Hi-Drive
Designing Automation

Hi-Drive Driving Scenario Concept

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1 Introduction

This document presents the Hi-Drive driving scenario concept, which was developed within work package (WP) 7.3 – *test case definition for scenarios and edge cases*. There are different objectives for developing and presenting the driving scenario concept. First, it enables the scenario-based technical evaluation of automated driving functions (ADFs) in the different Hi-Drive use cases (Bolovinou et al. 2023) using real-world driving data. Second, the driving scenario concept supports the impact assessment of ADFs by providing scenario-based real-world data for the calibration of models used in simulations. Third, it contributes to the driving scenario database (DSDB) that will be set up in the Hi-Drive project to enable the derivation of test cases for ADFs. The driving scenario concept aims at communicating the driving scenarios considered within the Hi-Drive project, and therefore, the driving scenarios or details thereof that are not considered in the Hi-Drive project are out of the scope of the presented concept.

As the goal is to fulfil the needs of the different objectives within the Hi-Drive project, the concept has been developed by collecting the required individual driving scenarios for each objective, as well as additional needed situational variables. Based on this, the collected individual scenarios have been harmonized and structured to achieve a consistent concept.

2 Fundamentals

2.1 Definitions

In Hi-Drive, specific terms are defined to achieve a common understanding and to allow efficient communication. Especially the term *scenario* itself is used in different ways in different contexts. This leads to the need for having a common definition and not using the term scenario standalone. The concept presented in this document deals with *driving scenarios* that are defined as follows:

Driving Scenario: A driving scenario is a short period of driving defined by its main driving task (e.g., car following, lane change) or triggered by an event (e.g., an obstacle in the lane).

Accordingly, driving scenarios are representative of different segments of a trip that can happen frequently within a trip but have common characteristics. Therefore, a driving scenario can be regarded as a class. If a specific segment is, e.g., detected in and extracted from data, this is an *instance* of the corresponding driving scenario:

Driving Scenario Instance: A driving scenario instance / instance of a driving scenario represents a single segment in time that is assigned to a certain driving scenario.

An alternative term for driving scenario instances is the term *case*, which is mainly used in the context of simulating driving scenarios.

These definitions can also be related to the terms used in the ISO 34501 standard (ISO 34501), which is shown in Table 2.1.

Table 2.1: Relation of Hi-Drive terms to ISO 34501 terms

Hi-Drive Terms	ISO Terms	Optional Hi-Drive Terms
Driving Scenario	Functional Scenario	Functional Driving Scenario
	Abstract Scenario	Abstract Driving Scenario
	Logical Scenario	Logical Driving Scenario
Driving Scenario Instance	Concrete Scenario	Concrete Driving Scenario Case

Defining the driving scenarios does not directly implie that it is already a *driving scenario concept*. Weber et al. (2023) define it as follows:

Driving Scenario Concept: A driving scenario concept shall give answers to the following questions:

1) Which driving scenarios exist?
2) How are these driving scenarios defined?
3) How are these driving scenarios related?

Beyond answering these questions, a driving scenario concept has an intended scope, which delineates its intended application and should be defined before deriving the concept. The scope is defined in Section 1.

It is worth mentioning that, in contrast to driving scenarios, *traffic scenarios* describe a larger traffic context by covering a longer period of time and longer road sections with certain traffic characteristics. Traffic scenarios are not covered by the driving scenario concept and therefore, are out of the scope of this document.

2.2 6-Layer Model

The 6-layer model by Scholtes et al. (2021) has been used as a reference to set up the Hi-Drive driving scenario concept. It helps to structure the relevant elements of the driving scenarios and to search for gaps of the concept to be filled to fulfil the project goals (cf. Section 1). Figure 2.1 shows the 6-layer model.

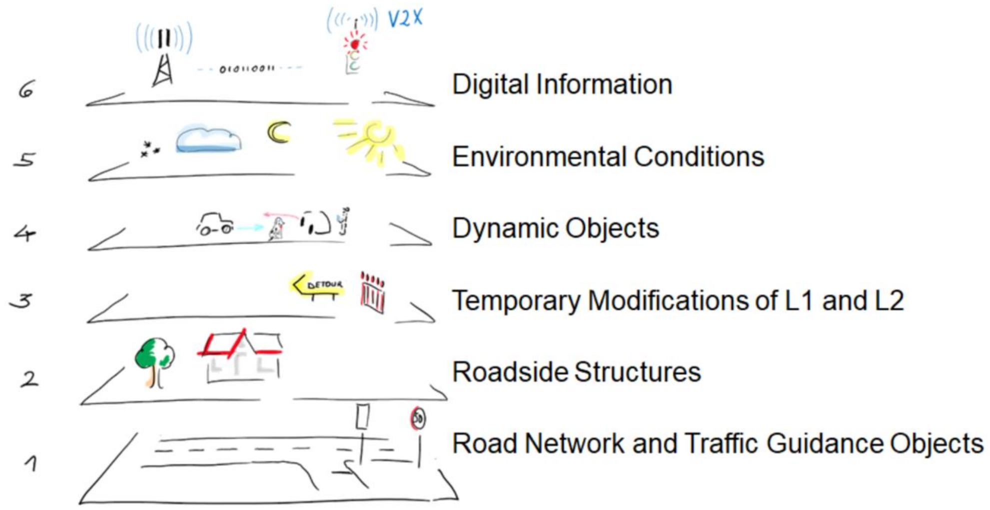


Figure 2.1: The 6-layer model by Scholtes et al. (2021). Illustration from Weber et al. (2023)

3 The Hi-Drive driving scenario concept

The driving scenarios are structured using the 6-layer model with some additions. Layer 4 (Dynamic Objects), which is the core layer for defining the driving scenarios in Hi-Drive, ensures that the driving scenarios are mutually exclusive. For the technical evaluation, it is important that the driving scenarios are mutually exclusive such that data are not processed more than once. If specific segments of a trip would appear in multiple driving scenario instances, they would be analysed multiple times, which would distort the evaluation results.

The other layers define *situational variables* (also called *tags* in this context) to further specify the driving scenario instances that are detected in data. Using tags is in line with the ISO/DIS 34504 standard (ISO/DIS 34504) that is under development.

The driving scenarios, as well as the situational variables, are visualized in tree structures. The purpose of this structure is to make the concept clearer, show connections of the driving scenarios and situational variables as well as to make it easier to check for consistency and completeness in terms of the Hi-Drive evaluation goals. The different layers of the tree structures can be regarded as different abstraction levels. At the higher levels, the driving scenarios are more generic and may contain a high variety of driving scenario instances. At the lower levels, the driving scenarios are more specific. Furthermore, the different layers can aid the implementation of the driving scenario detection algorithms. For example, the start and end points of each crossing driving scenario could be detected the same way.

To enable further specifying the driving scenarios, these structures are transferred into tables containing descriptions and pictograms (see Table 3.2). In addition, they contain machine-interpretable labels for the driving scenarios to be used for clearly referring to them.

3.1 Layer 4 - dynamic objects – Hi-Drive driving scenarios

3.1.1 Tree structure

As the dynamic objects define the driving scenarios, layer 4 is the basis for the Hi-Drive driving scenario concept. The leaves of this tree structure represent the driving scenarios at the lowest level (rounded corners) and the nodes (sharp corners) represent driving scenarios used as superclasses.

The first separation in the resulting tree structure is based on the movement of the ego vehicle in relation to the infrastructure. This leads to four nodes and, therefore, main superclasses of the driving scenarios: *Driving in Lane*, *Lane Change*, *Crossing* and *Turning* (see Figure 3.1). Each of these nodes is further divided.

