

Document Information

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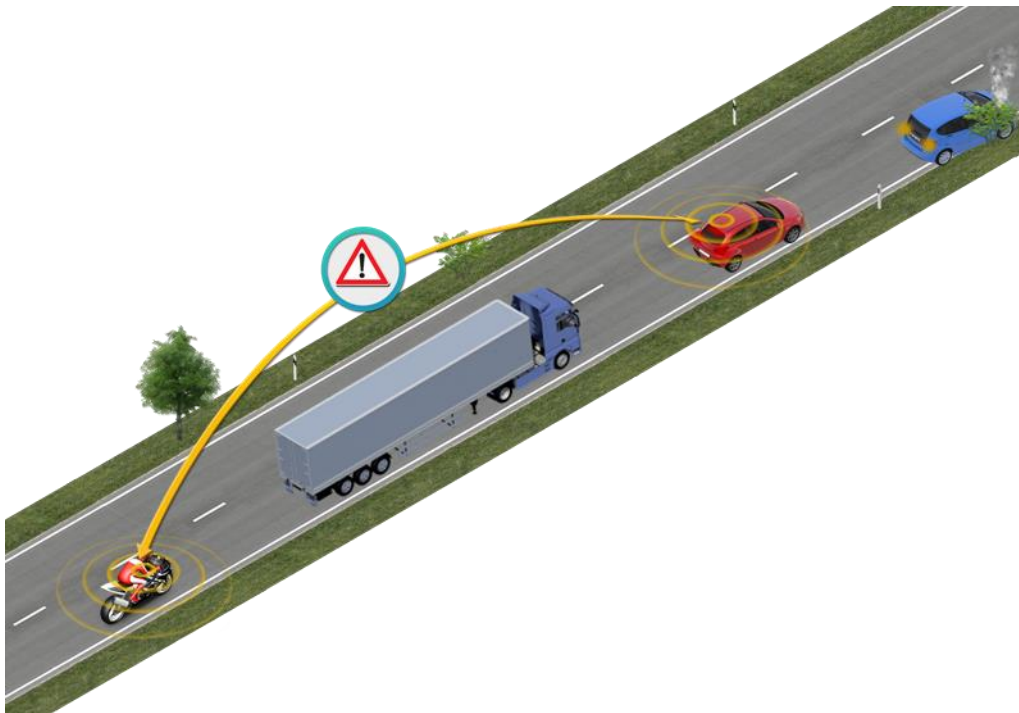
4.1 Electronic Emergency Brake Light (EEBL)

4.1.1 General description

The Electronic Emergency Brake Light (EEBL) application enables a vehicle to broadcast its own emergency braking situation to the surrounding vehicles, including those that have their line of sight obstructed by other vehicles or bad weather like fog or rain.

In case there are multiple vehicles driving behind each other, and the first vehicle has to perform an emergency braking, this application drastically reduces the delay in reaction time by subsequent vehicles: each driver / rider is informed immediately of the emergency braking performed ahead, and the risk of collision could be avoided.

