Cellular V2X Plugtests;
3rd C-V2X Plugtests;

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Foreword

Major TC ITS standards have been recently published, enabling ITS component vendors to design implementations compliant with stable specifications. Ongoing EU projects, like for instance DRIVE-C2X, are using TC ITS standards to develop cooperative system frameworks, as well as to use the cooperative systems in field operational tests to assess the benefit of this technology.

ETSI STF have already produced conformance test specifications and are currently developing a conformance test platform for the assessment of the cooperative systems component compliancy.

ETSI experience with other similar communication technologies (e.g. mobile communication systems) shows that compliant systems are not necessarily interoperable. Furthermore, the tests carried out during the interoperability event are using pragmatical test methods, which are perfectly matching the test needs for prototype ITS implementations.

Conformance testing aims to assess standard compliancy of implementations by checking individual requirements of a single protocol layer against a protocol simulator. But interoperability testing aims to test the interoperability of complete implementations in real conditions, thus exercising the complete system in communication operation to verify their correct behaviour.

1 Scope

This document forms the guidelines to lead the technical organization of the 5th Cooperative Mobility Services Plugtests event. This document is intended to be upgraded for future interoperability events.

This document describes:

• The testbed architecture showing which ITS systems and components are involved and how they are going to interwork

• The configurations used during test sessions, including the parameter values of the different layers (PHY, MAC, NWT, …)

• The interoperability test descriptions, which are describing the scenarios, which the participants will follow to perform the tests.

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are necessary for the application of the present document.

[1] ETSI TS 103 301 V1.3.1: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Facilities layer protocols and communication requirements for infrastructure services".

[2] ETSI EN 302 636-4-1 (V1.4.1): "Intelligent Transport System (ITS); Vehicular communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to multipoint communications; Sub-part 1: Media independent functionalities".

[3] ETSI EN 302 637-2 (V14.1): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[4] ETSI EN 302 637-3 (V1.3.1): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service".

[5] ETSI TS 102 940 (v1.4.1): "ITS Security; ITS communications security architecture and security management".

[6] ETSI TS 102 941 (v1.4.1): "ITS Security; Trust and Privacy Management".

[7] ETSI TS 103 097 (v1.4.1): "ITS Security; Security header and certificate formats".

[8] ETSI TS 102 894-2 (V1.3.1): " Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary"

[9] ETSI EN 302 636-5-1 (V2.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocol".

[10] ETSI TS 124 286 (V14.5.0): "LTE;User Equipment (UE) to V2X control function; protocol aspects; Stage 3 (3GPP TS 24.386 version 14.5.0 Release 14)".

3 Definitions and Abbreviations Vehicle equipped with OBU

3.1 Definitions

Host Vehicle	Vehicle equipped with an OBU

3.2 Abbreviations

For the purposes of the present document, the following abbreviations apply:

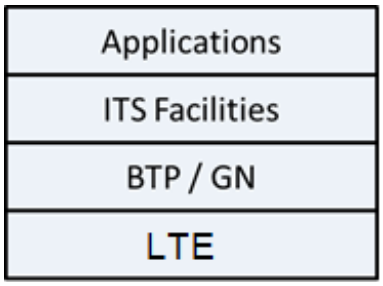
CAM	Cooperative Awareness Message
CPS	Central Position Server
DENM	Decentralized Environmental Notification Message
EUT	Equipment Under Test
GPSD	Daemon that receives data from a GPS receiver. It provides a unified interface to receivers of different types, and allows concurrent access by multiple applications
GN	GeoNetworking
GVL	Geographical Virtual Link
HV	Host Vehicle
ITS-S	ITS Station. Can be either RSU or OBU.
MAC	Media Access Control layer of the access layers
OBU	On Board Unit
PHY	The Physical layer of the access layers
RIS	ITS Roadside Station
RSU	Road Side Unit
RWW	Road Works Warning
TVL	Topological Virtual Link
VIS	ITS Vehicle Station

4 Configuration

To be updated. Will contain the configuration values to be referenced in the use cases

4.1 Protocol stacks in the devices

4.1.1 ITS Station



4.2 Common Rules for GN

Unless specified otherwise in the test description, the messages used in the present test specification shall respect the following common characteristics:

- Maximum repetition time: until the end of the test scenario
- Repetition interval: 1000ms
- Header Type (HT): GEOBROADCAST
- HopLimit: 1
- GeoArea
  - Circular or rectangular
  - Lat/Long: RSU position
  - Distance a/Distance b: 5000 m
  - Azimuth: 0

4.3 Common Rules for DEN messages

Unless specified otherwise in the test description, the DEN messages used in the present test specification shall respect the following common characteristics:

- detectionTime and validityDuration: at reception of the DENMs the event shall be valid, i.e. the detectionTime is in the past and the validityDuration is sufficiently long enough (validityDuration of 1.5 hours is recommended)
- termination: Negation is forbidden. Only cancelation of the own actionID is allowed
- eventPosition:
  - the positionConfidenceEllipse shall be set as follows:

```
positionConfidenceEllipse ::= {
  semiMajorConfidence 100,
  semiMinorConfidence 100,
  semiMajorOrientation 0
}
```

  - altitude shall be set to `0`
- relevanceDistance: `lessThan200m(2)`
- relevanceTrafficDirection: `upstreamTraffic(1)`

For the IoT test, the following triggering considerations will apply when using the polling mode:

- First time the sensor reports a change of condition, if relevant, the application requests an AppDENM_trigger, with a new actionID and Sequence number set to an unused value.

- At next polling events, if the information remains identical, the application requests an AppDENM_update, passing the same actionID. This remains valid until the sensor reports a change of condition.

Timing and period setting of the DENM is independent from the polling period.

4.4 Common rules for IVI messages

Unless specified otherwise in the test description, the IVI messages used in the present test specification shall respect the following common characteristics:

- serviceProviderId:

```
serviceProviderId {
   countryCode '1100 0000 01'B,
   issuerIdentifier event specific value
  }
```

- iviStatus: `new (0)`

- validTo: `end of current day`

4.5 Common rules for SPaT messages

Unless specified otherwise in the test description, the SPAT messages used in the present test specification shall respect the following common characteristics:

The IntersectionState object has two fields that are mandatory for Europe in ISO 19091.

- moy – minutes of the year (0 … 60*24*365)

- timestamp – milliseconds of the minute (0.000 … 60.000)

The fields shall be updated every time a SPaT message is transmitted. At the receiving side it can therefore be used for the following purposes:

- To check if there has been a transit delay or a large difference in clock time between sender and receiver.

- To discard older messages that have arrived via a different path (e.g. via the mobile data network).

4.6 Common rules for Access

All messages defined in the present document shall use of LTE -V2X PC5 interface based on 3GPP release 14 [10]., using resource allocation mode 4 (out of network coverage).

