

Automated Driving

What is it?

Do we need changes in UNECE Technical Regulations?

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OICA Secretary General

Agenda

Driver assistance and automated driving today

Definition of terms: Role of the driver vs. role of the system

Roadmap to automated driving and exemplary functions

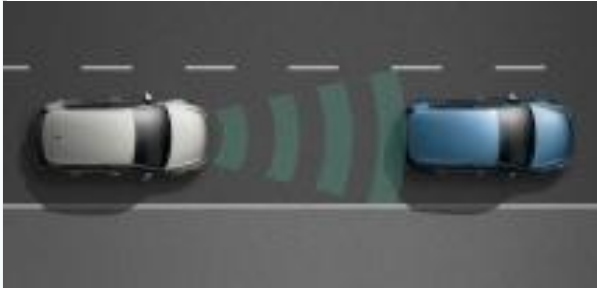
Regulatory situation

Conclusion

Today's Driver Assistance/Automated Systems

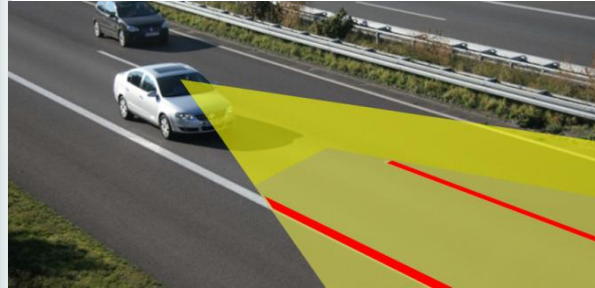
Examples of what already exists

Longitudinal Control



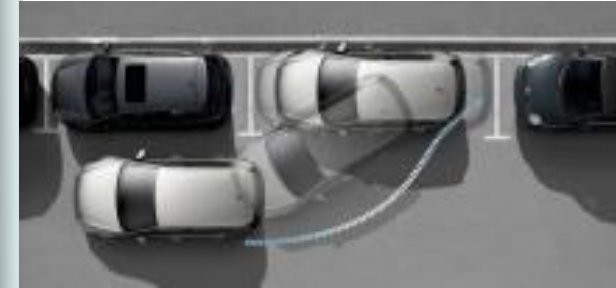
Adaptive Cruise Control
Forward Collision Warning