4.1.2 Use case description at PTW side



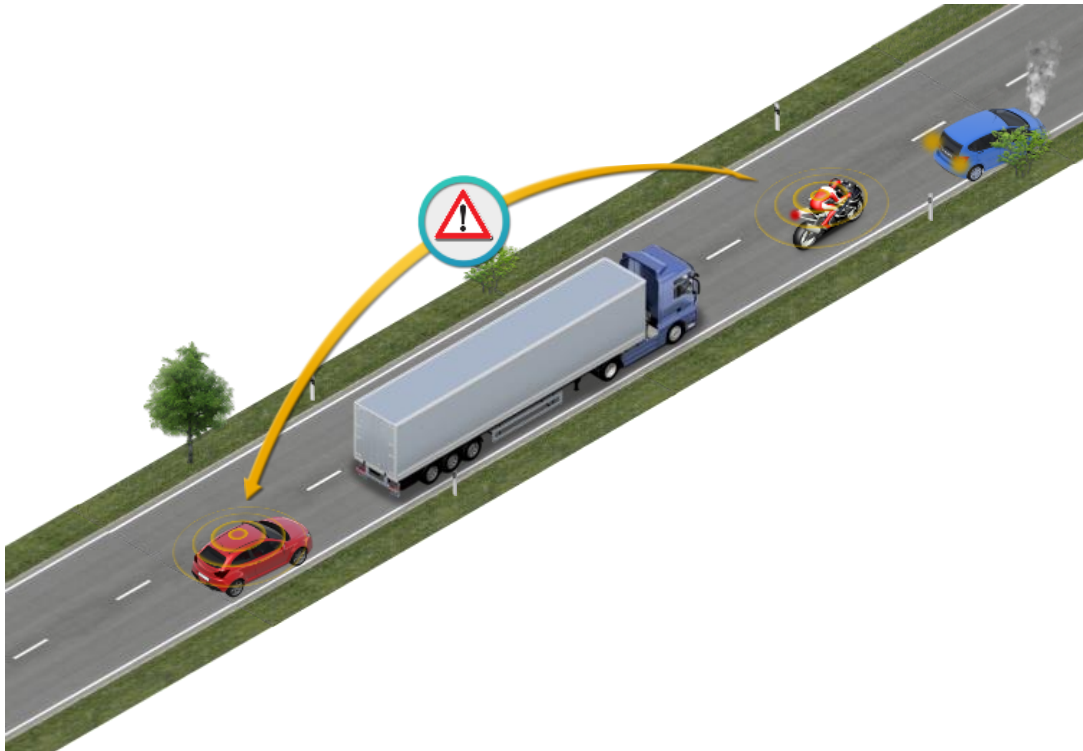
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Figure 1: Use case of “Electronic Emergency Brake Light”

This application alerts driver or rider of any hard / emergency braking that is performed by foregoing vehicles. Figure 1 shows an example of three vehicles travelling in line. In case of an incident that causes the first vehicle to perform an emergency braking, the following vehicles should react immediately in order to avoid rear end collisions. This can be complicated in situations with limited visibility, such as having the line of sight obstructed by other vehicles in front, but also adverse weather conditions. In this figure, the PTW can only see the brake lights of the truck ahead. Therefore, the stopping distance of the PTW is directly affected by the reaction time of the truck driver in front. The higher the number of vehicles in between, the

longer becomes the delay of noticing the obstacle ahead. The EEBL application eliminates this problem. The application enables a vehicle to broadcast a self-generated emergency brake event message to the surrounding vehicles. Upon receiving the event message, the receiving vehicle determines the relevance of the event and if appropriate provides a warning to the driver or rider in order to avoid a rear end collision. By doing so, the driver or rider is informed before even being able to see the incident ahead and this way, the danger of a collision may be mitigated.