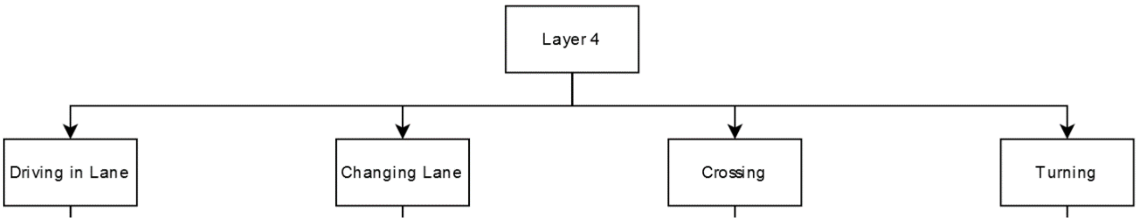


Figure 3.1: First level of the driving scenario structure on layer 4

3.1.1.1 Driving in Lane

The subclasses of *Driving in Lane* relevant for the Hi-Drive evaluations include *Standstill*, *Uninfluenced Driving*, *Following Object*, *Approaching Object*, *Cut-in* (passive, another vehicle is cutting into the ego vehicle's path) and *Oncoming Traffic in Lane* (see Figure 3.2). *Approaching* is further divided by the state of the object that the ego vehicle is approaching. The following states of the object that the ego vehicle is approaching are considered: *Static Object*, *Object in Traffic Jam*, *Longitudinally Moving Object*, and *Laterally Moving Object*. Cut-in separates two different resulting conflicts: *Rear-End Conflict* and *Sideswipe Conflict*.

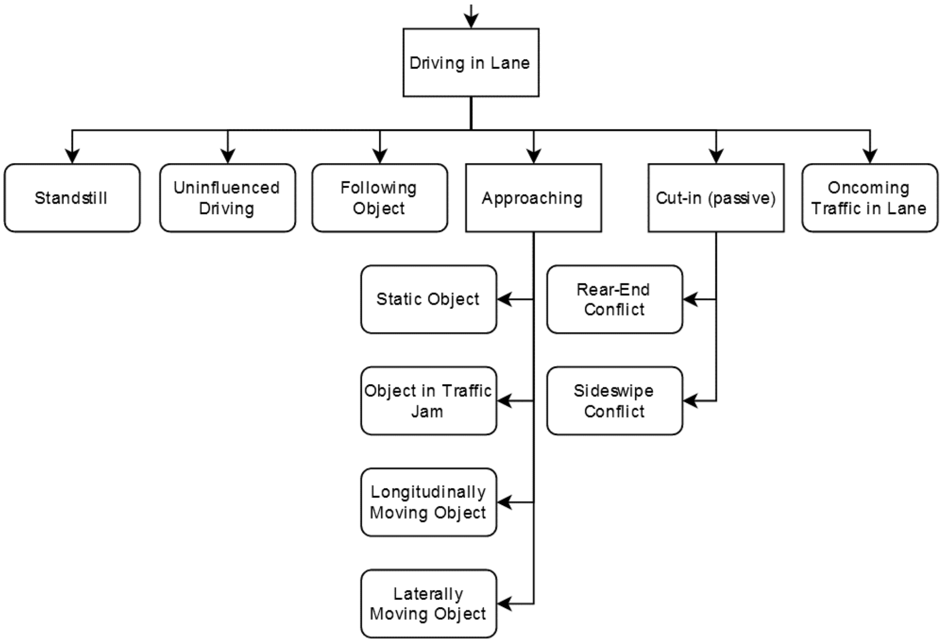


Figure 3.2: Tree structure for Driving in Lane

3.1.1.2 Changing Lane

For *Changing Lane*, the first separation is based on the general type of the lane change (see Figure 3.3). On the one hand, *Discretionary* lane changes do not need to be performed, but they are generally performed in order to optimize the traffic condition for the ego vehicle, for instance, in terms of speed, and comfort. On the other hand, *Mandatory* lane changes need to be performed to be able to reach the desired destination.

If mandatory lane changes *For Routing* cannot be performed, e.g., due to a blocked lane, the vehicle can reroute. At a *Lane Drop*, this is not possible, thus limiting the possible actions of the vehicle. Therefore, it is meaningful to have these driving scenarios separated in order to analyse them individually. Lane changes *For Routing* can be further specified using *Off-Ramp*, *Interchange*, and *Intersection*. To further specify the driving scenario *Lane Drop*, the driving scenarios *On-Ramp* and *Merging Lanes* can be used.

The direction of the lane change driving scenarios is added as a tag to the corresponding instances as it does not affect the general types of lane changes that can happen.

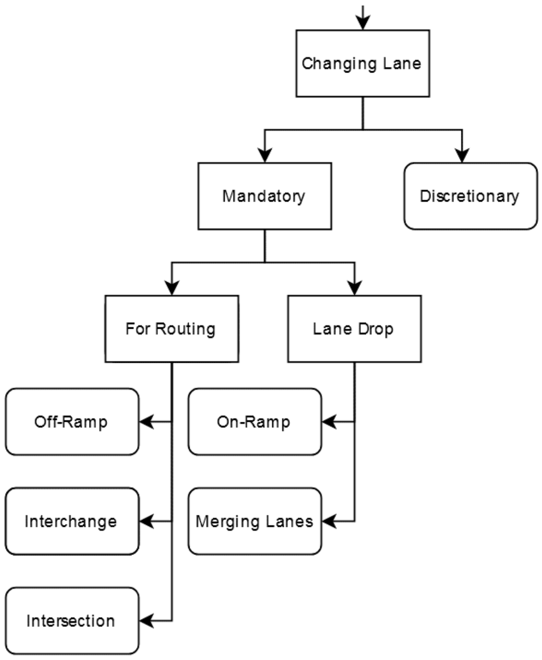


Figure 3.3: Tree structure for Lane Change

3.1.1.3 Crossing

The main criterion for the structure for *Crossing* driving scenarios is if there is an *Interaction with other Road Users* or *No interaction* taking place (see Figure 3.4). *Vehicles and Bicycles* can have shared lanes and could enter the intersection from all directions (*Lead Object, From Left, From Right, Oncoming Turning Left*) performing different manoeuvres (turning left or right and going straight). These manoeuvres of the other vehicle are represented using tags, but do not make up new driving scenarios. This level of detail is not needed for the main evaluations done in Hi-Drive, but this information should still be represented in the individual driving scenario instances, for instance, for deriving test cases.

A *Pedestrian* (or a bicycle on the sidewalk) can cross the intersection at different locations crossing the ego vehicle's path. Therefore, they are treated separately. The location of the pedestrian that is crossing is added to the individual driving scenario instances as a tag.

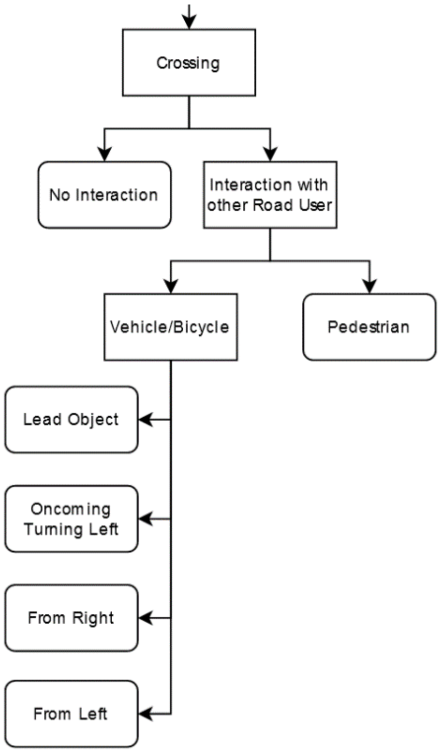


Figure 3.4: Tree structure for Crossing

3.1.1.4 Turning

The main criteria for the structure for *Turning* driving scenarios is the direction (*Left* or *Right*) of the turn (see Figure 3.5). The manoeuvres are in general different and lead to different possible interactions as other lanes are crossed, but the following tree structures are the same. If there is an *Interaction*, it is divided into interaction with a *Lead Object*, a *Laterally Moving Object* or a *Static Object*. Conflicts with static objects after turning are considered separately, as they might be not visible before turning leading to challenging situations. A laterally moving object is further divided into a *Pedestrian Crossing*, or a *Vehicle/Bicycle* that is driving on the road. For the latter, the direction of this object gives the last layer of the structure (*Coming from Right*, *Coming from Left*, *Oncoming*).

