

Document Information

Document Title:	Application Specification
Chapter:	Road Works Warning (RWW)
Version:	1.0
Release Date:	11/12/2020

Disclaimer

This document has been developed within the Connected Motorcycle Consortium and might be further elaborated within the consortium. The Connected Motorcycle Consortium and its members accept no liability for any use of this document and other documents from the consortium.

Copyright Notification: No part may be reproduced except as authorized by written prior permission. The copyright and the foregoing restriction extend to reproduction in all media. © 2020, Connected Motorcycle Consortium.

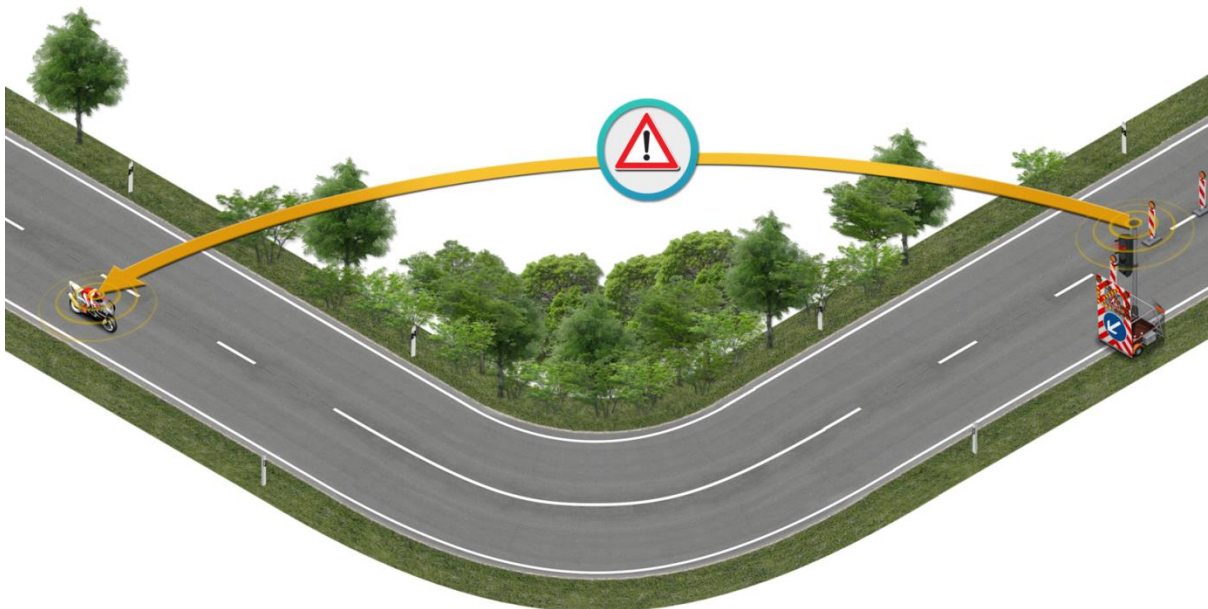
4.5 Road Works Warning (RWW)

4.5.1 General description

The Road Works Warning (RWW) application supports a PTW rider by providing warning information regarding road works in the vicinity.

The road works could be blocking an entire lane, or be restricted to certain lanes. RWW can be used to inform PTW riders of upcoming road works.