4.1.2.1 Scenario description: PTW transmit DENM

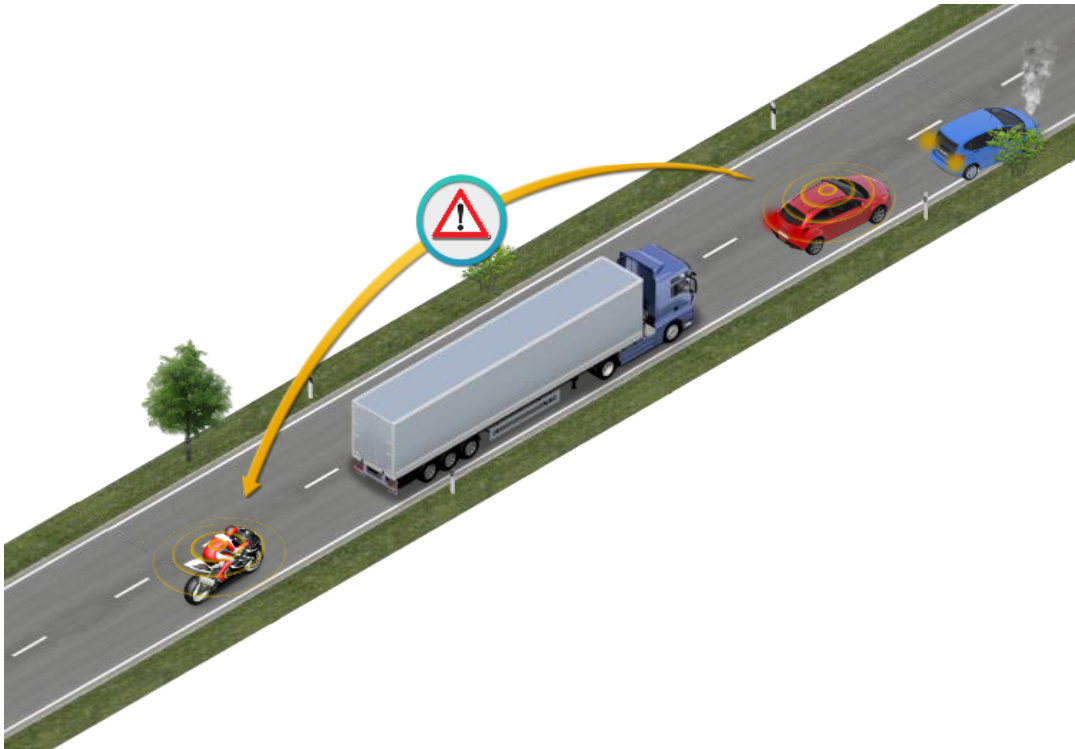


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Figure 2: Scenario description of PTW transmit DENM of “Electronic Emergency Brake Light”

Figure 2 shows the PTW transmit DENM scenario. In this scenario the PTW riding in front performs an emergency braking. Then the emergency brake event / message is broadcast from the PTW to the surrounding vehicles.

4.1.2.2 Scenario description: PTW receive DENM



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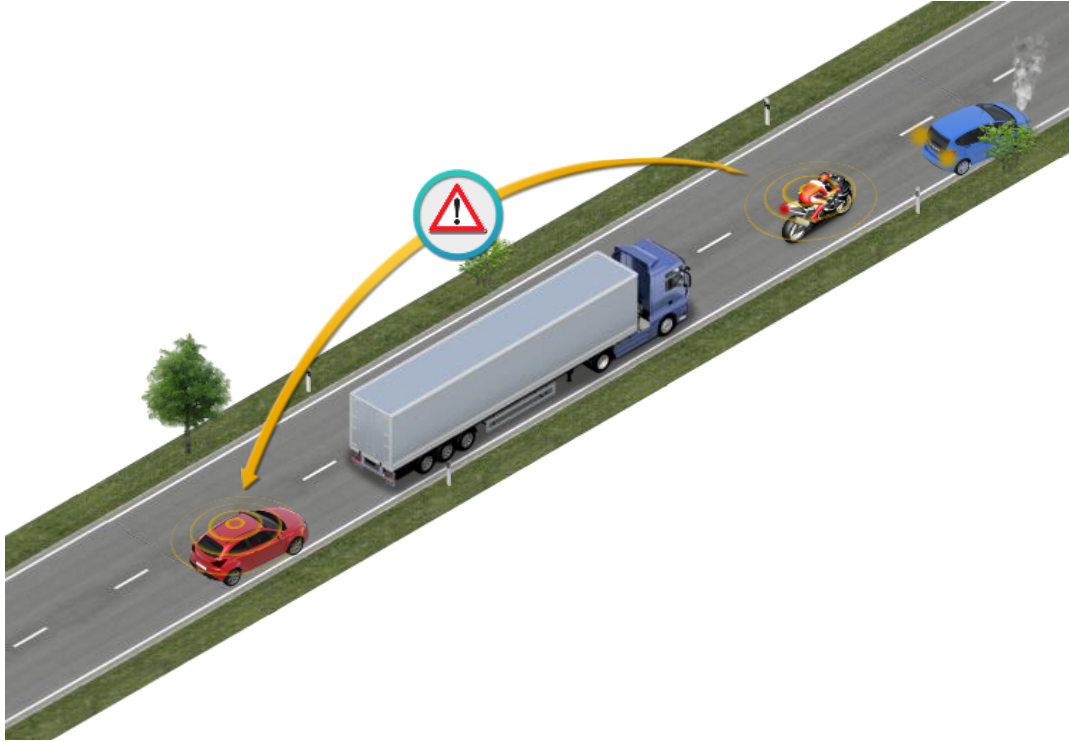
Figure 3: Scenario description of PTW receive DENM of “Electronic Emergency Brake Light”

Figure 3 shows the PTW receive DENM scenario. In this scenario the vehicle riding in front performs an emergency braking. Then the emergency brake event / message is broadcast from the vehicle to the surrounding vehicles. Upon receiving such an event information / message, the PTW determines the relevance of the event and provides a warning to the rider, if necessary.

4.1.3 Use case description at car side

This section shows the request for consideration of the PTW specific issues to car OEMs.

If a car receives the emergency brake event / message broadcast from a PTW, please emphasize that it involves a PTW because with PTWs there is always some risk that they may lose stability under emergency braking.