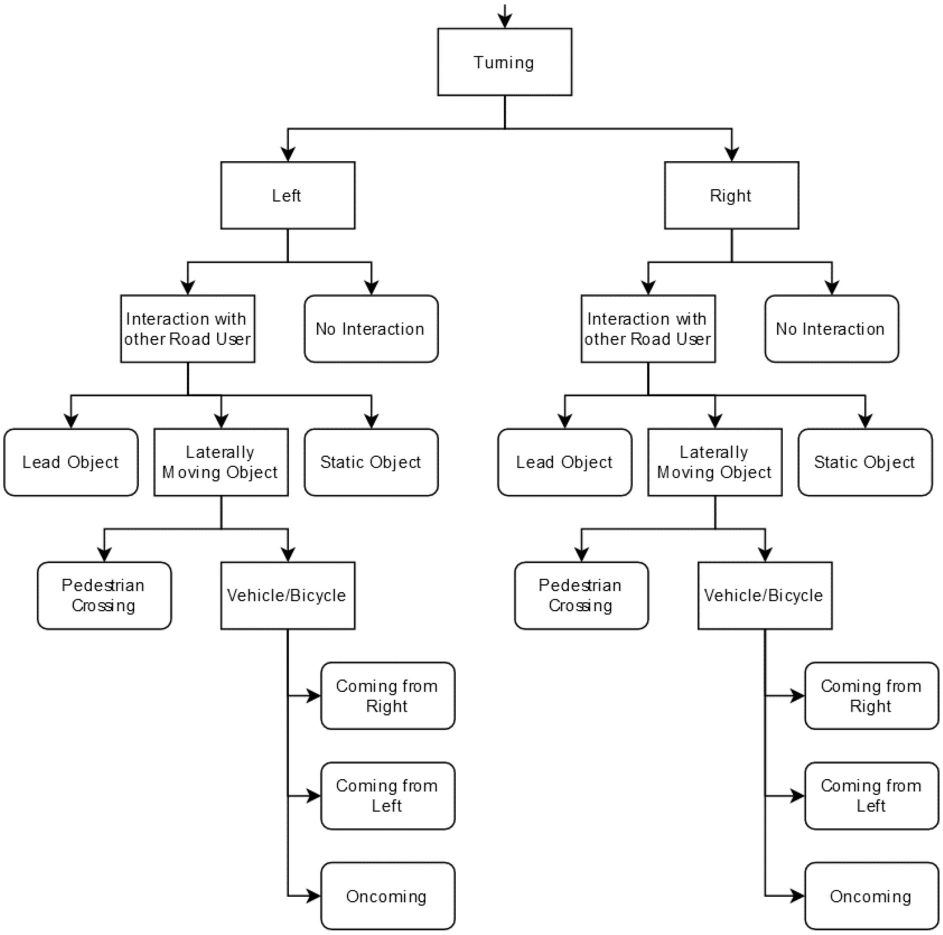


Figure 3.5: Tree structure for Turning

3.1.2 Resulting driving scenarios used as superclasses

Coming from the tree structures, the leaves represent the driving scenarios at the lowest level (rounded corners) and the nodes (sharp corners) represent driving scenarios used as superclasses. The benefits of having those superclasses are given in the introduction of Section 3. Table 3.1 lists all superclasses that are mentioned in Section 3.1.

Table 3.1: Superclasses in the Hi-Drive Driving Scenario Concept

Name	Label	Parent	Description
Driving in Lane	`in_lane`	–	The ego vehicle is driving in its lane and is not on a crossing or changing its lane.
Approaching an Object	`in_lane_approaching`	`in_lane`	The ego vehicle is driving in its lane and is approaching an object.
Cut-in (passive)	`in_lane_cut_in`	`in_lane`	The ego vehicle is following a lane and another object is doing a cut-in.

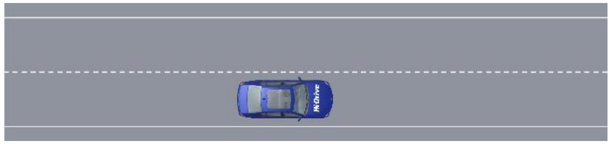
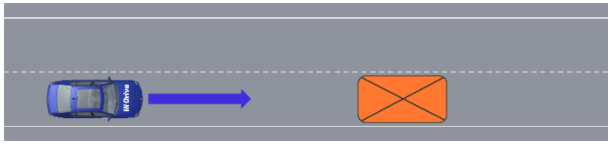
Name	Label	Parent	Description
Changing Lane	lc	-	The ego vehicle is changing lane and is not crossing an intersection.
Mandatory Lane Change	lc_mand	lc	The ego vehicle is changing lane. The lane change needs to be performed to be able to proceed the planned route.
Mandatory Lane Change for Routing	lc_mand_route	lc_mand	The ego vehicle is changing lane. The lane change needs to be performed for routing.
Mandatory Lane Change at Lane Drop	Lc_mand_lane_drop	lc_mand	The ego vehicle is changing lane. The lane change needs to be performed as its lane is dropped.
Crossing	cross	-	The ego vehicle is crossing an intersection (without turning).
Crossing with Interaction	cross_interact	cross	The ego vehicle is crossing an intersection and interacts with another dynamic object.
Crossing Interacting with a Vehicle/Bicycle	cross_interact_veh	cross_interact	The ego vehicle is crossing an intersection and interacts with a vehicle or bicycle that is driving on the road.
Turning	turn	-	The ego vehicle is turning at an intersection.
Turning Left	turn_left	turn	The ego vehicle is turning left at an intersection.
Turning Right	turn_right	turn	The ego vehicle is turning right at an intersection.
Turning Left Interacting with another Road User	turn_left_interact	turn_left	The ego vehicle is turning left at an intersection interacting with another static or dynamic road user.
Turning Right Interacting with another Road User	turn_right_interact	turn_right	The ego vehicle is turning right at an intersection interacting with another static or dynamic road user.
Turning Left Interacting with a Laterally Moving Object	turn_left_interact_lat	turn_left_interact	The ego vehicle is turning left at an intersection interacting with a laterally moving object. Laterally means that the trajectories of both objects intersect roughly perpendicular.

