

**Conformance test specifications for**

**Wireless Access in  
Vehicular Environments (WAVE)  
V2I Test Suite Structure and Test Purposes (TSS & TP)**

|  |  |
| --- | --- |
| Document Mnemonics: | WAVEV2I-TSS&TP |
| Revision: | [V0.2] |
| Revision Date: | 4/18/2017 |

**Table of Contents**

[1 Scope 5](#_Toc480356834)

[2 References 5](#_Toc480356835)

[2.1 Normative References 5](#_Toc480356836)

[2.2 Informative References 6](#_Toc480356837)

[3 Definitions and abbreviations 6](#_Toc480356838)

[3.1 Definitions 6](#_Toc480356839)

[3.2 Abbreviations 6](#_Toc480356840)

[4 Prerequisites and Test Configurations 8](#_Toc480356841)

[4.1 Test Configurations 8](#_Toc480356842)

[4.1.1 Functional Blocks 8](#_Toc480356843)

[4.1.1.1 Test System 8](#_Toc480356844)

[4.1.1.2 SUT 8](#_Toc480356845)

[4.1.1.3 DSRC Modem 8](#_Toc480356846)

[4.1.1.4 Network Switch/Router 9](#_Toc480356847)

[4.1.2 Test parameters 9](#_Toc480356848)

[4.1.2.1 Channels 9](#_Toc480356849)

[4.1.2.2 Data Rate 9](#_Toc480356850)

[4.1.2.3 Transmit Power 9](#_Toc480356851)

[4.1.2.4 PSID 9](#_Toc480356852)

[4.2 Feature Restriction 10](#_Toc480356853)

[4.2.1 Feature Restriction 10](#_Toc480356854)

[4.3 Rules for the behavior description 10](#_Toc480356855)

[4.3.1 States in Initial Conditions 10](#_Toc480356856)

[5 Test Suite Structure (TSS) 11](#_Toc480356857)

[5.1 Structure for Network Services tests 11](#_Toc480356858)

[5.1.1 Root 11](#_Toc480356859)

[5.1.2 Groups 11](#_Toc480356860)

[5.1.3 Sub-Groups 11](#_Toc480356861)

[6 Test Purposes (TP) 12](#_Toc480356862)

[6.1 Introduction 12](#_Toc480356863)

[6.1.1 TP definition conventions 12](#_Toc480356864)

[6.2 RSU SNMP Test purposes 12](#_Toc480356865)

[6.2.1 Operational Mode 12](#_Toc480356866)

[6.2.1.1 TP-RSU-SNMP-OPR-BV-01 12](#_Toc480356867)

[6.2.2 Functional Requirements 13](#_Toc480356868)

[6.2.2.1 TP-RSU-SNMP-FUN-BV-01 13](#_Toc480356869)

[6.2.2.2 TP-RSU-SNMP FUN-BV-02 13](#_Toc480356870)

[6.2.3 Positioning 14](#_Toc480356871)

[6.2.3.1 TP-RSU-SNMP-POS-BV-01 14](#_Toc480356872)

[6.2.4 Message Processing – Store and Repeat-Encoded Payload 15](#_Toc480356873)

[6.2.4.1 TP-RSU-SNMP-SAR-BV-01 15](#_Toc480356874)

[6.2.5 Notifications 16](#_Toc480356875)

[6.2.5.1 TP-RSU-SNMP-NOT-BV-01 16](#_Toc480356876)

[6.2.5.2 TP-RSU-SNMP-NOT-BV-02 16](#_Toc480356877)

[6.2.5.3 TP-RSU-SNMP-NOT-BV-03 17](#_Toc480356878)

[6.3 Message Processing Test purposes 17](#_Toc480356879)

[6.3.1 Receive and Decode MAP/SPAT 17](#_Toc480356880)

[6.3.1.1 TP-OBU-MSG-BV-01 17](#_Toc480356881)

[6.3.1.2 TP-OBU-MSG-BV-02 18](#_Toc480356882)

[6.3.2 Transmit MAP/SPAT 18](#_Toc480356883)

[6.3.2.1 TP-RSU-MSG-BV-01 18](#_Toc480356884)

[6.3.2.2 TP-RSU-MSG-BV-02 19](#_Toc480356885)

[6.3.2.3 TP-RSU-MSG-BV-03 19](#_Toc480356886)

[6.3.2.4 TP-RSU-MSG-BV-04 20](#_Toc480356887)

[6.4 RSU Multi-Channel Operation (1609.4) Test purposes 21](#_Toc480356888)

[6.4.1.1 TP-RSU-16094-MCTXRX-BV-01 21](#_Toc480356889)

[6.4.1.2 TP-RSU-1609-4-TXT-BV-01 22](#_Toc480356890)

[6.4.1.3 TP-RSU-1609-4-RXT-TXT-BV-01 22](#_Toc480356891)

[6.5 RSU GPS Positioning Operation Test purposes 23](#_Toc480356892)

[6.5.1.1 TP-RSU-POS-FUN-BV-01 23](#_Toc480356893)

[6.5.1.2 TP-RSU-POS-FUN-BV-02 24](#_Toc480356894)

[6.5.1.3 TP-RSU-POS-FUN-BV-03 24](#_Toc480356895)

[6.6 WSA Test purposes 25](#_Toc480356896)

[6.6.1 WSA transmission 25](#_Toc480356897)

[6.6.1.1 TP-RSU-WSA-V2I-BV-01 25](#_Toc480356898)

[6.6.1.2 TP-RSU-WSA-FUN-BV-01 25](#_Toc480356899)

[6.6.1.3 TP-RSU-WSA-FUN-BV-02 26](#_Toc480356900)

[6.6.1.4 TP-RSU-WSA-FUN-BV-03 27](#_Toc480356901)

[6.6.2 WSA reception and processing 28](#_Toc480356902)

[6.6.2.1 TP-OBU-WSA-FUN-BV-01 28](#_Toc480356903)

[6.6.2.2 TP-OBU-WSA-FUN-BV-02 28](#_Toc480356904)

[6.6.2.3 TP-OBU-WSA-FUN-BV-03 28](#_Toc480356905)

[Appendix A: 30](#_Toc480356906)

[Traceability Matrix 30](#_Toc480356907)

[Revision History 33](#_Toc480356908)

[Need to Change 33](#_Toc480356909)

**Table of Figures**

[Figure 1. Test Configuration 1 (TC1) 8](#_Toc476297083)

**List of Tables**

[Table 4‑1: Channels 9](#_Toc476297066)

[Table 4‑2: Data Rates 9](#_Toc476297067)

[Table 4‑3: Transmit Power 9](#_Toc476297068)

[Table 4‑4: PSID 10](#_Toc476297069)

[Table 6‑1: TP definition rules 12](#_Toc476297070)

# Scope

This document provides the Test Suite Structure and Test Purposes for the RSU as defined in the DSRC Roadside Unit (RSU) Specifications Document v4.1. In addition, several V2I tests are included for testing OBUs receiving RSU V2I messages.

These tests shall be executed in addition to the COC Council 802.11, 1609.2, 1609.3, 1609.4 and 2945/1 certification tests written for the V2V devices.

The ISO standard for the methodology of conformance testing (ISO/IEC 9646‑1 [3] and ISO/IEC 9646‑2 [4]) are used as a basis for the test methodology.

# References

## Normative References

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

[1] SAE J2945/1 MAR2016: “On-board System Requirements for V2V Safety Communications”.

[2] IEEE Std. 1609.4-2016 “IEEE Standard for Wireless Access in Vehicular Environments (WAVE) -- Multi-Channel Operation”.

