Issues and Questions: Levels 3 and 4 driving

B: Remarks: These answers do not necessarily reflect the point of view of Belgian representatives in all regulatory bodies, or might evolve with the evolution of technology and research. Some questions do not (only) concern the government, but depend on the products being developed by the private sector. Moreover, this questionnaire is on the same time very wide as well as too elaborated on certain points. It would be easier to start from systems available at the market or ready for market deployment.

1. Level 3 driving

B: Remark: right now, we are only in the testing phase for certain systems. Commercialization will occur after extensive testing. At that moment, circumstances are possible with hands-off and eyes-off solutions. There will be a warning device in case hands-on and eyes-on are required. For the questions below, the answer depends on the use cases. 'Level 3 driving' is a general concept; it means by definition in certain circumstances. If we take the example of the Traffic Jam Chauffeur, distracting activities might be allowed to a certain speed limit. Which limit should be part of thorough testing with scientific evaluation. We are in favour of an international solution, given the huge amount of cross-border traffic across Europe. Finally, these questions should be decided in UNECE after much more FOT's will bring more evidence of the possibilities of these technologies.

DE General comment: For level 3 the expectation is that the human driver will respond appropriately to a request to intervene.

ETRMA: Driver is still responsible. But car decides speed. To decide safe speed car needs to know: 1)Tire type (through tire ID and connected tire):maximum speed rating (we might assume AD to respect max speed of 130kph. Need to check OEM approach to level 3 for unlimited highways in Germany), winter performance potential (summer, all season or winter tire), 2) Tire condition (skid depth, friction) intelligent tire measures skid depth (technology not in market yet?), 3) Road condition (water level, friction) other tires/vehicles can operate as sensors to populate a map (technology not market ready yet?)

ETSC: Level 3 driving creates ambiguity about who (human or vehicle) is responsible. Level 2 clearly makes the driver ultimately responsible, and then it is sensible to require hands-on. It is also sensible to put boundaries on where AD can be enabled, i.e. via geofencing.

VW remark: Automated systems (Lv 3 + Lv4 whereby a driver is needed at the end of use-case) are based on a human-machine interaction concept, that means a human driver is still required and the automated driving system only performs the driving task automatically within the functional boundaries. This is the intended usage of the respective system.

Should hands-on be required?

ESP: NO

FIN: Not as such.

TFL: No, defeats what automation is trying to achieve

ICCS: no.

Daimler: No! When driving a Level 3 system the driver will be able to take his hands off the steering wheel when the system is engaged. However, hands-off driving is not yet (legally) allowed in all countries what is a prerequisite for hands-off driving.

VW: Level 3 driving systems have the capability of performing the longitudinal and lateral control, since they are able to monitor the driving environment. Before the functional boundaries are reached, a take-over (transition) demand is being issued to instruct the driver to resume manual control of the vehicle. The intended usage of Level 3 systems is hands-off and feet-off.

Should eyes-on be required? If so, how enforced?

ESP: yes. No enforcement would be needed. system functionalities should alert the driver to override, but driver must at all times actively control the vehicle, hands-on and eyes-on permanently.

FIN: Eyes-on should be required, enforcement could be done using e.g. eye-movement cameras (currently used in some vehicles for driver attentiveness monitoring).

ICCS: Yes at least for the first period. Eye tracking cameras can be used.

TFL: Not enforced but eyes-on encourages situational awareness – may require in-dash technology to assess driver alertness. May be advantageous to set thresholds for eyes-off traffic conditions e.g. in slow moving congestion, eyes-off acceptable for no longer than 10sec and the driver alertness system could issue warning messages if threshold is broken. As a highway authority and public service vehicle operator, data recorders to prove whether the driver was driving "hands-on or hands-off/eyes-on or eyes-off" will be advantageous to protect against liability claims.

Daimler: Required by whom? Eyes on what? In general, the manufacturer describes and instructs how to use a particular system (intended-use). A Level 3 system in general allows the driver in terms of the technical definitions not to monitor road traffic permanently in some driving situations, but the driver needs to be attentive to and react to system's warnings and requests (eyes-on, ears-on, etc.). If the driver is legally allowed to do so when using a Level 3 system depends on the national road traffic law.