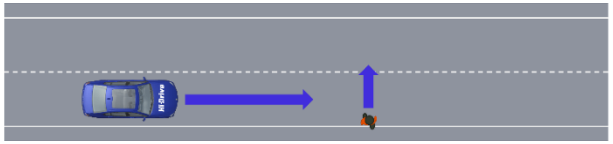
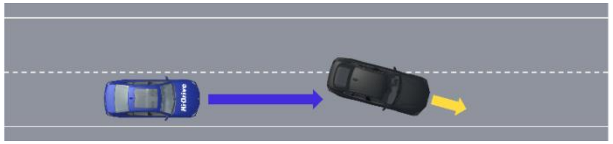
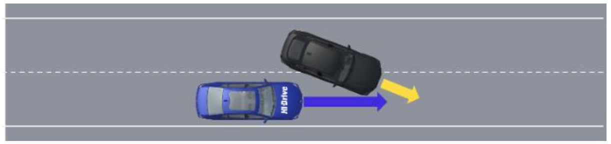
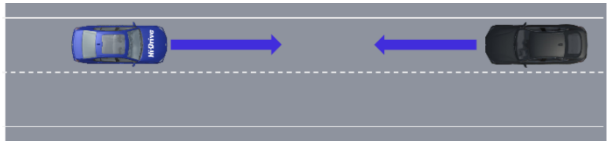
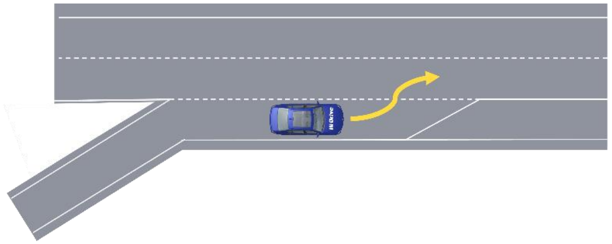
Name	Label	Parent	Description
Turning Right Interacting with a Laterally Moving Object	`turn_right_interact_lat`	`turn_right_interact`	The ego vehicle is turning right at an intersection interacting with a laterally moving object. Laterally means that the trajectories of both objects intersect roughly perpendicular.
Turning Left Interacting with a Laterally Moving Vehicle or Bicycle	`turn_left_interact_lat_veh`	`turn_left_interact_lat`	The ego vehicle is turning left at an intersection interacting with a laterally moving vehicle or bicycle that is driving on the road.
Turning Right Interacting with a Laterally Moving Vehicle or Bicycle	`turn_right_interact_lat_veh`	`turn_right_interact_lat`	The ego vehicle is turning right at an intersection interacting with a laterally moving vehicle or bicycle that is driving on the road.

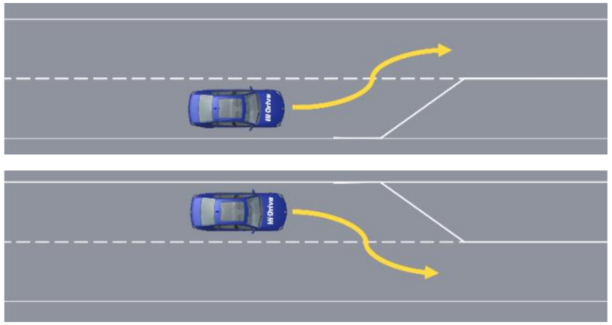
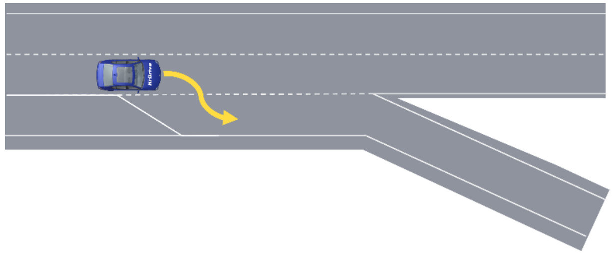
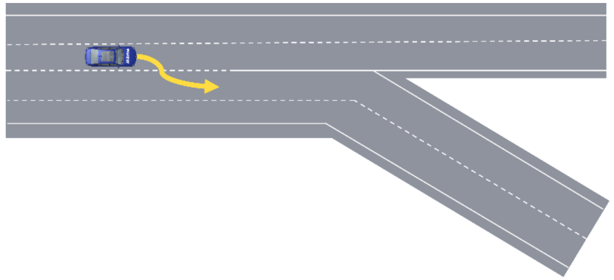
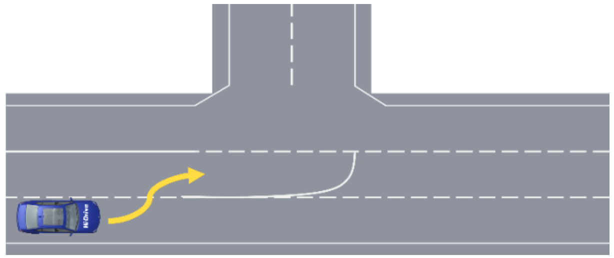
3.1.3 Resulting driving scenarios at the lowest level

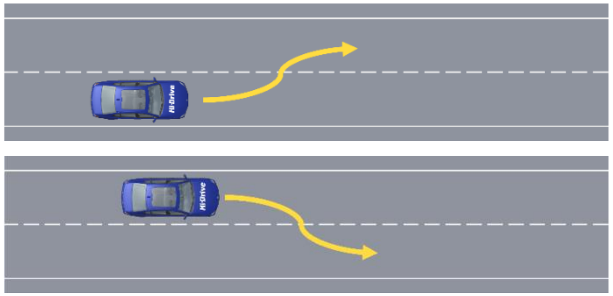
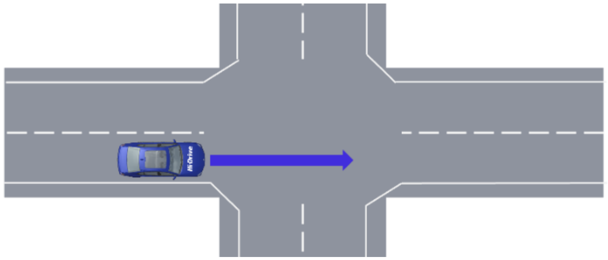
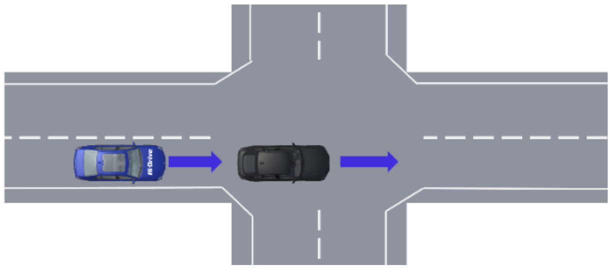
The resulting driving scenarios at the lowest level of the tree structure are described in Table 3.2. The instances derived from these driving scenarios are further specified by additional attributes like the direction (left, right) for the lane change driving scenarios or the manoeuvre (turn left, turn right, straight) of the other vehicle for crossing and turning driving scenarios with interaction.

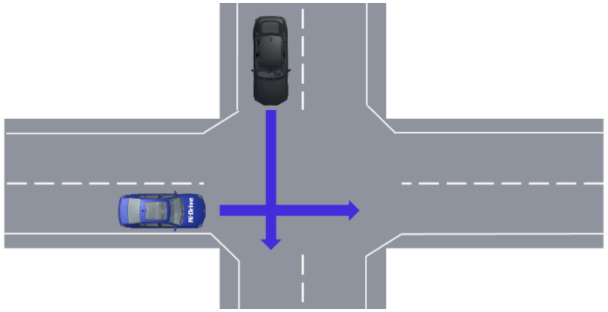
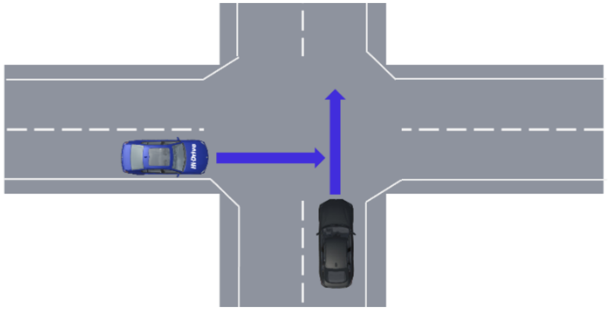
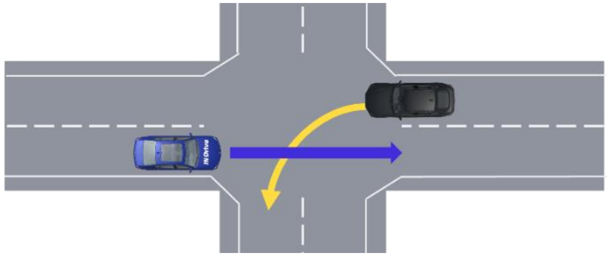
Table 3.2: Hi-Drive driving scenarios at the lowest level

