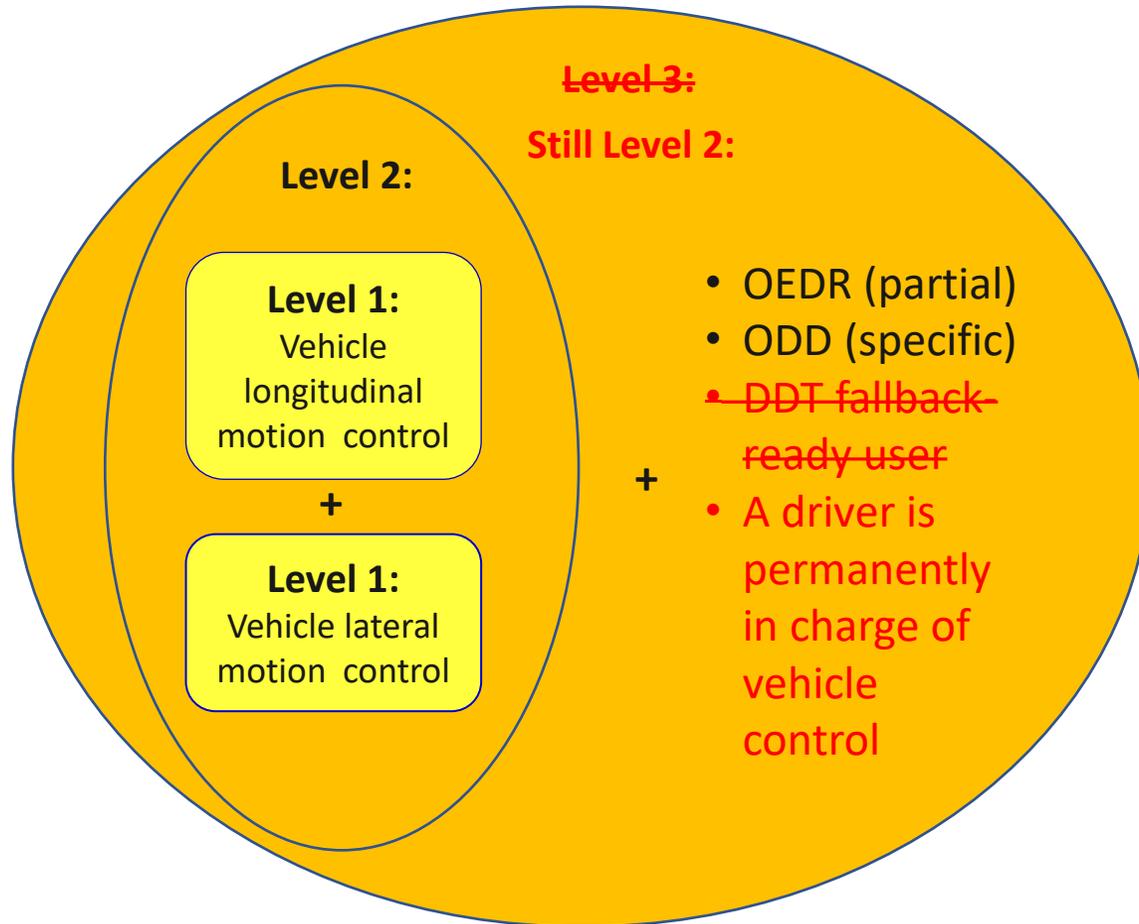
- Permanent driver's responsibility for vehicle control.

What is the safety risk?

- Since the aim is to make these systems as reliable as possible, the driver is likely to operate the system for long periods without any need to intervene. The better the system, the more likely the driver is to trust the system to always function correctly and decrease their level of supervision over time (even to the point of confusing the system with fully automated driving).

How to deal with such systems?

– Identify and address the risks



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.

