Submitted by the technical Secretary

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A proposal for the Definitions of Automated Driving under WP.29 and the General Principles for developing a UN Regulation

- ○ The following table reflects the general principles for automated driving systems as WP.29. These principles will be treated as guidelines for developing a new regulation related to automated driving systems at WP.29.
  - ・The control systems that intervening in case of emergency (AEB, ESC, Deadman, etc.) are not included in these definitions of automated driving.
  - ・The control functions that avoid dangers caused by unpredictable traffic conditions (goods/luggage dropping, frozen road, etc.) or other drivers' illegal driving behaviors are not considered in this table.
- ○ The regulation on automated driving needs to have new specific performance requirements and verification tests under various conditions depending on each level.
- ○ In discussing system requirements, it is desirable to organize them by level as well as by road way type (1: parking area; 2: motorway; 3: urban and interurban road).
- ○ The following table shows the distinguish way of level of automated driving under WP.29 at this present considering the results of discussions so far and the assumed use cases. This table should be reconsidered appropriately in accordance with each concept of automated driving system to be placed on the market in the future.

	Object and Event Detection and Response (OEDR) by the driver The driver may not perform secondary activities			**Object and Event Detection and Response (OEDR) by the system The driver may perform secondary activities**		
	Monitor by Driver	**Monitor by Driver (a)**	**Monitor by Driver (b)**	**Monitor by System (Return to Driver Control on System Request)**	**Monitor by System Full Time under defined use case**	**Monitor by System only**
Ref. SAE Level (J3016)	1	2		3	4	5
Outline of Classification	System takes care of longitudinal or lateral control. Monitoring by the driver.	The system takes care of both longitudinal and lateral control. Monitoring by driver necessary because the system is not able to detect all the situations in the use case. The driver shall be able to intervene at any time.		The system is able to cope with all dynamic driving tasks within its designed use-case* or will otherwise transition to the driver offering sufficient lead time (driver is fallback). The system drives and monitors (specific to the use-case) the environment. The system detects system limits and issues a transition demand if these are reached. *The Level 3 system is e.g. not expected to provide a corridor for emergency vehicle access or to follow hand signals given by traffic enforcement officers. The driver needs to remain sufficiently vigilant as to acknowledge and react on these situations (e. g. when he hears the sirens of an emergency vehicle in close vicinity).	The system is able to cope with any situations in the concerned use case (fallback included). The driver is not necessarily needed during the specific use-case, e. g. Vallet Parking/ Campus Shuttle. The system may however request a takeover if the use case boundaries are reached (e.g. motorway exit).	The system is able to cope with any situations on all road types, speed ranges and environmental conditions. No driver necessary.
Vehicle Tasks	1. Execute either longitudinal (acceleration/braking) or lateral (steering) dynamic driving tasks when activated. The system is not able to detect all the situations in the use case.	1. Execute longitudinal (accelerating, braking) and lateral (steering) dynamic driving tasks when activated. The system is not able to detect all the situations in the use case.		1. Execute longitudinal (accelerating/braking) and lateral (steering) portions of the dynamic driving task when activated. Shall monitor the driving environment for operational decisions when activated.	1. Execute longitudinal (accelerating/braking) and lateral (steering) portions of the dynamic driving task when activated. Shall monitor the driving environment for any decisions happening in the use case (for example Emergency vehicles).	1. Monitor the driving environment
	2. System deactivated immediately at the request of the driver	2. System deactivated immediately upon request by the human driver.		2. Permit activation only under conditions for which it was designed. System deactivated immediately at the request of the driver. However the system may momentarily delay deactivation when immediate human takeover could compromise safety	2 Permit activation only under conditions for which it was designed. System deactivated immediately at the request of the driver. However the system may momentarily delay deactivation when immediate human takeover could compromise safety	2. Execute longitudinal (accelerating/ braking) and lateral (steering)
		3. No transition demand as such, only warnings.		3. System automatically deactivated only after requesting the driver to take-over with a sufficient lead time; may − under certain, limited circumstances − transition (at least initiate) to minimal risk condition if the human driver does not take over. It would be beneficial if the vehicle displays used for the secondary activities were also used to improve the human takeover process.	3. Shall deactivate automatically if design/boundary conditions are no longer met and must be able to transfer the vehicle to a minimal risk condition. May also ask for a transition demand before deactivating.	3. Execute the OEDR subtasks of the dynamic driving task- human controls are not required in an extreme scenario.
		4. A driver availability recognition function (could be realized, for example, as hands-on detection or monitoring cameras to detect the driver's head position and eyelid movement etc.) could evaluate the driver's involvement in the monitoring task and ability to intervene immediately.		4. Driver availability recognition shall be used to ensure the driver is in the position to take over when requested by the system. Potential technical solutions range from detecting the driver's manual operations to monitoring cameras to detect the driver's head position and eyelid movement.	4. Driver availability recognition shall be used to ensure the driver is in the position to take over when requested by transition demand. This can however be lighter solutions than for level 3 because the system is able to transfer the vehicle to a minimal risk condition in the use case.	4. System will transfer the vehicle to a minimal risk condition.
				5. Emergency braking measures must be accomplished by the system and not expected from the driver (due to secondary activities)	5. Emergency braking measures must be accomplished by the system and not expected from the driver (due to secondary activities)	