VW: A Level 3 system performs the entire vehicle control within its functional boundaries and monitors continuously the driving environment to ensure safe operation inside these boundaries. Thus the driver need not continuously have "eyes-on" the road, however the driver must remain sufficiently vigilant as to acknowledge the take-over (transition) demand and any other vehicle warnings that do not necessarily lead to a take-over (transition) demand (e.g. fuel empty tank in 80 km, faulty headlamp, TPMS, etc.). To ensure that the driver remains sufficiently vigilant a driver

availability recognition system needs to be implemented such as a head/eyes tracking camera or an actuation device (button) that needs to be pressed periodically to ensure that the driver is still available for a take-over whenever the system requires the driver to resume control. Furthermore the driver has to remain seated in the driver seat. This can be enforced by checking that the seatbelt buckle is closed and the seat mat/camera evaluation indicates that a person is seating in the driver's seat. Whenever the presence check fails, a take-over demand (transition) is issued and failing to positively respond to this demand, the vehicle initiates a minimal risk manoeuvre.

Are distracting activities allowed?

ESP: No

FIN: Only within the boundaries of the eyes-on limitations .

ICCS: Depends on the activity - Current drivers are advised in certain cases not to be distracted - the same rules should be applied

TFL: Distracting activities are already commonplace – level 3 systems should be designed to manage distractions e.g. mobile phone usage only allowed when in eyes-off conditions. Customer research indicates that young people think that the car should adapt to their needs, not the other way around. Convenience is key selling point and will be a significant influencer in take-up

Daimler: Allowed by whom? By the OEM? By laws? What is a distracting activity? Drivers already today can decide to perform activities other than driving (e.g. radio, navigation, drinking, eating, telephone etc.) when driving manually. OEMs already today describe and instruct how to use a particular system. Besides, national traffic law (which can be different for each country) describes the driver's duties and how to behave in road traffic. In German traffic law only the use of hand-held mobile phones during driving is explicitly not allowed. There are no legal requirements on other "distracting" activities. It does not seem feasible for the legislator to regulate detailed distracting activities, because there too many different kinds of activities. For the intended use of Level 3, the OEM will instruct that the use of enhanced side activities is limited to an onboard-integrated device in specific situations that therefore can be controlled/switched-off automatically by the Level 3 system (e.g. in case of a takeover-alert). Hand-held devices will not be included in the intended use. And we as an OEM will instruct our customer/drivers not to use non-integrated activities like newspapers, hand-helds/smartphones, sleeping etc.)

VW: The driver needs to remain sufficiently vigilant during the Level 3 ride and must avoid any distracting activities that may delay the take-over in resuming manual driving whenever the take-over demand (transition) is issued. The vehicle may provide certain activities to the driver during a Level 3 ride. These activities shall be connected to the built-in infotainment system insofar that they are being displayed and controlled exclusively via the built-in infotainment system itself. This is important because whenever the vehicle issues a take-over (transition) demand, these activities can then be "disengaged automatically" such that the driver's vigilance is being directed to the take-over demand and the current driving scenario. These activities are offered solely when the automated driving system is activated .

1.1 Level 4 driving

B remark : the answers and so the legal framework will depend on the use cases, in particular vehicle category.

General requirement for rule compliance?

B: In future, there will be two kinds or rules: the actual ones for 'normal' vehicles and others for CAV. Each vehicle will have to comply to its rules. In case of disabling of CAV-functions, the driver will overtake and follow the normal rules again. Ensuring road safety is the aim of the rules for the vehicle and its driver, but there will be different ways to reach that goal.

ESP: NO

DE: This question is unclear.

TFL: Will we still need a person to be responsible for the vehicle and what it does? If so, what are the parameters? Expected that vehicles will largely self check for road worthiness. Likely to require C-ITS broadcasting capabilities

Daimler: Question unclear.

ETSC: Yes. All vehicles should comply with national laws and regulations, e.g. on speed limit.

VW: This question remains unclear. Of course a level 4 driving system has to comply with all applicable rules.

Where is it allowed? Different road categories in EU member states? What is a motorway?