[3] ISO/IEC 9646-1 (1994): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework - Part 1: General concepts".

[4] ISO/IEC 9646-2 (1994): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework -- Part 2: Abstract Test Suite specification".

[5] ISO/IEC 9646-7 (1995): "Information technology -- Open Systems Interconnection -- Conformance testing methodology and framework - Part 7: Implementation Conformance Statements".

[6] IEEE Std. 1609.12-2016 “IEEE Standard for Wireless Access in Vehicular Environments – Identifier Allocations”.

[7] TCIS (V0.3.0): “Test Control Interface Specification”, Revision date: 7/19/2016

[8] IEEE Std 802.11™-2012: “Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications”.

[9] IEEE Std 1609.3-2016 “IEEE Standard for Wireless Access in Vehicular Environments (WAVE) — Network Services”.

[10] DSRC Roadside Unit (RSU) Specifications Document v4.1, Version 1, Submitted: October 31, 2016.

[11] SAE J2735 (2016-01): “Dedicated Short Range Communication (DSRC) Message Set Dictionary”

[12] WAVENS-TSS&TP (V1.1): “Conformance test specifications for Wireless Access in Vehicular Environments (WAVE) — Networking Services Test Suite Structure and Test Purposes (TSS & TP)”. Revision date: 9/12/2016

[13] WAVESEC-TSS&TP (V1.0): “Conformance test specifications for Wireless Access in Vehicular Environments (WAVE) — Security Services Test Suite Structure and Test Purposes (TSS & TP)”. Revision date: 10/10/2016

## Informative References

The following referenced documents are not necessary for the application of the present document but they assist the user regarding a particular subject area.

[i.1] ETSI EG 202 798 (V1.1.1): "Intelligent Transport Systems (ITS); Testing; Framework for conformance and interoperability testing".

# Definitions and abbreviations

## Definitions

For the purposes of the present document, the terms and definitions given in IEEE 1609.4 [2], ISO/IEC 9646‑1 [3] and in ISO/IEC 9646‑7 [5] apply.

## Abbreviations

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

BI Behavior Invalid

BV Behavior Valid

CCH Control Channel

CH[#] Operating Channel

DSRC Dedicated Short Range Communications

GPGGA Global Positioning System Fix Data

IEEE Institute of Electrical and Electronics Engineers

IFM Immediate Forward Message

IP Internet Protocol

ISO International Organization for Standardization

MAC Media Access Control

MIB Management Information Base

NMEA National Marine Electronics Association

OBU On-board Unit

PC Personal Computer

PDU Protocol Data Unit

PICS Protocol Implementation Conformance Statement

PSID Provider Service Identifier

RF Radio Frequency

RSU Roadside Unit

SAE Society of Automotive Engineers

SCH Service Channel

SCMS Security Credential Management System

SRM Store and Repeat Message

SPAT Signal Phase & Timing

SUT System Under Test

TC Test Configuration

TP Test Purposes

TS Test System

TSF Timing Synchronization Function

TSS Test Suite Structure

UTC Coordinated Universal Time

V2I Vehicle-to-Infrastructure

V2V Vehicle-to-Vehicle

WAVE Wireless Access in Vehicular Environments

WSM WAVE Short Message

WRA WAVE Routing Advertisement

WSA WAVE Service Advertisement

# Prerequisites and Test Configurations

## Test Configurations

This clause introduces the test configuration that is used for the definition of test purposes and test descriptions. The test configuration covers the various scenarios of the test procedures in this document. The complete configuration is shown below, some test procedures may not use all components.



Figure 1. Test Configuration 1 (TC1)

### Functional Blocks

Following are the functional blocks used in the above diagram.

#### Test System

The Test System is based on a Personal Computer laptop running, among other things, a Test Software, an SNMP Manager software and DSRC Message sniffer software (e.g. WireShark).

#### SUT

The DSRC System Under Test (SUT) refers to a system that is being tested for correct implementation. The SUT may be an RSU or an OBU. The choice is identified for each Test Purpose in the header element titled SUT.

#### DSRC Modem

The DSRC Modem is a device capable of transmitting on command a valid DSRC over the air packet, the content of this packet is controlled by the test system. Also, this device can receive a DSRC over-the-air packet and forward the received packet to the Test System for analysis.

#### Network Switch/Router

The Network Switch/Router is used to connect to all network devices in the test setup (in Figure 1) via Ethernet cables. Then, the Test System laptop can be used to configure and monitor the DSRC modem and the SUT.

### Test parameters

Below are listed test parameters/conditions that are applicable to all test cases in this specification.

#### Channels

**Table 4‑1** lists all the channel used for testing, unless otherwise specified, the default channel, channel 178, is used for testing.

**Table 4‑1: Channels**

| **Parameter name** | **Range of permitted values** | **Setting used for testing** | **Reference** |
| --- | --- | --- | --- |
| Channel | 10MHz channels:  172, 174, 178, 180, 182, 184 | 178 | [9] |

#### Data Rate

**Table 4‑2** lists all the data rates that can be used for testing, unless otherwise specified the default data rate of 6 Mbps is used for testing.

**Table 4‑2: Data Rates**

| **Parameter name** | **Range of permitted values** | **Setting used for testing** | **Reference** |
| --- | --- | --- | --- |
| Data Rate (Mbps) | 3, 4.5, 6, 9, 12, 18, 24, 27 | 6 | [9] |

#### Transmit Power

**Table 4‑3** lists the possible transmit power that can be used for testing, unless otherwise specified the default power of 20 dbm is used for testing.

**Table 4‑3: Transmit Power**

| **Parameter name** | **Range of permitted values** | **Setting used for testing** | **Reference** |
| --- | --- | --- | --- |
| Transmit Power (dbm) | Transmit Power (EIRP):  Class A: -92 to 23 dBm  Class B: -92 to 23 dBm  Class C: -92 to 33 dBm  Class D:  non-government use: -92 to 33 dBm  government use : -92 to 44.8 dBm | 20 | Default setting selected per [1] |

#### PSID

**Table 4‑4** lists the PSID used for testing.

**Table 4‑4: PSID**

| **Message Type** | **Setting used for testing** | **Reference** |
| --- | --- | --- |
| WSA | 0p80-07 | [6] |
| BSM | 0p20 | [6] |
| SPAT | 0p80-02 | [6] |
| MAP | 0p80-02 | [6] |
| TIM | 0p80-03 | [6] |
| IP routing | 0pEF-FF-FF-FE | [6] |

## Feature Restriction

### Feature Restriction

In this clause, all feature restrictions are listed:

* 20MHz channels are not considered
* Immediate access or extended access to communication media is not considered
* No testing for Channel Load
* No testing for TSF messages
* Only signed WSAs are considered
* Multicast IPv6 is not tested

## Rules for the behavior description

The description of the TP is built per EG 202 798 [i.1].

Test purposes use a generic "Initial State" that corresponds to a state where the IUT is ready for starting the test execution. Furthermore, the IUT shall be left in this "Initial State", when the test is completed.

Being in the "Initial State" refers to the starting point of the initial device configuration. There are no pending actions, no instantiated buffers or variables, which could disturb the execution of a test.

### States in Initial Conditions

Most of the TPs start from the “initial state” which is defined as follows:

* Test Environment and Test System has reached room temperature (21 degrees Celsius +/- 5 degrees).
* The SUT acquired a GPS fix with 4 or more satellites.
* The SUT system time configured to use the UTC time standard
* SNMP setup
  + The RSU SNMP Agent is loaded and activated with the MIB database from [10] and configured to use authentication and privacy.
  + The Test System operator started the SNMPv3 Manager loaded with the RSU MIB database from [10] and provided authorized credentials to access the RSU SNMP agent using SNMPv3 protocol.
  + The RSU SNMP3 agent is configured to send traps to the IP address and port of the SNMP Manager running on the Test System.