Lateral Control



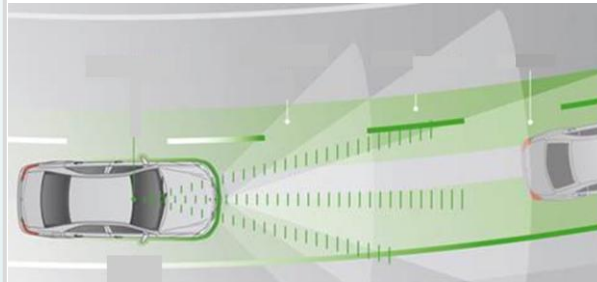
Lane Keeping Assistance

Parking, Maneuvering



Automated Parallel
Parking Assistance

Longitudinal+Lateral Control



ACC combined with
Lane Keeping Assistance

Longitudinal+Lateral Control



Traffic Jam Assist
ACC incl. Stop-&Go combined
with Lane Keeping Assistance

Parking, Maneuvering



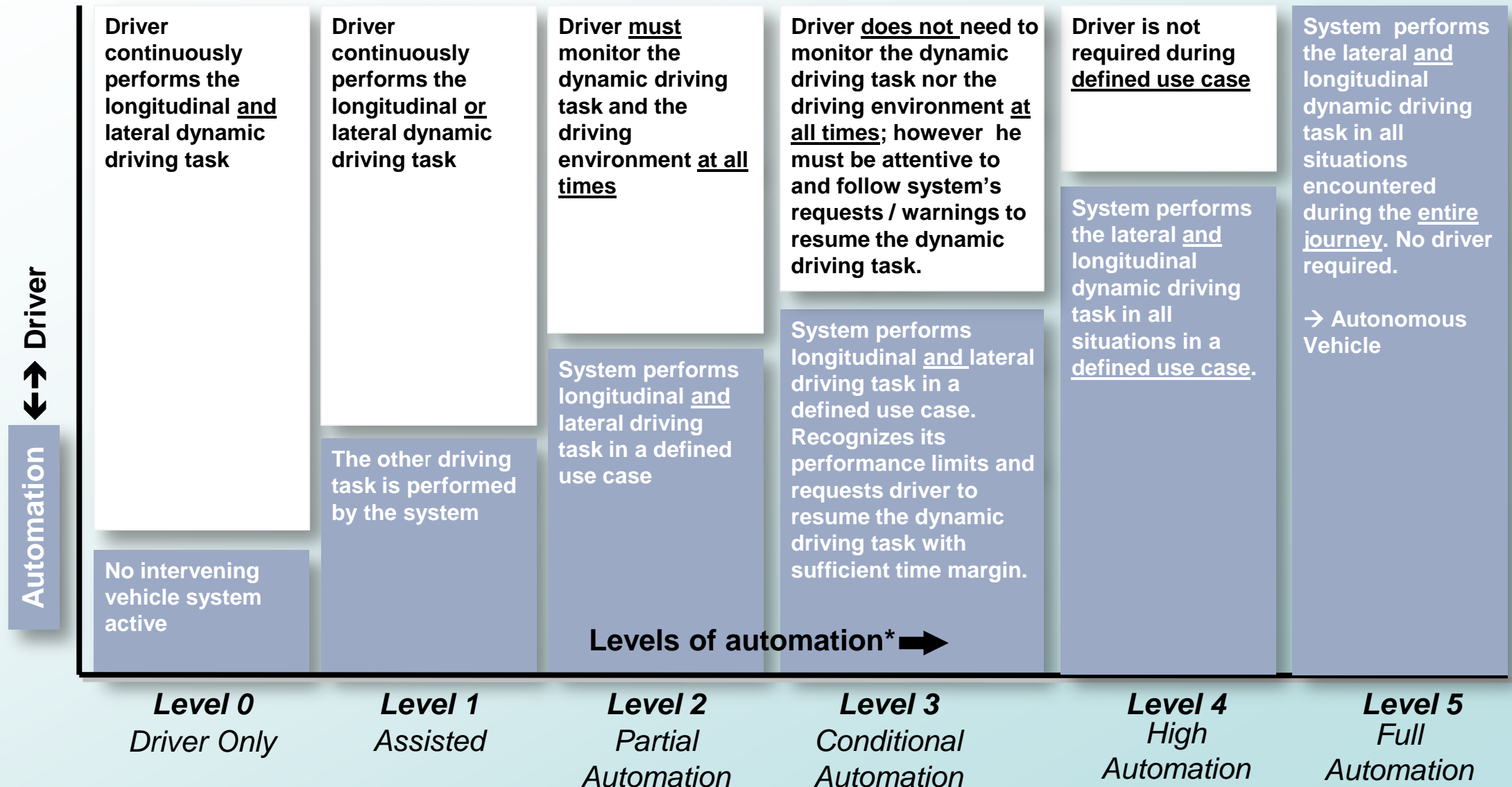
Automated Cross Parking
Assistance

Basic Categories of System Functions

Category A Information and Warning (classic driver assistance)	Category B: Intervening in Emergency (close-to-accident situations)	Category C: Automated (From advanced driver assistance towards „automated driving“)
<p>Only indirect influence on the dynamic driving task by the driver (driver controls everything)</p>	<p>Direct influence on the dynamic driving task (driver is definitely not able to master the situation)</p>	<p>Direct influence on the dynamic driving task (driver can always switch off or override the system)</p>
<p>Examples:</p> <ul style="list-style-type: none"> • Speed Limit Information • Lane Departure Warning (e.g. steering wheel vibration) • Lane Change Warning/Blindspot Detection (e.g. flashlight in the mirror base) 	<p>Examples:</p> <ul style="list-style-type: none"> • ESC, ABS 	<p>Examples:</p> <ul style="list-style-type: none"> • Adaptive Cruise Control • Parking Assistant • Traffic Jam Assistant

Based on a concept of BASt (Federal Highway Research Institute, Germany)

Levels of Automated Driving (Category C systems)



Level 0: Role of the driver and system

Driver

can always override or deactivate the system engaged

not applicable

performs the longitudinal and lateral dynamics

monitors the driving environment

is attentive to and responds to the vehicle's requests/warnings

time

Conclusion: The driver is in the loop and performs all tasks:

- Performs the dynamic driving task (longitudinal and lateral dynamics),
- monitors the driving environment,
- is attentive to and responds to vehicle's requests/warnings.