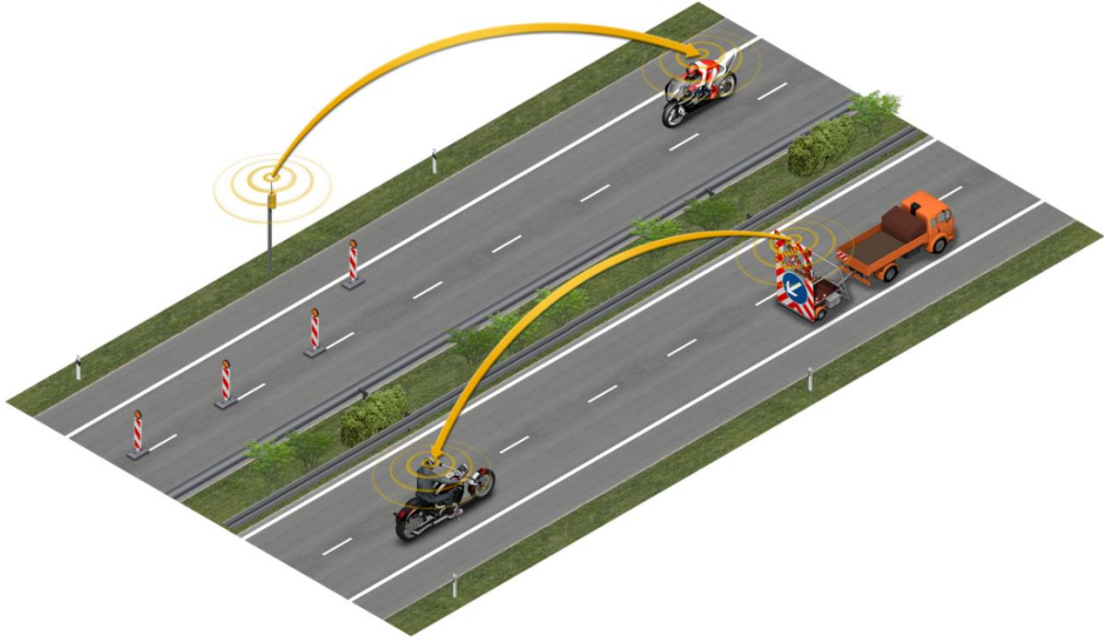
4.5.2 Use case description



© This picture was created using the C2C-CC Illustration Toolkit, owned by the CAR 2 CAR Communication Consortium

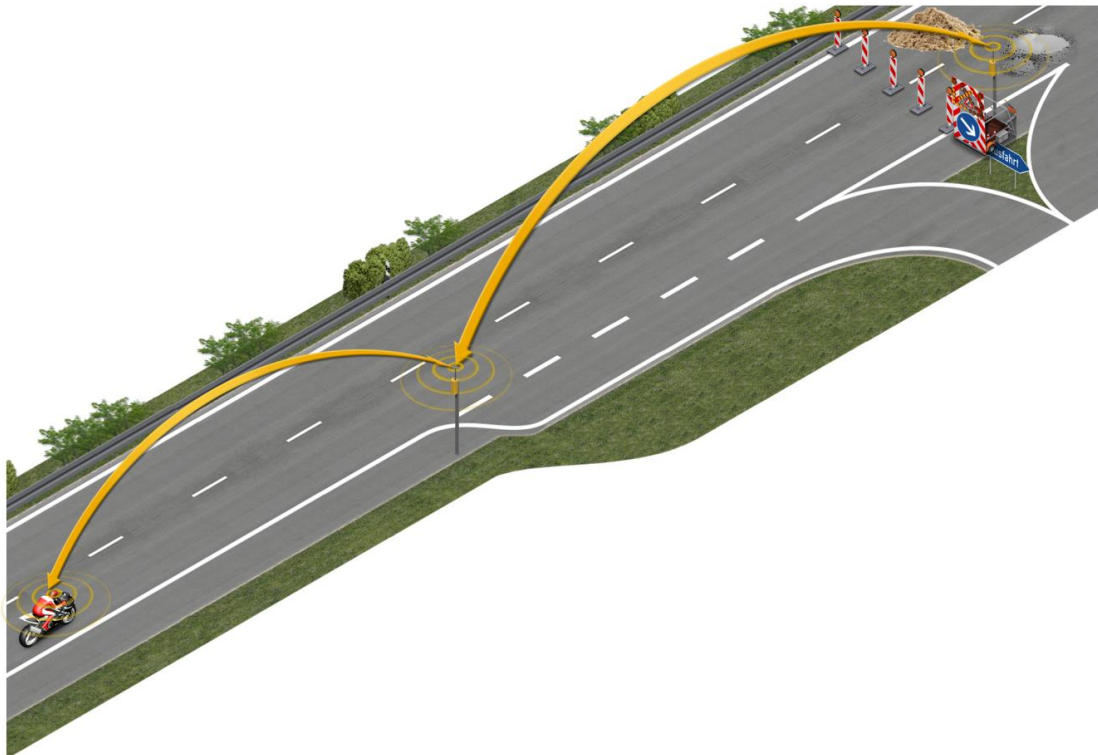
Figure 1: Use case of RWW: single lane closure with direction closure