4.7 Common rules for Security

All messages exchanges shall be secured according to [7], [8] and [9].

5 ITS Test Scenarios

5.1 UC1

5.1.1 Road Works Warning

5.1.1.1 Overview

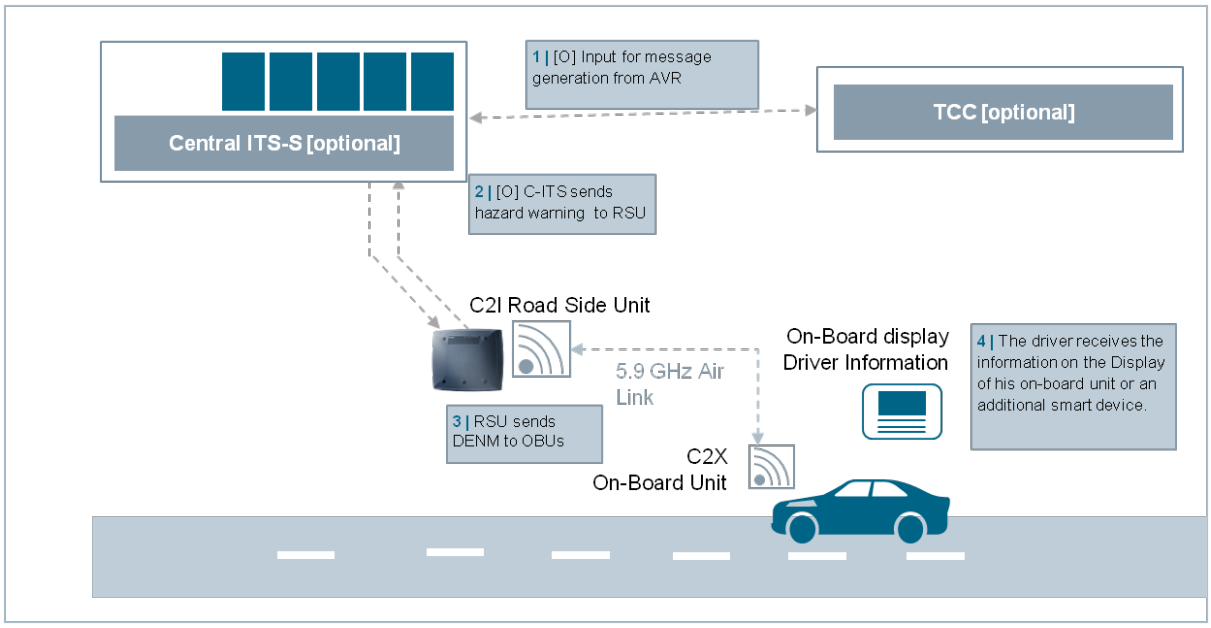


Figure 1:

The objective of this test is to verify the interoperability of ITS OBUs and RSUs in the context of Road Works Warning (RWW). In particular it is determined whether an OBU is able to process RWW specific DENMs which are sent by RSUs. Optionally the DENM content can be defined by a Traffic Control Center (TCC).

The equipment involved:

- Traffic Control Center: Optional
- Central ITS-S: Optional
- RSU: Mandatory
- HV: Mandatory
- HMI: Mandatory

Pre-conditions:

- HV is outside the relevance area
- RSU broadcasts RWW DENMs (pre-configured or via TCC)

Test Sequence:

- HV enters the use case zone on the test track
- HV receives and processes the DENMs
- HV determines that the received DENMs are relevant
- HMI notifies the driver

5.1.1.2 Test Setup

The figure below shows the test setup.

```
D3 {
 management {
  eventPosition POS3,
 },
 situation {
  eventType {
   causeCode roadworks(3),
   subCauseCode 0
  },
  eventHistory EventHistory3
 },
 location {
  traces Trace3
 },
 alacarte {
  roadWorks {
   closedLanes {
    hardShoulderStatus closed(1),
    drivingLaneStatus '100'B
   },
   speedLimit 30,
   trafficFlowRule passToLeft(3),
   referenceDenms { D1, D2 }
  }
 }
}
```

```
D2 {
 management {
  eventPosition POS2,
 },
 situation {
  eventType {
   causeCode roadworks(3),
   subCauseCode 0
  },
  eventHistory EventHistory2
 },
 location {
  traces Trace2
 },
 alacarte {
  roadWorks {
   closedLanes {
    hardShoulderStatus availableForDriving(2),
    drivingLaneStatus '011'B
   },
   speedLimit 30,
   trafficFlowRule passToRight(2),
   referenceDenms { D1, D3 }
  }
 }
}
```

```
D1 {
 management {
  eventPosition POS1,
 },
 situation {
  eventType {
   causeCode roadworks(3),
   subCauseCode 0
  },
  eventHistory EventHistory1
 },
 location {
  traces Trace1
 },
 alacarte {
  roadWorks {
   closedLanes {
    hardShoulderStatus availableForDriving(2),
    drivingLaneStatus '001'B
   },
   speedLimit 30,
   startingPointSpeedLimit POS0,
   trafficFlowRule passToRight(2),
   referenceDenms { D2, D3 }
  }
 }
}
```

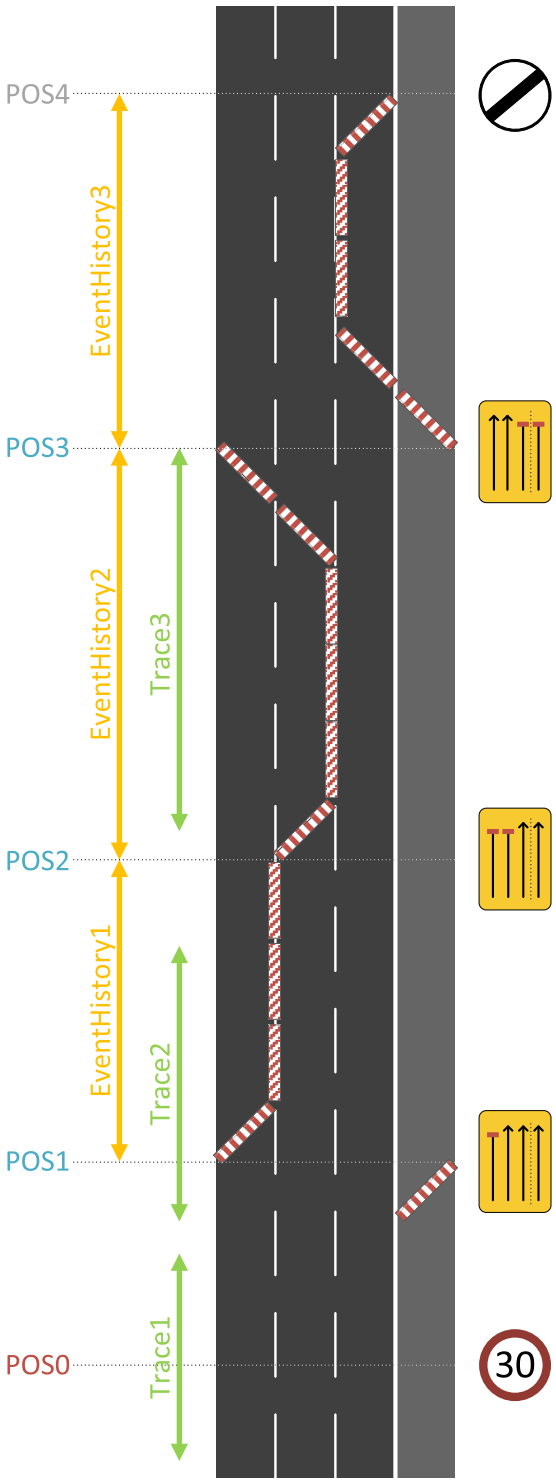
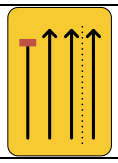
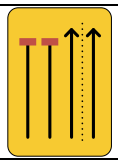
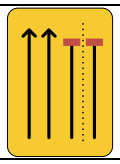
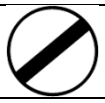