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Figure 4: Scenario description at car side

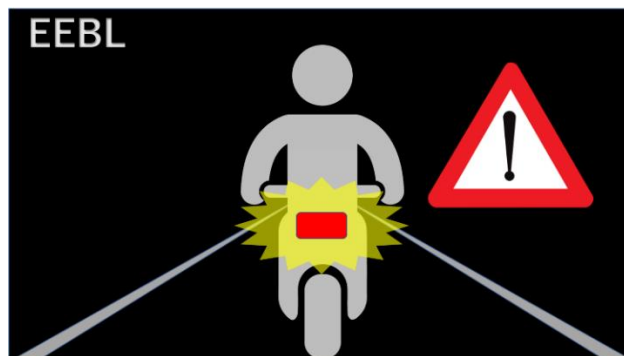


Figure 5: Image of emphasized warning

4.1.4 Technical description

4.1.4.1 PTW transmit DENM

4.1.4.1.1 State Flow

The function state flow from Service-In to Service-Out of PTW transmit DENM is indicated in the following figure.

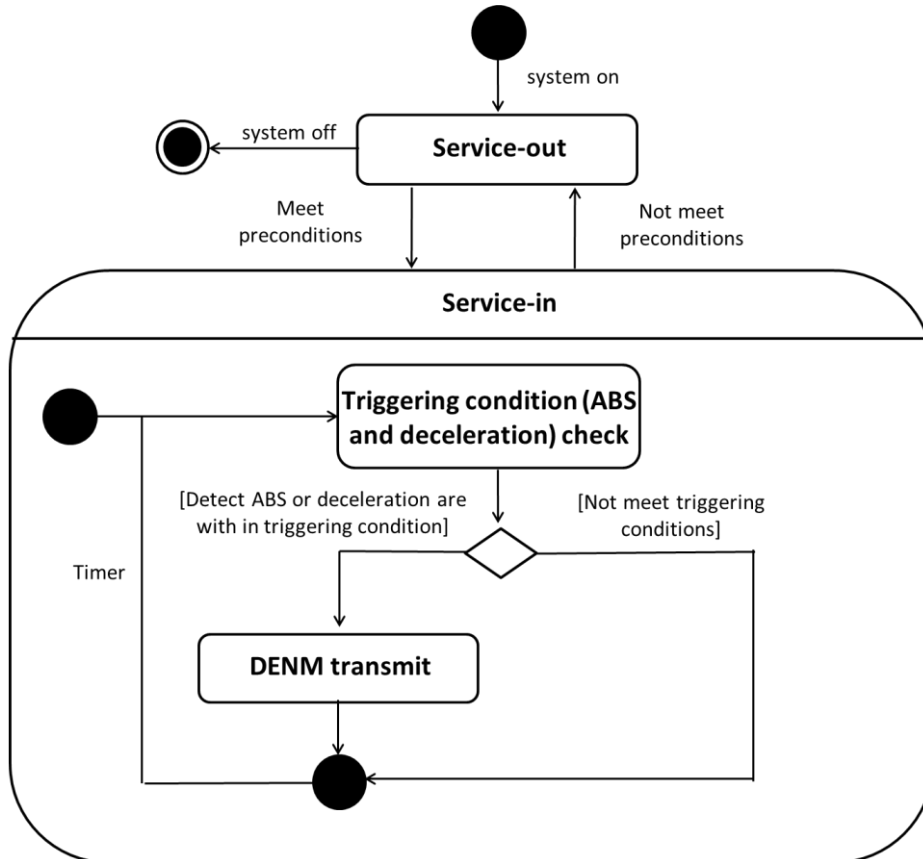


Figure 6: State Flow of EEBL (PTW transmit DENM)

4.1.4.1.2 Preconditions

The preconditions of PTW transmit DENM are stated below.

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

Table 1: Preconditions of ego vehicle (PTW transmit DENM)

#	Item	Condition
PC_1	Ego vehicle	PTW
PC_2	Speed range	> 20 km/h
PC_3	Location	-
PC_4	Road type	-
PC_5	Time	-
PC_6	Weather	-
PC_7	Other conditions	-
PC_8	Out of scope	-

4.1.4.1.3 Triggering Conditions

The triggering conditions conform to the C2C-CC definition shown in Figure 7 below.

