

Document Information

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4.3 Approaching Emergency Vehicle Warning (AEVW)

4.3.1 General description

The Approaching Emergency Vehicle Warning (AEVW) application alerts the rider about the location and the movement of public emergency vehicles responding to an incident¹. This allows the rider to take steps to not interfere with the emergency vehicle, e.g. to move out of the way in a planned and safe manner.

4.3.2 Use case description



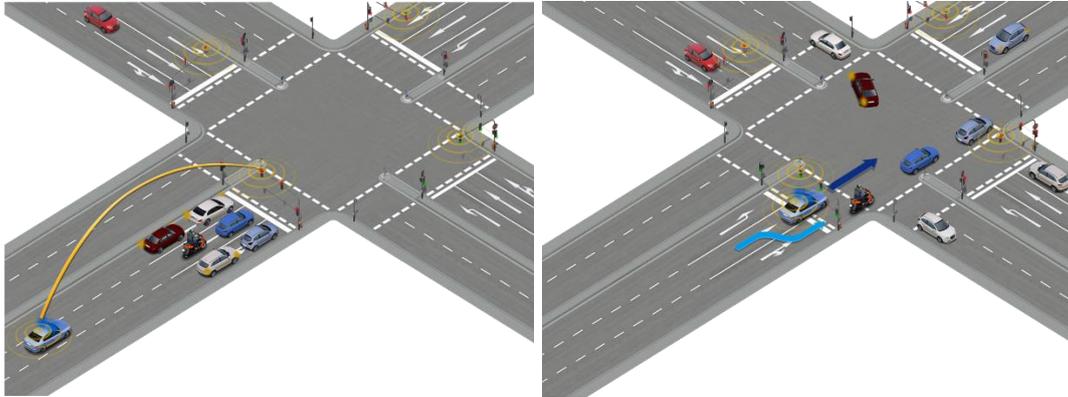
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Figure 1: General overview

An emergency vehicle responding to an incident continuously sends out messages to connected vehicles via Vehicle-to-Everything (V2X) communication. When the message is received by a PTW, the AEWV system can alert the rider about the location and movement of the emergency vehicle. This could be for example a police car approaching an accident or firefighters driving to a fire. This message will be sent in order to extend the range of visual (light bar) and audible (siren) notifications. It is very helpful in unclear traffic situations, like a winding road in a forest with no line of sight (Figure 1) or an intersection in a city where it is not known in which direction the emergency vehicle will travel (Figure 2). It is very likely that infrastructure applications will be implemented to grant the emergency vehicle the right of way

¹ Cf. Connected Vehicle Reference Implementation Architecture (<https://local.iteris.com/cvria/html/applications/app29.html#tab-3>) accessed: 16.11.2020.

and forward the message to other vehicles which are beyond direct communication range. The application will help to reduce upcoming dangerous situations, as emergency vehicles are often permitted by law to break conventional road rules.



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Figure 2: Police car approaching an intersection

This Application also includes stationary emergency vehicles in action, for example when they are stopped to rescue people trapped in a car, or to safeguard and support broken-down vehicles.

There are two scenarios for this use case to consider.

PTW transmit DENM will describe the transmitter side, where the PTW will act as an emergency vehicle. This is identical to the equivalent specification in the C2C-CC definition².

PTW receive DENM will describe the receiver side, the PTW is therefore a regular (two wheeled) road user.