Figure 2: UC1 Test Setup

5.1.1.3 Test Procedure

Interoperability Test Description				
Identifier:	TD_ITS_UC01_01			
Objective:	Process RWW Information			
Configuration:	See Figure 2			
Pre-test conditions:	• HV is outside the relevance area • A single RSU broadcasts RWW DENMs D1, D2 and D3 (pre-configured or via TCC) • HV receives RWW DENMs D1, D2 and D3			
Test Sequence:	**Step**	**Type**	**Description**	**HMI**
	1	stimulus	HV enters the use case zone on the test track	
	2	stimulus	HV enters the Relevance Area and synchronizes to the trace of D1	
	3	verify	HMI displays the speed limit before **POS0**	
	4	verify	HMI displays the closed lane information before **POS1**	
	5	stimulus	HV synchronizes to the trace of D2	
	6	verify	HMI displays the closed lane information before **POS2**	
	7	stimulus	HV synchronizes to the trace of D3	
	8	verify	HMI displays the closed lane information before **POS3**	
	9	stimulus	HV passes **POS4**	
	10	verify	HMI shows no more closed lane information and end of speed limitation	

5.2.1.3 Test Procedure

Interoperability Test Description				
Identifier:	TD_ITS_UC02_01			
Objective:				
Configuration:	See **Error! Reference source not found.**			
Pre-test conditions:	• RSU-1 and RSU-2 are not in direct communication range • HV-1 and HV-2 are not in direct communication range			
Test Sequence:	**Step**	**Type**	**Description**	**HMI**
	1	stimulus	HV-1 detects dangerous situation (Note 1)	
	2	verify	HV-1 broadcasts D1	
	3	verify	RSU-1 transmits D1 to Central ITS-S	
	4	verify	Central ITS-S dispatches D1 to RSU-2	
	5	verify	RSU-2 broadcasts D2	
	6	verify	HMI(HV-2) displays Road Hazard information	
Note 1: HV-1 can detect the dangerous situation by the means of an IoT stack or any other means, see **Error! Reference source not found.**				

5.3 UC3

5.3.1 Time To Green / Traffic Sign Violation

5.3.1.1 Overview

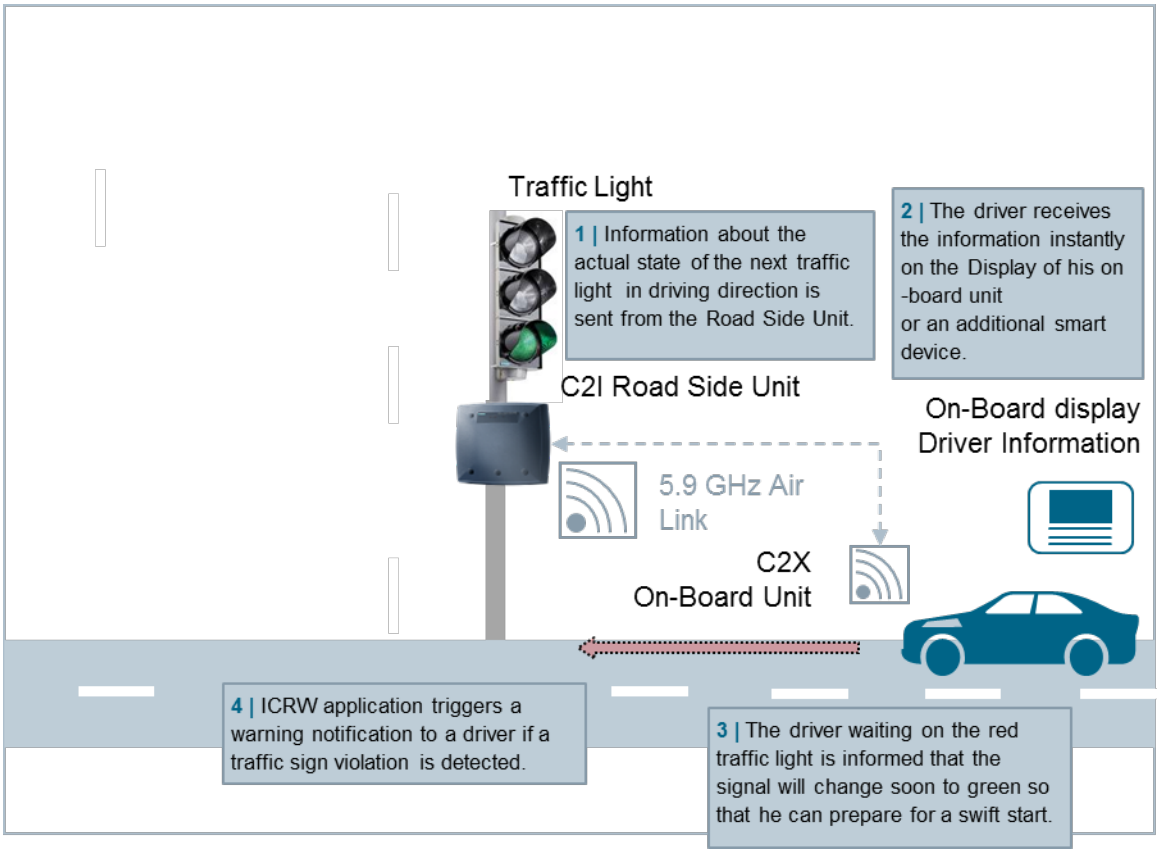


Figure 3:

The objective of this test is to verify the interoperability of ITS OBUs and RSUs in the context of Traffic Light Signalling. In particular it is determined whether an OBU is able to process MAPEM describing intersection and Signalling specific SPATEMs which are sent by RSUs. Optionally the MAPEM and SPATEM content can be defined by a Traffic Control Center (TCC).