Level 1: Role of the driver and system

Driver*

can always override or deactivate the system engaged

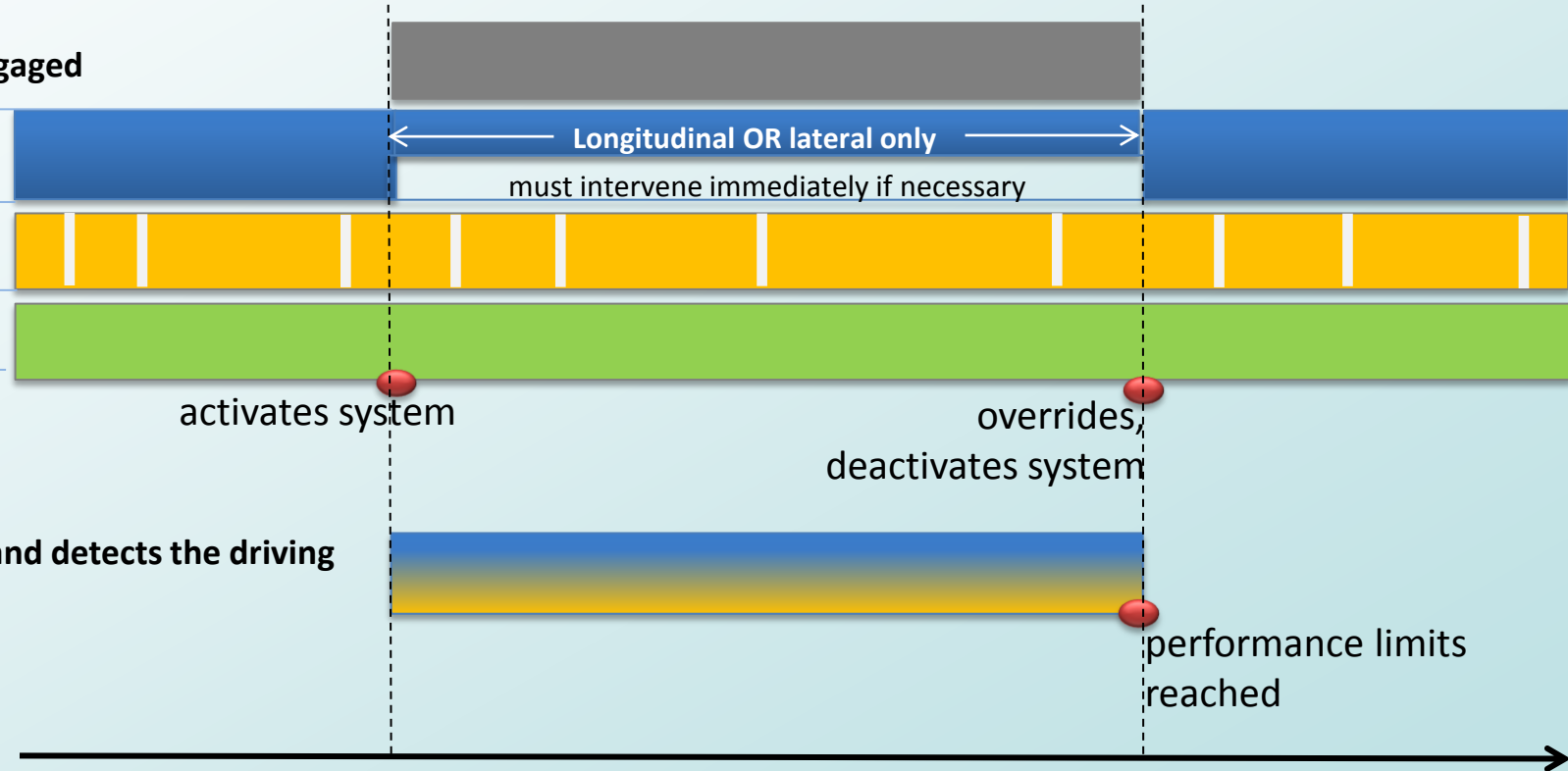
performs the longitudinal and lateral dynamics

monitors the driving environment

is attentive to and responds to the vehicle's requests/warnings

System

Performs the complementary driving dynamics and detects the driving environment to a limited degree



*Driver must be ready to immediately intervene if necessary: system cannot guarantee to recognize its performance limits (e.g. due to weather conditions, missing lane markings, etc.), neither reliably detect the driving environment.