4.3.2.1 Scenario description: PTW transmit DENM

AEV messages are transmitted in three different types,

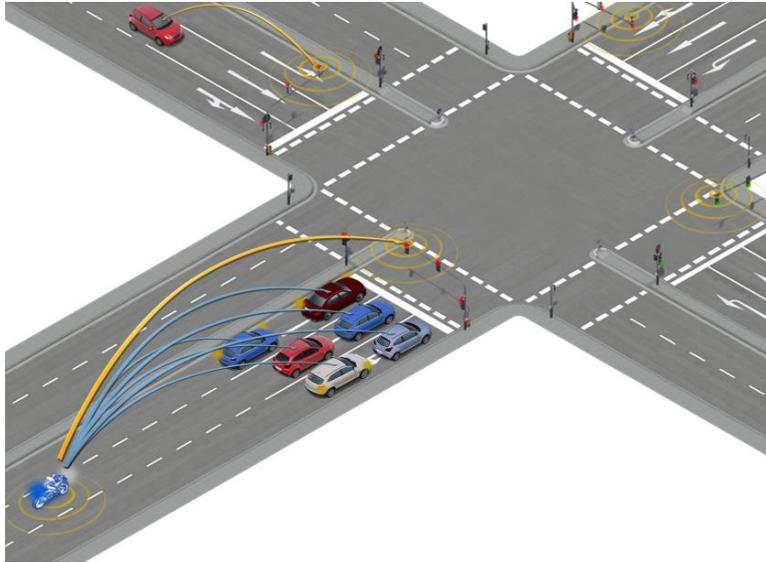
According to the C2C-CC definition, these three patterns are “Emergency vehicle in operation (EViO)”, “Stationary safeguarding emergency vehicle (SSEV)” and “Stationary recovery service warning (SRSW)”.

² CAR 2 CAR Communication Consortium; C2C-CC Basic System Profile; Release 1.5.0

<https://www.car-2-car.org/documents/basic-system-profile/> accessed 02.06.2020)

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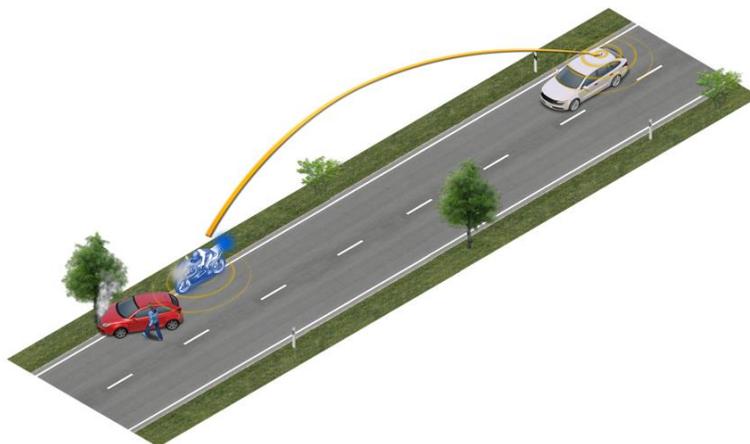
- EViO is triggered when the vehicle is using the light bar and is not stationary. Within this part of the application all scenarios are included while the emergency vehicle is moving.



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Figure 3: Emergency PTW approaching an intersection

- SSEV is triggered when the vehicle is using the light bar, is stationary and the vehicleRole is set to 'emergency (6)'.

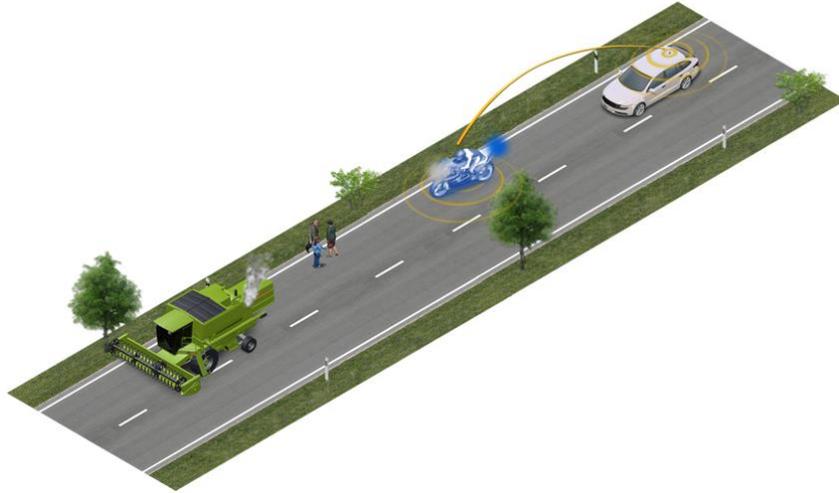


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Figure 4: Emergency PTW approaching an accident

- SRSW is triggered when the vehicle is using the light bar, is stationary and the vehicleRole is set to 'rescue (5)'. The conditions are similar but not equal to SSEV. This application will be triggered in any case of supporting a broken-down vehicle.