The equipment involved:

- Traffic Control Center: Optional
- Central ITS-S: Optional
- RSU: Mandatory
- HV: Mandatory
- HMI: Mandatory

Pre-conditions:

- HV is inside the relevance area
- HV is stopped at the stop-line (alternatively: driving towards the stop-line)
- RSU broadcasts MAPEM and SPATEMs for the intersection (pre-configured or via TCC)

Test Sequence:

- HV enters the use case zone on the test track
- HV receives and processes the MAPEM and SPATEMs
- HMI notifies the driver of the relevant signal states

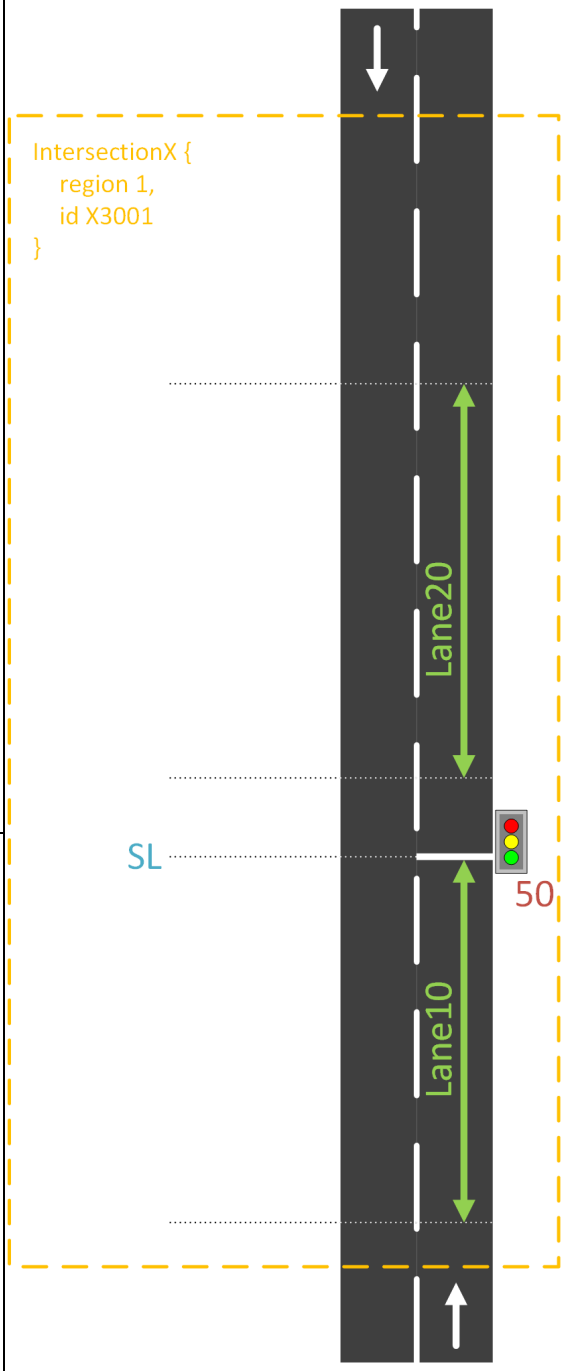
5.3.1.2 Test Setup

The figure below shows the test setup.

Note: SPATEMs described in the present document make use of the following notation for time references fields of type TimeMark: **[CurrentPhaseStartTime + XXs]**. The interpretation shall be the following: Add XX seconds to the exact time at which the currently active phase started. This notation provides an abstract way to describe time references in this document, and those fields should however be instantiated as TimeMark values in actual messages. As reminder, TimeMark values are encoded in units of $1/10^{th}$ second from current hour (UTC time), e.g. 9:34:23.11 AM (UTC+2) shall be encoded as 20631 (34 * 60 + 23) * 10 + 1).

```
MAP1 {
 intersections {
  {
   id IntersectionX,
   refPoint refPoint,
   laneSet {
    {
     laneID 10,
     ingressApproach 1,
     laneAttributes ::= {
      directionalUse '10'B,
      sharedWith '0000000000'B,
      laneType := { vehicle '00000000'B }
     },
     nodeList ::= {
      nodes Lane10
     },
     connectsTo {
      {
       connectingLane {
        lane 20
       },
       signalGroup 50
      }
     }
    },
    {
     laneID 20,
     egressApproach 2,
     laneAttributes ::= {
      directionalUse '01'B,
      sharedWith '0000000000'B,
      laneType := { vehicle '00000000'B }
     },
     nodeList ::= {
      nodes Lane20
     }
    }
   }
  }
 }
}
```

```
SPAT1 {
 intersections {
  {
   id IntersectionX,
   status '0000'H,
   states {
    {
     signalGroup 50,
     state-time-speed {
      {
       eventState permissive-Movement-Allowed,
       timing {
        minEndTime [CurrentPhaseStartTime + 30s]
       }
      },
      {
       eventState permissive-Clearance,
       timing {
        startTime [CurrentPhaseStartTime + 30s],
        minEndTime [CurrentPhaseStartTime + 40s]
       }
      }
     }
    }
   }
  }
 }
}
```



```
SPAT2 {
 intersections {
  {
   id IntersectionX,
   status '0000'H,
   states {
    {
     signalGroup 50,
     state-time-speed {
      {
       eventState permissive-Clearance,
       timing {
        minEndTime [CurrentTime + 10s]
       }
      },
      {
       eventState stop-And-Remain,
       timing {
        startTime [CurrentTime + 10s],
        minEndTime [CurrentTime + 30s]
       }
      }
     }
    }
   }
  }
 }
}
```

```
SPAT3 {
 intersections {
  {
   id IntersectionX,
   status '0000'H,
   states {
    {
     signalGroup 50,
     state-time-speed {
      {
       eventState stop-And-Remain,
       timing {
        minEndTime [CurrentPhaseStartTime + 20s]
       }
      },
      {
       eventState permissive-Movement-Allowed,
       timing {
        startTime [CurrentPhaseStartTime + 20s],
        minEndTime [CurrentPhaseStartTime + 50s]
       }
      }
     }
    }
   }
  }
 }
}
```

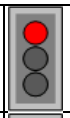
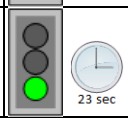
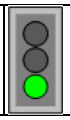
Figure 4: UC3 Test Setup

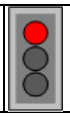
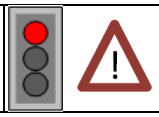
SPAT messages SPAT1, SPAT2 and SPAT3 are sent in a loop with the following timing:

