

Document Information

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3.5 Do Not Pass Warning (DNPW)

3.5.1 General description

The Do Not Pass Warning (DNPW) application warns the rider of a PTW during a passing maneuver attempt when a slower-moving vehicle, ahead and in the same lane, cannot be safely passed using a passing zone that is occupied by vehicles traveling in the opposite direction.¹

In addition, the DNPW application warns the rider of a PTW during a passing maneuver attempt when the vehicle in front starts turning left or overtaking.

3.5.2 Use case description

A DNPW is based on CAM, therefore no DENM shall be generated. CAM will be triggered according to the triggering conditions regulated in ETSI EN 302 637-2.²

According to the information received CAMs, the future trajectory of the surrounding vehicles shall be calculated and extrapolated. In this use case, the overtaking vehicle attempts to overtake the target vehicle, which is slower. The DNPW application shall therefore estimate the risk and, where appropriate, warn the driver/rider about the occupied lane.

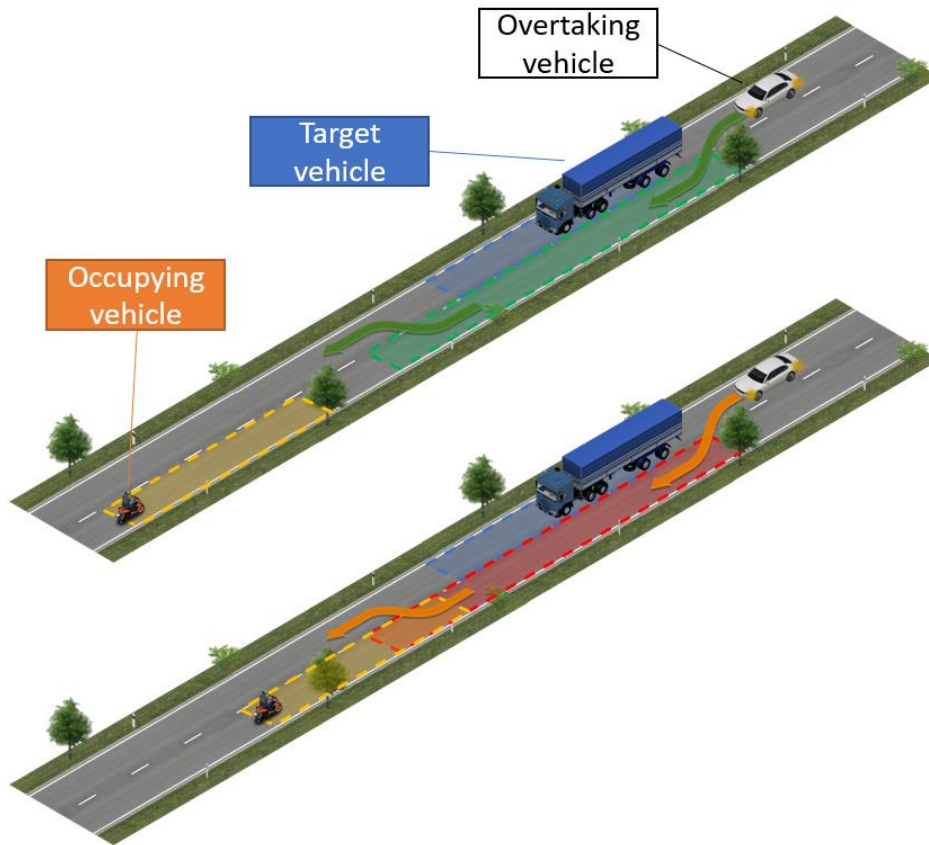
The vehicles involved can take different roles (Figure 1).

- Overtaking vehicle: The vehicle which performs or is going to perform the overtaking maneuver.
- Target vehicle: The vehicle which is going to be overtaken. It is possible that more than one target vehicles exist in case of high traffic.
- Occupying vehicle: The vehicle which occupies the lane. This could be either a vehicle coming from the opposite traffic direction, a stationary vehicle blocking the lane or something similar.
- Ego vehicle: This vehicle always refers to the actual perspective and could have one of the just mentioned roles.

