Common Scenario Catalogue: EC considerations

2nd GRVA Scenario Workshop

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Joint Research Centre

EC/JRC Proposal

- To identify short list of scenarios for testing/validation:
  - Short term Goal, an initial list of **core scenarios** can be defined by using the available references (R157, EU2022/1426, etc.).
  - This input will be given to the ADS IWG group so that it's possible:
    - to evaluate the completeness of **performance requirements,**
    - to start a discussion on **verifiable criteria**.
  - We suggest to limit to critical traffic scenarios:
    - to ensure that a common, proper minimum performance is achieved,
    - to evaluate mitigation strategy beyond the minimum performance.

- GRVA Workshop on Scenarios can work on **the harmonization of descriptors** to be used for the core scenarios.

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Example 1: critical interactions

Minimum performance to avoid collision is defined, evaluation is available:

Scenario	Evaluation to be done by ADS IWG

1. **Cut-in of vehicle from adjacent lane**
 	
    1.1. With different TTC, distance and relative velocity values, different cut-in vehicles, etc.
 	
    1.2. Avoidable / unavoidable.
	Requirements:
	• avoid collision for avoidable, mitigate for unavoidable
	• Criticality evaluation
	
	Evaluation:
	• Based on the requirements,
	• Criticality evaluation can be available

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Example 2: evaluation available

Minimum performance to avoid critical situations is defined

Scenario	Evaluation to be done by ADS IWG
1. **Lane change manoeuvre**	**Requirements:** • not to make an approaching vehicle in the target lane decelerate, or • Min. distance at a certain time after starting the LCM with a max. deceleration of the vehicle coming in the adjacent lane. **Evaluation:** based on requirements, no further assessment
1.1. **With a vehicle coming from the back**	
1.2. **Without a vehicle coming from the back**	
1.3. **Merging at lane end / into an occupied lane**	
1.4. **Vehicle in adjacent lane preventing lane change**	
1.5. **During MRM**	
1.6. **Changing lane to the same space as another vehicle intends**	

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Example 3: evaluation not available
Minimum performance to avoid critical situations

Scenario	Evaluation to be done by ADS IWG
1. Positioning in the lane of travel / lane keeping	
1.1. Driving around obstacles within the lane	
1.2. Increasing / decreasing lateral distance from road edge or vehicle in adjacent lane	**Requirement:** stable motion within the lane, safe distance from other objects.
1.3. With different speeds and road curvatures	**Evaluation: no evaluation yet.**
1.4. With different lane markings / lack of lane markings	

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JRC draft scenario list for track testing

- JRC has begun working on an extracted list of scenarios from different UN and regional regulations (draft and incomplete).

Track testing scenarios

Scenario	Evaluation
1. Positioning in the lane of travel / lane keeping	
1.1. Driving around obstacles within the lane	
1.2. Increasing / decreasing lateral distance from road edge or vehicle in adjacent lane	**Requirement:** stable motion within the lane **Evaluation:** no evaluation yet.
1.3. With different speeds and road curvatures	
1.4. With different lane markings / lack of lane markings	
2. Lane change manoeuvre	
2.1. On highways (roads with physical separation)	
2.1.1. With a vehicle coming from the back	**Requirements:** – not to make an approaching vehicle in the target lane decelerate, or – Min. distance at a certain time after starting the LCM with a max. deceleration of the vehicle coming in the adjacent lane. **Evaluation:** based on requirements, no further assessment
2.1.2. Without a vehicle coming from the back	
2.1.3. Merging at lane end / into an occupied lane	
2.1.4. Vehicle in adjacent lane preventing lane change	
2.1.5. During MRM	
2.1.6. Changing lane to the same space as another vehicle intends (avoid collision)	
2.2. On rural roads or in urban area (without physical separation)	**Requirements (DCAS):** no lane change if the target lane is designated for oncoming traffic. For ADS this has to be reviewed. **Evaluation:** based on requirement If we allow lane changes where oncoming traffic might be present, we need requirements + assessment.
2.2.1. Driving around an obstacle (no full lane change, just partial)	
2.2.2. With oncoming vehicle in the adjacent lane	
3. Ability to respond to another road user or object on the road	
3.1. Avoid a collision with a road user or object blocking the lane	
3.1.1. Stationary obstacle (vehicle / road user / object) ahead on a straight / curved section of road	**Requirement:** avoid collision, driving around allowed with or without lane change **Evaluation:** based on requirement, no further evaluation
3.1.2. Slower moving obstacle (vehicle / road user / object) ahead on a straight / curved section of road	
3.2. Following a lead vehicle / VRUs	**Requirements:** – Anticipatory behaviour – Stable following speed (no oscillation) – Avoid collision, including lead vehicle emergency braking **Evaluation:** based on requirements,
3.2.1. With different speeds, vehicle types, VRUs, straight / curved roads, including emergency braking	
3.3. Cut-out of lead vehicle	**Requirements:** avoid collision **Evaluation:** based on requirements,
3.3.1. With different vehicles, road users, objects (e.g. cone), including multiple consecutive objects.	
3.4. Cut-in of vehicle from adjacent lane	**Requirements:** avoid collision for avoidable, mitigate for unavoidable **Evaluation:** based on requirements, – Avoidable / unavoidable determination
3.4.1. With different TTC, distance and relative velocity values, different cut-in vehicles, etc.	
3.4.2. Avoidable / unavoidable.	