Challenge: Assistance systems perform like ADS

Concern	A possible way to address the concern
<ul style="list-style-type: none">• The driver shall not become the mitigator of risks associated with the operation of automated systems.• The driver shall not be treated as a backup option for an automated system.	<p>Carry out risk analysis per ISO 26262 + ISO 21448 (SOTIF). Establish the requirements for:</p> <ul style="list-style-type: none">• Risk management;• Minimum OEDR of the system;• System response to traffic situations. A driver should not immediately respond [in certain cases].
<ul style="list-style-type: none">• Taking routines and workload away from the driver by a comfort system does not always mean increased safety for the driving. Some workload may be only shifted for the driver and become even higher.	<ul style="list-style-type: none">• Define boundaries for these systems to avoid systems good enough to induce driver complacency, but bad enough that the complacent driver is at elevated risk of causing an avoidable crash.
<ul style="list-style-type: none">• Look at the system functionality: if the system performs like an ADS, it should fall in the scope of ALKS UN Regulation. Such a performance causes overlapping driver's functions The protection against misuse and the driver's misleading is needed.	<ul style="list-style-type: none">• DCAS meeting the definition of ALKS in UN R 157 cannot be approved under DCAS UN Regulation but should be approved under UN R 157.• The vehicle control strategy should involve mixed control actions by the system and by the driver.• Establish the operational frameworks for the systems (driver monitoring capabilities, etc.).

Constructing the cage:

The regulatory provisions shall address:

- Risk analysis per ISO 26262 + ISO 21448 (SOTIF);
- Risk management;
- Minimum OEDR by the system;
- System response to certain traffic situations;
- Driver engagement monitoring capabilities;
- Operational prevention of driver disengagement by the system (whether through active or passive means);
- Safeguards in case of driver disengagement (from warnings upon detection of signs of disengagement to risk mitigation in the case of unresponsive driver);
- System interaction with the driver. The frequency of the control actions by the driver.
- Management of transactions between the system and the driver (whether initiated by the system or the driver);
- Assurance of stable sustained control under the conditions specified by the manufacturer (ODD);
- Exclusion of driver's misunderstanding, misleading, overreliance, etc.
 - Proper driver information and education;
 - Easy, clear and reliable HMI.

Appendix

Comparison between SAE Level 2 & Level 3 (ECE/TRANS/WP.29/1140) (1) Up-to-date comments added

Item	Level 2	Level 3
<p>Supervision the DDT execution by the driver Execution of the DDT</p>	<ul style="list-style-type: none"> • The system does not perform the DDT. • The driver exercises dynamic control of the vehicle (i.e., operates the vehicle and its subsystems, including the assisted driving system). • The system assists the driver by providing sustained longitudinal and lateral vehicle motion control. • The system monitors and interacts with the driver to ensure driver engagement in exercising dynamic control of the vehicle. • The driver performs OEDR. • The driver monitors the system performance and determines when to intervene; however, the system may issue demands for driver intervention. • The driver constantly supervises the DDT executed by the system. Although the driver may be disengaged partly from the physical aspects of driving (operational tasks), he/she must be fully engaged mentally with the driving task and shall immediately intervene when required by the environment or by the system (no transition demand by the system, just warning in case of misuse or failure). 	<ul style="list-style-type: none"> • The system performs the entire DDT. • The system requires a fallback user. • The system monitors the fallback user to ensure readiness and receptivity to transfer-of-control notifications. • Depending upon conditions, the system may initiate a transfer of control or initiate an automated response to place the vehicle in a minimal risk condition. • The driver fallback user shall remain sufficiently vigilant receptive as to acknowledge the transition demand and, acknowledge vehicle warnings, or mechanical failures or emergency vehicles (increase lead time compared to level 2).

Comparison between SAE Level 2 & Level 3 (ECE/TRANS/WP.29/1140) (2) Up-to-date comments added

Item	Level 2	Level 3
Performing OEDR function in general	By the driver as the system is not able to detect all the situations.	By the system (within ODD)
Monitoring the driving environment by the system	The system may perform OEDR function. The system must provide OEDR sufficient to maintain sustained stable control of longitudinal and lateral motion of the vehicle under the driver's supervision.	It is the task of the system to perform OEDR function (within ODD). The system performs the entire OEDR relevant to the ADS feature in use (e.g., including detection of conditions that require a fallback response).
Monitoring the driving environment	By the driver as the system is not able to detect all the situations	By the system (within ODD)
Performing secondary activities by the driver Performing non-driving-related activities by the driver	<ul style="list-style-type: none"> • Not possible. • Permitted non-driving activities are the same as for manual driving. 	<ul style="list-style-type: none"> • Possible (when the system is in operation – in this case, there is no driver, but there is a fallback user). • The system ensures fallback-user readiness (i.e., non-driving activities are circumscribed). • The fallback user may engage in non-driving activities subject to limitations established for safe use. • The system monitors and interacts with the fallback user to ensure fulfilment of fallback-user roles and responsibilities.

