

**Conformance test specifications for**

**Wireless Access in  
Vehicular Environments (WAVE) —  
Multi-channel Operation**

**Test Suite Structure and Test Purposes (TSS & TP)**

|  |  |
| --- | --- |
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# Scope

This document provides the Test Suite Structure and Test Purposes for WAVE Multi-Channel Operation as defined in IEEE 1609.4 [2]. This document specifies tests to verify the behavior of a Wireless Access in Vehicular Environments (WAVE) device to utilize more than one wireless channel, possibly involving channel coordination in a wired environment. Operation in an over-the-air environment is currently out of scope of this document.

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 (V0.6.0): “Test Control Interface Specification.”: Revision date 4/21/2017, download from <https://github.com/certificationoperatingcouncil/TCI_ASN1>

[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”.

## Informative References

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to 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 Channel

DSRC Dedicated Short Range Communications

IEEE Institute of Electrical and Electronics Engineers

IP Internet Protocol

ISO International Organization for Standardization

ITS Intelligent Transport Systems

IUT Implementation Under Test

MAC Media Access Control

MIB Management Information Base

PC Personal Computer

PDU Protocol Data Unit

PICS Protocol Implementation Conformance Statement

PSID Provider Service Identifier

RF Radio Frequency

SAE Society of Automotive Engineers

SCH Service Channel

SCMS Security Credential Management System

TAI International Atomic Time

TC Test Configuration

TP Test Purposes

TS Test System

TSF Timing Synchronization Function

TSS Test Suite Structure

UTC Coordinated Universal Time

V2V Vehicle-to-Vehicle

V2X Vehicle-to-Device

WAVE Wireless Access in Vehicular Environments

WSM WAVE Short Message

# 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 IEEE 1609.4 tests. The Test System setup is implemented according to Figure 4‑1. The term ‘Test Equipment’ used in some test purposes refers to the combination of the Test System and the DSRC Wave Host with the corresponding software and firmware.

Test System

DSRC IUT

Tester Control Interface link (Ethernet)

DSRC Wave Host

Wired

Proxy Interface

(Ethernet)

GPS Simulator

RF Cable wired

Ethernet

Figure ‑: Test Configuration 1 (TC1)

### Functional Blocks

Following are the functional blocks used in the above diagram.

#### Global Positioning System (GPS) Simulator

The GPS simulator is used to provide GPS values to the IUT and DSRC Test Generator/Receiver and provides time synchronization. The configuration and use of this device is outside the scope of this document.

#### PC

A Personal Computer is used to harness different devices in the test setup and to build and run test cases.

#### DSRC Test Generator/Receiver

A Dedicated Short Range Communications (DSRC) Test Device is used as part of the test system to generate and receive DSRC traffic.

#### DSRC IUT

DSRC System Under Test refers to a system that is being tested for correct Wireless Access in Vehicular Environment (WAVE) operation.

### Test parameters

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

Note:

1. All the WSM messages transmitted from the IUT will be of a broadcast type unless otherwise specified.
2. Tests with 20MHz Channel Spacing are non-mandatory requirements for Connected Vehicle Pilots. In this case *pChannel* will be configured to be 175 and 181.

#### Channels

Select test values for Channel specified using *pChannel* according to the following table:

**Table 4‑1: Channels**

| **Parameter Name** | **Range of Values** | **Default** | **Reference** |
| --- | --- | --- | --- |
| Channels specified *pChannel* | 10MHz channels:  172, 174, 176, 178, 180, 182, 184  20MHz channels:  175, 181 | 172, 174, etc. | [2] |
| Channels specified as CH1 and CH2 |  | Perform test sequence with the following channel sets:  CH1=178, CH2 = 174  CH1=178, CH2 = 182  CH1=172, CH2 = 184 | [2] |

Set *pChannel* to each supported channel.

CH1 and CH2 will not be set to the same channel.

For testing alternative channel mode, CH1 and CH2 are selected from 10MHz channel list.

#### Data Rate

Select test values for Data Rate specified using *pDataRate* according to the following table.

**Table 4‑2: Data Rates**

| **Parameter Name** | **Range of Values** | **Default** | **Reference** |
| --- | --- | --- | --- |
| *pDataRate* | 10MHz channels:  3, 4.5, 6, 9, 12, 18, 24, 27 (Mbps)  20MHz channels:  6, 9, 12, 18, 24, 36, 48, 54 (Mbps) | 6 | [2] |

For tests requiring iteration through multiple data rates, set *pDataRate* to each supported data rate supported by the corresponding channel.