¹ National Highway Traffic Safety Administration: "Vehicle Safety Communications – Applications (VSC-A) Final Report", Report Date: September 2011 (<https://www.nhtsa.gov/sites/nhtsa.dot.gov/files/811492a.pdf>, accessed on 13/11/2020)

² ETSI EN 302 637-2, V1.4.1 (2019-04)

(https://www.etsi.org/deliver/etsi_en/302600_302699/30263702/01.04.01_60/en_30263702v010401p.pdf, accessed on 13/11/2020)



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Figure 1: General overview of different vehicle roles.

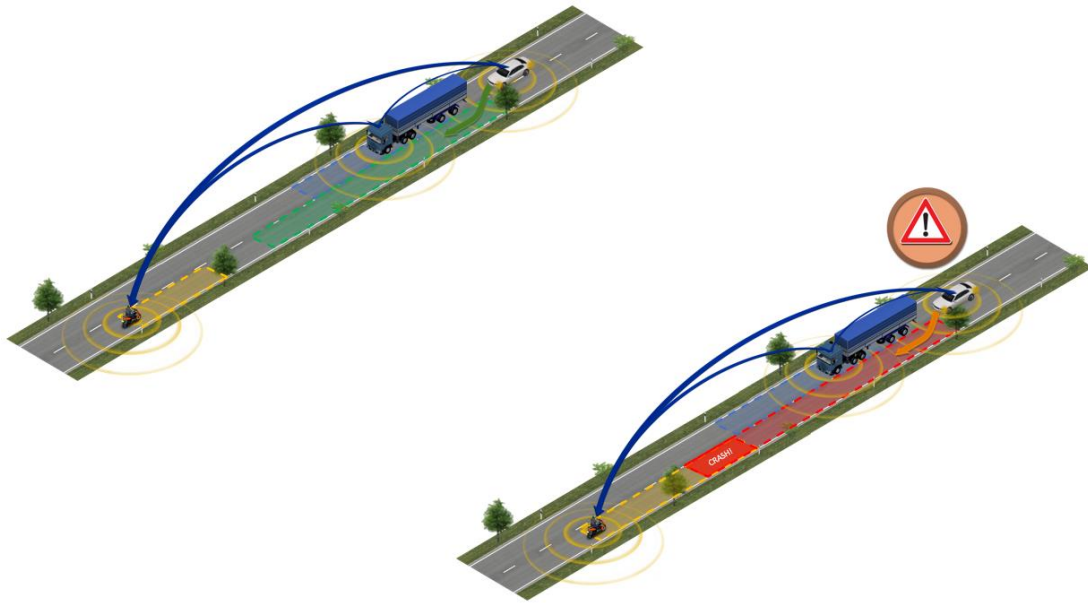
There are two scenarios for this example use case to consider on the viewpoint of the PTW.

PTW transmit CAM where the PTW continuously sends CAMs. In this scenario the PTW will be the vehicle who is occupying the lane riding in the opposite direction of the vehicle performing the overtaking maneuver. No extra calculation will be done on the ego vehicle. A further potential collision could be addressed for example in an FCW – forward collision warning application.

PTW receive CAM where the PTW performs the calculation on the ego vehicle receiving CAMs. It will act as the overtaking vehicle and in case warns the rider about the occupied lane.

3.5.2.1 Scenario description: PTW transmit CAM

The DNPW application is not active in this case. The PTW C-ITS system is broadcasting periodically the CAMs, sharing the vehicle's state and position. The other vehicle shall perform the calculation as such described in PTW receive CAM.