Application Specification



© This picture was created using the C2C-CC Illustration Toolkit, owned by the CAR 2 CAR Communication Consortium

Figure 2: Use case of RWW: single lane closure in a double lanes for direction; mobile road works warning.



© This picture was created using the C2C-CC Illustration Toolkit, owned by the CAR 2 CAR Communication Consortium

Figure 3: Use case of RWW: road closure

The RWW utilises connected vehicle technologies to warn PTWs and other vehicles about potentially dangerous situation, due to the road being blocked by road works.

The application can provide warning in various road works scenarios. For example the road works could impact a single lane on a multi-lane road, all lanes in one direction of travel, or the whole road (requiring diversion). Road works may be static or mobile.

The RWW is intended to be preventive for dangerous situations, especially in bad/limited visibility conditions, regardless of the weather or road condition.

According to Common C-ITS Service Definitions¹ (C-ROADS), the events and therefore the use cases of the C-ITS service group RWW are grouped in the following six use cases:

- Lane Closure (And Other Restrictions) (RWW – LC)
- Road Closure (RWW - RC)
- Road Works – Mobile (RWW - RM)
- Winter Maintenance (RWW - WM)
- Road Operator Vehicle in Intervention (RWW - ROVI)
- Road Operator Vehicle Approaching (RWW - ROVA)

All six C-ITS services transmit I2V information to road users using DENM through mobile or fixed transmission points.

4.5.2.1 Scenario description: PTW receive DENM

When a PTW is driving on the road, it receives DENM informing road works.

As soon as the PTW receives the message referring to road works, independently from the sub-use case mentioned in chapter 4.5.2, it starts the RWW application.

Initially, the function identifies the correlation between the position of the road works and the PTW. If the road works are in the path of the PTW, and the distance is less than a certain threshold, then the system triggers the warning to the rider.

Finally, as soon as the PTW passes the road works, the system shall stop the warning.

In any case, the system shall ignore the DENM if the PTW already passed the road work location.

¹ Common C-ITS Service Definitions Version 1.7 from C-Roads (<https://www.c-roads.eu/platform/about/news/News/entry/show/release-17-of-c-roads-harmonised-c-its-specifications.html> accessed on 16.10.2020)

4.5.2.1.1 Lane Closure (And Other Restrictions) (RWW - LC)

As stated in the C-ROADS document, the road user receives information about the closure of a part of a lane, a whole lane or several lanes (including the hard shoulder), but without the road closure and alternate mode.

Situations included in this lane closure scenario are:

- Road works equipped with warning beacons / temporary road signs / illuminated lights arrows, on a road with separate carriageways or on a dual carriageway.
- Carriageway crossover (in a divided highway. situation where vehicles need to use the contraflow carriageway because their own carriageway is closed)
- Lane closure by sign gantries (line control system)
- Lane closure by warning trailer equipped with Road Side Unit (short term road works)

4.5.2.1.2 Road Closure (RWW - RC)

As stated in the C-ROADS document, the road user receives information about a road closure due to a set of static road works. The closure is temporary.

This information could help to prevent road users being stuck in traffic jams without being informed on the situation, becoming anxious and doing dangerous U-turns or using an inappropriate lane (e.g. hard shoulder).