State 2

SUT is in “Initial State”

State 1

SUT is powered off

State 3

Test Purpose Initial Conditions/Pre-test Conditions

State 4

Test Execution

Initial conditions required for specific test cases defined in the Initial condition section of a Test Purpose.

# Test Suite Structure (TSS)

## Structure for Network Services tests

### Root

The root identifies the RSU as defined in the DSRC Roadside Unit (RSU) Specifications Document v4.1. [10]. Some tests pertaining reception and processing of the RSU messages use OBU as the root identifier.

### Groups

This level contains the testing types identified as:

* SNMP;
* Message Processing;
* RSU Multi-Channel Operation (1609.4);
* RSU GPS Positioning Operation Test purposes

### Sub-Groups

Only the SNMP testing group contains sub-groups identified as:

* Operational Mode;
* Functional Requirements;
* Positioning;
* Message Processing;
* Notifications;

# Test Purposes (TP)

## Introduction

### TP definition conventions

The TPs are defined by the rules shown in Table 6‑1 built per EG 202 798 [i.1].

**Table 6‑1: TP** **definition** **rules**

|  |  |
| --- | --- |
| Test Purpose ID | The Test Purpose ID is a unique identifier. It shall be specified per the TP naming conventions defined in the clause below. |
| Summary | Short description of test purpose objective per the requirements from the base standard. |
| References | The reference indicates the sub-clauses of the reference standard specifications in which the conformance requirement is expressed. |
| Test Configuration | The Config Id references the test configuration selected for this TP. |
| PICS Selection | Reference to the PICS statement involved for selection of the TP. It may contain a Boolean expression. |
| Pre-Test Conditions | A list of test specific pre-conditions that need to be met by the SUT including information about equipment configuration, i.e. precise description of the initial state of the SUT required to start executing the test sequence |
| Test Sequence | An ordered list of equipment operation and observations. In case of a conformance test description the test sequence contains also the conformance checks as part of the observations |
| **Event Types** | |
| Stimulus | Corresponds to an event that enforces an SUT to proceed with a specific protocol action, like sending a message for instance. |
| Verify | Consists of verifying that the IUT behaves according to the expected behavior (for instance the IUT behavior shows that it receives the expected message). Outcome of this event typically evaluate for verdict (i.e. Pass/Fail) |
| Configure | Corresponds to an action to modify the SUT configuration. |
| Procedure | Procedural action directing the flow of TP execution. |

## RSU SNMP Test purposes

### Operational Mode

#### TP-RSU-SNMP-OPR-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-SNMP-OPR-BV-01 | |
| **Summary** | | The roadside unit shall allow an authorized user to perform a MIB walk on the SNMPv3 MIB to produce a complete list of all supported MIBs and OIDs and the current setting for each Object. Also, verify that MIB changes are retained after SUT power is cycled. | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_490-v001, Req\_489-v001, Req\_487-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Verify | All MIB entries as defined in Appendix B of [10] are present. | Pass/Fail |
| 2 | Verify | Each entry has a valid default value. | Pass/Fail |
| 3 | Verify | Modify writable MIB entries with different valid values. | Pass/Fail |
| 4 | Configure | Power cycle the SUT and then login into the RSU SNMP agent. |  |
| 5 | Verify | Verify that the new values are still present in the MIB. | Pass/Fail |

### Functional Requirements

#### TP-RSU-SNMP-FUN-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-SNMP-FUN-BV-01 | |
| **Summary** | | Verify that the roadside unit shall forward WSMP messages received on any DSRC interface, containing a specified PSID, to a specified network host, as configured in SNMPv3 MIB OID 1.0.15628.4.1.7. | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_437-v005 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | Set MIB parameters to the values listed in parentheses:   * rsuDsrcFwdPsid (0x20) * rsuDsrcFwdDestIpAddr (Test System IPv6 address) * rsuDsrcFwdDestPort (Test System UDP port) * rsuDsrcFwdProtocol (UDP) * rsuDsrcFwdRssi (any valid value) * rsuDsrcFwdMsgInterval (1 sec) * rsuDsrcFwdDeliveryStart (current time of the test) * rsuDsrcFwdDeliveryStop (2 minutes after Delivery Start Time) * rsuDsrcFwdEnable (1 – enable) |  |
|  | Configure | Set the SUT to receive WSM on channel 172 |  |
|  | Configure | Set the Test System to transmit a WSM to the SUT on channel 172 with the specified PSID (0x20), at a rate of 1 msg/sec |  |
|  | Stimulus | The Test System to transmit WSM repetitively for 3 minutes. |  |
|  | Verify | The MIB Fwd Status is set to Enable | Pass/Fail |
|  | Verify | The Test System received WSM messages forwarded from the SUT on the port specified in the MIB until Delivery Stop time. | Pass/Fail |

#### TP-RSU-SNMP FUN-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-SNMP FUN-BV-02 | |
| **Summary** | | Verify that the roadside unit shall send the GPGGA NMEA String to a specified UDP port at a specified rate, upon acquisition of 3 or more Satellites, as configured in SNMPv3 MIB OID 1.0.15628.4.1.8. | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_438-v004 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Verify | Verify that the following sub-entries exist under GPS Output node:   * Output Port * Output IP Address * Output Interface * Output Interval * Output String * RefLat (Reference Latitude) * RefLon (Reference Longitude) * RefElv (Reference Elevation) * Max Deviation | Pass/Fail |
| 2 | Configure | Set the MIB entries:   * The Output IP address in the MIB to be the IP address of the Test System * The Output Port to be the port of the application on the Test System receiving the NMEA messages. * The Output Interface to the SUT Ethernet port * The Output Interval to be 60 (sec) |  |
| 3 | Verify | * The SUT is sending the GPGGA NMEA string at the specified Output Interval. * The GPGGA NMEA string contains time, latitude, longitude, altitude, fix quality, number of satellites consistent with the current SUT position. * The GPGGA NMEA string shows the number of satellites to be 4 or more. * The MIB entry rsuGpsStatus (1.0.15628.4.1.3) shows the number of satellites equal to the report from the GPGGA NMEA string * The MIB entry rsuGpsOutputString (OID 1.0.15628.4.1.8.5) contains the GPGGA NMEA string output from the SUT | Pass/Fail |
| 4 | Verify | The position information included in the GPGGA sentence matches with information provided by a reference GPS receiver. | Pass/Fail |

### Positioning

#### TP-RSU-SNMP-POS-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-SNMP-POS-BV-01 | |
| **Summary** | | The roadside unit shall notify a remote host via SNMPv3 if its GPS position deviates from the stored reference by more than a configurable radius (OID 1.0.15628.4.1.100.0.11) | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_614-v002 (partial 1 of 3) | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * Configure the Test System to receive SNMP traps from the SUT | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1. 1 | Configure | Set RefLat, RefLon and RefElv in the MIB subtree OID 1.0.15628.4.1.8. to match the RSU coordinates obtained from GPGGA NMEA string generated by the SUT.  Set rsuGpsMaxDeviation to a value corresponding to 10 meters |  |
|  | Verify | The SUT does not generate position deviation notifications (OID 1.0.15628.4.1.100.1.11) | Pass/Fail |
|  | Configure | Increase the **RefLat** entry in the SUT MIB by twice the amount specified in the rsuGpsMaxDeviation. |  |
|  | Verify | The SUT generates an SNMP trap rsuGpsDeviationMsg indicating the discrepancy in the SUT latitude information. | Pass/Fail |
|  | Configure | Repeat step 1 |  |
|  | Configure | Increase the **RefLon** entry in the SUT MIB by twice the amount specified in the MIB entry Max Deviation. |  |
|  | Verify | The SUT generates an SNMPv3 trap rsuGpsDeviationMsg indicating the discrepancy in the SUT longitude information. | Pass/Fail |
|  | Configure | Repeat step 1 |  |
|  | Configure | Increase the **RefElv** entry in the SUT MIB by twice the amount specified in the MIB entry Max Deviation. |  |
|  | Verify | The SUT generates an SNMPv3 trap rsuGpsDeviationMsg indicating the discrepancy in the elevation information. | Pass/Fail |