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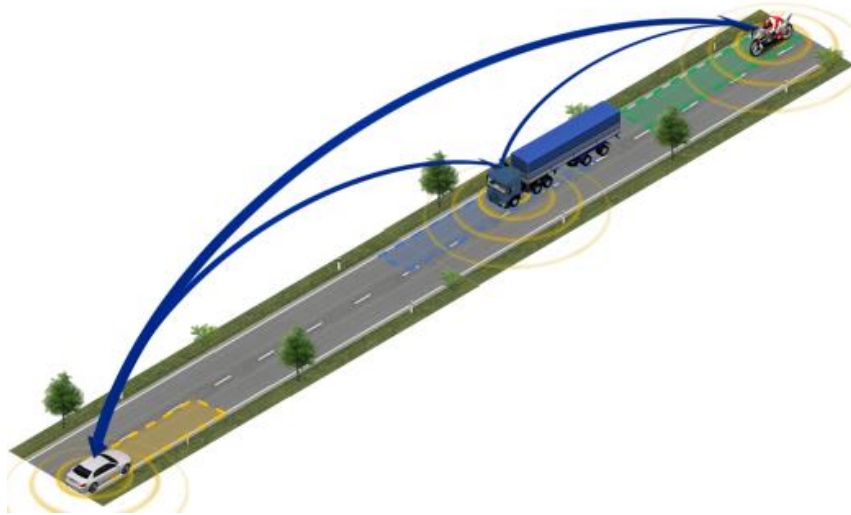
Figure 2: Use case of DNPW (PTW transmit CAM)

3.5.2.2 Scenario description: PTW receive CAM

This scenario is classified in four time sequences, starting with an approaching PTW, the ego vehicle, to a slower moving target vehicle this time illustrated as a blue truck. The next sequence describes the overtaking attempt of the ego vehicle, indicated by the ego vehicle's left turn signal turned on. Time sequence three has three different options, one with a clear lane, one with an occupied lane and one with a clear lane but the target vehicle starts turning left or overtaking. The three different options have different outcomes. The last time sequence terminates the overtaking process.

Time sequence 1:

Figure 3 visually describes the starting point of the scenario in which a PTW (ego vehicle) is approaching a slower moving truck (target vehicle). On the opposite lane there is a white car travelling towards the ego vehicle's overtaking area. All vehicles are equipped with a C-ITS function and can interchange Vehicle-to-Everything (V2X) messages such as CAMs. Hence, if they are within the communication range, all vehicles are able to understand other vehicles' state (incl. position).

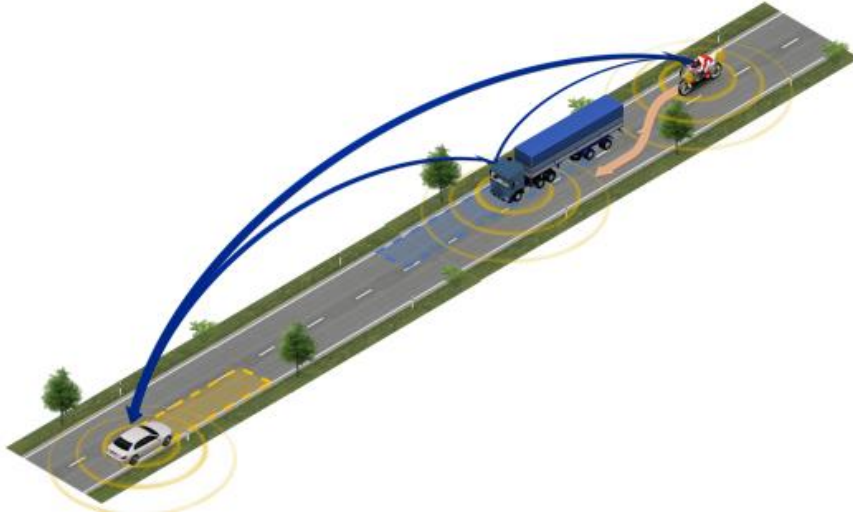


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Figure 3: Time sequence 1 (PTW receive CAM)

Time sequence 2:

As in Figure 4, the PTW indicates his attempt for an overtaking maneuver by turning on his left turn signal, in case of right-hand drive regulations. At this point the DNPW application shall start and calculate the possibility of an occupied lane by using the vehicle state information received by its C-ITS function.