There is an added value in this use case if the information is accurately linked with re-routing information. As a matter of fact this allows the rider to anticipate the closure of a road so they can choose an alternate route or time to travel.

Situations included in this road closure scenario are:

- On a dual carriageway: one direction is closed, without carriageway crossover.
- On a two-way carriageway: the whole road is closed (therefore without alternate).
- In both case: a deviation is indicated near the closure

4.5.2.1.3 Road Works – Mobile (RWW - RM)

As stated in the C-ROADS document, the road user receives information about a zone on the road that contains, at some point, the neutralization of part of a lane or a lane closure (but without road closure) due to a planned mobile work site.

Situations included in this scenario are:

- Mowing
- Road markings
- Fixing restraint systems
- Phyto-sanitary treatments
- Sweeping, road cleaning
- etc.

4.5.2.1.4 Winter Maintenance (RWW - WM)

As stated in the C-ROADS document, the winter maintenance vehicle, equipped with the necessary technology for a road operator Vehicle-to-Vehicle (Vro2V) communication, sends a message signaling their activity (salting and/or snow/ice removal). The alerted road users can adapt their driving behavior accordingly.

4.5.2.1.5 Road Operator Vehicle in Intervention (RWW - ROVI)

As stated in the C-ROADS document, an operating agent in their vehicle stops in front of an accident/incident to cordon off the obstacles, or is currently setting the equipment (lane delineation) to protect a site (in case of road works for example).

Situations included in this scenario are:

- accident
- incident (stopped vehicle on the road, obstacle)
- stop during a patrol tour
- lane delineation
- moving the warning trailers
- etc.

4.5.2.1.6 Road Operator Vehicle Approaching (RWW - ROVA)

As stated in the C-ROADS document, a road operating agent in their intervention vehicle needs to urgently access an incident area in order to cordon it off. The agent broadcasts a message requesting road users to facilitate the agent's route through traffic.

Situations included in this scenario are:

- Situation of bottleneck: the road operating vehicle can for example bypass using the hard shoulder, or in between lanes
- Free flow traffic

4.5.3 Technical description

4.5.3.1 PTW receive DENM

4.5.3.1.1 Lane Closure (And Other Restrictions) (RWW - LC)

4.5.3.1.1.1 State flow

The function state flow from Service-In to Service-Out of RWW – LC is indicated in the following figure.