### Message Processing – Store and Repeat-Encoded Payload

#### TP-RSU-SNMP-SAR-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-SNMP-SAR-BV-01 | |
| **Summary** | | The roadside unit shall allow authorized users to add/remove Messages from the Active Message directory through SNMPv3 rsuSRMStatusTable (OID 1.0.15628.4.1.4)  The roadside unit SHALL allow authorized users to view the contents of Active Messages in the Active Message directory through SNMPv3 rsuSRMStatusTable (OID 1.0.15628.4.1.4)  The roadside unit SHALL allow authorized users to modify an Active Message in the SNMPv3 rsuSRMStatusTable (OID 1.0.15628.4.1.4) | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_454-v003, USDOT\_RSU-Req\_455-v003 and USDOT\_RSU-Req\_457-v003. | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * The SUT SNMPv3 rsuSRMStatusTable is loaded with 2 messages | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | Two test messages are loaded in the MIB rsuSRMStatusTable |  |
|  | Verify | The SUT transmits the message over the air with message parameters set in step 1. | Pass/Fail |
|  | Configure | Modify one of the test messages in the MIB |  |
|  | Verify | The SUT transmits the modified message with the new changes. | Pass/Fail |
|  | Configure | Remove one of the messages from the MIB. |  |
|  | Verify | The SUT no longer transmit the message over the air. | Pass/Fail |

### Notifications

#### TP-RSU-SNMP-NOT-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-SNMP-NOT-BV-01 | |
| **Summary** | | The roadside unit shall notify a remote host via SNMPv3 of its current NMEA GPGGA string at a configurable interval rsuGpsOutputInterval (OID 1.0.15628.4.1.8.4) | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_614-v002 (partial 3 of 3) | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * Configure the Test System to receive SNMP traps from the SUT | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | The SUT MIB rsuGpsOutput (OID 1.0.15628.4.1.8) is configured with the sub-entries:   * rsuGpsOutputPort * rsuGpsOutputAddress * rsuGpsOutputInterface   Set rsuGpsOutputInterval to 1 sec |  |
|  | Verify | The SUT is transmitting NMEA GPGGA string at periodic regular time intervals of 1 second as specified by the MIB. | Pass/Fail |
|  | Configure | Set rsuGpsOutputInterval to 20 sec |  |
|  | Verify | The SUT is transmitting NMEA GPGGA string at periodic regular time intervals of 20 seconds as specified by the MIB. | Pass/Fail |
|  | Configure | Set rsuGpsOutputInterval to 300 sec |  |
|  | Verify | The SUT is transmitting NMEA GPGGA string at periodic regular time intervals of 300 seconds as specified by the MIB. | Pass/Fail |

#### TP-RSU-SNMP-NOT-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-SNMP-NOT-BV-02 | |
| **Summary** | | Verify that multiple users can access RSU with different valid SNMPv3 authentication credentials  Verify that RSU sends a notification if a configurable number of consecutive authentication attempts have failed. | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_615-v001, Req\_467-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 (i.e. the first instance of the SNMPv3 Manager has access to the SUT SNMP Agent) * Second authenticated user accounts setup for access to the SNMPv3 SUT agent * Configure the Test System to receive SNMP traps from the SUT | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1. 1 | Configure | Start the second instance of the SNMPv3 Manager using different user credentials, load the MIB from [10] and access the SUT SNMP Agent |  |
|  | Configure | Change the notification threshold limit for invalid access to a number N in range 1-100 | Pass/Fail |
| 1. 3 | Verify | The first instance of the SNMPv3 manager can walk the SUT MIB tree. | Pass/Fail |
|  | Verify | The first instance of the SNMPv3 manager can walk the SUT MIB tree. |  |
| 1. 4 | Configure | In the second instance of the SNMPv3 Manager, use invalid password and try to access the SUT N+1 times to trigger a trap. |  |
| 1. 5 | Verify | The SUT send a trap notification indicating several consecutive authentication attempts have failed. | Pass/Fail |

#### TP-RSU-SNMP-NOT-BV-03

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-SNMP-NOT-BV-03 | |
| **Summary** | | Verify that RSU sends a notification if a time source input has been lost for a configurable period or has failed after a configurable number of query attempts (note: the time source itself shall also be indicated) (OID 1.0.15628.4.1.100.0.7) | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_615-v001, USDOT\_RSU-Req\_618-v002 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * Configure the Test System to receive SNMP traps from the SUT | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Verify | The SUT MIB entry rsuGpsStatus (1.0.15628.4.1.3) shows the number of satellites 4 or more | Pass/Fail |
|  | Configure | Change the notification threshold limit for rsuTimeSourceLostMsg (.1.0.15628.4.1.100.1.7) to a number of seconds N in range 10-1000 |  |
|  | Stimulus | Remove the GPS antenna from the SUT connector. |  |
|  | Verify | The SUT MIB entry rsuGpsStatus (1.0.15628.4.1.3) shows the number of satellites is 0 | Pass/Fail |
|  | Configure | Wait a period of time set in step 2. |  |
|  | Verify | The SUT sends a notification rsuTimeSourceLostMsg that a time source has failed and indicating which time source has failed. | Pass/Fail |

## Message Processing Test purposes

### Receive and Decode MAP/SPAT

#### TP-OBU-MSG-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-OBU-MSG-BV-01 | |
| **Summary** | | Verify that OBU can receive and decode MAP messages over DSRC on CH172 | |
| **Test Configuration** | | TC1 | |
| **SUT** | | OBU | |
| **Reference:** | |  | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * The Test System transmits WSMs on CH172 containing MAP messages (MessageFrame containing MSG\_MapData per [11]) | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Stimulus | At least one MAP message is sent over Channel 172 |  |
|  | Verify | The SUT received MAP messages | Pass/Fail |
|  | Verify | The SUT decoded correctly at least one randomly picked sample MAP message in its entirety as indicated by the SUT output in log file, console, etc | Pass/Fail |

#### TP-OBU-MSG-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-MSG-BV-02 | |
| **Summary** | | Verify that the OBU can receive and decode SPAT messages over DSRC on CH172 | |
| **Test Configuration** | | TC1 | |
| **SUT** | | OBU | |
| **Reference:** | |  | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * The Test System transmits WSMs on CH172 containing SPAT messages (MessageFrame containing MSG\_SignalPhaseAndTiming per [11]) | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Stimulus | At least one SPAT message is sent over Channel 172 |  |
|  |  | The SUT received SPAT messages |  |
|  | Verify | The SUT decoded correctly at least one randomly picked sample SPAT message in its entirety as indicated by the SUT output in log file, console, etc | Pass/Fail |