Conclusion: The driver is in the loop: he/she must perform the longitudinal or lateral dynamic driving task and remain ready to intervene at all times in the other driving task.

Level 2: Role of the driver and system

Driver*

can always override or deactivate the system engaged

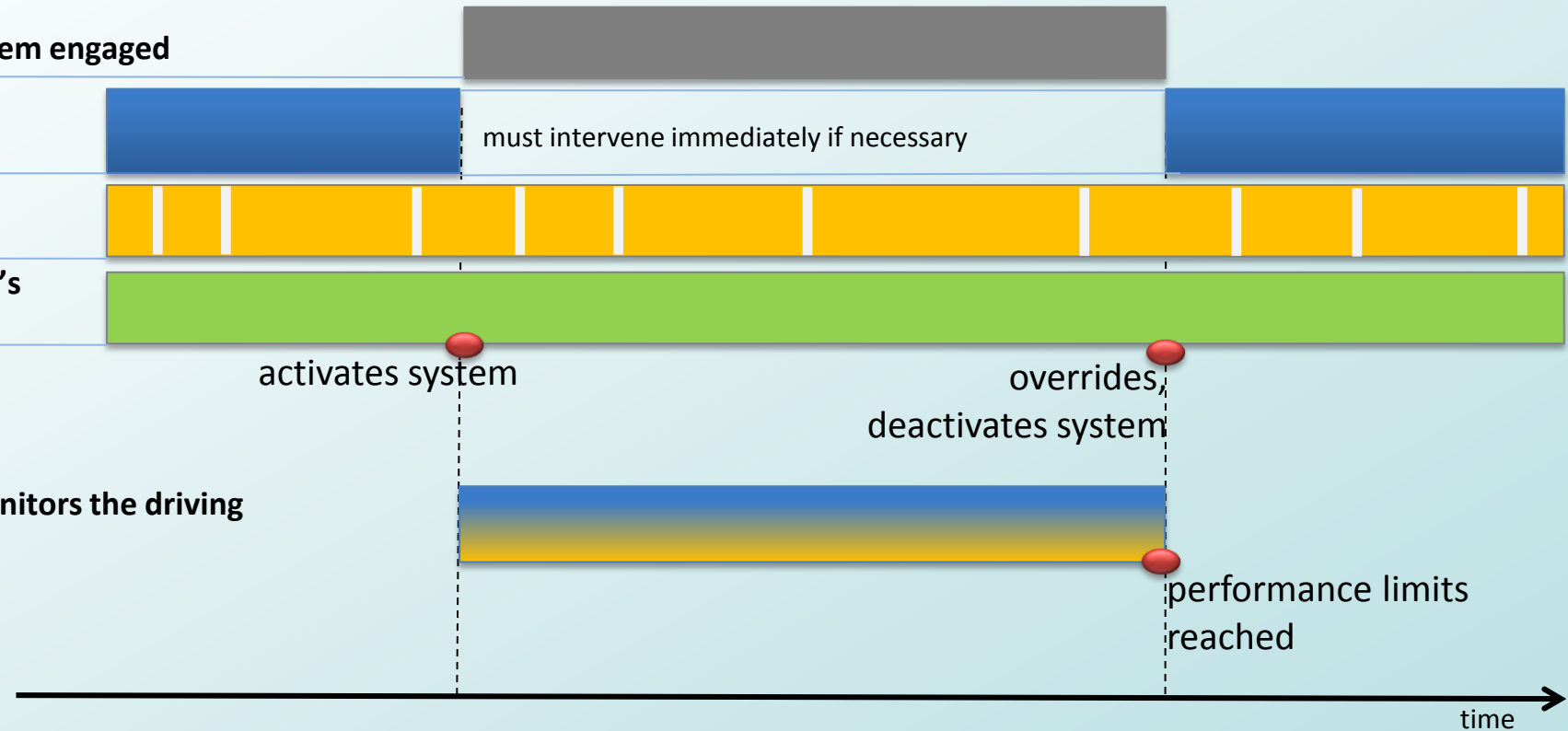
performs the longitudinal and lateral dynamics

monitors the driving environment

is attentive to and responds to the vehicle's requests/warnings

System

performs the dynamic driving task and monitors the driving environment to a limited degree



*The driver must be ready to immediately intervene when necessary, since the system cannot guarantee to recognize its performance limits (e.g. due to weather conditions, missing lane markings, etc.).