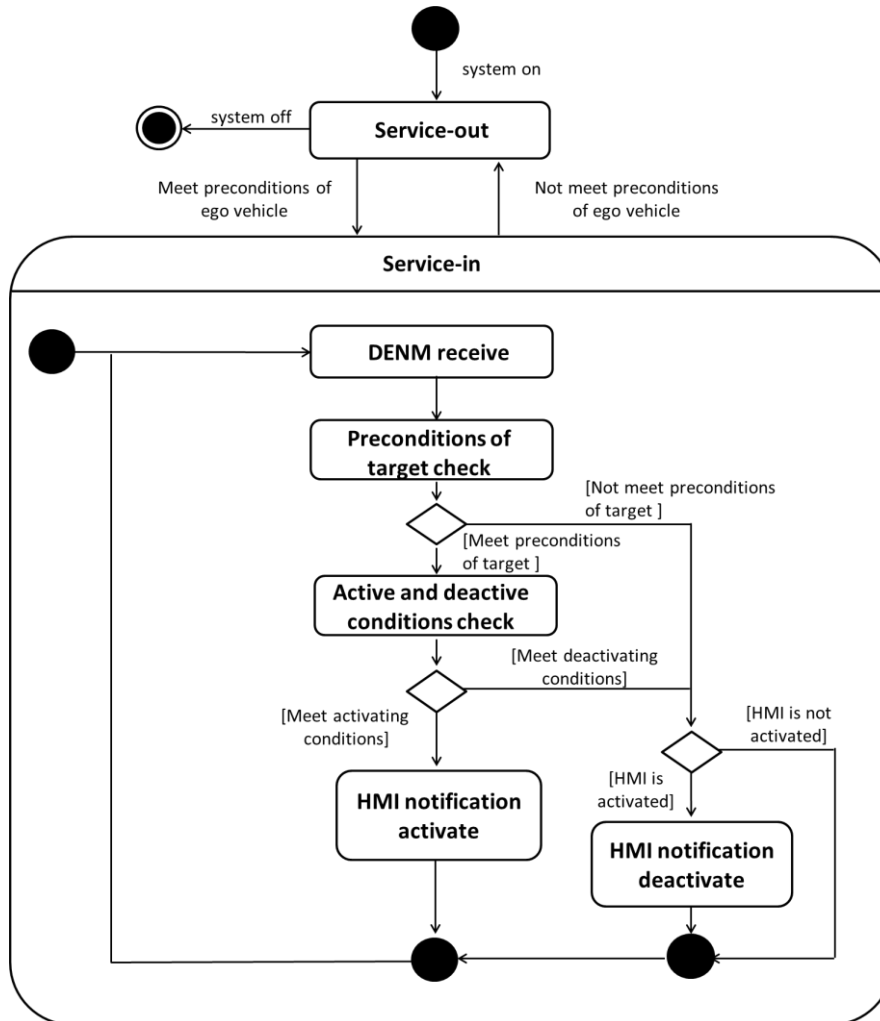


Figure 4: State Flow of RWW - LC

4.5.3.1.1.2 Preconditions

The preconditions of RWW - LC are stated below.

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 (RWW - LC)

#	Item	Condition
PC_1	Ego vehicle	PTW
PC_2	Speed range	> 5 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 2: Preconditions of target (RWW - LC)

#	Item	Condition
PC_9	Target	Event (Road Works)
PC_10	Relative distance	lessThan5km(5)
PC_11	causeCode	roadworks(3)
PC_12	subCauseCode	0 or 4
PC_13	Vehicle type	NA

4.5.3.1.1.3 Activation and deactivation requirements

The activating and deactivating requirements of RWW - LC are stated below.

Activate the warning scheme when all of the conditions below (AC_1 AND AC_2 AND AC_3 AND AC_4) are satisfied.

Table 3: Activating conditions of RWW (RWW - LC)

#	Item	Condition	Used Data
AC_1	Target	Relative DENM received (RWW-LC)	Target signal cause (causeCode and subCauseCode)
AC_2	Event position	On the route of ego vehicle	pathHistory
AC_3	TTC	Less than 15s	eventPosition
AC_4	Traffic direction	Same traffic direction of the current ego vehicle direction	relevanceTrafficDirection

Deactivate the warning when the condition below (DC_1) is satisfied.

Table 4: Deactivating condition of RWW (RWW - LC)

#	Item	Condition	Used Data
DC_1	Position	Passed the RWW site by 15m of the DENM transmitted position	eventPosition

4.5.3.1.2 Road Closure (RWW - RC)

4.5.3.1.2.1 State flow

The function state flow from Service-In to Service-Out of RWW – RC is same as RWW - LC.

4.5.3.1.2.2 Preconditions

The preconditions of RWW – RC are stated below.

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

Table 5: Preconditions of ego vehicle (RWW - RC)

#	Item	Condition
PC_1	Ego vehicle	PTW
PC_2	Speed range	> 5 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 6: Preconditions of target (RWW - RC)

#	Item	Condition
PC_9	Target	Event (Road Works)
PC_10	Relative distance	lessThan5km(5)
PC_11	causeCode	roadworks(3)
PC_12	subCauseCode	1
PC_13	Vehicle type	NA

4.5.3.1.2.3 Activation and deactivation requirements

The activating and deactivating requirements of RWW – RC are stated below.