### Transmit MAP/SPAT

#### TP-RSU-MSG-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-MSG-BV-01 | |
| **Summary** | | Verify that the RSU transmits MAP messages (i.e. MessageFrame containing MSG\_MapData per [11]) according to the specified Time instructions | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | RSU-Req\_468-v001, RSU-Req\_470-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | The SUT time instructions for MAP transmissions are set with the start date/time at T1 and the stop date/time at T2, where T1 and T2 are set in the future, and T1 is earlier than T2 |  |
|  | Stimulus | The SUT activated to send MAP messages continuously over Channel 172 according to the time instructions |  |
|  | Verify | The SUT does not transmit MAP messages earlier than T1 | Pass/Fail |
|  | Verify | The MAP message are transmitted only from T1 to T2. | Pass/Fail |
|  | Verify | The SUT does not transmit MAP messages after T2 | Pass/Fail |

#### TP-RSU-MSG-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-MSG-BV-02 | |
| **Summary** | | Verify that the RSU changes message transmit parameters when the RSU Store & Repeat Message (SRM) proxy configuration is altered | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_468-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * Sample MAP message payloads (i.e. MessageFrame containing MSG\_MapData per [11]) is encoded in octet string format | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Config | The SUT SRM proxy parameters are configured with the values listed in parentheses:   * SRM Psid (0x8002) * SRM DsrcMsgId (any valid value) * SRM TxMode (continuous) * SRM TxChannel (172) * SRM TxInterval (1 second apart) * SRM DeliveryStart (present date/time) * SRM DeliveryStop (future date/time) * SRM Payload (encoded MAP message) * SRM Enable (1 – enable) |  |
|  | Stimulus | The SUT sends at least one WSM with MAP |  |
|  | Verify | The SUT transmitted WSMs with the parameters specified in step 1 | Pass/Fail |
|  | Config | Make changes to the following SRM proxy parameters using other valid values:   * SRM Psid * SRM TxMode * SRM TxChannel * SRM TxInterval * SRM DeliveryStart * SRM DeliveryStop * SRM Payload |  |
|  | Stimulus | The SUT sends at least one WSM after parameter changes took effect. |  |
|  | Verify | The SUT transmitted WSM messages according with the changed parameters specified in step 4 | Pass/Fail |

#### TP-RSU-MSG-BV-03

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-MSG-BV-03 | |
| **Summary** | | Verify that the RSU can convert inbound UDP frames to outbound SPAT messages with a delay not exceeding 50 milliseconds from the time the messages are received from an external host | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_554-v001, USDOT\_RSU-Req\_471-v003 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * The DSRC Sniffer configured to capture outbound WSM messages from the SUT on channel 172. * The DSRC Sniffer software configured to capture inbound UDP messages to the SUT Ethernet interface and the UDP port assigned to the SUT Immediate Forward Proxy configured for SPAT * The Test System transmitting UDP containing SPAT messages to the SUT UDP port assigned to the SUT Immediate Forward Proxy configured for SPAT   + UDP containing SPAT means UDP payload includes MessageFrame per [11] containing MSG\_SignalPhaseAndTiming encoded per [11] | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | The SUT Immediate Forward Proxy is configured to receives UDP messages and forward them as outbound WSMs on Channel 172, continuous mode. |  |
|  | Stimulus | The SUT receives UDP messages over the Ethernet interface |  |
|  | Verify | The SUT sends WSMs containing SPAT messages on Channel 172, continuous mode. | Pass/Fail |
|  | Verify | Measure the delay between the time T1 when the SUT receives a UDP message from the SUT Ethernet port, and the time T2 when the corresponding SPAT is sent over DSRC.  Verify that the delay (T2-T1) does not exceed 50 milliseconds | Pass/Fail |

#### TP-RSU-MSG-BV-04

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-MSG-BV-04 | |
| **Summary** | | Verify that the RSU changes message transmit parameters when the RSU Immediate Forward Message (IFM) proxy configuration is altered | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | USDOT\_RSU-Req\_554-v001, USDOT\_RSU-Req\_471-v003 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * The Test System sends UDP messages containing SPAT information to the SUT   + UDP containing SPAT means UDP payload includes MessageFrame from [11] containing MSG\_SignalPhaseAndTiming and encoded per [11] | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Config | The SUT IFM proxy parameters are configured with the values listed in parentheses:   * IFM Psid (0x8002) * IFM DsrcMsgId (any valid value) * IFM TxMode (continuous) * IFM TxChannel (172) * IFM Enable (1-enable) |  |
|  | Stimulus | The SUT sends at least one WSMs with SPAT message |  |
|  | Verify | The SUT transmitted WSMs with the parameters specified in step 1 | Pass/Fail |
|  | Config | Make changes to the following IFM parameters using other valid values:   * IFM Psid * IFM DsrcMsgId * IFM TxMode * IFM TxChannel |  |
|  | Stimulus | The SUT sends at least one WSM after parameter changes took effect. |  |
|  | Verify | The SUT sends at least one WSM after parameter changes took effect. | Pass/Fail |
|  | Verify | The SUT transmitted WSM messages according with the changed parameters specified in step 4 | Pass/Fail |

## RSU Multi-Channel Operation (1609.4) Test purposes

#### TP-RSU-16094-MCTXRX-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-16094-MCTXRX-BV-01 | |
| **Summary** | | The roadside unit shall support Continuous Mode and Alternating Mode radio operations simultaneously | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | Req\_360-v002, Req\_588-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | The Test System is set to receive WSMs   * on radio 1 in continuous channel mode on channel 178 and * on radio2 in alternating mode using   + timeslot0 on channel 172 and   + timeslot1 on channel 174 |  |
|  | Configure | The SUT is set to transmit at a repeat rate of 10 packets per second   * WSM1 in continuous channel mode on channel 178 and * WSM2 (different WSM payload from WSM1) in alternating mode using timeslot0 on channel 172 and * WSM3 (different WSM payload from WSM1 and WSM2) in alternating mode using timeslot1 on channel 174 |  |
|  | Stimulus | The SUT transmitted WSM1 on channel 178, WSM2 on channel 172 and WSM3 on channel 174. |  |
|  | Verify | The Test System received WSM1, WSM2 and WSM3 every 100 ms. | PASS / FAIL |
|  | Stimulus | The SUT to stop transmitting. |  |
|  | Procedure | Repeat steps 1-4 with channel 182 for the continuous mode, channel 180 (timeslot0) and 184 (timeslot1) for the two alternating mode channels. |  |
|  | Configure | The SUT to the initial state. |  |
|  | Configure | The SUT to receive WSMs   * on radio 1 in continuous channel mode on channel 178 and * on radio 2 in alternating mode using   + timeslot0 on channel 172 and   + on channel 174 using timeslot1. |  |
|  | Configure | The Test System to transmit at a repeat rate of 10 packets per second   * WSM1 in continuous channel mode on channel 178 and * WSM2 (different WSM payload from WSM1) in alternating mode using timeslot0 on channel 172 and * WSM3 (different WSM payload from WSM1 and WSM2) in alternating mode using timeslot1 on channel 174 |  |
|  | Stimulus | The Test System transmitted WSM1 on channel 178, WSM2 on channel 172 and WSM3 on channel 174. |  |
|  | Verify | The Test System received WSM1, WSM2 and WSM3 every 100 ms | PASS / FAIL |
|  | Stimulus | The SUT to stop receiving. |  |
|  | Procedure | Repeat steps 8-11 with channel 182 for the continuous mode, channel 180 (timeslot0) and 184 (timeslot1) for the two alternating mode channels. |  |