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Figure 4: Time sequence 2 (PTW receive CAM)

Time sequence 3:

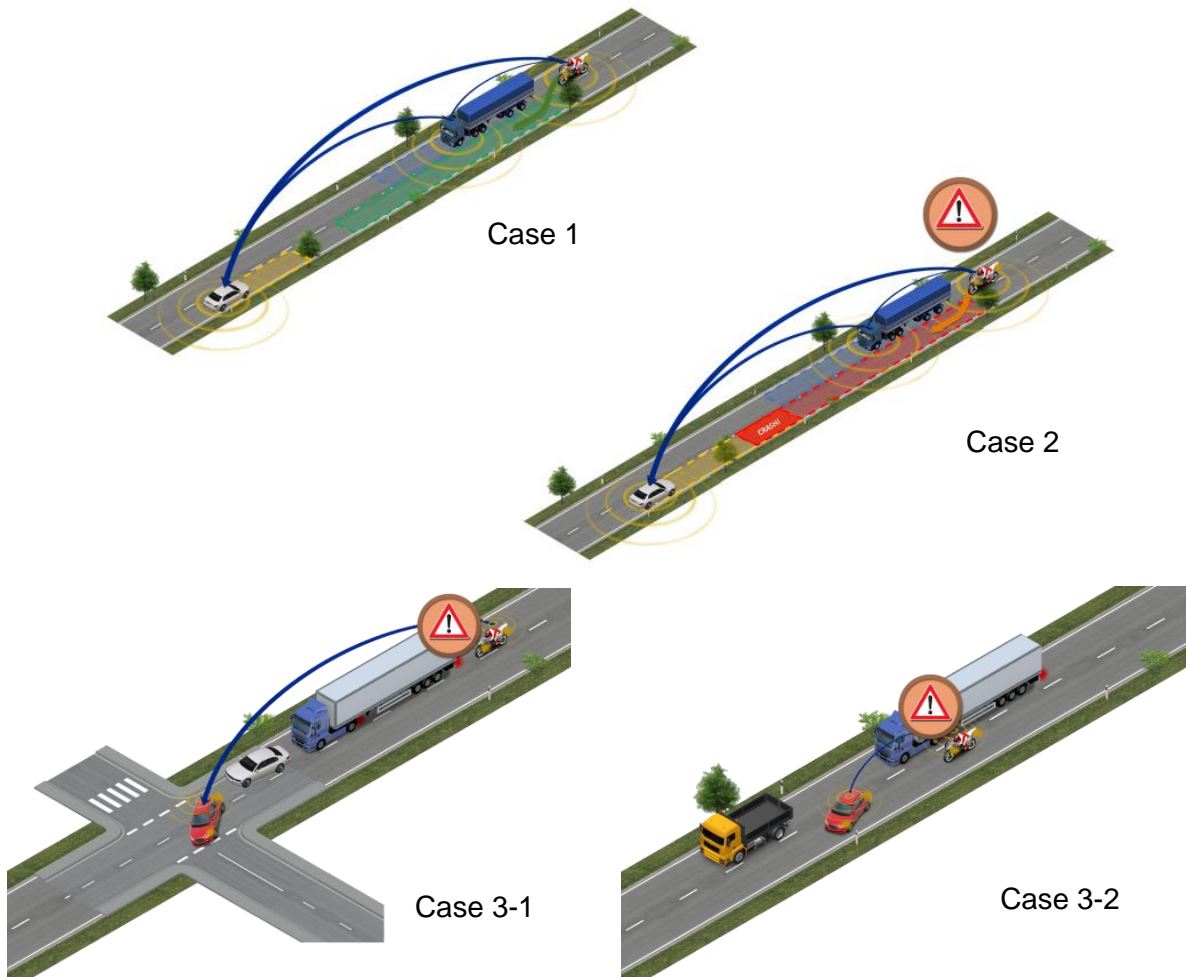
Now there are three possibilities for this situation.