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Figure 5: Emergency PTW approaching a broken-down vehicle

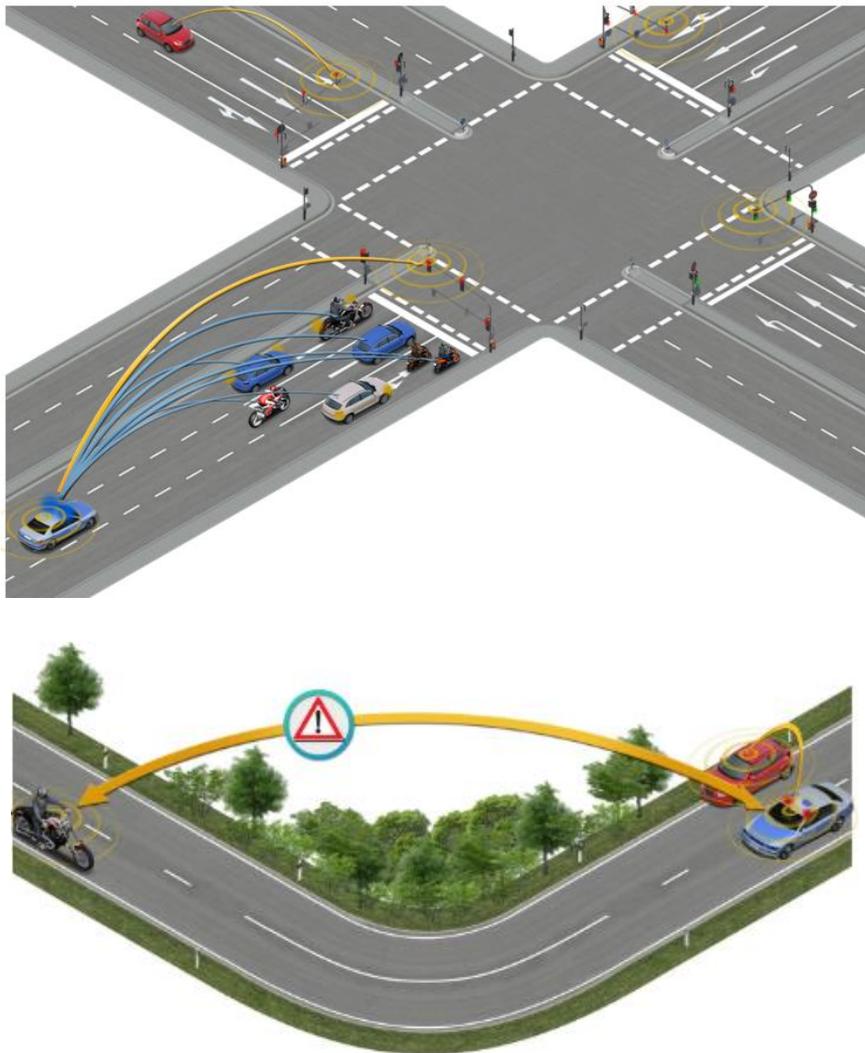
The triggering conditions described above are simplified, please consider the full set of conditions and timers with reference to the C2C-CC definition.

4.3.2.2 Scenario description: PTW receive DENM

For the PTW receive DENM, PTWs will receive an AEV Message.

The scenario of PTW receive DENM - EViO is as follows:

When an emergency vehicle, police/firefighters/..., are heading towards an incident they will broadcast a message. The receiver of this message can either be a car, bus, truck, PTW or even Road Side Unit (RSU) which can forward the message or guide the way.