Activate the warning scheme when all of the conditions below (AC_1 AND AC_2 AND AC_3 AND AC_4) are satisfied.

Table 7: Activating conditions of RWW (RWW - RC)

#	Item	Condition	Used Data
AC_1	Target	Relative DENM received (RWW-RC)	Target signal cause (causeCode and subCauseCode)
AC_2	Event position	On the route of ego vehicle	pathHistory
AC_3	TTC	Less than 2' 30''(150sec)	eventPosition
AC_4	Traffic direction	Same traffic direction of the current ego vehicle direction	relevanceTrafficDirection

Deactivate the warning when the condition below (DC_1) is satisfied.

Table 8: Deactivating condition of RWW (RWW - RC)

#	Item	Condition	Used Data
DC_1	Position	Passed the RWW site by 15m of the DENM transmitted position	eventPosition

4.5.3.1.3 Road Works – Mobile (RWW - RM)

4.5.3.1.3.1 State flow

The function state flow from Service-In to Service-Out of RWW – RM is same as RWW - LC.

4.5.3.1.3.2 Preconditions

The preconditions of RWW – RM are stated below.

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

Table 9: Preconditions of ego vehicle (RWW - RM)

#	Item	Condition
PC_1	Ego vehicle	PTW
PC_2	Speed range	> 5 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 10: Preconditions of target (RWW - RM)

#	Item	Condition
PC_9	Target	Event (Road Works)
PC_10	Relative distance	lessThan5km(5)
PC_11	causeCode	roadworks(3)
PC_12	subCauseCode	3
PC_13	Vehicle type	NA

4.5.3.1.3.3 Activation and deactivation requirements

The activating and deactivating requirements of RWW – RM are stated below.

Activate the warning scheme when all of the conditions below (AC_1 AND AC_2 AND AC_3 AND AC_4) are satisfied.

Table 11: Activating conditions of RWW (RWW - RM)

#	Item	Condition	Used Data
AC_1	Target	Relative DENM received (RWW-RM)	Target signal cause (causeCode and subCauseCode)
AC_2	Event position	On the route of ego vehicle	pathHistory
AC_3	TTC	Less than 15s	eventPosition
AC_4	Traffic direction	Same traffic direction of the current ego vehicle direction	relevanceTrafficDirection

Deactivate the warning when the condition below (DC_1) is satisfied.

Table 12: Deactivating condition of RWW (RWW - RM)

#	Item	Condition	Used Data
DC_1	Position	Passed the RWW site by 15m of the DENM transmitted position	eventPosition

4.5.3.1.4 Winter Maintenance (RWW - WM)

4.5.3.1.4.1 State flow

The function state flow from Service-In to Service-Out of RWW – WM is same as RWW - LC.

4.5.3.1.4.2 Preconditions

The preconditions of RWW – WM are stated below.

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

Table 13: Preconditions of ego vehicle (RWW - WM)

#	Item	Condition
PC_1	Ego vehicle	PTW
PC_2	Speed range	> 5 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 14: Preconditions of target (RWW - WM)

#	Item	Condition
PC_9	Target	Event (Road Works)
PC_10	Relative distance	lessThan5km(5)
PC_11	causeCode	roadworks(3)
PC_12	subCauseCode	6
PC_13	Vehicle Type	NA

4.5.3.1.4.3 Activation and deactivation requirements

The activating and deactivating requirements of RWW – WM are stated below.

Activate the warning scheme when all of the conditions below (AC_1 AND AC_2 AND AC_3 AND AC_4) are satisfied.

Table 15: Activating conditions of RWW (RWW - WM)

#	Item	Condition	Used Data
AC_1	Target	Relative DENM received (RWW-WM)	Target signal cause (causeCode and subCauseCode)
AC_2	Event position	On the route of ego vehicle	pathHistory
AC_3	TTC	Less than 15s	eventPosition
AC_4	Traffic direction	allTrafficDirection	relevanceTrafficDirection

Deactivate the warning when the condition below (DC_1) is satisfied.