B: Similar as for level 3 driving: we are in favour of an international solution, given the huge amount of cross-border traffic across Europe. These questions should be decided in UNECE after much more FOT's will give more evidence of the possibilities of these technologies.

DE: These questions do not make sense. Under conditions of normal driving there are no performance differences between level 3 and Level 4 functions. Differences become visible in those situations where level 3 functions require an intervention by the driver whereas level 4 functions do not.

FIN: Allowed use based on the functionality (e.g. motorway autopilot). Some harmonization on road category definitions is needed between Member States.

ICCS: In Greece currently it is not allowed

TFL: At a minimum, it should be allowed on all TERN highways that guarantee users a high, uniform and continuous level of services, comfort and safety. A validation process may be required to define which roads meet minimum operational and safety standards e.g. status of 3D LIDAR mapping, no communication dead spots etc. The widely accepted definition of a motorway in the UK is a main road for fast-moving traffic over long distances, having limited access, separate carriageways for vehicles travelling in opposite directions

Daimler: Question unclear. What iIs allowed by whom…?

ETSC: Similar to truck platooning, systems should be capable of being enabled only on high quality roads. Operation in weaving sections may be appropriate, unlike for truck platoons. Lane-change capability may require extra verification, e.g. to ensure that motorcycles are detected

VW: Level 4 systems such as valet parking or city/campus shuttle services do not require a driver's presence. Other Level 4 systems that e.g. perform only on a highway still need the driver's presence at the end of the use-case. So it depends on the use-case on which roads the vehicle operates. There are different road categories in the EU member states but they can be divided in highways, interurban and urban roads. An EU-wide harmonization of road categories would be reasonable. However, as stated above, a lot depends on the use case. For certain use cases, especially truck platooning it may well be useful for roads to have a special attribute in a map where platooning is allowed.

Is hands-off and eyes-off the norm?

B: yes, by definition for level 4 driving.

DE: Who should define this norm? This question does not make sense.

ESP: YES

FIN: Yes

ICCS: the norm is hands-off, eyes-on

TFL: Yes, otherwise why automate?

Daimler: For Level 4 "yes" this is the norm, because a level 4 vehicle can even be driverless in limited situations (e.g. valet parking, shuttle, etc.).

ETSC: Yes. All infotainment needs to be through the vehicle system, so that when handover back to the driver takes place, distracting activities can be suppressed.

VW: Within the boundaries of the intended usage of a level 4 system eyes-off and hands-off is a permissible condition.

How do we reengage the driver?

B: Probably via visual commands.

DE: This question can only be answered if the driver status is clear.

ESP: OEM TO DEFINE

FIN: This is more of an issue at level 3.

ICCS: appropriate HMI, tactile feedback, interactive windscreen

TFL: Escalating warnings based on event urgency or threat level

Daimler: Reengaging the driver is not an issue in Level 4, because a level 4 system technically does not rely on a driver as fallback. It is rather able to safely stop the vehicle aside moving traffic in all situations (risk minimal condition).

ETSC: Critical. With loud alarms, etc. The fall back is the minimum safe manoeuvre, but this is not ideal as it can leave the vehicle in a risky location (the hard shoulder).

VW: Reengaging the driver of a level 4 system depends on the intended usage of the system and the respective use case. Since a Level 4 system is generally supposed to cope with all encountered traffic situations it only issues a take-over demand (transition) at the end of use-case if a driver is required at the end of use case. Thus, reengaging the driver can be achieved by optical/haptic/acoustic means.

Do we need HMI standardisation? What information should be conveyed to the driver in Level 4 driving?

B: Standardisation is required: the basics should be identical for all vehicle manufacturers in a view to facilitate driver comprehension of the system and to support car sharing. Once again, we are in favour of an international solution.

DE: Design, process or performance standards? What does the I mean: Interaction vs. Interface? Is it more reasonable to ask which information should not be conveyed?

ESP: IT WOULD BE RECOMMENDABLE. SYSTEMS CAPABILITIES

FIN: Yes, HMI standardisation is needed (applies also to Level 3).

ICCS: Yes we do. Information that should be provided should be about possible hazards ahead, alert level due to traffic, alert level because of de-platooning, etc.