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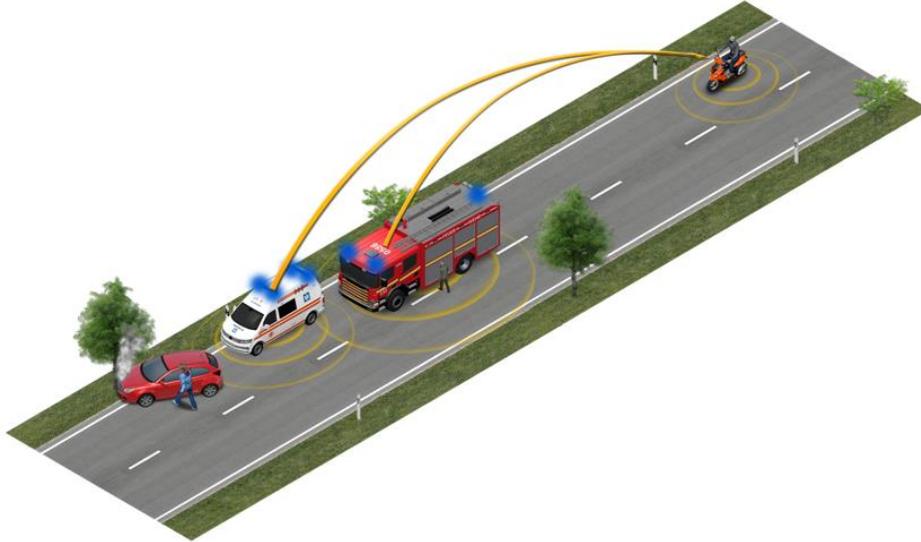
Figure 6: PTW receives an AEV message from a police car

In each case the receiver will be alerted to an approaching emergency vehicle and watch carefully. This means riders and drivers will have more time to move out of the way in a planned and safe manner.

The scenario of PTW receive DENM - SSEV is as follows:

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The emergency vehicle has stopped at the incident. To notify the other road users about an ongoing emergency operation, an SSEV message is sent out. The receiving PTW then provides its rider notification about the position of the incident and if a lane is occupied. The rider then has the chance to go another way or safely pass.

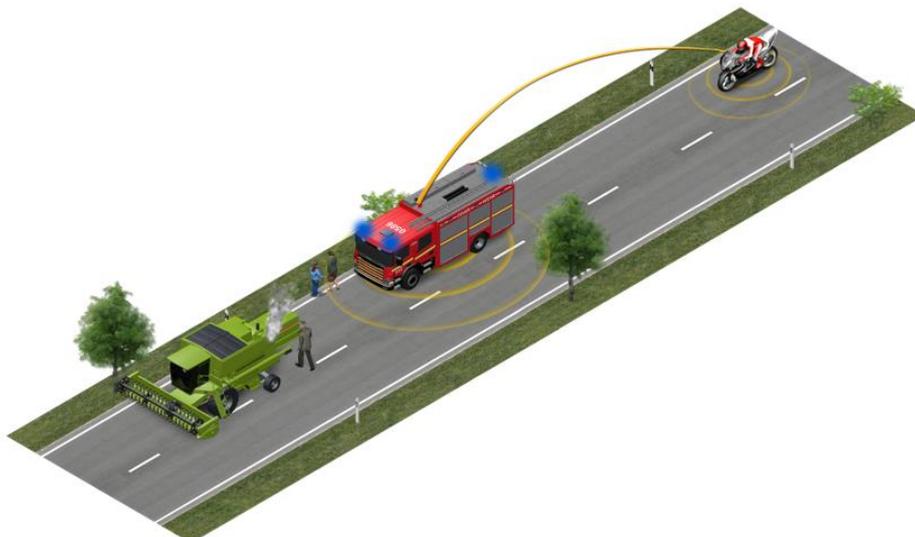


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Figure 7: PTW receives an AEV message because of an ongoing emergency operation

The scenario of PTW receive DENM - SRSW is as follows:

On the receiver side, this scenario shall be the same as SSEV. The reaction of the receiving vehicles' rider shall be the same; get a notification and reroute or safely pass.