Comparison between SAE Level 2 & Level 3 (ECE/TRANS/WP.29/1140) (3) Up-to-date comments added

Item	Level 2	Level 3
Override by the driver	<ul style="list-style-type: none"> Necessary in general. The driver may intervene at any time; however, driver interventions may be overridden by automatic safety systems such as EVSC, AEBS, CSF, ESF, etc. 	<ul style="list-style-type: none"> Necessary in general. The fallback user may intervene at any time; however, the system may override fallback user interventions (e.g., during a safety-critical event response or inadequate fallback user response). The fallback user may initiate transfers of control subject to system verification regarding his/her readiness to take over.
System deactivation by the driver	Immediately upon request by the driver.	Immediately upon request by the driver fallback user, but the system may delay deactivation for safety reasons.
The driver's engagement	Required and to be ensured (hands-off detection, etc.). The system monitors and interacts with the driver to ensure that the driver maintains a level of vehicle operational and environmental awareness and readiness to intervene in vehicle control as required for safe use of the system.	The driver fallback user availability recognition required.

Comparison between SAE Level 2 & Level 3 (ECE/TRANS/WP.29/1140) (4) Up-to-date comments added

Item	Level 2	Level 3
Transition demand	No transition demand as such, only warnings, <i>as the driver remains responsible for controlling the vehicle. The driver is expected to respond immediately.</i>	The system may <i>shall</i> issue the transition demand in certain conditions. <i>Transfers of control involve sequences of notifications and verifications of fallback-user responses until the system confirms that the fallback user has assumed the role of driver (i.e., the fallback user has achieved stable control of the vehicle under safe conditions).</i>

Thank you for your attention!

Questions?

Comments?

Back-up

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 currently not regulated today.
 - To consider combinations of **lateral and longitudinal assisted driving systems**.
- To introduce a **comprehensive** approach to **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 (similar to what exists e.g. for braking with UN R 13-H and AEBS UN Regs.)

The regulatory approach:

- To make sure that the system in question falls in the scope of the UN Regulation, i.e., meets qualification criteria
- To verify whether the system in question meets the specifications of the UN Regulation

Reference: The Definition of the DDT

(FRAV-14-07-Rev.1)

- “Dynamic driving task” (DDT), in the context of an ADS-equipped vehicle, means all of the real-time operational and tactical functions required to operate the vehicle, excluding strategic functions such as trip scheduling and selection of destinations and waypoints.
- The ADS should have the means to perform all DDT functions (i.e., the entire DDT) on a sustained basis within the Operational Design Domain (ODD), if any, of the ADS’s feature(s).
- DDT functions can logically be grouped into three general categories that provide a useful basis for discussion:
 - Sensing and Perception
 - Planning and Decision
 - Control
- The **sensing and perception** category includes:
 - Monitoring the driving environment via object and event detection, recognition, and classification, which includes:
 - Perceiving other vehicles and road users, the roadway and its fixtures, objects in the vehicle’s path, and relevant environmental conditions
 - Sensing the ODD boundaries, if any, of the ADS feature
 - Positional awareness
- The **planning and decision** category includes:
 - Prediction of actions of other road users
 - Response preparation
 - Maneuver planning
- The **control** category includes:
 - Object and event response execution
 - Lateral vehicle motion control
 - Longitudinal vehicle motion control
 - Enhancing conspicuity via lighting, signaling and/or gesturing, etc.

Reference: The Definition of the ALKS

(UN R 157)

- "Automated Lane Keeping System (ALKS)" **for low speed application** is a system which is activated by the driver and which keeps the vehicle within its lane **for travelling speed of 60 km/h or less** by controlling the lateral and longitudinal movements of the vehicle for extended periods without the need for further driver input.