TFL: Yes – terminology needs to be standardised to avoid different interpretations, particularly when travelling outside country of residence. Vehicles should be aware of local conventions e.g. “prioritié a droite” in France/Belgium. Vehicle and trip status information (safety critical/non-critical information for vehicle systems, weather, incidents ahead, congestion and alternative routing).

Daimler : HMI standardization is not an issue for Level 4, because a level 4 system does not rely on a driver as fallback and can even be driverless in limited situations. HMI is more important for Level 3, because the system still need a driver as fallback and hands-over to the driver as soon as the operational domain limits are reached. To ensure safe hand-over to the driver some HMI criteria should be fulfilled by all OEMs (e.g. multichannel take-over request, switch-off, infotainment content which is not relevant for driving, shall be deactivated in case a take-over request is issued and it shall instead show a take-over request.

ETSC: Yes. We do not want to create mode confusion, and lots of differences between different makes and models of vehicle. Systems that confirm that drivers have both hands

on the steering wheel to enable and disable automation are desirable and perhaps necessary. Ideally drivers should continue to receive route (strategic information) as well as tactical information such as speed and manoeuvre intention.

VW: A standardization of the HMI makes sense once a state-of-the-art is apparent. Too early standardization may stifle innovation and possibly hinder optimal solutions. If a driver is still required at the end of the use-case of a level 4 system, then a take-over demand (transition) shall be issued well in advance. If a driver is not required and thus not present (e. g. valet parking system) information about the vehicle status may be delivered to the vehicle operator.

Tom tom: Yes we need standardisation, especially with regards to icons (HMI). The iMobility WG on SafeApps has worked on this topic last year under the chairmanship of TomTom and HERE but its' Report is not widely disseminated (due to the fact that the iMobility is not running yet). We could use the Report as a good starting point. The icons take into account the short attention span allowed to the drivers. Everything should be instantaneously comprehensive. Standardization is needed to support safety-that means minimization of standards. Of course, it is better to have an Industry agreement on that (in the form of ESoP or similar) rather than EU Regulation.

Can the windscreen be taken over by infotainment?

B: At least the lower part of it. In level 3 it might even be recommended to transfer texting from the smartphone to the windscreen and the driver's voice. In level 4 the software can be programmed as to use the windscreen for more disengaging entertainment.
In both cases, two conditions will certainly be:
- driving related messages should always have priority;
- the messages on the windscreen may not disturb the driver in such a way that it would cause additional time to regain control.

DE: Re-wording of the question is needed.

ESP: WHY NOT

FIN: At level 4, by definition yes. At level 3, no.

ICCS: Not for the first period of operation.

TFL: Yes, with an extraordinary event takedown. In-vehicle advertising and other digital media will be a strong presence, particularly in shared use/ownership vehicles. Daimler: In the future, the windscreen may be a mean to project infotainment similar to today's Headup-Displays.

ETSC: No, not at the expense of important driving-related information.

VW: We do not see infotainment over the entire windscreen in near future. Rather there will be a step-by-step approach and as long as there is a human-machine-interaction needed, an occupation of the entire windscreen would at this stage be not reasonable. In general, this deserves further elaboration – especially with regards to specific use cases, such as truck platooning.

Do we need to change laws and regulations on distraction and mobile phone use?

B:Yes, their use will be allowed (in certain circumstances).

DE: These issues concern the principles of Member States highway codes and do not need to be addressed on an EU level.

ESP: ONLY TO INCLUDE AN EXEMPTION WHILE LEVEL 4 SYSTEM ACTIVATED.

FIN: Yes.

ICCS: For the time being I would say no.

TFL: Yes, in a fully automated environment (note comments around level 3 driving). Legislation needs to be framed to accommodate new and emerging technologies, including wearables.

Daimler: Which laws are referred to? Example national traffic law: Depending on today's content it may become necessary to amend the law in certain countries. While for level 4 systems the intended-use of side activities will be further extended, we believe we still would not want to allow drivers/passengers to use hand-held devices, because there's another issue besides distraction: In case of emergency events/crash flying parts/objects in the interior cabin need to be avoided. You can only avoid this if you somehow integrate those devices. Therefore: The prohibition of the use of hand-held mobile phones is not an issue and its use in the driver's/passenger's hand may even continue to be prohibited even in level 4.