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Figure 8: PTW receives an AEV message because of an ongoing rescue operation

4.3.3 Technical description

4.3.3.1 PTW transmit DENM

Because the triggering conditions of AEVW are identical amongst all vehicles (cars, trucks and PTWs), and are clearly defined in the C2C-CC definition, the PTW transmit DENM will not be elaborated upon.

4.3.3.2 PTW receive DENM

As mentioned in 4.3.2.1, there are three different scenarios of AEVW, EViO, SSEV and SRSW. In each case relevance of the message to the rider needs to be verified.

4.3.3.2.1 EViO

4.3.3.2.1.1 State flow

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

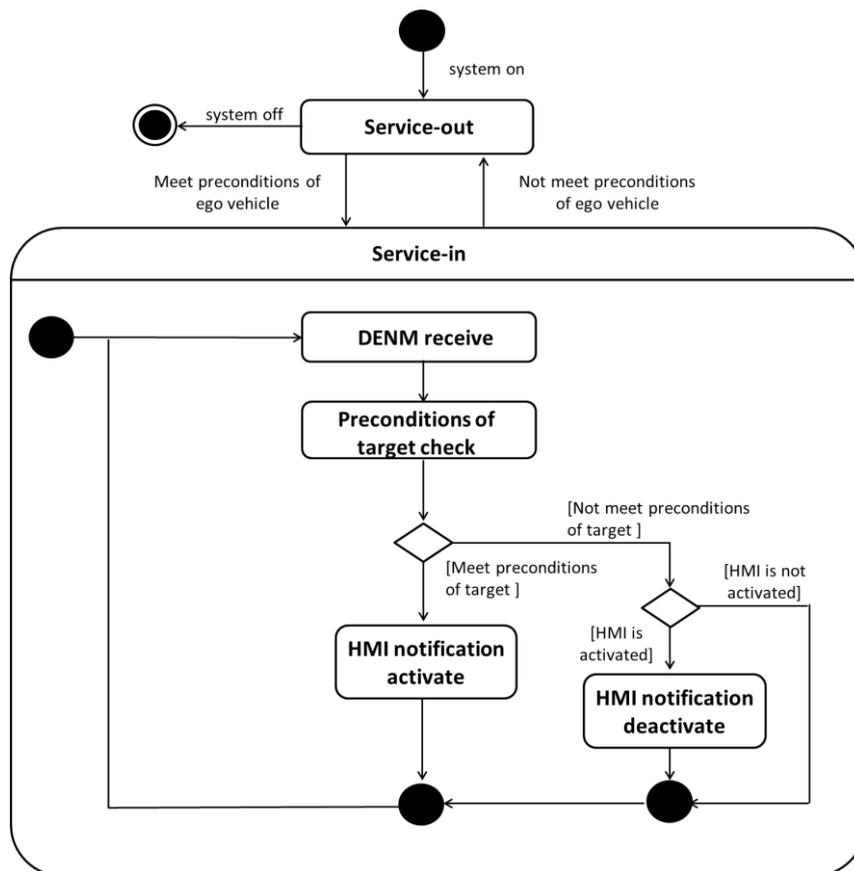


Figure 9: State flow of AEVW (PTW receive DENM – EViO)

4.3.3.2.1.2 Preconditions

The preconditions of PTW receive DENM – EViO is stated below.

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

Table 1: Preconditions of ego vehicle (PTW receive DENM – EviO)

| # | Item | Condition |
|------|------------------|-------------------------------|
| PC_1 | Ego vehicle | PTW |
| PC_2 | Speed range | - |
| PC_3 | Location | Any, sharing the same roadway |
| PC_4 | Road type | - |
| PC_5 | Time | - |
| PC_6 | Weather | - |
| PC_7 | Other conditions | - |
| PC_8 | Out of scope | - |

HMI warning activates when all of the following preconditions of target (PC_9 and PC_10) are satisfied.