SPATEM	Repetition Duration	Repetition Interval
SPAT1	30s	1s
SPAT2	10s	1s
SPAT3	20s	1s

Figure 5: SPATEM timing for UC3

5.3.1.3 Test Procedure

Interoperability Test Description				
Identifier:	TD_ITS_UC03_01			
Objective:	Process Signalling information and indicate Time To Green			
Configuration:	See Figure 4			
Pre-test conditions:	• RSU broadcasts IntersectionX MAPEM MAP1 (pre-configured or via TCC) • RSU broadcasts sequentially SPATEMs SPAT1 (30s), SPAT2 (10s) and SPAT3 (20s) • HV receives MAPEM MAP1 • HV approaches the stop-line **SL**			
Test Sequence:	**Step**	**Type**	**Description**	**HMI**
	1	stimulus	HV receives SPATEM SPAT3	
	2	verify	HMI indicates that current traffic light status is 'red'	
	3	verify	HMI indicates timing information to next green light	
	4	stimulus	HV receives SPATEM SPAT1	
	5	verify	HMI indicates that current traffic light status is 'green'	

Interoperability Test Description				
Identifier:	TD_ITS_UC03_02			
Objective:	Process Signalling information and indicate Traffic Sign Violation			
Configuration:	See Figure 4			
Pre-test conditions:	• RSU broadcasts IntersectionX MAPEM MAP1 (pre-configured or via TCC) • RSU broadcasts alternatively SPATEMs SPAT1 (30s), SPAT2 (10s) and SPAT3 (20s) • HV receives MAPEM MAP1 • HV approaches the stop-line **SL**			
Test Sequence:	**Step**	**Type**	**Description**	**HMI**
	1	stimulus	HV receives SPATEM SPAT3	
	2	verify	HMI indicates that current traffic light status is 'red'	
	3	stimulus	HV drives over stop-line	
	4	verify	HMI indicates Traffic Sign Violation	

5.5 UC5

5.5.1 In-Vehicle Signage

5.5.1.1 Overview

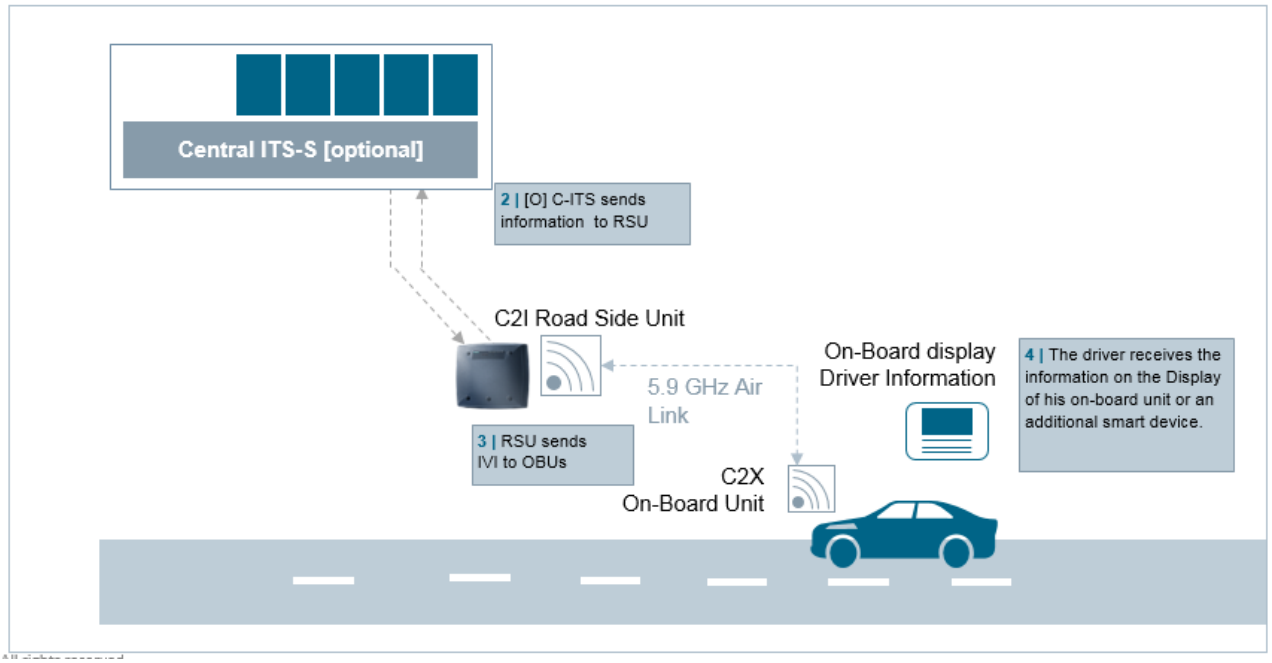


Figure 6:

The objective of this test is to verify the interoperability of ITS OBUs and RSUs in the context of In-Vehicle Signage. In particular it is determined whether an OBU is able to process IVI messages describing current road signalling which are sent by RSUs. Optionally the IVI message content can be defined by a Traffic Control Center (TCC).

The equipment involved:

- Traffic Control Center: Optional
- Central ITS-S: Optional
- RSU: Mandatory
- HV: Mandatory
- HMI: Mandatory

Pre-conditions:

- HV approaches the relevance area
- RSU broadcasts IVI messages

Test Sequence:

- HV enters the relevance area
- HV receives and processes the IVI messages
- HMI notifies the driver of the current road signalling information

5.5.1.2 Test Setup

The figure below shows the test setup.

```
IVI1 {
 optional {
  {
   glc : {
    referencePosition POS1,
    parts {
     {
      zoneId 1,
      zone segment : {
       line deltaPositions : Trace1
      }
     },
     {
      zoneId 2,
      zone segment : {
       line deltaPositions : Trace2
      }
     }
    }
   },
   giv : {
    {
     detectionZoneIds {1},
     relevanceZoneIds {2},
     direction sameDirection=0,
     minimumAwarenessTime 4,
     iviType regulatoryMessages=1,
     roadSignCodes {
      {
       code iso14823 : {
        pictogramCode {
         serviceCategoryCode
          trafficSignPictogram : regulatory=1,
         pictogramCategoryCode {
          nature 5,
          serialNumber 57
         }
        },
        attributes {
         spe : {
          spm SpeedLimit,
          unit kmperh=0
         }
        }
       }
      }
     }
    },
    {
     detectionZoneIds {1},
     relevanceZoneIds {2},
     direction sameDirection=0,
     minimumAwarenessTime 15,
     iviType regulatoryMessages=1,
     vehicleCharacteristics {
      {
       train {
        equalTo {
         euVehicleCategoryCode : euVehicleCategoryN : n2,
         euVehicleCategoryCode : euVehicleCategoryN : n3
        },
        ranges {
         {
          comparisonOperator greaterThan=0,
          limits vehicleWeightLimits : {
           vehicleMaxLadenWeight 0,
           vehicleTrainMaximumWeight 750,
           vehicleWeightUnladen 0
          }
         }
        }
       }
      }
     },
     roadSignCodes {
      {
       code iso14823 : {
        pictogramCode {
         serviceCategoryCode
          trafficSignPictogram : regulatory=1,
         pictogramCategoryCode {
          nature 5,
          serialNumber 44
         }
        }
       }
      }
     }
    }
   }
  }
 }
}
```