#### Tester Transmit Power

For all IUT reception testing, TX power of -60dBm and the minimum sensitivity as per [1] and [8], +/- 1dB (at the IUT's antenna connector) shall be used unless otherwise specified by the respective test purpose.

#### IUT Transmit Power

The transmit power out of the DSRC Radio Subsystem measured at the antenna connector of the Subsystem housing, unless otherwise stated in the Test Purpose shall use a *pTxPowerDefault* = Round\_Up (( (MaxTxPowerCap - PwrRange) + MaxTxPowerCap) / 2)

The rationale for parameters *MaxTxPowerCap, PwrRange, vTxPwrCtrlStep* used in this documentis as specified in SAE J2945/1 [1]*.*

*MaxTxPowerCap* will need to be provided with the IUT by the test requestor.

*MaxTxPowerCap* is the maximum conducted transmit power setting in dBm of the DSRC Radio Subsystem at which 802.11 [8] transmitter requirements are met.

PwrRange is calculated as: MaxTxPowerCap + vTxPwrRange – vRPMax + MinSectorAntGain – CLoss

Assuming

vTxPwrRange = 10dBm [1]*.*

vRPMax = 20dBm [1]*.*

              MinSectorAntGain – CLoss = 0 (for module testing at connector port)

#### Timeout

The TIMEOUT interval is 100ms unless otherwise specified.

Rationale: This is two times the channel switching interval.

#### WSM Max Data Length

Default value for *WsmMaxDataLength* is 1400 bytes.

#### Transmission Rates

Select test values for message repeat rates according to the following table.

**Table 4‑3: Repeat Rate**

| **Parameter Name** | **Test Purpose ID** | **Value** |
| --- | --- | --- |
| Repeat Rate for WSM transmissions  *(pWSMRepeatRate)* | TP-16094-RXT-MDE-BV-01, TP-16094-TXT-MDE-BV-01 | 20 messages per second |
| Repeat Rate for WSM transmissions  *(pWSMRepeatRate)* | TP-16094-RXT-MDE-BV-02, TP-16094-TXT-MDE-BV-02,  TP-16094-TXT-PER-BV-01,  TP-16094-TXT-PER-BV-02 | 20 messages per second |
| Repeat rate for IPv6 message transmissions  (*pIPv6epeatRate)* | TP-16094-TXT-PER-BV-01  TP-16094-TXT-PER-BV-02 | 10 messages per second |

Message repeat rates used in [7] uses the message repeat rate as the number of messages per 5 sec interval. When *pWSMRepeatRate* or *pIPv6epeatRate* are used in a test system which uses the TCI interface defined in [7], the test settings in **Table 4‑3** must be multiplied by 5. For example, the IUT requested to be tested at a repeat rate of 10 messages per second will receive a TCI request with the repeat rate value set to 50 (i.e. 50 messages per 5 seconds).

#### Messages

WSM1: WSM1 is a Wave Short Message identified by PSID1 (see Table 4-5).

WSM2: WSM2 is a Wave Short Message identified by PSID2 (see Table 4-5).

#### PSID

Select test values for PSID according to the following table.

**Table 4‑5: PSID table**

| **Parameter name** | **Range of permitted values (p-encoded)** | **Setting used for testing** | **Reference** |
| --- | --- | --- | --- |
| PSID | 1byte PSID: 0p00 to 0p7F  2byte PSID: 0p80-00 to 0pBF-FF  3byte PSID: 0pC0-00-00 to 0pDF-FF-FF  4byte PSID: 0pE0-00-00-00 to 0pEF-FF-FF-FF | 0p7F  0pBF-FF  0pDF-FF-FF  0pEF-FF-FF-FF | IEEE 1609.12 [6] |
| PSID1  PSID2 |  | 0p7F  0pBF-FF | IEEE 1609.12 [66] |
| PSID for  WSA  WAVE Sec Mgmt  BSM  IP routing |  | 0p80-07  0p23  0p20  0pEF-FF-FF-FE | IEEE 1609.12 [6] |

#### IP transmission and reception

For testing communication IP datagrams, the IUT is provided a transmitter profile (i.e. the channel, transmit power, data rate, and other parameters). This transmitter profile parameter values will be provided by the Test System as part of the test configuration.