Scenario	Evaluation
3.5. Vehicle and VRU crossing scenarios	
3.5.1. Pedestrian / bicycle / other VRU target crossing into the path of the ADS on a straight section	**Requirements:** avoid collision up to 60 km/h, decrease speed at least by 20 km/h above **Evaluation:** based on requirements
3.5.2. VUT turns across a path of an oncoming vehicle	**Requirements:** TTC requirements in ADS Implementing Act **Evaluation:** based on requirements
3.5.3. VUT crosses the straight path of the vehicle target in an intersection	
3.5.4. Right hook scenario	**Requirements:** avoid collision **Evaluation:** based on requirements
3.6. VRUs in the lane, going parallel with ADS	**Requirements:** avoid collision, driving around allowed **Evaluation:** based on requirement
3.7. Avoid emergency manoeuvre before a passable object in the lane	**Requirements:** If obstacle can be driven over, avoid braking harder than 5 m/s² **Evaluation:** based on requirement
3.7.1. With different lead vehicles / without a lead vehicle	
3.8. Emergency / enforcement / service personnel directing traffic	**Requirements:** Act as directed by personnel **Evaluation:** based on requirement
3.9. Wrong way driver (highway only)	**Requirements:** Don't change lane in case of oncoming vehicle in adjacent lane. **Evaluation:** based on requirement
4. Ability to respond to different road circumstances / national traffic rules	
4.1. Crossings and turnings	
4.1.1. Y-split of highway lanes	**Requirements:** Act according to local traffic rules. **Evaluation:** based on requirement
4.1.2. T-junctions (three-way intersections)	
4.1.3. Crossroads (four or more way intersections)	
4.1.4. Roundabouts	
4.2. Traffic lights	
4.2.1. Going straight, right an left	
4.3. Speed limit signs and other traffic signs	
4.4. Motorway entry / exit (+ toll stations)	**Requirements:** Lane changing requirements + local traffic rules. **Evaluation:** based on requirement
4.5. Temporary modifications (e.g. yellow lane marking, cones, traffic signs, access restrictions)	**Requirements:** Lane changing requirements + local traffic rules apply **Evaluation:** based on requirement
4.6. Faded / erase / hidden lane markings	**Requirements:** Handle according to manufacturer strategy. **Evaluation:** based on requirement
4.7. Parking on curb side	**Requirements:** General avoidance and anticipatory requirements apply. **Evaluation:** based on requirement
4.8. Parking / navigating in a parking facility	**Requirements:** General avoidance and anticipatory requirements apply. Special focus on tight spaces and obstruction.

Scenario	Evaluation
	Evaluation: based on requirements. Testing requirements might be specific.
5. Miscellaneous	
5.1. Emergency vehicles	
5.2. Field of view test	
5.2.1. Forward / side / rearward detection range	
5.3. Off mode after new engine start/run (only dual-modes)	**Requirements:** General requirements based on ODD and use case. **Evaluation:** based on requirements.
5.4. System activation check (fallback user available, self checks)	
5.5. Activation / deactivation	
5.6. System override (only dual-modes)	
5.7. Driver attentiveness (only dual-modes)	
5.8. Transition demand (only with fallback user)	
5.9. System reaction in case of detectable collision	
6. Failure scenarios	**Requirements:** ADS has to evaluate failure. Based on remaining capabilities, either continue DDT without changes, continue DDT with a reduced functionality or go to MRC. **Evaluation:** based on requirements (failure detection and MRM requirements).
7. HMI scenarios and checks	To be discussed.

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Conclusion

A common scenario catalogue can support the development and the implementation of the ADS regulation.

EC/JRC considers as first priority the identification of a set of core mandatory scenarios for the ADS system in order to:

- Assess critical interactions
- Identify minimum performance (e.g. to avoid collision)
- Mitigate/avoid collisions for "unavoidable"

This short-list of critical scenarios shall be considered for design and verified.

This core set of scenarios can be also used to start a discussion on verifiable criteria (Are they necessary? Are they already available?)

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Conclusion

This can also be the first step for the development of a common scenario catalogue which can serve different purposes/use cases.

The common scenarios catalogue should also ensure implementation of the ISMR.

Regarding the use of the common scenario catalogue to verify the adequacy (e.g. coverage) of ADS developers' catalogue:

- It seems difficult to develop a "complete" catalogue to support the activities of the IWG ADS.
- Better to focus on the definition of **coverage metrics.**

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Thank you

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