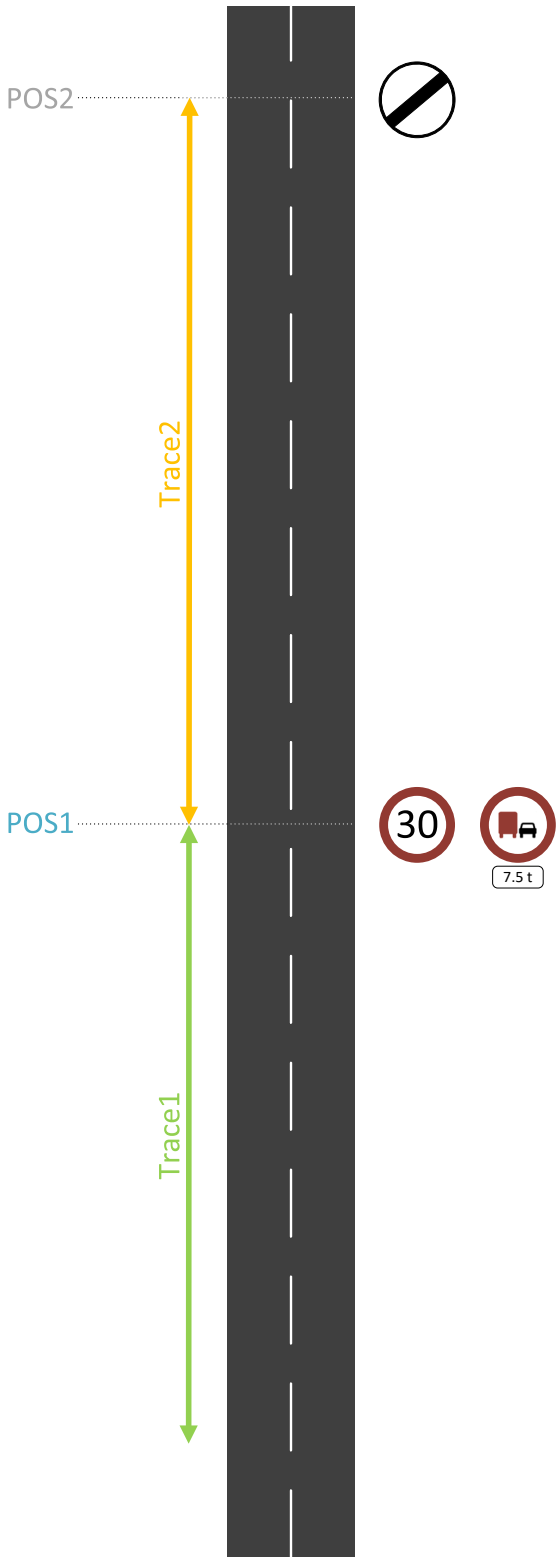
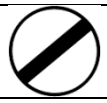


Figure 7: UC5 Test Setup

5.5.1.3 Test Procedure

Interoperability Test Description				
Identifier:	TD_ITS_UC05_01			
Objective:	Process In-Vehicle Signalling information			
Configuration:	See Figure 7			
Pre-test conditions:	• RSU broadcasts IVI message IVI1 (pre-configured or via TCC) • HV receives IVI message IVI1 • HV approaches relevance zone			
Test Sequence:	**Step**	**Type**	**Description**	**HMI**
	1	stimulus	HV enters relevance zone at **POS1**	
	2	verify	HMI display current road signalling information: • Overtaking forbidden for trucks above 7.5t • Speed limitation **SpeedLimit**	
	3	stimulus	HV exits relevance zone at **POS2**	
	4	verify	HMI stop displaying previous road signalling information	

5.6 UC6

5.6.1 Intersection Collision Risk Warning

5.6.1.1 Overview

- HV (host vehicle under test) will run ICRW.
- Target speed of RV can be 20/40 kmh (depends on real traffic situations)
- The distance (testing criteria) between cone RV-A and cone RV-D can be 50m/25m (can be changed according to a vendor's implementation) with respect to the target speed 20/40 kmh.