## Feature Restriction

In this clause all feature restrictions are listed:

* For multiple radio devices only one radio is tested at a time.
* No external DSRC units within range of IUT
* Testing for other Internet Engineering Task Force (IETF) protocols except User Datagram Protocol (UDP) and Transmission Control Protocol (TCP) over IPv6 is not considered
* Simultaneous operation of DSRC device on Control Channel (CCH) and Service Channel (SCH) for multi-radio devices is not considered
* Immediate access or extended access to communication media is not considered
* User Priorities are not tested
* Tests are performed in isolation with no other traffic on the DSRC channel
* Timing Synchronization Function (TSF) is not tested
* Service Access Points (SAP) are not tested

## Rules for the behavior description

Test purposes use a generic "Initial State" that corresponds to a state where the Implementation Under Test (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 IUT is polled until the device is ready for operation.
* The IUT is not transmitting or receiving messages over DSRC link.
* The IUT is not exchanging any IP traffic.
* The IUT is provisioned with any required security credentials to enable transmission or reception of messages over DSRC.
* The IUT is running Certification Interface Application [7].

Certificate Interface Application acts as an interface between IUT and Test System which defines a message protocol to simulate valid and invalid protocol behaviors and helps in analyzing the reaction of IUT.

Some TPs start from a different initial condition which is explicitly defined in the TP. However, the “initial state” defined above is the starting point before the different initial conditions are established.

When the execution of the initial condition does not succeed, the test verdict is said to fail and testing is halted.

Overall state diagram for a test system is shown below.

State 2

IUT is in “Initial State”

State 1

IUT 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

The test suite is structured as a tree with the root defined as 16094. The tree is of rank 3 with the first rank a Group, the second a Sub-group, and the third a category. The third rank is the standard ISO conformance test categories.

### Root

The root consists of the relevant clauses of 1609.4 [2] as indicated by the References and PICS Selections in the individual Test Purposes (section 5.1.4 of this document).

### Groups

This level contains two message types identified as:

|  |
| --- |
| Transmit tests |
| Receive tests |

### Sub-Groups

This level contains functional areas identified as:

|  |
| --- |
| Channel Access Mode tests |
| Performance tests |
| IPv6 tests |
|  |

### Categories

This level contains the standard ISO conformance test categories limited to the behavior valid event and behavior invalid event.

# Test Purposes (TP)

## Introduction

### TP definition conventions

The TPs are defined by the rules shown in Table 6‑1 built according to 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 according to the TP naming conventions defined in the clause below. |
| Summary | Short description of test purpose objective according to 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 IUT including information about equipment configuration, i.e. precise description of the initial state of the IUT 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 IUT 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). |
| Configure | Corresponds to an action to modify the IUT configuration. |
| Procedure | Procedural action directing the flow of TP execution. |

### TP Identifier naming conventions

TP identifiers are built according to

| **Identifier** | **TP-<root>-<gr>-<sgr>-<x>-<nn> or TP-<root>-<gr>-<x>-<nn> when no <sgr>** |  |  |
| --- | --- | --- | --- |
|  | <root> = root | 16094 |  |
|  | <gr> = group | RXT | Receive |
|  |  | TXT | Transmit |
|  | <sgr> =sub- group | MDE | Channel Access Mode |
|  |  | PER | Performance |
|  |  | IP6 | IPv6 |
|  |  | BV | Valid Behavior tests |
|  | <x> = type of testing | BI | Invalid Syntax or Behavior Tests |
|  | <nn> = sequential number |  | 01 to 99 |

**Table 6‑2**.

| **Identifier** | **TP-<root>-<gr>-<sgr>-<x>-<nn> or TP-<root>-<gr>-<x>-<nn> when no <sgr>** |  |  |
| --- | --- | --- | --- |
|  | <root> = root | 16094 |  |
|  | <gr> = group | RXT | Receive |
|  |  | TXT | Transmit |
|  | <sgr> =sub- group | MDE | Channel Access Mode |
|  |  | PER | Performance |
|  |  | IP6 | IPv6 |
|  |  | BV | Valid Behavior tests |
|  | <x> = type of testing | BI | Invalid Syntax or Behavior Tests |
|  | <nn> = sequential number |  | 01 to 99 |

**Table 6‑2: TP naming convention**

### Sources of TP definitions

All TPs are specified according to IEEE 1609.4 [2]. Traceability from PICS to TPs is included in the Appendix A.