Case 1: The lane is **not** occupied and the PTW can safely overtake the truck. No warning to be provided. (Figure 5-upper left)

Case 2: When the DNPW application detects that the lane is occupied by another vehicle, it should immediately send a warning to the rider through PTW HMI to cancel his overtaking attempt. The other vehicle could also be a stationary vehicle blocking the lane, for example in case of a broken-down vehicle. (Figure 5-upper right)

Case 3: The lane is NOT occupied. However, when one of the target vehicles starts turning left or overtaking, the DNPW application should immediately send a warning to the rider through PTW HMI to cancel his overtaking attempt. (Figure 5-lower)

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Figure 5: Time sequence 3 (PTW receive CAM)

Time sequence 4:

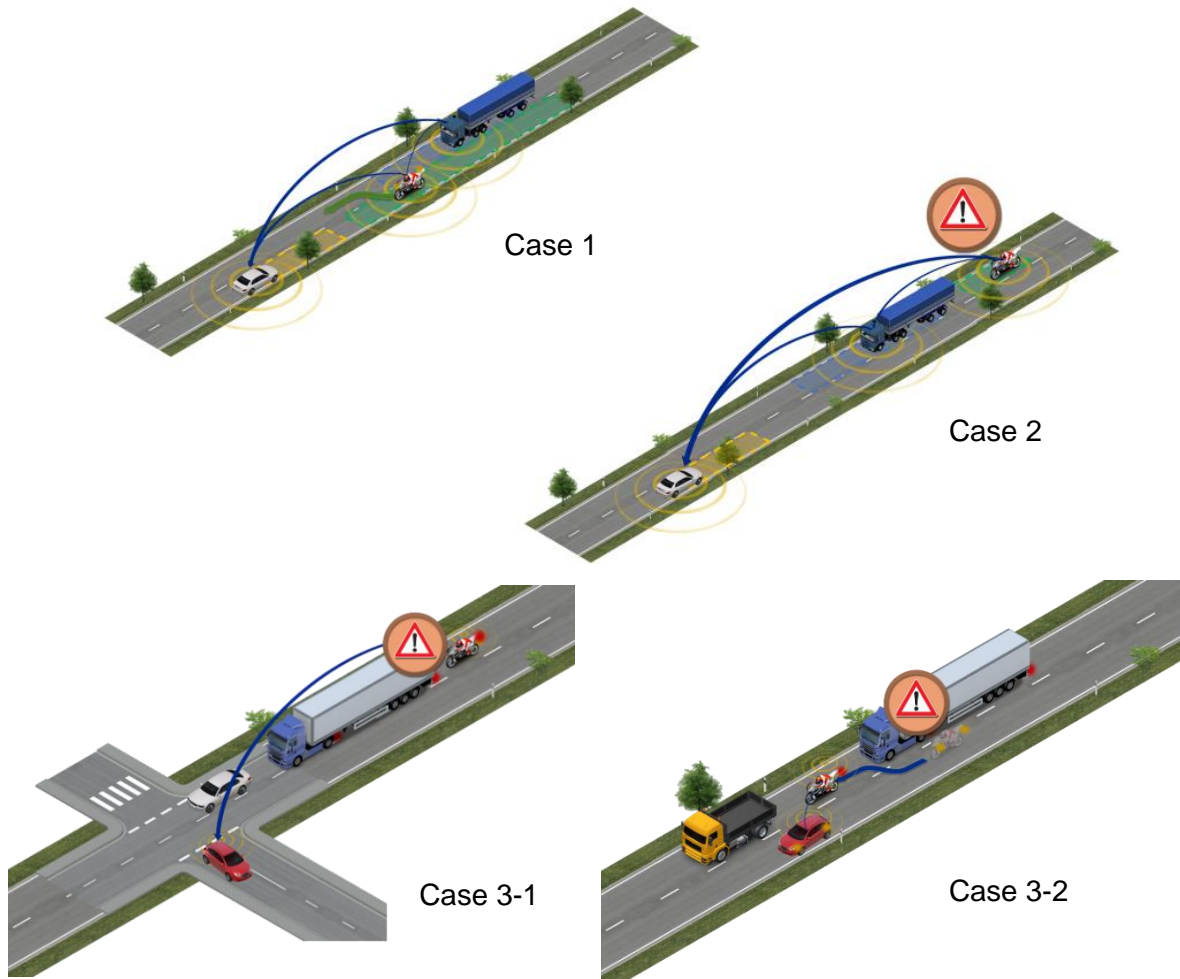
Case 1: The PTW has safely passed the truck and finished his overtaking maneuver. (Figure 6-upper left)