Conclusion: The driver is in the loop because he/she must remain ready to intervene at all times in the dynamic driving task.

Level 3: Role of the driver and system

Driver*

can always override or deactivate the system engaged

performs the longitudinal and lateral dynamics

monitors the driving environment

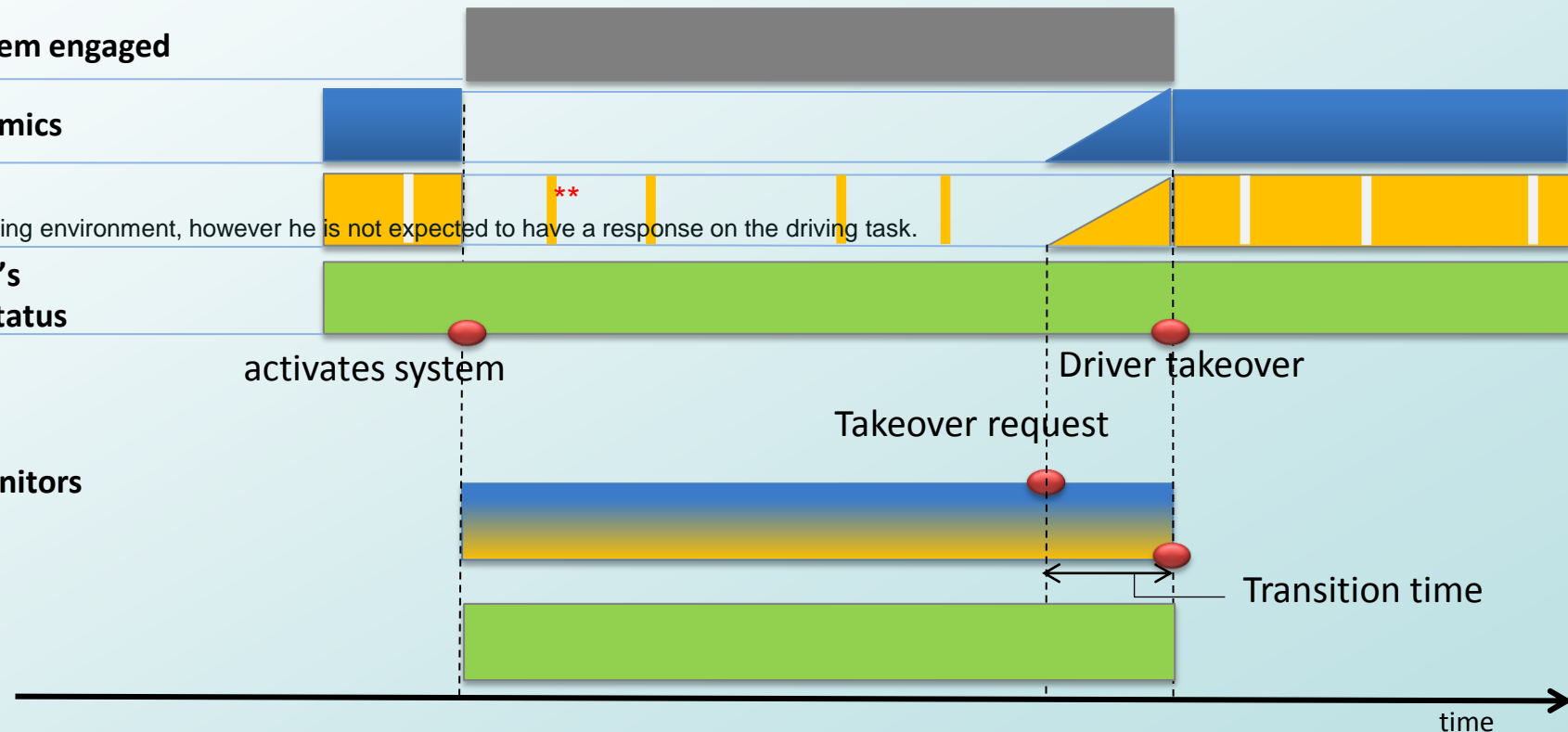
**Driver may naturally look from time to time at the driving environment, however he is not expected to have a response on the driving task.