Appendix A includes a full list of PICs from IEEE 1609.4 relevant to this document. SAE J2945/1 [1] uses a subset of PICS from IEEE 1609.4. Those PICS are identified with status V2V and SCMS.

## Test purposes for 1609.4

### 1609.4 Receive Channel Access Mode Validation

#### TP-16094-RXT-MDE -BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Purpose Id** | | TP-16094-RXT-MDE-BV-01 | |
| **Summary** | | Transmit WSMs in continuous channel mode (non-switching) and verify IUT receives the transmitted messages. | |
| **Test Configuration** | | TC1 | |
| **Reference:** | | [2] 5.2, 6.3.1, 5.2.1, 5.2.3 | |
| **PICS Selection** | | M2, M2.1, M3, M3.1 | |
| **Pre-test conditions** | | | |
| * The IUT is in initial state as per sec 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Configure | IUT to receive WSM messages in continuous channel mode on ‘*pChannel’* |  |
| 2 | Configure | Test Equipment to transmit WSMs in continuous channel mode on ‘*pChannel’* with *‘pDataRate’* at ‘*pWSMRepeatRate*’. |  |
| 3 | Stimulus | Test Equipment to continuously transmit WSM messages |  |
| 4 | Verify | IUT receives WSM messages available on ‘*pChannel’* at every ‘*pWSMRepeatRate*’. | PASS / FAIL |
| 5 | Procedure | Repeat steps 1-4 for each supported value of *‘pDataRate’* in Table 4-2 |  |
| 6 | Procedure | Repeat steps 1-5 for each supported value of ‘*pChannel’* in Table 4-1 |  |

#### TP-16094-RXT-MDE-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Purpose Id** | | TP-16094-RXT-MDE-BV-02 | |
| **Summary** | | Transmit WSMs in alternating channel mode and verify IUT receives the transmitted messages. | |
| **Test Configuration** | | TC1 | |
| **Reference:** | | [2] 6.3.2 | |
| **PICS Selection** | | M4.2 | |
| **Pre-test conditions** | | | |
| * The IUT is in initial state as per sec 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Configure | IUT to receive WSM1 message in alternating channel mode on ‘CH1’ |  |
| 2 | Configure | IUT to receive WSM2 message in alternating channel mode on ‘CH2’ |  |
| 3 | Configure | Test Equipment to transmit WSM1s in alternating channel mode on ‘CH1’ with ‘*pDataRate*’ at ‘*pWSMRepeatRate*’ |  |
| 4 | Configure | Test Equipment to transmit WSM2s in alternating channel mode on ‘CH2’ with ‘*pDataRate*’ at ‘*pWSMRepeatRate*’ |  |
| 5 | Stimulus | Test Equipment to transmit WSM1 and WSM2 |  |
| 6 | Verify | The IUT receives WSM1 messages available on ‘CH1’. | PASS / FAIL |
| 7 | Verify | The IUT receives WSM2 messages available on ‘CH2’. | PASS / FAIL |
| 8 | Procedure | Repeat steps 1-7 for each supported value of *‘pDataRate’* in Table 4-2 |  |
| 9 | Procedure | Repeat steps 1-8 for each supported value of ‘CH1’, ‘CH2’ in Table 4-1 |  |

### 16094 Transmit Access Mode Validation

#### TP-16094-TXT-MDE-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Purpose Id** | | TP-16094-TXT-MDE-BV-01 | |
| **Summary** | | Verify that the IUT will transmit WSMs in continuous channel mode on a selected channel | |
| **Test Configuration** | | TC1 | |
| **Reference:** | | [2] 5.2, 6.3.1, 5.2.1, 5.2.3 | |
| **PICS Selection** | | M2, M2.1, M3, M3.1 | |
| **Pre-test conditions** | | | |
| * The IUT is in initial state as per sec 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Configure | Test Equipment to receive WSMs in continuous channel mode on ‘*pChannel’* |  |
| 2 | Configure | IUT to transmit WSMs continuously in continuous channel mode on ‘*pChannel’* and ‘*pDataRate*’at‘*pWSMRepeatRate*’ |  |
| 3 | Stimulus | The IUT to transmit WSMs. |  |
| 4 | Verify | The Test Equipment received WSMs every *pWSMRepeatRate*. | PASS / FAIL |
| 5 | Stimulus | The IUT to stop transmitting. |  |
| 6 | Procedure | Repeat steps 1-5 for each supported value of *‘pDataRate’* in Table 4-2 |  |
| 7 | Procedure | Repeat steps 1-6 for each supported value of ‘*pChannel’* in Table 4-1 |  |