Case 2: The PTW has taken the warning into account, slowed down his speed and remained behind the truck. (Figure 6-upper right)

Case 3: If the PTW has not start passing yet, the PTW has taken the warning into account, slowed down his speed and remained behind the truck. If the PTW has already started passing, the PTW terminated passing and went back to the original lane to ensure safety, or the PTW followed the red vehicle to continue passing. (Figure 6-lower)

After completion, in all these cases the DNPW application can turn back to its initial state.

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Figure 6: Time sequence 4 (PTW receive CAM)

3.5.3 Technical description

3.5.3.1 PTW transmit CAM

As mentioned in 3.5.2, the triggering conditions for CAMs are regulated in ETSI EN 302 637-2. Other than that, there are no calculations required within the DNPW application.

3.5.3.2 PTW receive CAM

3.5.3.2.1 State flow

The function state flow from Service-In to Service-Out of PTW receive CAM is indicated in Figure 7.

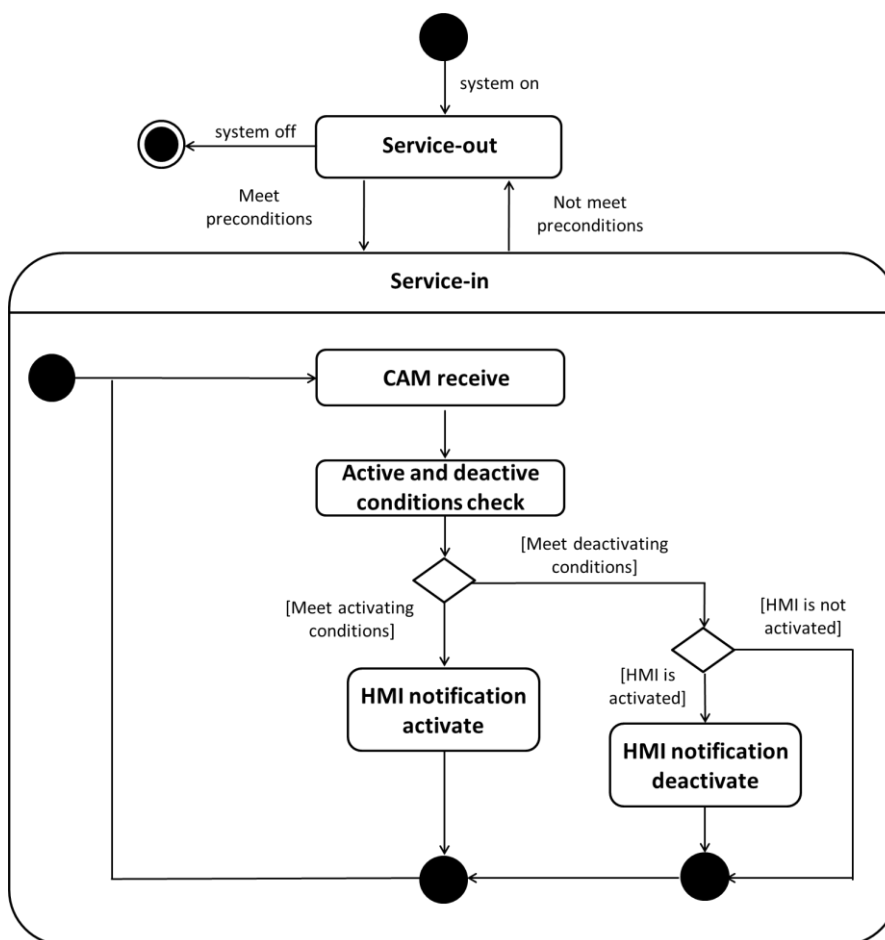


Figure 7: State flow of DNPW (PTW receive CAM)

3.5.3.2.2 Preconditions

The preconditions of PTW receive CAM are stated Table 1 .