is attentive to and responds to the vehicle's requests/warnings; aware of the system status

System

performs the dynamic driving task and monitors the driving environment

Indicates the system control status



*In case the system reaches its performance limits (e.g. weather conditions, missing lane markings, etc.), the driver is expected to resume the dynamic driving task: driver is the system's fallback. The driver will be given a transition time for an orderly takeover.

Conclusion: The driver is considered to be part of the loop: he/she must remain sufficiently attentive in order to be able to intervene upon system's request within a transition time for an orderly takeover.

Level 4: Role of the driver and system

Driver

can always override or deactivate the system engaged

performs the longitudinal and lateral dynamics

monitors the driving environment

**Driver may naturally look from time to time at the driving environment, however he is not expected to have a response on the driving task.

is attentive to and responds to the vehicle's requests/warnings

activate system

Driver takeover

end use case

System*

performs the dynamic driving task and monitors the driving environment

indicates the system control status

Takeover request

Transition time

time

*Minimal risk condition can be achieved in case of a system failure under any driving situation during the entire use case and/or when the human driver fails to respond to the takeover request.

Driver is not in the loop during the use-case but is expected to takeover at the end of the use-case within a transition time.

Level 5: Role of the driver and system

Driver (if present)

can always override or deactivate the system engaged

performs the longitudinal and lateral dynamics

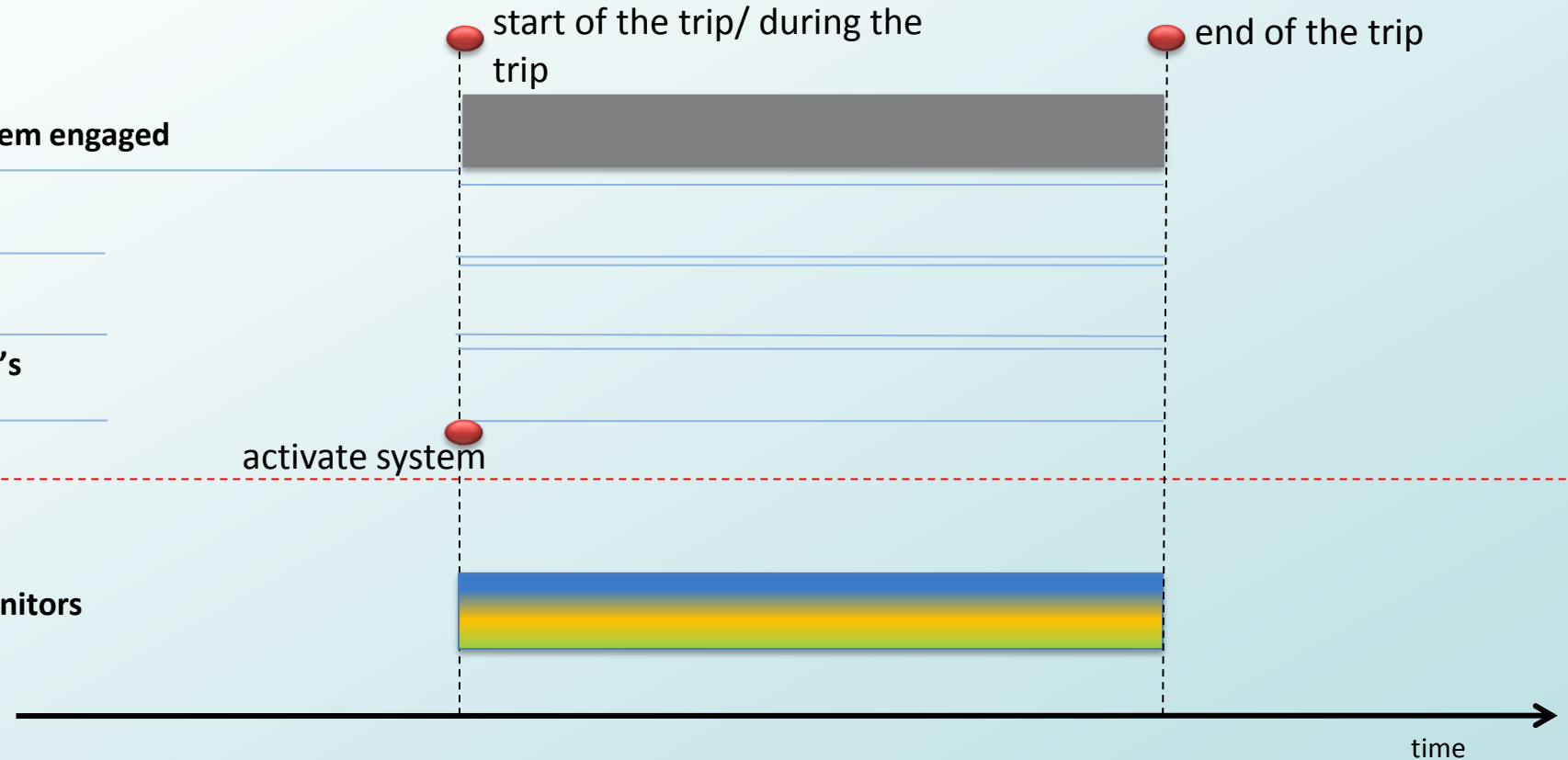
monitors the driving environment

Is attentive to and responds to the vehicle's requests/warnings

System*

performs the dynamic driving task and monitors the driving environment

*In case of system failure, system can achieve the minimum risk condition out of any driving situation during the whole trip. Driver not necessarily present.