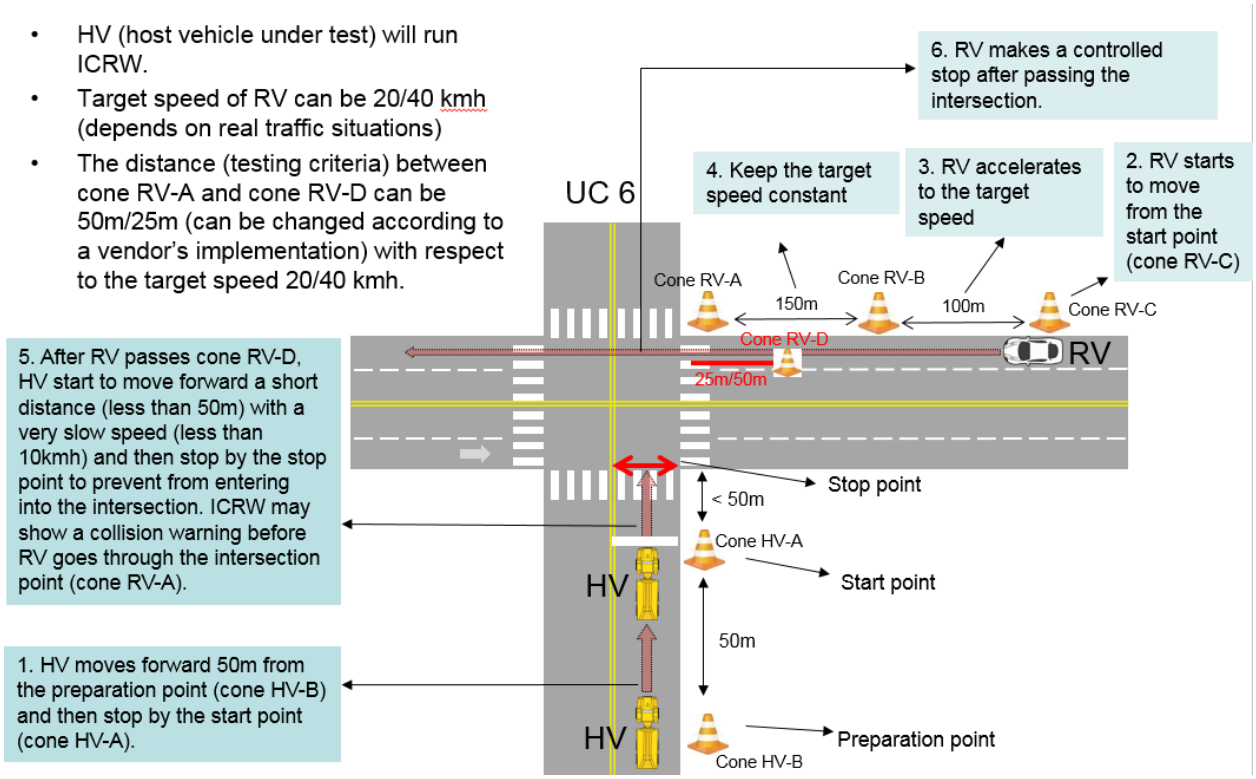


Figure 8: UC6 Test setup

The objective of this test is to verify the Intersection Collision Risk Warning (ICRW) scenario. In particular it is determined whether an OBU is able to process CAM messages from other vehicle to determine a potential collision risk.

The equipment involved:

- RV: Mandatory
- HV: Mandatory
- HMI (HV): Mandatory

5.6.1.2 Test Procedure

Interoperability Test Description				
Identifier:	TD_ITS_UC06_01			
Objective:	Process Signalling information and indicate Time To Green			
Configuration:	See Figure 8			
Pre-test conditions:	• HV is running ICRW • HV is positioned at point HV-B and sends CAMs • RV is positioned at point RV-C and sends CAMs • RV is accelerating to TARGET_SPEED between points RV-C and RV-B			
Test Sequence:	**Step**	**Type**	**Description**	**HMI**
	1	stimulus	RV passes point RV-D	
	2	stimulus	HV drives towards point HV-A and stops	
	3	verify	HMI indicates a forward collision risk before RV passes point RV-A	intersection collision

5.7 UC7

5.7.1 Longitudinal Collision Risk Warning

5.7.1.1 Overview

- HV (vehicle under test) will run LCRW
- The distance (testing criteria) between the point A and the emulator is 20m (can be changed according to a vendor's implementation).

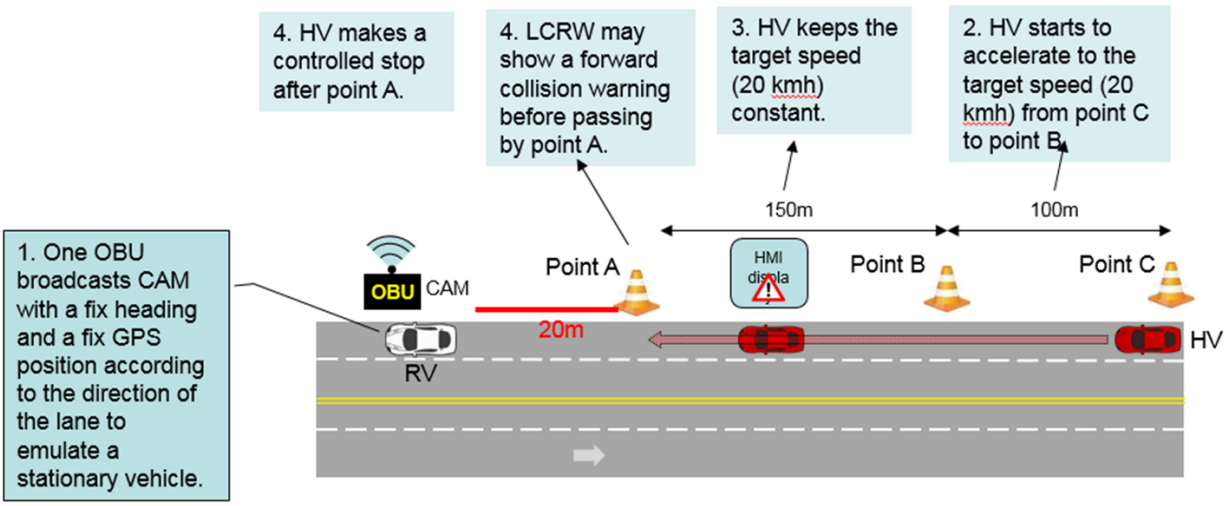


Figure 9: UC7 Test setup

The objective of this test is to verify the Longitudinal Collision Risk Warning (LCRW) scenario. In particular it is determined whether an OBU is able to process CAM messages from other vehicle to determine a potential collision risk.

The equipment involved:

- RV: Mandatory
- HV: Mandatory
- HMI (HV): Mandatory

5.7.1.2 Test Procedure

Interoperability Test Description				
Identifier:	TD_ITS_UC07_01			
Objective:				
Configuration:	See Figure 9			
Pre-test conditions:	• HV is running LCRW • RV is stationary and sends CAMs • HV is accelerating to TARGET_SPEED between points C and B			
Test Sequence:	**Step**	**Type**	**Description**	**HMI**
	1	stimulus	HV passes point B	
	2	verify	HMI indicates a forward collision risk before point A	Forward collision

5.8 UC8

5.8.1 Traffic jams

5.8.1.1 Overview

The objective of this test is to verify the interoperability of ITS OBUs in the context of the distribution of traffic jams information using CAMs and DENMs.

The equipment involved:

- HV: Mandatory
- HMI: Mandatory
- HV is outside the relevance area
- RSU broadcasts Hazard DENMs (pre-configured or via TCC)

Test Sequence:

- HV enters the use case zone on the test track
- RSU queries the Smart device and detects hazard condition
- RSU broadcasts HRW DENMs (pre-configured)
- HV receives and processes the DENM
- HV enters the relevance area. It determines that the received DENM is relevant
- HMI notifies the driver

5.8.1.2 Test Setup

The figure below shows the test setup.

```
D1 {
 management {
  eventPosition POS,
  relevanceDistance lessThan100m(1)
  relevanceTrafficDirection allTrafficDirections(0)
 },
 situation {
  eventType {
   causeCode CAUSE_CODE,
   subCauseCode SUB_CAUSE_CODE
  },
 }
}
```