#### TP-16094-TXT-MDE-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Purpose Id** | | TP-16094-TXT-MDE-BV-02 | |
| **Summary** | | Verify that the IUT will transmit WSMs in alternating channel mode on channels CH1 and CH2 | |
| **Test Configuration** | | TC1 | |
| **Reference:** | | [2] 6.3.2 | |
| **PICS Selection** | | M4.2 | |
| **Pre-test conditions** | | | |
| * The IUT is in initial state as per sec 4.3.1. | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Configure | Test Equipment to receive WSM1 message in alternating channel mode on ‘CH1’ |  |
| 2 | Configure | Test Equipment to receive WSM2 message in alternating channel mode on ‘CH2’ |  |
| 3 | Configure | IUT to transmit WSM1s continuously in alternating channel mode on ‘CH1’ with ‘*pDataRate*’ at ‘*pWSMRepeatRate*’ |  |
| 4 | Configure | IUT to transmit WSM2s continuously in alternating channel mode on ‘CH2’ with ‘*pDataRate*’ at ‘*pWSMRepeatRate*’ |  |
| 5 | Stimulus | IUT to transmit WSM1 and WSM2 messages |  |
| 6 | Verify | The Test Equipment receives WSM1 messages available on ‘CH1’ every *pWSMRepeatRate*. | PASS / FAIL |
| 7 | Verify | The Test Equipment receives WSM2 messages available on ‘CH2’ every *pWSMRepeatRate*. | PASS / FAIL |
| 8 | Stimulus | IUT to stop transmitting WSM1 and WSM2 messages. |  |
| 9 | Procedure | Repeat steps 1-8 for each supported value of ‘*pDataRate*’ in Table 4-2 |  |
| 10 | Procedure | Repeat steps 1-9 for each supported value of ‘CH1’, ‘CH2’ in Table 4-1 |  |

### 1609.4 Transmit IPv6 Validation

#### TP-16094-TXT-IP6-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Purpose Id** | | TP-16094-TXT-IP6-BV-01 | |
| **Summary** | | Verify transmission of IPv6 message on service channel from IUT | |
| **Test Configuration** | | TC1 | |
| **Reference:** | | [2] 5.3.4 | |
| **PICS Selection** | | M5.6 | |
| **Pre-test conditions** | | | |
| * The IUT is in initial state as per sec 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Configure | The Test Equipment is configured to receive IPv6 messages on *pChannel* |  |
| 2 | Configure | The IUT is configured with a transmitter profile which includes *pChannel* and *pDataRate* to be used for communicating using IPv6 |  |
| 3 | Configure | The IUT is to transmit IPv6 messages using transmitter profile |  |
| 4 | . Stimulus | The IUT transmitted IPv6 messages |  |
| 5 | Verify | The Test Equipment received IPv6 messages on *pChannel*. | PASS / FAIL |
| 6 | Procedure | Repeat steps 1-7 for each supported value of *pDataRate* in Table 4-2 |  |
| 7 | Procedure | Repeat steps 1-8 for each supported value of *pChannel* in Table 4-1 |  |