#### TP-RSU-1609-4-TXT-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-1609-4-TXT-BV-01 | |
| **Summary** | | Each DSRC radio in the roadside unit SHALL be configurable to send messages either on Channel 178 during the Control Channel (CCH) interval or on any of the 10 MHz or 20 MHz channels with no time interval restrictions. | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | Req\_421-v001, Req\_587-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | The Test System to receive WSMs in alternating channel mode using timeslot0 on channel 178 and on alternating mode using timeslot1 on channel2 (channel 172 to start). |  |
|  | Configure | The SUT to transmit WSM1 in alternating channel mode using timeslot0 on channel 178 and WSM2 (different WSM payload from WSM1) on alternating channel mode using timeslot1 on channel2 at a repeat rate of 10 packets per second. |  |
|  | Stimulus | The SUT to transmit WSM1 on channel1 and WSM2 on channel2. |  |
|  | Verify | The Test System receives WSM1 and WSM2 every 100 ms. | PASS / FAIL |
|  | Stimulus | The SUT to stop transmitting. |  |
|  | Procedure | Repeat steps 1-4 with values for channel2 = 174, 176, 180, 182 and 184. |  |
|  | Comment | ***20 MHz channels are not supported.***  ***Restrictions on time intervals are not verified.*** |  |

#### TP-RSU-1609-4-RXT-TXT-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-1609-4-RXT-TXT-BV-01 | |
| **Summary** | | Roadside unit DSRC Radios in Alternating Mode shall be capable of switching to the configured Service Channel every Service Channel interval with no time interval restrictions. | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | Req\_422-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | The Test System to receive WSMs in alternating mode on channel 178 using timeslot0 and on alternating mode using timeslot1 on channel2 (172 to start). |  |
|  | Configure | The SUT to transmit WSM1 in alternating mode on channel1 and WSM2 (different WSM payload from WSM1) on alternating mode using timeslot1 on channel2 at a repeat rate of 10 packets per second. |  |
|  | Stimulus | The SUT to transmit WSM1 on channel1 and WSM2 on channel2. |  |
|  | Verify | The Test System receives WSM1 and WSM2 every 100 ms. | PASS / FAIL |
|  | Stimulus | The SUT to stop transmitting. |  |
|  | Procedure | Repeat steps 1-4 with values for channel2 = 174, 176, 180, 182 and 184. |  |
|  | Configure | The SUT to the initial state. |  |
|  | Configure | The SUT to receive WSMs in alternating mode using timeslot0 on channel 178 and on alternating mode using timeslot1 on channel2 (172 to start). |  |
|  | Configure | The Test System to transmit WSM1 in alternating mode on channel 178 using timeslot0 and WSM2 (different WSM payload from WSM1) on alternating mode using timeslot1 on channel2 at a repeat rate of 10 packets per second. |  |
|  | Stimulus | The Test System to transmit WSM1 on channel 178 and WSM2 on channel2. |  |
|  | Verify | The SUT receives WSM1 and WSM2 every 100 ms. | PASS / FAIL |
|  | Stimulus | The SUT to stop receiving. |  |
|  | Procedure | Repeat steps 8-11 with values for channel2 = 174, 176, 180, 182 and 184. |  |
|  | Comment | ***Restrictions on time interval are not verified.*** |  |

## RSU GPS Positioning Operation Test purposes

#### TP-RSU-POS-FUN-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-POS-FUN-BV-01 | |
| **Summary** | | Verify that RSU uses its built-in positioning system to determine its position on the surface of the earth | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | RSU\_Req\_510-v002, Req\_363-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * GPS signal is available * The location of the RSU position is established as the *Expected SUT Position* | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Check | The SUT is powered up and acquired GPS signal and its 3D position |  |
|  | Stimulus | The *Measured SUT Position* information is retrieved from the SUT |  |
|  | Verify | The *Measured SUT Position* is within the *Test Requirement* (see Note1 below) of the *Expected SUT Position* | Pass/Fail |
|  | Configure | The SUT is power cycled |  |
|  | Procedure | Repeat steps 1-4 two more times |  |
| *Note1: Test Requirement is established as the* Maximum difference between the *Measured SUT Position* and the *Expected SUT Position* shall not exceed 3 meters | | | |

#### TP-RSU-POS-FUN-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-POS-FUN-BV-02 | |
| **Summary** | | Verify that RSU system clock conforms to the UTC timing standard | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | RSU-Req\_514-v002 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * GPS signal is available * A reference UTC time clock is available | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Check | The SUT acquired GPS signal and its 3D position |  |
| 2 | Check | Retrieve the SUT system time |  |
| 3 | Verify | The SUT system time is uses the UTC format as compared to the reference clock time | Pass/Fail |

#### TP-RSU-POS-FUN-BV-03

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-POS-FUN-BV-03 | |
| **Summary** | | Verify that the RSU system clock is based off timing information from its built-in positioning system that manages leap second corrections | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | RSU-Req\_513-v003, Req\_363-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 * GPS signal is available * A reference UTC time clock is available | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Check | The SUT acquired GPS signal and its 3D position |  |
|  | Verify | The SUT current system time matches the reference clock | Pass/Fail |
|  | Stimulus | Manually change the SUT system time to an incorrect value |  |
|  | Verify | The SUT corrected its internal system clock to match the reference clock within 1 min | Pass/Fail |

## WSA Test purposes

### WSA transmission

#### TP-RSU-WSA-V2I-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-WSA-V2I-BV-01 | |
| **Summary** | | Verify that the RSU transmits WSA with security profile defined in IEEE 1609.3-2016 Annex H.1 | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | RSU-Req\_586-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 and the section 4.3.1 in [13] | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Verify | Perform TP-16092- SPDUWSA-SEND-BV-01 from [13] | Pass/Fail |
|  | Verify | Perform TP-16092- SPDUWSA-SEND-BV-02 from [13] | Pass/Fail |
|  | Verify | Perform TP-16092- SPDUWSA-SEND-BV-03 from [13] | Pass/Fail |
|  | Verify | Perform TP-16092- SPDUWSA-SEND-BV-04 from [13] | Pass/Fail |

#### TP-RSU-WSA-FUN-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-WSA-FUN-BV-01 | |
| **Summary** | | Verify that RSU transmit WSA with Service Channel (SCH) Services from WSA MIB OID 1.0.15628.4.1.13 | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | RSU-Req\_570-v002, Req\_587-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | The WSA MIB subtree (OID 1.0.15628.4.1.13) parameters are configured with the values listed in parentheses:  Service 1   * rsuWsaPsid (0x8003) * rsuWsaPriority (any valid value) * rsuWsaProviderContext (any valid value) * rsuWsaIpAddress (none) * rsuWsaPort (none) * rsuWsaChannel (176)   Service 2   * rsuWsaPsid (0xEFFFFFFE) * rsuWsaPriority (any valid value) * rsuWsaProviderContext (any valid value) * rsuWsaIpAddress (IPv6 address of RSE) * rsuWsaPort (any valid value) * rsuWsaChannel (176) | Pass/Fail |
|  | Stimulus | The SUT transmits WSAs |  |
|  | Verify | The WSA transmitted on the Control channel (178) | Pass/Fail |
|  | Verify | The WSA contains Service Info Segment, Channel Info Segment and the WAVE Router Advertisement containing information from the MIB configured in step 1 | Pass/Fail |