All of the following preconditions (PC_1 to PC_8) shall be satisfied every time before this use case is activated.

Table 1: Preconditions of ego vehicle (PTW receive CAM)

#	Item	Condition
PC_1	Ego vehicle type	PTW
PC_2	Speed range	10km/h to 100km/h (or Vmax)
PC_3	Location	-
PC_4	Road type	All roads excluding: <ul style="list-style-type: none"> - Freeway - Roads with central barrier to separate opposite lanes - More than one lane in direction of travel
PC_5	Time	-
PC_6	Weather	-
PC_7	Other conditions	-
PC_8	Out of scope	-

3.5.3.2.3 Activation and deactivation requirements

The activating and deactivating warning requirements of case 1 and 2 are stated in Table 2.

A warning shall be provided when at least the following activation/triggering conditions are fulfilled (minimum requirements):

Table 2: Activating conditions of case 1 and 2 (PTW receive CAM)

#	Item	Condition
AC_1	Relative TTC to the occupying vehicle	Dynamic (e.g. <15s)
AC_2	Overtaking attempt* <ul style="list-style-type: none"> - E.g., status turn signal (ego vehicle) 	Switched from OFF to ON (left)
AC_3	Δ Velocity of ego vehicle and target vehicle	≥ 0 km/h
AC_4	Lane detection	The riding lane can be clearly detected.

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		e.g. camera systems, radar, high precision GNSS and map data, ...
AC_5	Target vehicle	Target vehicle is in the same lane

*To detect the overtaking attempt different calculation methods may be applicable.

The warning shall be deactivated if the following conditions are fulfilled (Table 3).

Deactivation = (DC_1 OR DC_2 OR DC_3) AND DC_4

Table 3: Deactivating condition of case 1 and 2 (PTW receive CAM)

#	Item	Condition
DC_1	Status turn signal (ego vehicle)	Switched from ON (left) to OFF
DC_2	Status turn signal (ego vehicle)	Switched from OFF to ON (right)
DC_3	Status turn signal (ego vehicle)	Switch from left side ON to right side ON
DC_4	Lane status	No lane change detected

If the rider has successfully finished his overtaking maneuver or has cancelled the overtaking maneuver and changed back to the original lane, the warning shall also disappear.

The activating and deactivating warning requirements of case 3 are stated in Table 4 and Table 5.

A warning shall be provided when at least the following activation/triggering conditions are fulfilled (minimum requirements):

Table 4: Activating conditions of case 3 (PTW receive CAM)

#	Item	Condition
AC_6	Overtaking attempt* E.g., status turn signal (ego vehicle)	Switched from OFF to ON (left)
AC_7	Turning left or overtaking attempt of the target vehicle in front* - E.g., Status turn signal (target vehicle)	ON (left) or switched from OFF to ON (left)

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AC_8	Δ Velocity of ego vehicle and target vehicle	≥ 0 km/h
AC_9	Lane detection	The riding lane can be clearly detected. e.g. camera systems, radar, high precision GNSS and map data, ...
AC_10	Target vehicle	Target vehicle is in the same lane or occupies the opposite lane

*To detect the overtaking attempt different calculation methods may be applicable.

The warning shall be deactivated if the following conditions are fulfilled (Table 5).

Deactivation = (DC_5 OR DC_6 OR DC_7) AND DC_8

Table 5: Deactivating condition of case 3 (PTW receive CAM)

#	Item	Condition
DC_5	Status turn signal (ego vehicle)	Switched from ON (left) to OFF
DC_6	Status turn signal (ego vehicle)	Switched from OFF to ON (right)
DC_7	Status turn signal (ego vehicle)	Switch from left side ON to right side ON
DC_8	Lane status	Target vehicle does not occupy the opposite lane

If the rider has successfully finished his overtaking maneuver the warning shall also disappear.

Abbreviations

Please refer to the abbreviations in Preamble document.