ETSC: Yes. This area needs a major rethink. Activity through the vehicle should be permissible.

Tom tom: No, we have the HMI ESoP

VW: There should be clarity on mobile phone usage in the laws. Regulating distraction depends on the use case and the intended usage of the respective level 4 system. Whenever a driver remains in the vehicle, we believe that mobile phone usage via nomadic devices shall be prohibited. This is because of two reasons:
1. Driver's vigilance: In cases where a take-over of the driver still is required (e.g. highway pilot, end of the highway). Then only nomadic mobile phones which are not connected to the vehicle's infotainments system in a way to disengage the phone usage whenever a take-over demand (transition) is issued by the vehicle shall be allowed.
2. Product Safety (esp. in case of a crash): From a product safety perspective, nomadic devices should not be used since they stipulate a potential additional risk.

Should all infotainment be governed via the vehicle?

B: We see no reason why.

DE: What would be the alternative?

FIN: Not necessarily.

TFL: No, vehicle systems need to be robust enough to deal with possible interference. Future infotainment platforms may not be vehicle based e.g. virtual reality headsets

ICCS: Yes.

Daimler: Yes, infotainment should be integrated to the vehicle and controlled by the vehicle. External devices can be used as long their integration into the vehicle / user-interface is foreseen.

ETSC: Yes, for the driving seat.

VW: Yes. Arguments: Product safety, keeping the driver sufficiently vigilant.

How is driver incapacity (sleeping) handled?

B:Manufacturers can make a proposal.

DE: A driver's seat in a vehicle in motion is not a comfortable place for recreative deep sleep. States of critical driver fatigue e.g. resulting from extensive time on task may be prevented by driver state monitoring systems.

ESP: IN CASE OF NOT RESPOND, VEHICLE MUST STOP SAFELY

FIN: The vehicle must be able to perform a safe stop.

ICCS: Through eye-gaze cameras

TFL: In vehicle sensors may be required to determine nature of incapacity e.g. sleep, medical emergency, intoxication and drugs. Head for preselected destination – potential priority status assigned in case of medical situation. For medical emergencies vehicle communicates and can redirect to suitable emergency facilityDaimler: Not an issue for level 4, because a level 4 system technically does not rely on a driver as fallback. It is rather able to safely stop the vehicle aside moving traffic in all situations (risk minimal condition).

ETSC: We need eye-tracking. However, this is not 100% reliable. So we need the development of better driver monitoring systems.

VW: This depends on the use case and the intended usage of the level 4 system. Whenever the system requires a human-machine-interaction, sleeping will not be allowed. If the vehicle detects a sleeping driver, the functionality will be disengaged and the vehicle performs a minimal risk manoeuvre.

Should there be limitations on driver takeover in certain situations (e.g. in high-speed lane changes)?

B: This question holds from driver assistance systems onwards (level 1 driving) and our answer is affirmative. Automated technologies are not only about bringing comfort to the driver, but also to combat negative effects of road transport. As such, obeying the speed limits is not just an option that can be disabled whenever you want. Driver takeover might be presented in the shape of an emergency button, with the driver retaking control of all functionalities for a short duration.

DE: General comment: This is by the end a legal issue. However, for my understanding it is not possible to restrict drivers' options to takeover/intervene at any time.

ESP: NO

FIN: Currently no limitations should be set. In some cases in the future, it might be useful to consider some limitations in specific use cases.

ICCS: a case by case scenario development should be developed followed by appropriate testing. Limitations should be an outcome of technology readiness level.

TFL: Vehicle could prevent extreme actions under certain circumstances. Many vehicles already have sophisticated driver safety systems which require specific actions to disable this functionality. If shared use vehicles become more common, will drivers be sufficiently familiar with vehicle/cockpit layouts of different vehicles? Should certain functionality be standardised?

