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: limited space; 2: motorway; 3: urban 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.
- ○ The color represents who modified it: Results of 1st ad hoc in Blue font, EC in Yellow background, MLIT (Japan) in Green font, and Results of 2nd ad-hoc in Red font

	~~Monitor~~ OEDR (object and event detection and response) by Driver The driver may not perform secondary activities ~~tasks~~			~~Monitor~~ OEDR (object and event detection and response) by System The driver may perform secondary activities ~~task~~		
	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: ~~(system takes care of longitudinal or lateral control, monitoring by the driver)~~	2: ~~(the system takes care of both longitudinal and lateral control). Monitoring by driver (monitoring by system allowed?) necessary because the system is not able to detect all the situations in the use case. The driver shall be able to take over at any time May include some monitoring of the driving environment.~~		3: ~~The system is able to cope with any situations in the concerned use case, which includes the period of transition to driver control, the system drives and monitors (specific to the use-case) the environment and is able to warn the driver sufficiently in advance if a takeover is necessary in the use case. The system detects system limits and issues a transition demand if these are reached.~~	4: ~~The system is able to cope with any situations in the concerned use case (fallback included), Driver not necessarily needed during specific use-case, e. g. Vallet Parking/ Campus Shuttle. It may however request a takeover if the use case boundaries are reached (e.g. motorway exit).~~	5: ~~The system is able to cope with any situations on all road types, speed ranges and environmental conditions. No driver necessary.~~
Outline of Classification	(system takes care of longitudinal or lateral control, monitoring by the driver)~~The vehicle cannot be driven without the driver's continuous operation.~~	(The system takes care of both longitudinal and lateral control). Monitoring by driver (monitoring by system allowed?) necessary because the system is not able to detect all the situations in the use case. The driver shall be able to ~~take over~~ intervene at any time. ~~The driver and the system share dynamic driving tasks (see SAE's definitions) under limited driving environments and conditions~~		~~The system is able to cope with any situations in the concerned use case, which includes the period of transition to driver control, the system drives and monitors (specific to the use-case) the environment and is able to warn the driver sufficiently in advance if a takeover is necessary in the use case. The system detects system limits and issues a transition demand if these are reached.~~ 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 Lv3 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 occasionally performs all dynamic driving tasks.~~	The system is able to cope with any situations in the concerned use case (fallback included), Driver not necessarily needed during specific use-case, e. g. Vallet Parking/ Campus Shuttle. It may however request a takeover if the use case boundaries are reached (e.g. motorway exit). ~~The systems do not require the driver to provide fallback performance~~	The system is able to cope with any situations on all road types, speed ranges and environmental conditions. No driver necessary. ~~The system always operates all dynamic driving tasks.~~
	~~The system offers to operate in response to the driver's request, or to operate the vehicle for the driver just for a limited period (short time)*.~~ ~~*GRRF expert group should quantify~~	~~The system offers to operate the vehicle for the driver for a certain period (Long time)* which the driver requests.~~ ~~[Meaning of "Long time" is assumed to be hands off duration.]~~ ~~*GRRF expert group should quantify~~		~~Only secondary activities tasks with appropriate reaction time are allowed (e.g. texting, internet surfing, video-telephony)~~	~~All secondary activities tasks are allowed within the use case boundaries (e.g. motorway).~~	

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. ~~May include some monitoring of the driving environment.~~ 2. System deactivated immediately at the request of the driver	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. ~~May/Shall include some monitoring of the driving environment.~~ 2. System deactivated immediately upon request by the human driver. 3. No transition demand as such, only warnings. 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. ~~[If the vehicle has safety function(s) such as driver monitoring system (e.g. monitoring cameras to detect the driver's head position and eyelid movement), minimal risk manoeuvre and predictable and reproducible takeover scenarios, hands off may be allowed to some extent.]~~	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. 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 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. 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. 5. Emergency braking measures must be accomplished by the system and not expected from the driver (due to secondary activities ~~tasks~~)	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~~?~~). 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 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. 4. Driver availability recognition shall~~might~~ 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. 5. Emergency braking measures must be accomplished by the system and not expected from the driver (due to secondary activities ~~tasks~~)	1. Monitor the driving environment 2. Execute longitudinal (accelerating/ braking) and lateral (steering) 3. Execute the OEDR subtasks of the dynamic driving task- human controls are not required in an extreme scenario 4. System will transfer the vehicle to a minimal risk condition