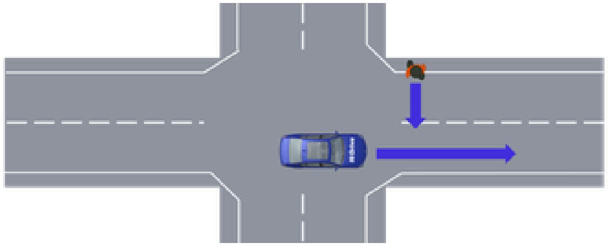
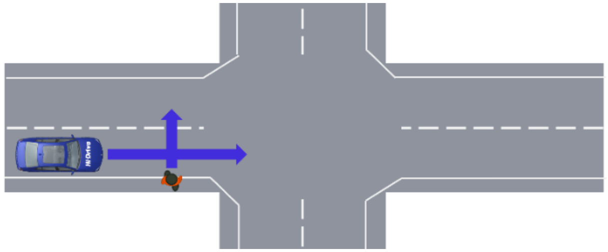
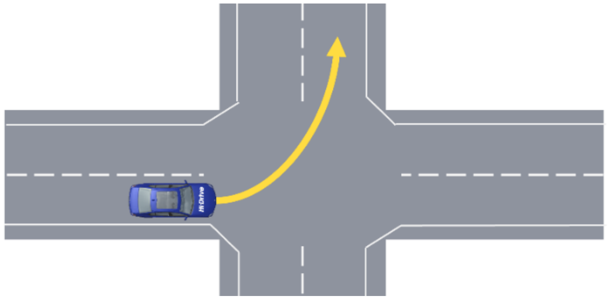
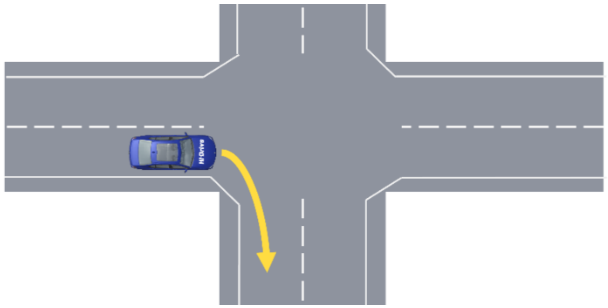
Name	Label	Parent	Description	Pictogram
Standstill	`in_lane_standstill`	`in_lane`	The ego vehicle does not move for a period of time.	
Uninfluenced Driving	`in_lane_uninfluenced`	`in_lane`	The ego vehicle is following a lane without being influenced by front objects.	
Following Object	`in_lane_following`	`in_lane`	The ego vehicle is following a lane and is following a dynamic object.	
Approaching Static Object	`in_lane_approaching_static`	`in_lane_approaching`	The ego vehicle is following a lane and is approaching a static object.	
Approaching Object in Traffic Jam	`in_lane_approaching_traffic_jam`	`in_lane_approaching`	The ego vehicle is following a lane and is approaching an object in a traffic jam.	

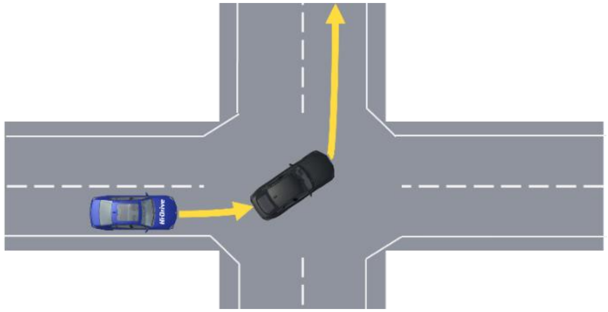
Name	Label	Parent	Description	Pictogram
Approaching Longitudinally Moving Object	`in_lane_approaching_long_moving`	`in_lane_approaching`	The ego vehicle is following a lane and is approaching an object that is driving in the same lane.	
Approaching Laterally Moving Object	`in_lane_approaching_lat_moving`	`in_lane_approaching`	The ego vehicle is following a lane and is approaching a laterally moving object at a road section that is not near a crossing.	
Cut-in with a Rear-End Conflict	`in_lane_cut_in_rear_end`	`in_lane_cut_in`	The ego vehicle is following a lane and another object is doing a cut-in that results in a rear-end conflict.	
Cut-in with a Sideswipe Conflict	`in_lane_cut_in_sideswipe`	`in_lane_cut_in`	The ego vehicle is following a lane and another object is doing a cut-in that results in a sideswipe conflict.	
Oncoming Traffic in Lane	`in_lane_oncoming_traffic`	`in_lane`	The ego vehicle is following a lane and in the same lane is oncoming traffic (happens e.g. when ego is overtaking).	
On-Ramp	`lc_mand_lane_drop_ramp`	`lc_mand_lane_drop`	The ego vehicle is changing lane. The lane change needs to be performed for routing as the ego vehicle is doing an on-ramp.	

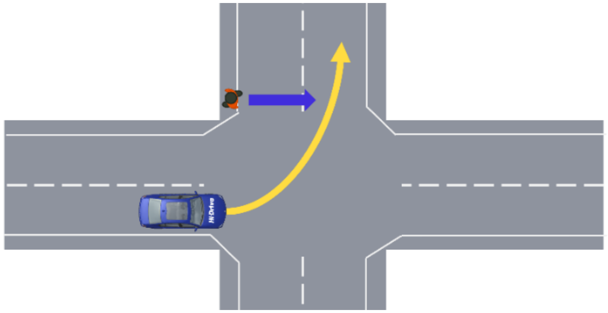
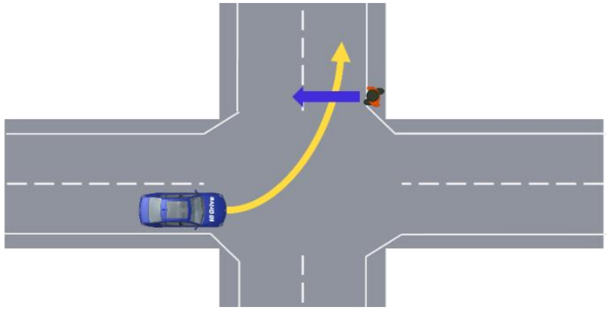
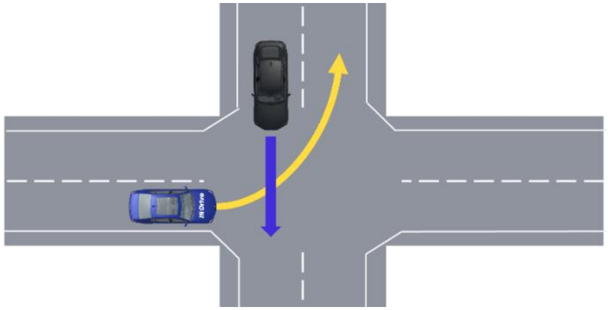
Name	Label	Parent	Description	Pictogram
Lane Change at Merging Lanes	`lc_mand_lane_drop_merge`	`lc_mand_lane_drop`	The ego vehicle is changing lane. The lane change needs to be performed as lanes are merging.	
Off-Ramp	`lc_mand_route_off_ramp`	`lc_mand_route`	The ego vehicle is changing lane. The lane change needs to be performed for routing as the ego vehicle is doing an off-ramp.	
Lane Change at Interchange	`lc_mand_route_interchange`	`lc_mand_route`	The ego vehicle is changing lane. The lane change needs to be performed for routing as the ego vehicle is at an interchange.	
Lane Change at Intersection	`lc_mand_route_intersection`	`lc_mand_route`	The ego vehicle is changing lane. The lane change needs to be performed for routing as the ego vehicle needs to change its lane at an intersection.	