Table 2: Preconditions of target (PTW receive DENM – EviO)

| # | Item | Condition |
|-------|----------------------------------|----------------|
| PC_9 | Distance to DENM originator | < 300m |
| PC_10 | Originating vehicles speed range | Moving (>0m/s) |

4.3.3.2.2 SSEV and SRSW

SSEV and SRSW can be covered by the same technical description because they share identical triggering conditions and have the same effect on the receiver.

4.3.3.2.2.1 State flow

The function state flow from Service-In to Service-Out of PTW receive DENM – SSEV and SRSW are indicated in the following figure.

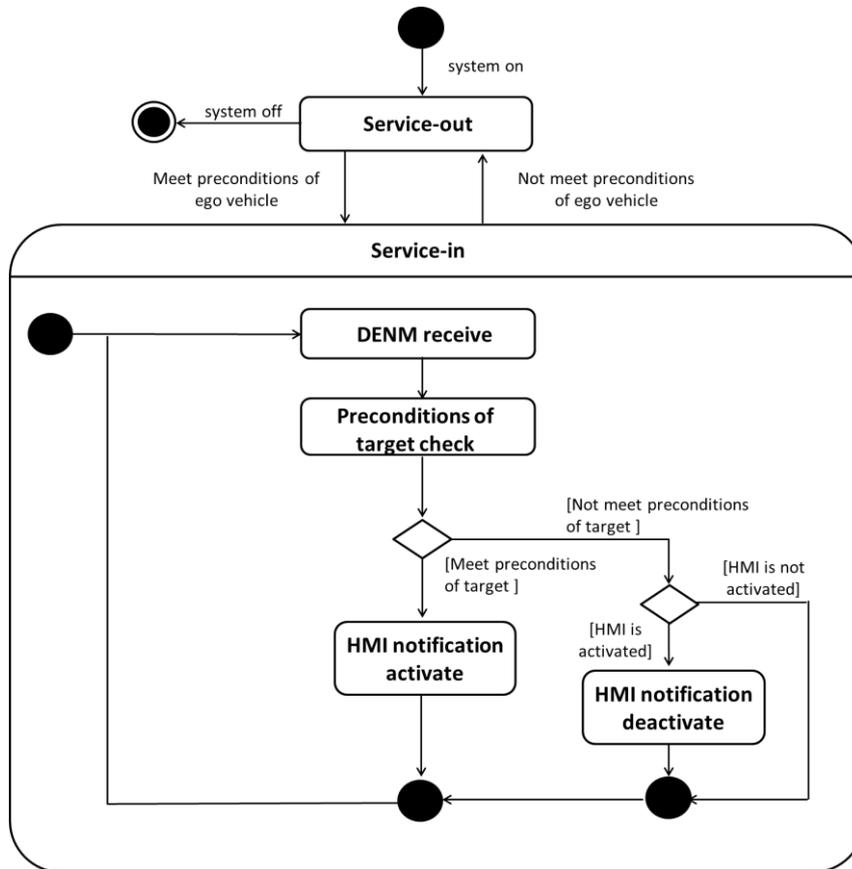


Figure 10: State flow of AEVW (PTW receive DENM – SSEV and SRSW)

4.3.3.2.2 Preconditions

The preconditions of PTW receive DENM – SSEV and SRSW are stated below.

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

Table 3: Preconditions of ego vehicle (PTW receive DENM – SSEV and SRSW)

| # | Item | Condition |
|------|------------------|-------------------------------|
| PC_1 | Ego Vehicle | PTW |
| PC_2 | Speed range | - |
| PC_3 | Location | Any, sharing the same roadway |
| PC_4 | Road type | - |
| PC_5 | Time | - |
| PC_6 | Weather | - |
| PC_7 | Other conditions | - |
| PC_8 | Out of scope | - |

HMI warning activates when all of the following preconditions of target (PC_9 and PC_10) are satisfied.

Table 4: Preconditions of target (PTW receive DENM – SSEV and SRSW)

| # | Item | Condition |
|-------|----------------------------------|------------|
| PC_9 | Distance to DENM originator | < 300m |
| PC_10 | Originating vehicles speed range | Stationary |

Abbreviations

Please refer to the abbreviations in Preamble document.