Driver Tasks	1. Determine when activation or deactivation of assistance system is appropriate 2. Monitor the driving environment. Execute either longitudinal (acceleration/braking) or lateral (steering) dynamic driving task 3. Supervise the dynamic driving task executed by driver assistance system and intervening ~~take over~~ immediately when required by the environment and the system (warnings) 4. The driver shall~~may~~ not perform secondary activities ~~tasks~~ which will hamper him in intervening ~~taking over~~ immediately when required.	1. Determine when activation or deactivation of the system is appropriate. 2. Execute the OEDR by monitoring the driving environment and responding if necessary (e.g. emergency vehicles coming). 3. Constantly supervise the dynamic driving task executed by the system. Although the driver may be ~~is physically~~ disengaged from the physical aspects of driving, he/she must be fully engaged mentally with the driving task ~~must be engaged~~ and ~~must~~ 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). 4. The driver shall~~may~~ not perform secondary activities ~~tasks~~ which will hamper him in intervening ~~taking over~~ immediately when required.	1. Determine when activation or deactivation of the automated driving system is appropriate. 2. Does not need to execute the longitudinal, lateral driving tasks and monitoring of the environment for operational decisions in the use case. 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). 4. ~~The driver~~ May turn his attention away from the complete dynamic driving task in the use case ~~certain domains~~ but can only perform secondary activities ~~tasks~~ with appropriate reaction times. It would be beneficial if the vehicle displays were used for the secondary activities.	1. Determine when activation/deactivation of the automated driving system is appropriate. 2. Does not need to execute the longitudinal, lateral driving tasks and monitoring of the environment in the use case. 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. 4. ~~The driver~~ May~~could~~ perform a wide variety of secondary activities ~~tasks~~ in the use case.	1. Activate and deactivate the automated driving system. 2. Does not need to execute the longitudinal, lateral driving tasks and monitoring of the environment during the whole trip. 3. Determine waypoints and destinations ~~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 whole trip.~~ 4. ~~The driver~~ May~~could~~ perform a wide variety of secondary activities ~~tasks~~ 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. 2. Consider regulatory provision to ensure the system is deactivated immediately upon request by the human driver. 3. Consider the warning strategy to be used. 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.	1. Consider which regulatory provision for longitudinal (accelerating, braking) and lateral control (steering) are necessary including the monitoring of the driving environment. 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 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,	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). 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 3. Consider regulatory provision to ensure the system	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. 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

			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. 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. 5. Consider regulatory provision for emergency braking measures by the system. ~~The regulation needs to require that the driver is in a condition (driver availability) that enables him or her to resume operation of dynamic driving tasks when the driver must resume the driving task (transition demand by the system) under other than the use cases. The system shall be able to detect its own functional limitations. With respect to systems of level 3 consideration should be given to the minimum level of the data capture concerning system status. Furthermore, for system of level 3 consideration should be also given for requirement for minimal risk maneuver and emergency braking.~~ ~~Driver (availability recognition) activation monitoring might~~~~should~~ ~~be used to only~~~~allow secondary~~ ~~activities tasks~~ ~~with appropriate reaction time are allowed. Potential technical solutions range from detecting the driver's manual operations to monitoring cameras to detect the driver's head position and eyelid movement.~~	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. 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.	immediately upon request by the driver. However the system may momentarily delay deactivation when immediate driver takeover could compromise safety 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 regulatory provision for emergency braking measures by the system.