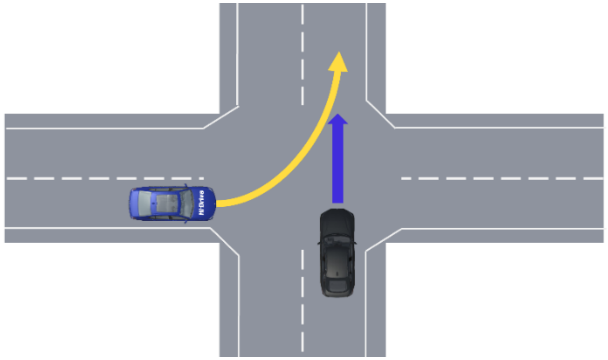
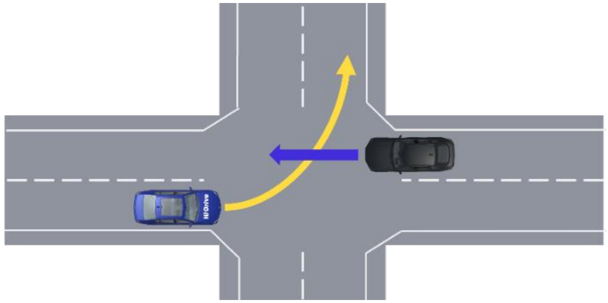
Name	Label	Parent	Description	Pictogram
Discretionary Lane Change	`lc_disc`	`lc`	The ego vehicle is changing lane. The lane change does not need to be performed but it optimizes speed, comfort etc.	
Crossing with no Interaction	`cross_no_interact`	`cross`	The ego vehicle is crossing an intersection and does not interact with any other dynamic object.	
Crossing Interacting with a Lead Object	`cross_interact_veh_lead`	`cross_interact_veh`	The ego vehicle is crossing an intersection and interacts with a leading vehicle or bicycle that is driving on the road.	

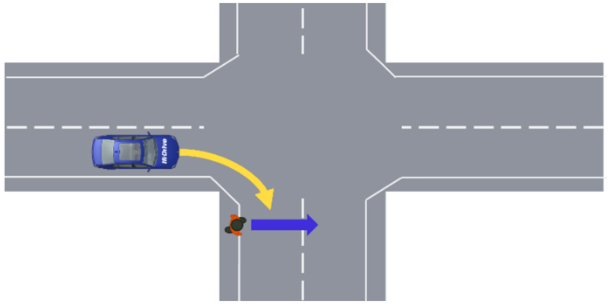
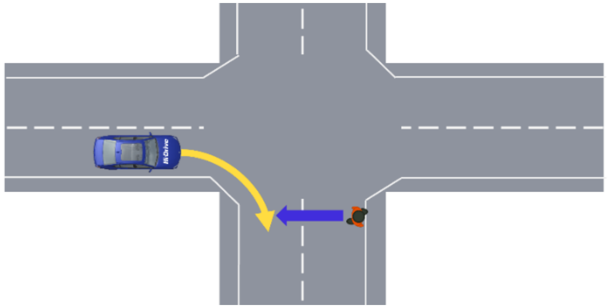
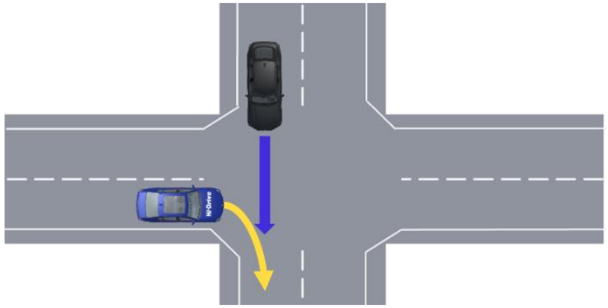
Name	Label	Parent	Description	Pictogram
Crossing Interacting with a Vehicle/Bicycle Coming from the Left	cross_interact_veh_left	cross_interact_veh	The ego vehicle is crossing an intersection and interacts with a vehicle or bicycle that is driving on the road and is coming from the left. The other vehicle can either turn or cross.	
Crossing Interacting with a Vehicle/Bicycle Coming from Right	cross_interact_veh_right	cross_interact_veh	The ego vehicle is crossing an intersection and interacts with a vehicle or bicycle that is driving on the road and is coming from the right. The other vehicle can either turn or cross.	
Crossing Interacting with an Oncoming Vehicle/Bicycle Turning Left	cross_interact_veh_oncoming	cross_interact_veh	The ego vehicle is crossing an intersection and interacts with a vehicle or bicycle that is driving on the road and is oncoming and e.g. turning left.	

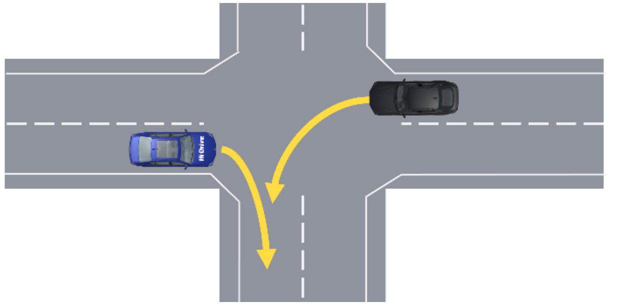
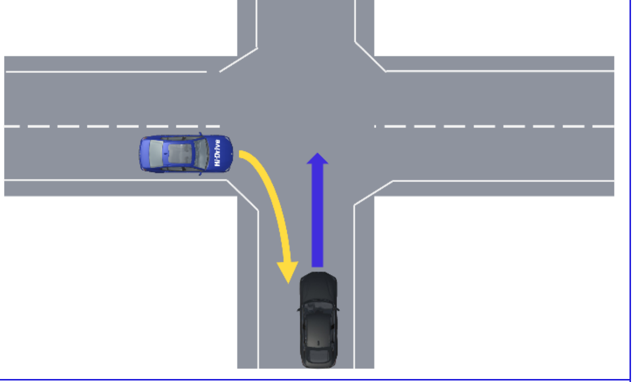
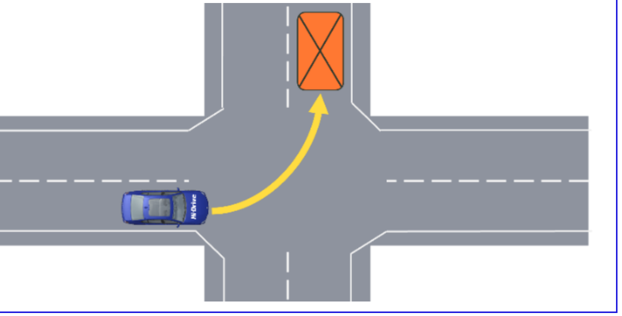
Name	Label	Parent	Description	Pictogram
Crossing Interacting with a Pedestrian Crossing	cross_interact_ped	cross_interact	The ego vehicle is crossing an intersection and interacts with a pedestrian crossing the road who may cross the road right before or after the intersection from the right or left.	 
Turning Left no Interaction	turn_left_no_interact	turn_left	The ego vehicle is turning left at an intersection without interacting with any other road user.	
Turning Right no Interaction	turn_right_no_interact	turn_right	The ego vehicle is turning right at an intersection without interacting with any other road user.	