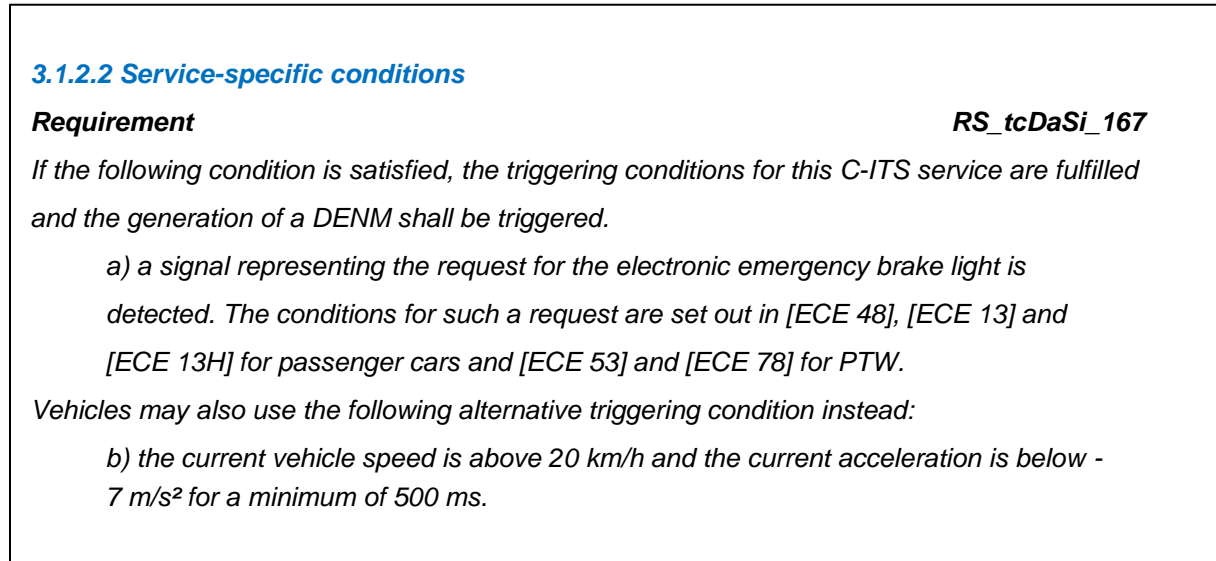


Figure 7: The triggering conditions of the C2C-CC definition¹

4.1.4.1.4 Message Parameter

The message parameters conform to those stated in the C2C-CC.

¹ CAR 2 CAR Communication Consortium; C2C-CC Basic System Profile Release 1.5.1; Triggering Conditions and Data Quality Dangerous Situation CAR 2 CAR Communication Consortium (https://www.car-2-car.org/fileadmin/documents/Basic_System_Profile/Release_1.5.1/C2CCC_RS_2003_DangerousSituation.pdf accessed 13.11.2020)

4.1.4.2 PTW receive DENM

4.1.4.2.1 State Flow

The function state flow from Service-In to Service-Out of PTW receive DENM is indicated in the following figure.