Table 16: Deactivating condition of RWW (RWW - WM)

#	Item	Condition	Used Data
DC_1	Position	Passed the RWW site by 15m of the DENM transmitted position	eventPosition

4.5.3.1.5 Road Operator Vehicle in Intervention (RWW - ROVI)

4.5.3.1.5.1 State flow

The function state flow from Service-In to Service-Out of RWW – ROVI is same as RWW - LC.

4.5.3.1.5.2 Preconditions

The preconditions of RWW – ROVI are stated below.

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

Table 17: Preconditions of ego vehicle (RWW - ROVI)

#	Item	Condition
PC_1	Ego vehicle	PTW
PC_2	Speed range	> 5 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 18: Preconditions of target (RWW - ROVI)

#	Item	Condition
PC_9	Target	Event (Road Works)
PC_10	Relative distance	lessThan5km(5)
PC_11	causeCode	roadworks(3)
PC_12	subCauseCode	0
PC_13	Vehicle type	NA

4.5.3.1.5.3 Activation and deactivation requirements

The activating and deactivating requirements of RWW – ROVI are stated below.

Activate the warning scheme when all of the conditions below (AC_1 AND AC_2 AND AC_3 AND AC_4) are satisfied.

Table 19: Activating conditions of RWW (RWW - ROVI)

#	Item	Condition	Used Data
AC_1	Target	Relative DENM received (RWW-ROVI)	Target signal cause (causeCode and subCauseCode)
AC_2	Event position	On the route of ego vehicle	pathHistory
AC_3	TTC	Less than 15s	eventPosition
AC_4	Traffic direction	allTrafficDirection	relevanceTrafficDirection

Deactivate the warning when the condition below (DC_1) is satisfied.

Table 20: Deactivating condition of RWW (RWW - ROVI)

#	Item	Condition	Used Data
DC_1	Position	Passed the RWW site by 15m of the DENM transmitted position	eventPosition

4.5.3.1.6 Road Operator Vehicle Approaching (RWW - ROVA)

4.5.3.1.6.1 State flow

The function state flow from Service-In to Service-Out of RWW – ROVA is same as RWW - LC.

4.5.3.1.6.2 Preconditions

The preconditions of RWW – ROVA are stated below.

All of the following preconditions (PC_1 to PC_13) shall be satisfied every time before this use case is activated:

Table 21: Preconditions of ego vehicle (RWW - ROVA)

#	Item	Condition
PC_1	Ego vehicle	PTW
PC_2	Speed range	> 5 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 22: Preconditions of target (RWW - ROVA)

#	Item	Condition
PC_9	Target	Event (Road Works)
PC_10	Relative distance	lessThan5km(5)
PC_11	causeCode	emergencyVehicleApproaching (95)
PC_12	subCauseCode	0
PC_13	Vehicle type	NA

4.5.3.1.6.3 Activation and deactivation requirements

The activating and deactivating requirements of RWW – ROVA are stated below.

Activate the warning scheme when all of the conditions below (AC_1 AND AC_2 AND AC_3 AND AC_4) are satisfied.

Table 23: Activating conditions of RWW (RWW - ROVA)

#	Item	Condition	Used Data
AC_1	Target	Relative DENM received (RWW-ROVA)	Target signal cause (causeCode and subCauseCode)
AC_2	Event position	On the route of ego vehicle	pathHistory
AC_3	TTC	Less than 15s	eventPosition
AC_4	Traffic direction	allTrafficDirection	relevanceTrafficDirection

Deactivate the warning when the condition below (DC_1) is satisfied.

Table 24: Deactivating condition of RWW (RWW - ROVA)

#	Item	Condition	Used Data
DC_1	Position	Passed the RWW site by 15m of the DENM transmitted position	eventPosition

Abbreviations

Please refer to the abbreviations in Preamble document.