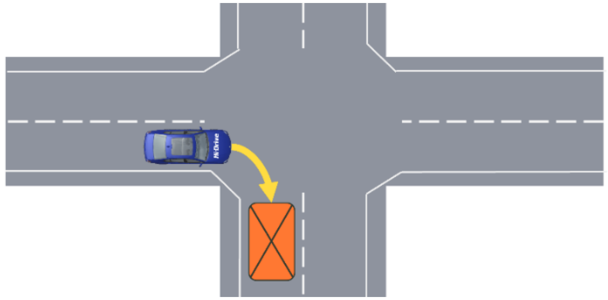
Name	Label	Parent	Description	Pictogram
Turning Left with a Lead Object	`turn_left_interact_lead`	`turn_left_interact`	The ego vehicle is turning left at an intersection interacting with a dynamic lead object that is turning left as well.	
Turning Right with a Lead Object	`turn_right_interact_lead`	`turn_right_interact`	The ego vehicle is turning right at an intersection interacting with a dynamic lead object that is turning right as well.	

Name	Label	Parent	Description	Pictogram
Turning Left Interacting with a Pedestrian Crossing	turn_left_interact_lat_ped	turn_left_interact_lat	The ego vehicle is turning left at an intersection interacting with a pedestrian crossing the road from the left or right.	 
Turning Left Interacting with a Vehicle/Bicycle Coming from Left	turn_left_interact_lat_veh_left	turn_left_interact_lat_veh	The ego vehicle is turning left at an intersection interacting with a vehicle or bicycle that is driving on the road coming from the left.	

Name	Label	Parent	Description	Pictogram
Turning Left Interacting with a Vehicle/Bicycle Coming from Right	turn_left_interact_lat_veh_right	turn_left_interact_lat_veh	The ego vehicle is turning left at an intersection interacting with a vehicle or bicycle that is driving on the road coming from the right.	
Turning Left Interacting with an Oncoming Vehicle/Bicycle	turn_left_interact_lat_veh_oncoming	turn_left_interact_lat_veh	The ego vehicle is turning left at an intersection interacting with an oncoming vehicle or bicycle that is driving on the road.	

Name	Label	Parent	Description	Pictogram
Turning Right Interacting with a Pedestrian Crossing	turn_right_interact_lat_ped	turn_right_interact_lat	The ego vehicle is turning right at an intersection interacting with a pedestrian crossing the road from the left or right.	 
Turning Right Interacting with a Vehicle/Bicycle Coming from Left	turn_right_interact_lat_veh_left	turn_left_interact_lat_veh	The ego vehicle is turning right at an intersection interacting with a vehicle or bicycle that is driving on the road coming from the left.	

Name	Label	Parent	Description	Pictogram
Turning Right Interacting with an Oncoming Vehicle/Bicycle	turn_right_interact_lat_veh_oncoming	turn_left_interact_lat_veh	The ego vehicle is turning right at an intersection interacting with an oncoming vehicle or bicycle that is driving on the road.	
Turning Right Interacting with a Vehicle/Bicycle Coming from Right	turn_right_interact_lat_veh_right	turn_left_interact_lat_veh	The ego vehicle is turning right at an intersection interacting with a vehicle or bicycle that is driving on the road coming from the right.	
Turning Left Interacting with a Static Object on the Road	turn_left_interact_static	turn_left_interact	The ego vehicle is turning left at an intersection interacting with a static object on the road.	

Name	Label	Parent	Description	Pictogram
Turning Right Interacting with a Static Object on the Road	`turn_right_interact_static`	`turn_right_interact`	The ego vehicle is turning right at an intersection interacting with a static object on the road.	

3.2 Layer 1-3, 5, 6 and beyond – situational variables

For each driving scenario instance that is detected or defined based on layer 4, additional tags for situational variables are to be added to give the context of that driving scenario instance. These are structured on the top level using the other layers of the 6-Layer-Model. Each layer is again represented as a tree structure. In contrast to layer 4, the other layers are not mutually exclusive. In fact, multiple tags per layer can be added to the driving scenario instances as situational variables. The goal is to be able to represent the use cases in the Hi-Drive project using these tags (cf. section 1).

3.2.1 Layers 1-3 – traffic infrastructure and street layer

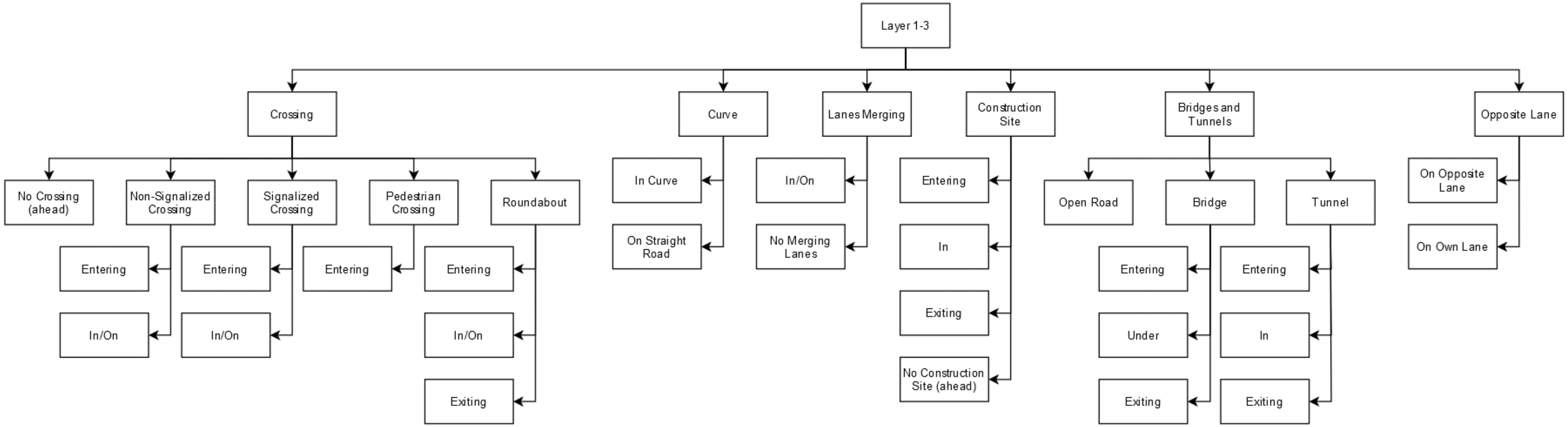


Figure 3.6: Tags for layers 1-3

The tags for the traffic infrastructure and street layer are shown in Figure 3.6. The first layer contains the categories of the infrastructure as well as if the ego vehicle is driving in its own lane or in the opposite lane (e.g., during overtaking). The first-layer tags are not mutually exclusive as there can be, e.g., curves or construction sites in tunnels. The following structures of each of these categories, however, are mutually exclusive. I.e., for crossings, there can only be one subtype at a time. In fact, for each driving scenario instance, there is a crossing type to be defined (or that no crossing is ahead) and the state of the ego vehicle in regard to this crossing like approaching/entering.

3.2.2 Layer 5 – environmental conditions

The tags for the environmental conditions are shown in Figure 3.7. For each driving scenario instance, tags for the weather, the road condition, and spray can be defined. The following classification of each of these are mutually exclusive.