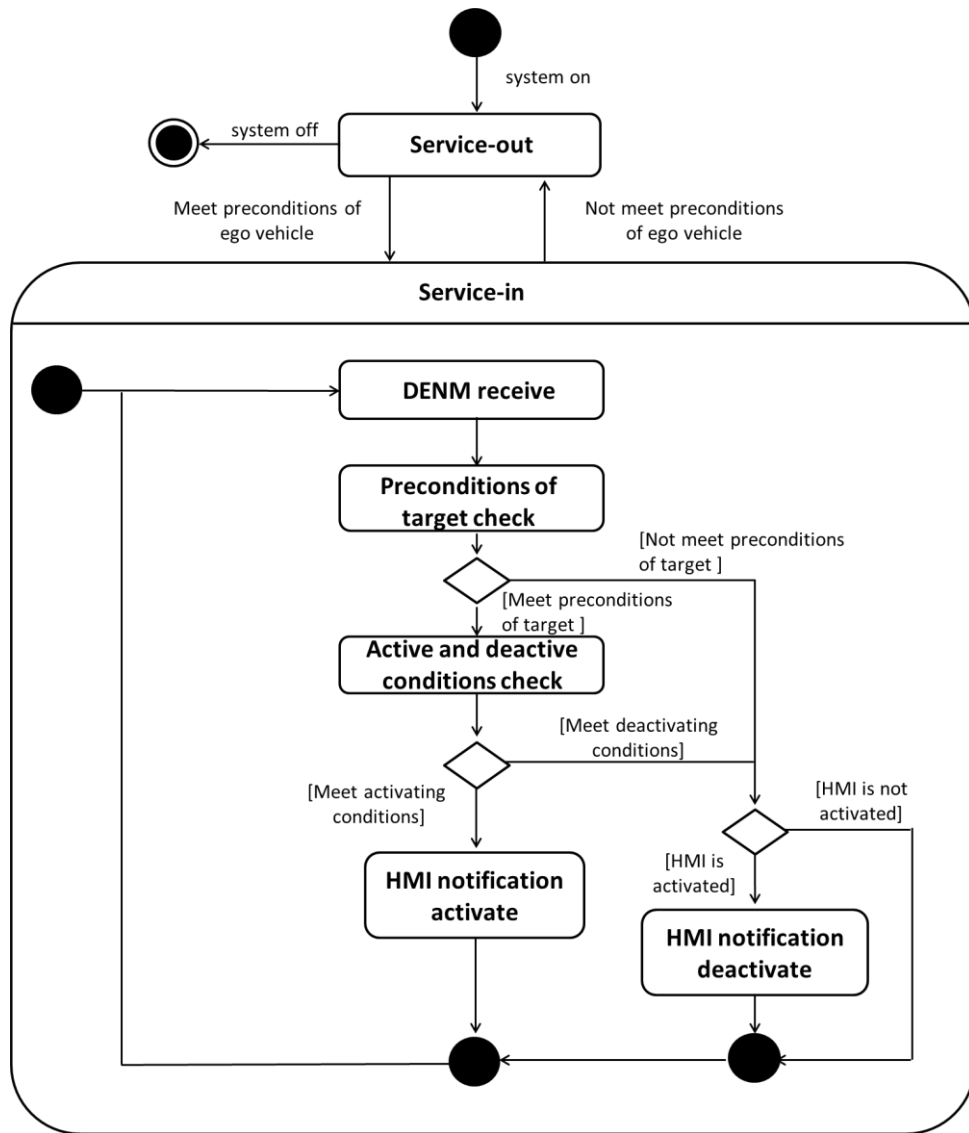


Figure 8: State Flow of EEBL (PTW receive DENM)

4.1.4.2.2 Preconditions

The preconditions of PTW receive DENM are stated below.

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

Table 2: Preconditions of ego vehicle (PTW receive DENM)

#	Item	Condition
PC_1	Ego vehicle	PTW
PC_2	Speed range	> 20 km/h
PC_3	Location	-
PC_4	Road type	-
PC_5	Time	-
PC_6	Weather	-
PC_7	Other conditions	-
PC_8	Out of scope	-

All of the preconditions of target (PC_9 to PC_13) shall be satisfied before active and deactivate condition check.

Table 3: Preconditions of target (PTW receive DENM)

#	Item	Condition
PC_9	Target	Event (Electronic emergency brake light)
PC_10	Relevance distance	< 500m
PC_11	CauseCode	dangerousSituation(99)
PC_12	subCauseCode	emergencyElectronicBrakeLights(1)
PC_13	Vehicle type	-

4.1.4.2.3 Activation and deactivation requirements

The activation and deactivation requirements of PTW receive DENM of EEBL are stated below. The warning will be activated when all of the conditions below (AC_1 AND AC_2 AND AC_3) are satisfied.

Table 4: Activating conditions of EEBL (PTW receive DENM)

#	Item	Condition	Used data
AC_1	Target	Relative DENM received (Electronic emergency brake light)	Target signal cause (causeCode and subCauseCode)
AC_2	Event position	On the route of ego vehicle	Estimated route of ego vehicle (latitude, longitude, path history etc.) Target signal position (eventPosition)
AC_3	TTC	e.g. Less than 7.5s	eventPosition eventSpeed

The warning will be deactivated when at least one of the conditions below (DC_1 OR DC_2) is satisfied.

Table 5: Deactivating conditions of EEBL (PTW receive DENM)

#	Item	Condition	Used data
DC_1	Position	Ego vehicle stopped	Position of ego vehicle (latitude, longitude)
DC_2	Position	Ego vehicle passes event position	Position of ego vehicle (latitude, longitude) Target signal position (eventPosition)

Abbreviations

Please refer to the abbreviations in Preamble document.