Examples of the necessary system performance requirements						
Override (e.g. steering, braking, accelerating) function by the driver	O (Necessary in general)	O (Necessary in general)	O (Necessary in general)	~~Δ~~O ~~(necessity depends on the system)~~(Necessary in General)	Δ ~~(~~Unnecessary when driverless mode. Otherwise necessary in general. However the system may momentarily delay deactivation when immediate human takeover could compromise safety.	X （Unnecessary）
Aspects of arrangement that ensures the driver's involvement in dynamic driving tasks (driver monitoring, etc.)	Δ (detection of hands- off when Lv1 addresses LKAS)	Δ (detection of hands-off ~~as necessary~~).	O Detecting the driver availability recognition 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)	O (detection of driver's availability to take over the driving task upon request or when required: e.g. seated/unseated, ~~reminder to the driver to avoid that he falls asleep etc.).~~ driver availability recognition system e.g. head and/or eye movement and/or input to any control element of the vehicle)	~~O~~X (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.	X （Unnecessary）
Aspects of arrangement that ensures the driver's resumption of dynamic driving tasks (transition	X （~~Unnecessary~~not applicable）	X （~~Unnecessary~~not applicable）	Δ (not applicable）	O (~~sufficient~~ consideration of the methods used to reengage the driver following system request (including minimal risk maneuver and cognitive stimulation- if applicable the vehicle	~~O~~ X ~~(periods that depends on the driver's conditions that can resume to driving operation)~~Unnecessary when driverless operation/use case but level 3 requirement when	X （Unnecessary）

periods to the driver, etc.) Aspect of transition demand procedure.				infotainment system showing non-driving relevant content to be deactivated automatically when transition demand is issued).	the end of use case.	
System reliability	Consideration shall be given to evaluation of the system reliability and redundancy as necessary.					
Comprehensive recognition of surrounding environment (sensing, etc.)	The area to be monitored (depends on the system function).	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~~the Object and Event Detection and Response~~).	The area to be monitored necessary for lateral and longitudinal control (depends on the system function, while recognizing it is the task of OEDR ~~the driver to perform the Object and Event Detection and Response~~). Additionally the system may perform OEDR function.	~~Lateral and longitudinal directions~~The area to be monitored depends on the system function (Lateral and longitudinal directions) It is the task of the system to perform OEDR ~~the Object and Event Detection and Response (system performance requirements necessary).~~		
Recording of system status(inc. system behavior) (DSSA-Data Storage System for ACSF, EDR, etc.)	X （Unnecessary）	X （Unnecessary）	O (the driver's operations and the system status**(inc. system behavior)**)	O (the driver's operations and the system status**(inc. system behavior)**)	O (the system status**(inc. system behavior)**)	
Security Cybersecurity ~~(E-security)~~	O (Necessary if the information communication in connected vehicles, etc. affects the vehicle control)					
Compatibility with traffic law (WP.1)	Yes	Yes	Yes	[WP.1-IWG-AD recommends WP.1 to state that the use of these functions remain within the requirements of the Conventions.]	[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.]	Further consideration necessary to reflect driverless systems before a conclusion can be made.
Summary of the current conditions and the issues to be discussed (specific use cases)						
Parking area	○ Already put into practice ・ Parking Assist	・ Automated parking by the driver's remote control (monitoring) (RCP-Remote Control Parking, CAT. A under ACSF (amendment of R79)	Requirements need to be developed			
Roads exclusively for motor vehicles with physical separation from oncoming traffic	~~1. To be develop standardized (guideline etc) as necessary~~ ・LKA (draft standards) ・ACC (no specific performance requirements) ・ACSF Cat.B1 (Steering Function hands-on)~~IPA (Intelligent)~~	(Under discussion) ・ Categories B2, C, and D under ACSF (amendment of R79) ・ CAT B1 in combination with longitudinal control	・ Under discussion ACSF B2, B2+E	Requirements need to be developed		
		・ACC+ACSF (Cat.B1, Cat.C (Basic Lane Change Assist), Cat.D [Smart LCA])	・ [ACSF Cat. E] ・ ACSF Cat.B2 (Continuous Lane Guidance hands-off)			
Urban and interurban roads		・ CAT B1 in combination with longitudinal Control ・To be discussed in ACSF (CAT B1 in combination with C, D to be clarified in IWG ACSF)	Requirements need to be developed			