The activated system performs all driving tasks at all times. Driver is not necessarily present anymore and therefore not in the loop.

The technical complexity influences the roadmap to automated driving

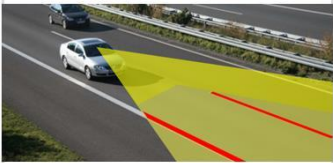
	Low Velocity	High Velocity
Structured Traffic Environment	Traffic Jam Level 2 (limited*) already introduced Level 3 in development	Highways Level 2 (limited*) already introduced (traffic jam) Level 3 in development
Unstructured (complex) Traffic Environment	Parking and Maneuvering Level 2 already introduced Level 4 in research/development	Urban and Rural Roads Level 2 (limited*) already introduced (traffic jam) Level 3 in research

Automated Functions like Traffic Jam-, Highway- and Parking System are currently in development and can be introduced in midterm perspective.

* Current UN R79 allows, above 10 kph, only corrective steering (lateral assistance). Therefore steering capability of today's Level 2 is still limited.

Current regulatory situation for UN Regulations and Road Traffic Code / Law

Lateral Control



Lane Change Assistant
Lane Keeping Assistant

Longitudinal Control



ACC Traffic Jam Assistance
Forward Collision Warning

Longitudinal+Lateral Control



Traffic Jam Assist
ACC incl. Stop-&Go combined
with Lane Keeping Assistance

UN R 79 steering equipment

- Automatically Commanded Steering Function allowed only up to 10 km/h (parking maneuvers)
- Beyond 10kph, only „corrective steering function“ is allowed (LKAS)

Some Level 2, 3, 4, 5 systems are impossible with current requirements of UN-Regulation R 79 (steering) Amendment is necessary and urgent as a prerequisite for automated driving functions.

VIENNA Convention & GENEVA Convention

- The VIENNA Convention includes harmonized minimum requirements for the signatories
- A driver shall at all times be able to control his vehicle (Vienna Convention Art. 8 and 13)
- Requires a driver (Vienna Convention Art. 1 and 8)

Future Level 4, 5 systems are mostly impossible even with the 2014 amendment to the Vienna Convention, because a driver may not be required depending on the use case. Therefore, further evolution is necessary.