Driver Tasks	1. Determine when activation or deactivation of assistance system is appropriate	1. Determine when activation or deactivation of the system is appropriate.	1. Determine when activation or deactivation of the automated driving system is appropriate.	1. Determine when activation/deactivation of the automated driving system is appropriate.	1. Activate and deactivate the automated driving system.
	2. Monitor the driving environment. Execute either longitudinal (acceleration/braking) or lateral (steering) dynamic driving task	2. Execute the OEDR by monitoring the driving environment and responding if necessary (e.g. emergency vehicles coming).	2. Does not need to execute the longitudinal, lateral driving tasks and monitoring of the environment for operational decisions in the use case.	2. Does not need to execute the longitudinal, lateral driving tasks and monitoring of the environment in the use case.	2. Does not need to execute the longitudinal, lateral driving tasks and monitoring of the environment during the whole trip.
	3. Supervise the dynamic driving task executed by driver assistance system and intervening immediately when required by the environment and the system (warnings)	3. Constantly supervise the dynamic driving task executed by the system. Although the driver may be disengaged from the physical aspects of driving, 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).	3. Shall remain sufficiently vigilant as to acknowledge the transition demand and, acknowledge vehicle warnings, mechanical failure or emergency vehicles (increase lead time compared to level 2).	3. May be asked to take over upon request within lead time. However the system does not require the driver to provide fallback performance under the use case.	3. Determine waypoints and destinations
	4. The driver shall not perform secondary activities which will hamper him in intervening immediately when required.	4. The driver shall not perform secondary activities which will hamper him in intervening immediately when required.	4. May turn his attention away from the complete dynamic driving task in the use case but can only perform secondary activities with appropriate reaction times. It would be beneficial if the vehicle displays were used for the secondary activities.	4. May perform a wide variety of secondary activities in the use case.	4. May perform a wide variety of secondary activities during the whole trip.
Consideration points on development of vehicle regulation	Same as current principle (manner)	1. Consider whether regulatory provision for longitudinal (accelerating, braking) and lateral control (steering) are necessary.	1. Consider which regulatory provision for longitudinal (accelerating, braking) and lateral control (steering) are necessary including the monitoring of the driving environment.	1. Consider which regulatory provision for longitudinal (accelerating, braking) and lateral control (steering) are necessary including the monitoring of the driving environment for any decisions happening in the use case (for example Emergency vehicles).	*Note: Preliminary analysis only- subject further review.* 1. Consider which regulatory provision for longitudinal (accelerating, braking) and lateral control (steering) are necessary including the monitoring of the driving environment for any decisions (for example Emergency vehicles).
		2. Consider regulatory provision to ensure the system is deactivated immediately upon request by the human driver.	2. Consider regulatory provision to ensure the system: i) Permits activation only under conditions for which it was designed, and ii) Deactivates immediately upon request by the driver. However the system may momentarily delay deactivation when immediate driver takeover could compromise safety.	2. Consider regulatory provision to ensure the system: i) Permits activation only under conditions for which it was designed, and ii) Deactivates immediately upon request by the driver. However the system may momentarily delay deactivation when immediate driver takeover could compromise safety.	2. Depending upon the vehicle configuration, consider regulatory provision to ensure the system: i) Permits activation only under conditions for which it was designed, and ii) Deactivates immediately upon request by the driver. However the system may momentarily delay deactivation when immediate driver takeover could compromise safety.
		3. Consider the warning strategy to be used.	3. Consider regulatory provision to ensure the system automatically deactivates only after requesting the driver to take-over with a sufficient lead time; including − under certain, limited circumstances − transition (at least initiate) to minimal risk condition if the driver does not take over. It would be beneficial if the vehicle displays used for the secondary activities were also used to improve the human takeover process.	3. Consider regulatory provision to ensure the system automatically transfer the vehicle to a minimal risk condition preferably outside of an active lane of traffic if design/boundary conditions are no longer met.	3. Consider regulatory provision to ensure the system automatically transfer the vehicle to a minimal risk condition preferably outside of an active lane of traffic.
		4. Consider the driver availability recognition function to evaluate the driver's involvement in the monitoring task and ability to intervene immediately. For example, as hands-on detection or monitoring cameras to detect the driver's head position and eyelid movement etc.	4. Consider regulatory provision for driver availability recognition is used to ensure the driver is in the position to take over when requested by the system. .	4. Consider regulatory provision for driver availability recognition is used to ensure the driver is in the position to take over when requested by the system transition demand at the end of the use case.	
			5. Consider regulatory provision for emergency braking measures by the system	5. Consider regulatory provision for emergency braking measures by the system.	4. Consider regulatory provision for emergency braking measures by the system.