#### TP-RSU-WSA-FUN-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-WSA-FUN-BV-02 | |
| **Summary** | | Verify that RSU transmits WSA with Service Channel (SCH) Services based on the Store and Repeat Messages (SRM) contained in MIB OID 1.0.15628.4.1.4  SRM services configured for the Control Channel (CCH), 178 are NOT included in the WSA | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | |  | |
| **PICS Selection** | | Req\_571-v001, Req\_573-v002, Req\_587-v001 | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | The WSA MIB subtree (OID 1.0.15628.4.1.4) parameters are configured with the values listed in parentheses:  Service 1   * SRM Psid (0x8003) * SRM DsrcMsgId (unique valid value) * SRM TxMode (alternating) * SRM TxChannel (176) * SRM TxInterval (1 second apart) * SRM DeliveryStart (present date/time) * SRM DeliveryStop (future date/time) * SRM Payload (MessageFrame containing MSG\_TravelerInformation encoded per [11]) * SRM Enable (1 – enable)   Service 2   * SRM Psid (0x8003) * SRM DsrcMsgId (unique valid value) * SRM TxMode (alternating) * SRM TxChannel (178) * SRM TxInterval (1 second apart) * SRM DeliveryStart (present date/time) * SRM DeliveryStop (future date/time) * SRM Payload (MessageFrame containing MSG\_TravelerInformation encoded per [11]) * SRM Enable (1 – enable) |  |
|  | Configure | The MID table rsuDsrcChannelModeTable (OID 1.0.15628.4.1.12) is configured with values listed in parentheses:   * rsuDCMRadio (name of the SUT wireless interface) * rsuDCMMode (alternating) * rsuDCMCCH (178) * rsuDCMSCH (176) |  |
|  | Stimulus | The SUT transmits WSA |  |
|  | Verify | WSA are transmitted on the channel 178 | Pass/Fail |
|  | Verify | The WSA contains:   * one Service Info Segment with parameters derived from Service 1 configuration * one Channel Info Segment with the Service channel 176 listing | Pass/Fail |
|  | Verify | The WSA does not contain:   * Service Info Segment with parameters derived from Service 2 configuration * Channel Info Segment with the Control channel 178 listing | Pass/Fail |

#### TP-RSU-WSA-FUN-BV-03

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-RSU-WSA-FUN-BV-03 | |
| **Summary** | | Verify that RSU transmits WSA with Service Channel (SCH) Services based on Immediate Forward Messages (IFM) received on non-DSRC interfaces as listed in MIB OID 1.0.15628.4.1.5  IFM services configured for the Control Channel (CCH), 178 are NOT included in WSA | |
| **Test Configuration** | | TC1 | |
| **SUT** | | RSU | |
| **Reference:** | | RSU-Req\_572\_v001, RSU-Req\_574\_v001, Req\_587-v001 | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Configure | The SUT IFM proxy parameters are configured with the values listed in parentheses:  Service 1   * IFM Psid (0x8003) * IFM DsrcMsgId (unique valid value) * IFM TxMode (alternating) * IFM TxChannel (176) * IFM Enable (1-enable)   Service 2   * IFM Psid (0x8003) * IFM DsrcMsgId (unique valid value) * IFM TxMode (alternating) * IFM TxChannel (178) * IFM Enable (1-enable) |  |
|  | Configure | The MID table rsuDsrcChannelModeTable (OID 1.0.15628.4.1.12) is configured with values listed in parentheses:   * rsuDCMRadio (name of the SUT wireless interface) * rsuDCMMode (alternating) * rsuDCMCCH (178) * rsuDCMSCH (176) |  |
|  | Stimulus | The SUT transmits WSA |  |
|  | Verify | WSA are transmitted on the channel 178 | Pass/Fail |
|  | Verify | The WSA contains:   * one Service Info Segment with parameters derived from Service 1 configuration * one Channel Info Segment with the Service channel 176 listing | Pass/Fail |
|  | Verify | The WSA does not contain:   * Service Info Segment with parameters derived from Service 2 configuration * Channel Info Segment with the Control channel 178 listing | Pass/Fail |

### WSA reception and processing

#### TP-OBU-WSA-FUN-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-OBU-WSA-FUN-BV-01 | |
| **Summary** | | Verify that OBU can receive WSA and join selected advertised service | |
| **Test Configuration** | | TC1 | |
| **SUT** | | OBU | |
| **Reference:** | |  | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 and section 4.3.1. from [12] | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Verify | Perform TP-16093-WSA-PP-BV-01 from [12] | Pass/Fail |
|  | Verify | Perform TP-16093-WSA-PP-BV-02 from [12] | Pass/Fail |
|  | Verify | Perform TP-16093-WSA-PP-BV-03 from [12] | Pass/Fail |
|  | Verify | Perform TP-16093-WSA-PP-BV-04 from [12] | Pass/Fail |

#### TP-OBU-WSA-FUN-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-OBU-WSA-FUN-BV-02 | |
| **Summary** | | Verify that OBU can receive WSA with WRA and ping external host connected to RSU via IPv6 | |
| **Test Configuration** | | TC1 | |
| **SUT** | | OBU | |
| **Reference:** | |  | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 and section 4.3.1. from [12] * RSU connected to external host | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Verify | Perform TP-16093-IP-COM-BV-01 from [12] | Pass/Fail |

#### TP-OBU-WSA-FUN-BV-03

|  |  |  |  |
| --- | --- | --- | --- |
| **Identifier** | | TP-OBU-WSA-FUN-BV-03 | |
| **Summary** | | Verify that OBU can receive WSA with WRA and ping RSU via IPv6 | |
| **Test Configuration** | | TC1 | |
| **SUT** | | OBU | |
| **Reference:** | |  | |
| **PICS Selection** | |  | |
| **Pre-test conditions** | | | |
| * The SUT is in the initial state as described in 4.3.1 and section 4.3.1. from [12] | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
|  | Verify | Perform TP-16093-IP-COM-BV-02 from [12] | Pass/Fail |



Traceability Matrix

This section of the document contains the traceability matrix for RSU requirements from [10]. As shown below, Table A- 1 lists the RSU requirement ID from [10] (prefix “USDOT-RSU” in the ID omitted) traceability to TPs.