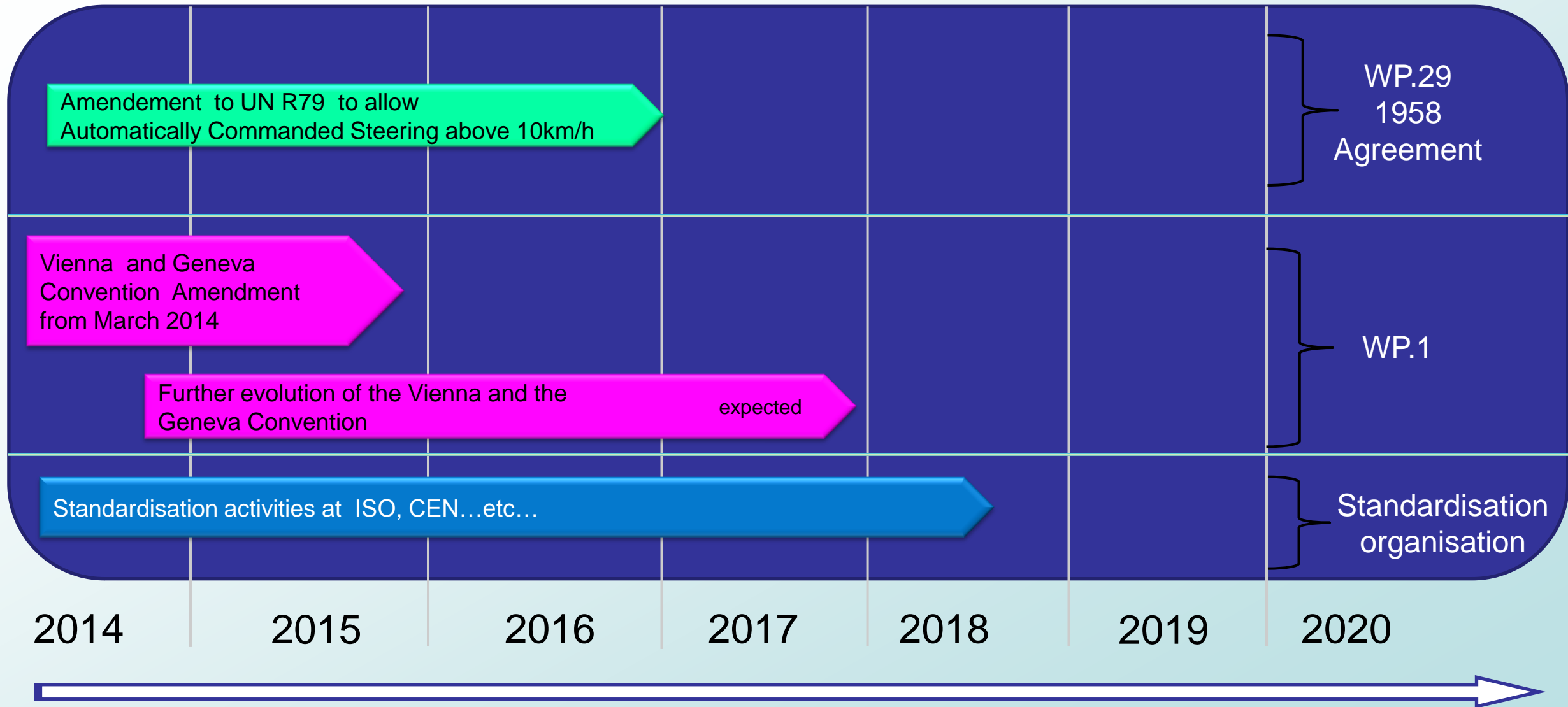
National Traffic Laws

- Often based on the VIENNA Convention, but details can be different for each country.

Level 3, 4 and 5 require evaluation for each country. Amendments may become necessary.



Roadmap/Principles regulatory/standardisation aspects



Conclusion

- **Levels of Automation as presented are widely used**
- **Views on short/medium/long term introduction of automated driving are becoming clearer: level 4 (except for some systems) and level 5 are not coming soon**
- **The higher the speed and the more complex the driving environment, the longer it will take to introduce automated driving**
- **The key issue in terms of technical regulations (UNECE) is the amendment to UN R79 currently in development to allow automatically commanded steering functions at speeds > 10 km/h**
- **Other existing UN Regulations do not appear to prevent the introduction of automated vehicles at increasing levels – only minor adjustments may be needed (e.g. automatic activation of direction indicators)**
- **There is no perceived contradiction between the future expected evolution of the Vienna Convention and the absence of specific UN Regulation(s) for automated vehicles: the "driver" will still be in control (switch on/off and override) in the foreseeable future**
- **Main issue in general is with traffic code and the risk of fragmented conditions depending on the country/region.**



Thank you for your attention