<table>
<tr><th colspan="7">Examples of the necessary system performance requirements</th></tr>
<tr><td>Override (e.g. steering, braking, accelerating) function by the driver</td><td colspan="4">Necessary in general</td><td>Unnecessary when driverless mode. Otherwise necessary in general. However the system may momentarily delay deactivation when immediate human takeover could compromise safety.</td><td>Unnecessary</td></tr>
<tr><td>Aspects of arrangement that ensures the driver’s involvement in dynamic driving tasks (driver monitoring, etc.)</td><td>Detection of hands-off when Level 1 addresses LKAS</td><td>Detection of hands-off</td><td>Detecting the driver availability recog-nition function to evaluate the driver’s involvement in the monitoring task and ability to intervene immediately (e.g. hands off detection, head and/or eye movement and/or input to any control element of the vehicle)</td><td>Detection of driver’s availability to take over the driving task upon request or when required:
e.g. seated/unseated,
driver availability recognition system (e.g. head and/or eye movement and/or input to any control element of the vehicle)</td><td>Unnecessary when driverless operation/use case.

Necessary when driver is requested to take over at the end of use case. In these circumstances, this can be lighter solutions than for level 3 because the system is able to transfer the vehicle to a minimal risk condition in the use case.</td><td>Unnecessary</td></tr>
<tr><td>Aspects of arrangement that ensures the driver’s resumption of dynamic driving tasks (transition periods to the driver, etc.)
Aspect of transition demand procedure.</td><td colspan="3">not applicable</td><td>Consideration of the methods used to reengage the driver following system request (including minimal risk maneuver and cognitive stimulation- if applicable the vehicle infotainment system showing non-driving relevant content to be deactivated automatically when transition demand is issued).</td><td>Unnecessary when driverless operation/use case but level 3 requirement when the end of the use case is reached.</td><td>Unnecessary</td></tr>
<tr><td>System reliability</td><td colspan="6">Consideration shall be given to evaluation of the system reliability and redundancy as necessary.</td></tr>
<tr><td>Comprehensive recognition of surrounding environment (sensing, etc.)</td><td>The area to be monitored (depends on the system function).</td><td>The area to be monitored necessary for lateral and longitudinal control (depends on the system function, while recognizing it is the task of the driver to perform OEDR).</td><td>The area to be monitored necessary for lateral and longitudinal control (depends on the system function, while recognizing it is the task of the driver to perform OEDR). Additionally the system may perform OEDR function.</td><td colspan="3">The area to be monitored depends on the system function (Lateral and longitudinal directions).

It is the task of the system to perform OEDR.</td></tr>
<tr><td>Recording of system status (inc. system behavior) (DSSA-Data Storage System for ACSF, EDR, etc.)</td><td>Unnecessary</td><td>Unnecessary</td><td>The driver’s operations and the system status (incl. system behavior)</td><td>The driver’s operations and the system status (incl. system behavior)</td><td colspan="2">The system status (incl. system behavior))</td></tr>
<tr><td>Cyber-Security</td><td colspan="6">Necessary if the information communication in connected vehicles, etc. affects the vehicle control</td></tr>
<tr><td>Compatibility with traffic law (WP.1)</td><td>Yes</td><td>Yes</td><td>Yes</td><td>[WP.1-IWG-AD recommends WP.1 to state that the use of these functions remain within the requirements of the Conventions.]</td><td>[WP.1-IWG-AD recommends WP.1 to state that the use of these functions remain within the requirements of the Conventions. These are functions whereby a driver is still available at the end of the use-case. Functions that do not require a driver (e.g. campus shuttle) at all (driverless) are still in discussion – except for those that do not interact on/with public roads.]</td><td>Further consideration necessary to reflect driverless systems before a conclusion can be made.</td></tr>
<tr><th colspan="7">Summary of the current conditions and the issues to be discussed (specific use cases)</th></tr>
<tr><td>Parking area</td><td rowspan="3">Already put into practice:

・ Parking Assist
・ LKA (draft standards)
・ ACC (no specific performance requirements)
・ ACSF Cat.B1 (Steering Function hands-on)</td><td colspan="2">・ Automated parking by the driver’s remote control (monitoring) (RCP-Remote Control Parking, CAT. A under ACSF amendment of R79)</td><td colspan="3">Requirements need to be developed</td></tr>
<tr><td>Roads exclusively for motor vehicles with physical separation from oncoming traffic (e.g. motorway)</td><td colspan="2">Under discussion:
・ Categories [B2], C, D and [E] under ACSF (amendment of R79)
・ Category B1 in combination with longitudinal control</td><td>Under discussion :
・ Categories B2, B2+E under ACSF (amendment of R79)</td><td colspan="2">Requirements need to be developed</td></tr>
<tr><td>・ ACC+ACSF (Cat.B1, Cat.C [Basic Lane Change Assist], Cat.D [Smart LCA])</td><td>・ [ACSF Cat. B2]
・ [ACSF Cat.E] (Continuous Lane Guidance hands-off)</td></tr>
<tr><td>Urban and interurban roads</td><td colspan="2">・ Category B1 in combination with longitudinal Control
・ To be discussed by R79 IWG ACSF: Cat. B1 in combination with C, D</td><td colspan="3">Requirements need to be developed</td></tr>
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