Table A- 1 RSU Requirements Traceability Matrix

| **Req ID** | **Req Summary** | **Reference to Test Purposes** |
| --- | --- | --- |
|  |  |  |
| **Req\_355-v001** | Use of authenticated NTP | Not tested |
| **Req\_360-v002** | Continuous and alternating channel modes | TP-RSU-16094-MCTXRX-BV-01 |
| **Req\_363-v001** | RSU integrated GPS | TP-RSU-POS-FUN-BV-01  TP-RSU-POS-FUN-BV-03 |
| **Req\_372-v002** | IEEE 802.11 Conformance | 802.11 test spec |
| **Req\_373-v003** | IEEE 802.11 Physical layer | 802.11 test spec |
| **Req\_375-v001** | IEEE 802.11 Frame default values | 802.11 test spec |
| **Req\_376-v001** | IEEE 802.11 QOS | TP-80211-TXT-MAC-BV-01 |
| **Req\_377-v001** | IEEE 802.11 AIFSN | Not tested |
| **Req\_378-v001** | IEEE 802.11 TXOP | Not tested |
| **Req\_379-v001** | IEEE 802.11 CWmin | Not tested |
| **Req\_382-v001** | IEEE 802.11 Basic service set | 802.11 spec testing |
| **Req\_383-v001** | IEEE 802.11 Operating class | 802.11 spec testing |
| **Req\_384-v003** | IEEE 802.11 Operating class | 802.11 spec testing |
| **Req\_385-v001** | IEEE 802.11 EDCA | Not tested |
| **Req\_388-v002** | IEEE1609.2 Conformance | Covered by 1609.2 test specification |
| **Req\_412-v002** | IEEE1609.3 Conformance | Covered by 1609.3 test specification |
| **Req\_413-v001** | IEEE1609.3 IP Data | TP-OBU-WSA-FUN-BV-02  TP-OBU-WSA-FUN-BV-03 |
| **Req\_414-v001** | IEEE1609.3 WSM Data | TP-OBU-MSG-BV-01  TP-OBU-MSG-BV-02  Also, covered by other test specifications, i.e. IEEE16093 test specification:  TP-16093-WSM-ROP-BV-01 (transmit) TP-16093-WSM-PP-BV-01 (receive) |
| **Req\_415-v001** | IEEE1609.3 PSID specific user priority | Covered by other test specifications (i.e. IEEE16093 and 80211 test specification) |
| **Req\_416-v001** | COC V2I Testing Scope | TP-16093-WSM-ROP-BV-01 |
| **Req\_419-v001** | IEEE1609.4 standard conformance | Covered by other test specifications (i.e. IEEE16094 test specification) |
| **Req\_420-v002** | IEEE1609.4 radio continuous or alternating mode | TP-16094-TXT-MDE-BV-01 |
| **Req\_421-v001** | IEEE1609.4 radio channel usage | TP-RSU-1609-4-TXT-BV-01  Use TP-16094-TXT-MDE-BV-02 but set one of the channels to 178.  *20 MHz channels not supported*  *Time interval bounds are not tested* |
| **Req\_422-v001** | IEEE1609.4 continuous mode | TP-RSU-1609-4-RXT-TXT-BV-01  *20 MHz channels not supported*  *Time interval bounds are not tested* |
| **Req\_424-v002** | Service channel intervals | TP-RSU-1609-4-RXT-TXT-BV-01 |
| **Req\_425-v002** | RSU sets configuration | Not tested |
| **Req\_429-v001** | IEEE1609.4 synchronized collision | Not tested |
| **Req\_430-v001** | IEEE1609.4 readdressing option | Not tested |
| **Req\_432-v004** | RSU receiver range | TP-802.11-RXT-PHY-BV-01 |
| **Req\_433-v004** | RSU transmission range | TP-802.11-TXT-PHY-BV-04 (Constell./output power) |
| **Req\_435-v001** | RSU configuration via MIB | TP-RSU-SNMP-OPR-BV-01 |
| **Req\_436-v001** | IEEE1609.4 alternative channel mode | TP-RSU-1609-4-RXT-TXT-BV-01  *20 MHz channels not supported*  *Time interval bounds are not tested* |
| **Req\_437-v005** | DSRC message forwarding | TP-RSU-SNMP-FUN-BV-01 |
| **Req\_438-v004** | GPS output | TP-RSU-SNMP FUN-BV-02 |
| **Req\_452-v002** | SRM max file storage | Not tested |
| **Req\_453-v002** | SRM Active Message file installation | Not tested |
| **Req\_454-v003** | SRM removal | TP-RSU-SNMP-SAR-BV-01 |
| **Req\_455-v003** | SRM review | TP-RSU-SNMP-SAR-BV-01 |
| **Req\_457-v003** | SRM modifications | TP-RSU-SNMP-SAR-BV-01 |
| **Req\_459-v001** | SRM Authorized Access Log Entry | Not tested |
| **Req\_462-v001** | SRM Active message log entry | Not tested |
| **Req\_467-v001** | Multiple user access via SNMPv3 | TP-RSU-SNMP-NOT-BV-02 |
| **Req\_468-v001** | SRM transmission | TP-RSU-MSG-BV-01,  TP-RSU-MSG-BV-02 |
| **Req\_469-v001** | SRM failed access in log file | Not tested |
| **Req\_470-v001** | SRM transmission | TP-RSU-MSG-BV-01 |
| **Req\_471-v003** | IMF transmissions | TP-RSU-MSG-BV-03 TP-RSU-MSG-BV-04 |
| **Req\_487-v001** | RSU use of MIB | TP-RSU-SNMP-OPR-BV-01 |
| **Req\_489-v001** | MIB default values | TP-RSU-SNMP-OPR-BV-01 |
| **Req\_490-v001** | MIB Walk | TP-RSU-SNMP-OPR-BV-01 |
| **Req\_491-v002** | MIB modification by authorized user | TP-RSU-SNMP-OPR-BV-01 |
| **Req\_492-v002** | MIB modification in log file | Not tested |
| **Req\_493-v001** | MIB installation | Not tested |
| **Req\_494-v001** | MIB copy authorization | Not tested |
| **Req\_495-v002** | MIB validation status in log file | Not tested |
| **Req\_498-v001** | MIB valid range checking | Not tested |
| **Req\_499-v001** | MIB integrity mechanism | Not tested |
| **Req\_510-v002** | Use of RSU GPS | TP-RSU-POS-FUN-BV-01 |
| **Req\_511-v001** | Position Failure log entry | Not tested |
| **Req\_512-v002** | Position corrections | Not tested |
| **Req\_513-v003** | System Time | TP-RSU-POS-FUN-BV-03 |
| **Req\_514-v002** | System Time Standard | TP-RSU-POS-FUN-BV-02 |
| **Req\_554-v001** | Immediate Forward Message Receive | TP-RSU-MSG-BV-03  TP-RSU-MSG-BV-04 |
| **Req\_570-v002** | WSA Configuration General | TP-RSU-WSA-FUN-BV-01 |
| **Req\_571-v001** | WSA Configuration SRM | TP-RSU-WSA-FUN-BV-02 |
| **Req\_572-v001** | WSA Configuration IFM | TP-RSU-WSA-FUN-BV-03 |
| **Req\_573-v002** | Control Channel SRM | TP-RSU-WSA-FUN-BV-02 |
| **Req\_574-v001** | Control Channel IFM | TP-RSU-WSA-FUN-BV-03 |
| **Req\_586-v001** | WSA Security Profile | TP-RSU-WSA-V2I-BV-01 |
| **Req\_587-v001** | WSA Broadcast Channel | TP-RSU-WSA-FUN-BV-01  TP-RSU-WSA-FUN-BV-02  TP-RSU-WSA-FUN-BV-03 |
| **Req\_588-v001** | WSA Broadcast Time Slot | TP-RSU-16094-MCTXRX-BV-01 |
| **Req\_592-v002** | RSU Reporting over SNMPv3 | No testing |
| **Req\_602-v001** | RSU store of GPS Reference | Log checking is not tested |
| **Req\_604-v002** | Antenna Output Power | Optional requirement - Not tested |
| **Req\_613-v002** | GPS data legitimacy | Optional requirement - Not tested |
| **Req\_614-v002** | RSU notifications – GPS triggered | TP-RSU-SNMP-POS-BV-01 TP-RSU-SNMP-NOT -BV-01 |
| **Req\_615-v001** | RSU notifications – integrity/authentication triggered | TP-RSU-SNMP-NOT-BV-02 TP-RSU-SNMP-NOT-BV-03 |
| **Req\_618-v002** | RSU notifications – time integrity triggered | TP-RSU-SNMP-NOT-BV-03 |
| **Req\_627-v001** | TMC Message signature verification | No testing |
| **Req\_636-v001** | RSU handling of expired app certificates | No testing |
| **N/A** | OBU reception of SPAT/MAP | TP-OBU-MSG-BV-01  TP-OBU-MSG-BV-02 |
| **N/A** | OBU reception of WSA | TP-OBU-WSA-FUN-BV-01  TP-OBU-WSA-FUN-BV-02  TP-OBU-WSA-FUN-BV-03 |

# Revision History

|  |  |  |
| --- | --- | --- |
| V0.1 | 3/13/2017 | Initial Draft |
| V0.2 | 4/18/2017 | Updated as a result of comments received from Noblis. Iteris and Volpe. |

# Need to Change

◙ End of Document ◙