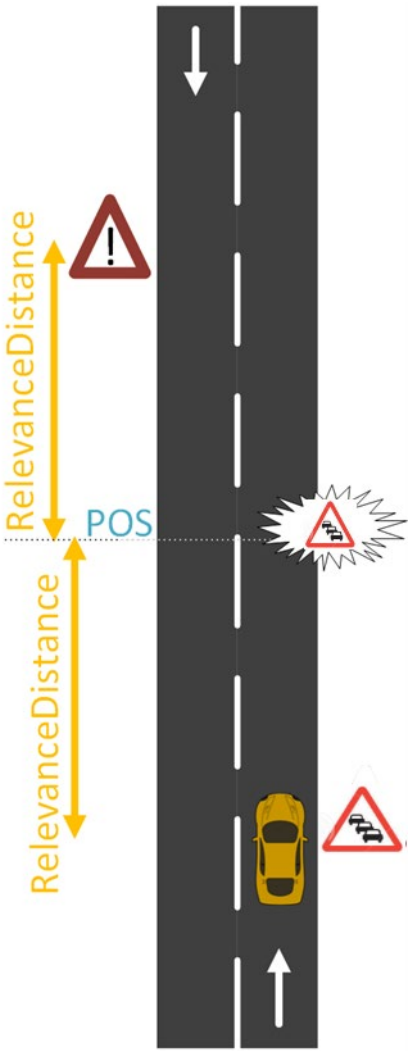


Figure 10: Test Setup

5.8.1.3 Test Procedure

Interoperability Test Description				
Identifier:	TD_ITS_UC08_01			
Objective:	Process Traffic Jams Warning (TJW) Information			
Configuration:	See Figure 10			
Pre-test conditions:	• HV is outside the relevance area			
Test Sequence:	**Step**	**Type**	**Description**	**HMI**
	1	stimulus	HV enters the use case zone on the test track	
	2	verify	RSU broadcasts D1	
	3	stimulus	HV enters the Relevance Area	
	4	verify	HMI displays the Traffic Jams Warning	

5.9 UC9

5.91 Hazard on the Road

5.91.1 Overview

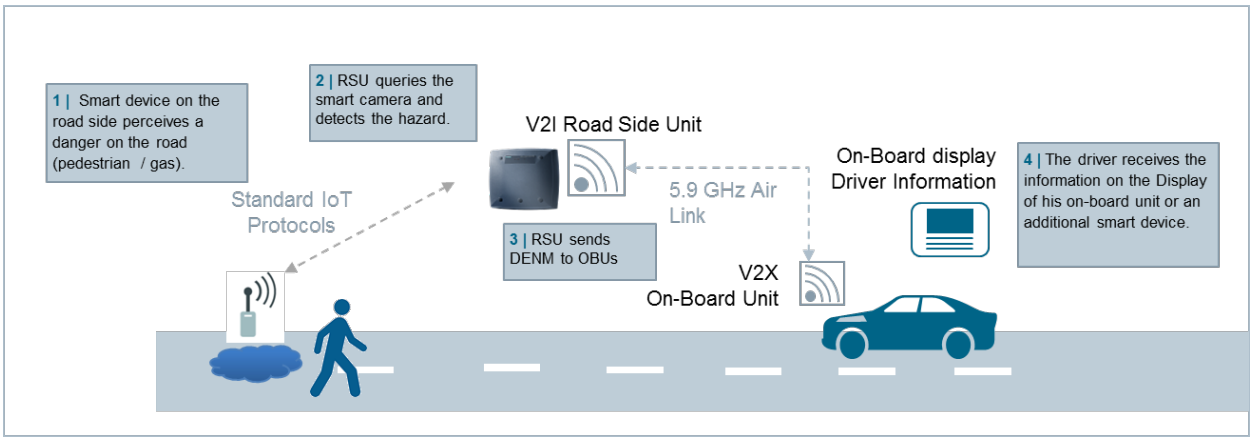


Figure 11: Hazard on the road

The objective of this test is to verify the interoperability of ITS OBUs and RSUs in the context of a Hazard on the Road Warning (HRW). Hazard on the road can be of any nature, such as pedestrian or bad weather.

- Active road safety; Driving assistance; Road hazard signalling (RHS)

The equipment involved:

- RSU: Mandatory
- HV: Mandatory
- HMI: Mandatory

Pre-conditions:

- HV is outside the relevance area
- RSU broadcasts Hazard DENMs (pre-configured or via TCC)

Test Sequence:

- HV enters the use case zone on the test track
- RSU queries the Smart device and detects hazard condition
- RSU broadcasts HRW DENMs (pre-configured)
- HV receives and processes the DENM
- HV enters the relevance area. It determines that the received DENM is relevant
- HMI notifies the driver

5.9.1.2 Test Setup

The figure below shows the test setup.

```
D1 {
 management {
  eventPosition POS,
  relevanceDistance lessThan100m(1)
  relevanceTrafficDirection allTrafficDirections(0)
 },
 situation {
  eventType {
   causeCode CAUSE_CODE,
   subCauseCode SUB_CAUSE_CODE
  },
 }
}
```

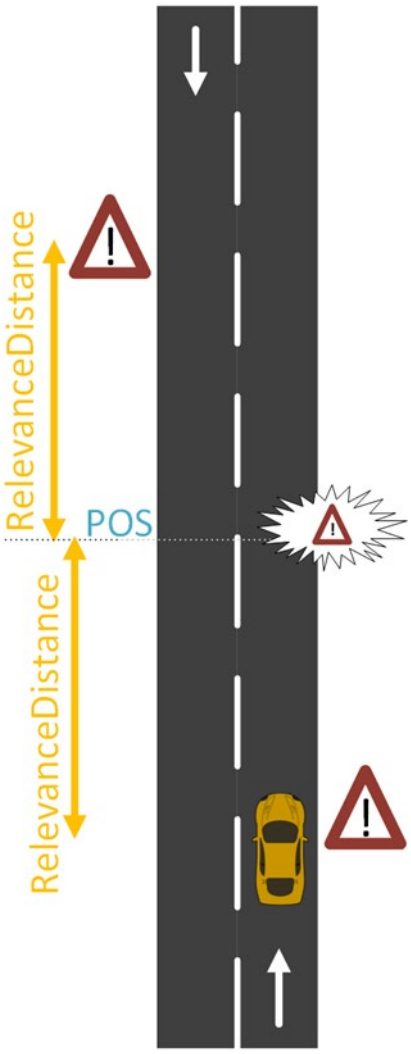


Figure 12: Test Setup

5.9.1.3 Test Procedure

Interoperability Test Description				
Identifier:	TD_ITS_UC09_01			
Objective:	Process Hazard on the Road Warning (HRW) Information			
Configuration:	See Figure12			
Pre-test conditions:	• HV is outside the relevance area			
Test Sequence:	**Step**	**Type**	**Description**	**HMI**
	1	stimulus	HV enters the use case zone on the test track	
	2	verify	RSU broadcasts D1	
	3	stimulus	HV enters the Relevance Area	
	4	verify	HMI displays the Hazard on the Road Warning	