Daimler : Take-over is not an issue for level 4, because a level 4 system according to the technical definitions does not rely on a driver as fallback. It is rather an issue for level 3 systems that still rely on a driver as fallback. In time-critical emergency situations, the level 3 function does e.g. not request the driver to take-over the driving task, because the driver cannot be expected to take-over without a sufficient lead time. However, there are other less-time-critical situations where driver takeover becomes necessary and can for good reasons be expected from the driver: E.g. approaching ODD limit (e.g., end of freeway), missing lane markings, missing front vehicle, curve radius too narrow, weather conditions deteriorate (rain, fog, temperature falls, etc.), tunnel, border crossing/tollgate, failure of a third sensor/camera (but function can still work).

ETSC: Yes. Immediate take-over mid-manoeuvre could be dangerous.

VW: The take-over by the driver is designed by the vehicle manufacturer and thus depends on the functional boundaries. The technical regulations may impose certain limitations on the take-over e.g. when a lateral acceleration is reached or about to be reached or when a certain velocity threshold is reached or about to be reached. If however the specified functional boundaries (by the vehicle manufacturer) are not reached, the take-over demand does not need to be limited.

Lane changing and motorcycles

ESP: SYSTEM

FIN: This is an important issue, applies also to level 3.

TFL: It is anticipated that future motorcycles will have connected capabilities. Systems may enable undertaking and navigating gaps in traffic at pre-determined speeds. Potential to exclude motorcycles without basic broadcast functionality from validated/restricted highways.

ETSC: We need good detection of motorcycles, including on fast approach. In the medium term, inclusion of motorcycles in V2V communications is vital.

VW: A level 4 system is expected to perform lane changes by taking into account the surrounding traffic flow – if the use-case entails a lane change manoeuvre, as a driver (if present) is not required

until the end of use-case. The aforementioned is valid as well for Level 3 systems if they provide a lane change manoeuvre that does not require initiation/confirmation by the driver.

Environmental limitations on operation

ESP: SYSTEM

FIN: Current technology has serious issues with varying weather conditions, so this needs to be monitored.

TFL: Auto monitoring and response.

ETSC: AD systems need to identify and respond to poor environmental conditions (fog, snow, heavy rain, etc.). Safe operation at night needs to assured, as does being able to handle bright sunlight.

VW: In contrast to Level 3 systems, a Level 4 system is expected to cope with environmental limitations by its own and as a last resort, initiate and perform a minimal risk manoeuvre.

Tyres: checking and space-saver spares

ESP: SYSTEM

TFL: Auto monitoring and response.

ETRMA: In case of low pressure warning the car needs to take action by itself. In case of level 4/5 passengers do not need to know how to drive. But this means that car needs to be able to get to a safe place (ie a homologated and maintained inflation centre) in case of a breakdown of tire or related components. The tire should therefore have some kind of extended mobility solution in case of tire damage. Or some other technology that protects tire from damage

ETSC: We need tyre pressure monitoring and drivers need to take responsibility for checking their tyres. Disabling of AD with space-savers is necessary.

VW: It is expected that Level 4 systems receive information from the TPMS during the ride. The operator of the Level 4 system needs to ensure the proper tyres' condition.

Speed compliance with dynamic limits

ESP: SYSTEM

FIN: This is an important issue, applies also to level 3

TFL: Auto monitoring and response.

ETSC: This is necessary.

VW: A level 4 system is expected to comply with the speed limits, as a driver (if present) is not required until the end of use-case. V2X communication would be helpful, especially with regards to platooning – however, in the latter case, the driver in the first truck would have to drive according to the speed limits, the others would follow.

Road works

ESP: SYSTEM.

TFL: See comments on HMI standardisation.

ETSC: AD may have to be disabled around road works. Maps may potentially not work properly around road works. This is an area for R&D.

VW: A level 4 system is expected to handle the driving task around road works, as a driver (if present) is not required until the end of use-case. Again V2X communication could provide further assistance.

VW: This is an important issue, applies also to level 3

Handling of emergency vehicles

B remark: We are not qualified as vehicle technicians. It is up to the sector to conceive and develop the technical solutions and we will be happy to follow their progress by means of test reports.

ESP: SYSTEM.

FIN: This is an important issue, applies also to level 3.

TFL: Auto monitoring and response. Prioritisation.

ETSC: AD systems need to be able to detect emergency vehicles and tell the driver to reengage.

VW: A level 4 system is expected to form/follow a corridor for emergency vehicle access, as a driver (if present) is not required until the end of use-case.