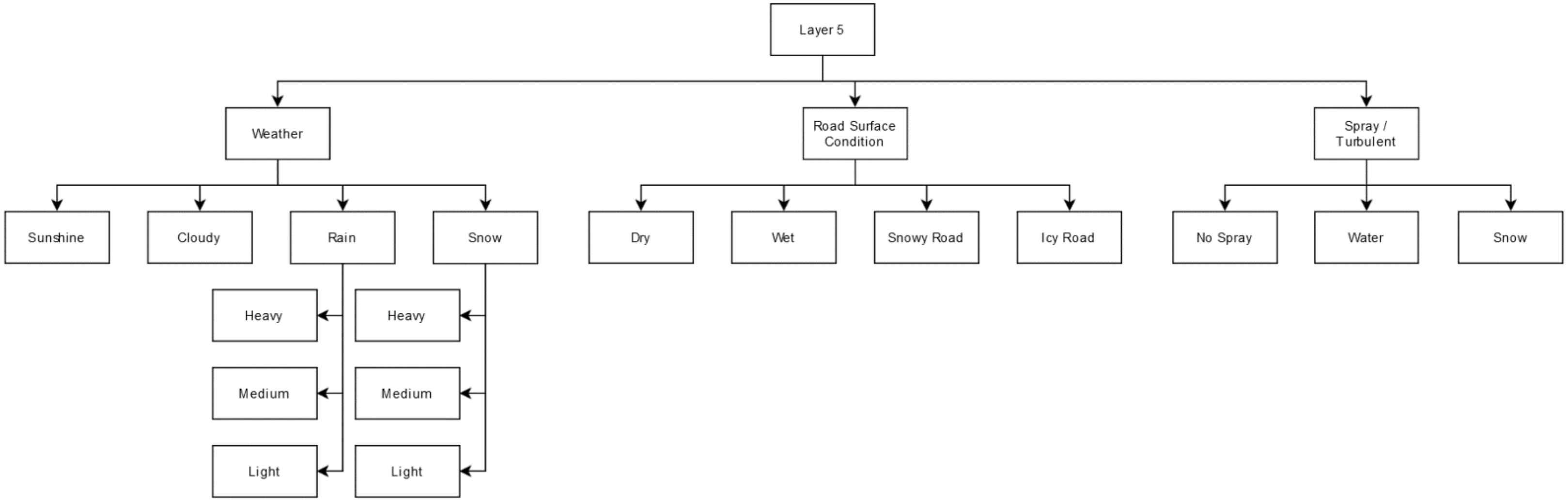


Figure 3.7: Tags for layer 5

3.2.3 Layer 6 – digital information

The tags for the digital information are shown in Figure 3.8. For each driving scenario instance, tags for V2X and GNSS signals can be defined. The following classification of each of these are mutually exclusive.

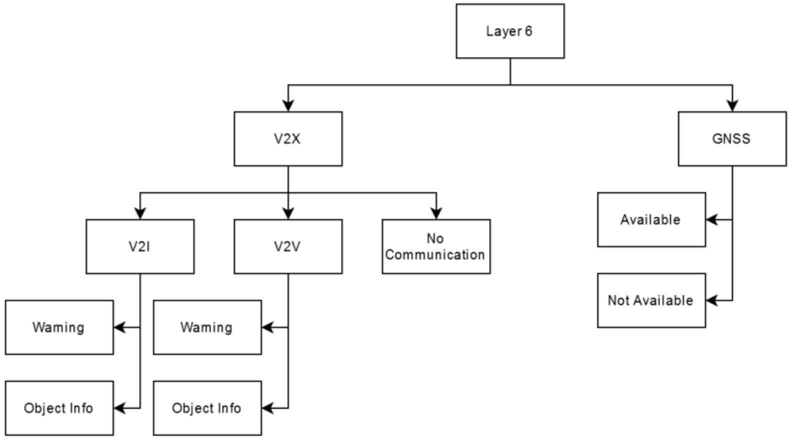


Figure 3.8: Tags for layer 6

3.2.4 Other situational variables not represented by the 6-layer model

There are additional situational variables that are not reflected by the 6-layer model but are considered in Hi-Drive. These are, for instance, a tag for left- or right-hand traffic, a tag if the driving scenario instance was part of a minimal risk manoeuvre, or tags regarding the driver.

4 Compatibility and mapping

4.1 Base scenarios defined by BASt FE 82.0729/2019

As the extracted driving scenario instances will be stored in a database for further use, compatibility with other driving scenario concepts is beneficial. This allows using those driving scenarios instances also beyond the Hi-Drive project. One example mapping to the Bast scenario concept is shown in Table 4.1.

Table 4.1: Mapping of Hi-Drive driving scenarios to BASt base scenarios

Hi-Drive Name	Hi-Drive Label	BASt Name	BASt Label
Driving in Lane	`in_lane`	State	`state`
Approaching an Object	`in_lane_approaching`	Approaching	`approach`
Cut-in (passive)	`in_lane_cut_in`	Leading vehicle entering → Approaching	`enter → approach`
Lane Change	`lc`	Lane change	`Lane_change`
Mandatory Lane Change	`lc_mand`	*No distinction between mandatory and discretionary lane changes*	
Mandatory Lane Change for Routing	`lc_mand_route`		
Uninfluenced Driving	`in_lane_uninfluenced`	Free Driving	`free`
Following Object	`in_lane_following`	Follow	`follow`
Approaching Static Object	`in_lane_approaching_static`	Approach a leading object	`approach_static`
Approaching Object in Traffic Jam	`in_lane_approaching_traffic_jam`	Approach a traffic jam	`approach_traffic_jam`
Approaching Longitudinally Moving Object	`in_lane_approaching_long_moving`	Approach leading object	`approach_lead`

Approaching Laterally Moving Object	in_lane_approaching_lat_moving	Approach laterally moving object	approach_lat
Cut-in with a Rear-End Conflict	in_lane_cut_in_rear_end	A leading object entering → Approach	enter → approach
Cut-in with a Sideswipe Conflict	in_lane_cut_in_sideswipe	Lateral close distance event	lat_close_distance
Oncoming Traffic in Lane	in_lane_oncoming_traffic	Approach oncoming object	approach_oncoming
On-Ramp	lc_mand_route_on_ramp	*No distinction between infrastructure elements at which transitions take place*	
Off-Ramp	lc_mand_route_off_ramp		
Lane Change at Interchange	lc_mand_route_interchange		
Lane Change at Intersection	lc_mand_route_intersection		
Lane Change at Merging Lanes / Lane Drop	lc_mand_merge		
Discretionary Lane Change	lc_disc		

5 Conclusions

In this work, the Hi-Drive driving scenario concept is presented. It aims at supporting the data analysis, technical evaluation, and impact assessment endeavours in the Hi-Drive Project. It uses the 6-layer model as a reference with layer 4 defining the specific driving scenarios, and the other layers adding tags for further specifying the driving scenario instances detected for those driving scenarios. For layer 4, the top-level superclasses are "Driving in Lane", "Changing Lane", "Turning", and "Crossing". Those superclasses are further separated resulting in 36 driving scenarios at the bottom level. Each driving scenario is specified using a name, a label, a description, and a pictogram.

The other layers give information about the street topology, the traffic infrastructure, the environmental conditions and available digital information. Additionally, further tags not represented by the 6-layer model can be specified.

This driving scenario concept will be used to detect driving scenario instances in the data collected in the Hi-Drive operations to enable the effects evaluation inside the project. The methodology for this evaluation will be reported in Hi-Drive deliverable D4.5. Furthermore, based on this driving scenario concept a driving scenario database will be developed. The results will be reported in Hi-Drive deliverable D7.6.

References

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