### 1609.4 Performance Validation

#### TP-16094-TXT-PER-BV-01

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Purpose Id** | | TP-16094-TXT-PER-BV-01 | |
| **Summary** | | Transmit WSM messages from IUT in alternating channel mode while receiving IPv6 messages on service channel and verify proper transmission of WSM & reception of IPv6 messages | |
| **Test Configuration** | | TC1 | |
| **Reference:** | | [2] 5.3.4, 6.3.2 | |
| **PICS Selection** | | M6.3, M4.2 | |
| **Pre-test conditions** | | | |
| * The IUT is in initial state as per sec 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Configure | The IUT is configured with a transmitter profile with *pDataRate* to receive IPv6 messages on ‘CH2’ in alternating channel mode. |  |
| 2 | Configure | The IUT is configured to transmit WSMs on ‘CH1’ in alternating channel mode with *pDataRate*. |  |
| 3 | Stimulus | The Test Equipment transmits IPv6 messages on ‘CH2’ in alternative mode with the repeat rate *pIPv6epeatRate* |  |
| 4 | Stimulus | The IUT transmit WSMs on ‘CH1’ with alternative with the repeat rate *pWSMRepeatRate* |  |
| 5 |  | The *‘*CH2*’* using alternative channel mode and *pDataRate* with an average repeat rate of  *pIPv6epeatRate*. |  |
| 6 | Verify | The Test Equipment receives WSMs on ‘CH1’ using alternative channel mode and *pDataRate* with an average repeat rate of *pWSMRepeatRate* | PASS / FAIL |
|  |  |  |  |
| 7 | Procedure | Repeat Steps 1-6 for each supported *pDataRate* in Table 4-2 |  |
| 8 | Procedure | Repeat Steps 1-7 for each supported combination of ‘CH1’ and ‘CH2’ in Table 4-1 |  |

#### TP-16094-TXT-PER-BV-02

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Purpose Id** | | TP-16094-TXT-PER-BV-02 | |
| **Summary** | | Transmit WSM messages from IUT in alternating channel mode while transmitting IPv6 messages in service channel and verify proper transmission of WSM & IPv6 messages | |
| **Test Configuration** | | TC1 | |
| **Reference:** | | [2] 5.3.4, 6.3.2 | |
| **PICS Selection** | | M5.6, M4.2 | |
| **Pre-test conditions** | | | |
| * The IUT is in initial state as per sec 4.3.1 | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Configure | The IUT is configured with a transmitter profile with *pDataRate* to transmit IPv6 messages on ‘CH2’ in alternating channel mode. |  |
| 2 | Configure | The IUT is configured to transmit WSMs on ‘CH1’ in alternating channel mode with *pDataRate*. |  |
| 3 | Stimulus | The IUT transmits IPv6 messages on ‘CH2’ in alternative mode with the repeat rate *pIPv6epeatRate* |  |
| 4 | Stimulus | The IUT transmit WSMs on ‘CH1’ with alternative with the repeat rate *pWSMRepeatRate* |  |
| 5 | Verify | The Test Equipment receives IPv6 messages on *‘*CH2*’* using alternative channel mode and *pDataRate* with an average repeat rate of  *pIPv6epeatRate*. | PASS / FAIL |
| 6 | Verify | The Test Equipment receives WSMs on ‘CH1’ using alternative channel mode and *pDataRate* with an average repeat rate of *pWSMRepeatRate* | PASS / FAIL |
| 7 | Procedure | Repeat Steps 1-6 for each supported *pDataRate* in Table 4-2 |  |
| 8 | Procedure | Repeat Steps 1-7 for each supported combination of ‘CH1’ and ‘CH2’ in Table 4-1 |  |

#### TP-16094-TXT-PER-BV-03

|  |  |  |  |
| --- | --- | --- | --- |
| **Test Purpose Id** | | TP-16094-TXT-PER-BV-03 | |
| **Summary** | | Transmit WSM from IUT and verify channel identifier [2] refers to a valid channel. | |
| **Test Configuration** | | TC1 | |
| **Reference:** | | [2] 5.3.3 | |
| **PICS Selection** | | M5.5 | |
| **Pre-test conditions** | | | |
| * The IUT is in initial state. | | | |
| **Test Sequence** | | | |
| **Step** | **Type** | **Description** | **Verdict** |
| 1 | Configure | Test Equipment to receive WSM on a channel supported by IUT |  |
| 2 | Configure | The IUT to transmit WSMs on the same channel configured in step 1 |  |
| 3 | Stimulus | The IUT to transmit WSMs |  |
| 4 | Verify | Test Equipment receives WSMs | PASS / FAIL |
| 5 | Configure | Test Equipment to receive WSM on achannel not supported by IUT |  |
| 6 | Configure | The IUT to transmit WSMs on the same channel configured in step 5 |  |
| 7 | Stimulus | The IUT to transmit WSMs |  |
| 8 | Verify | Test Equipment does not receive WSM | PASS / FAIL |
| 9 | Configure | Test Equipment to receive WSM on a channel supported by IUT |  |
| 10 | Configure | The IUT to transmit WSMs onthe same channel configured in step 9 |  |
| 11 | Stimulus | The IUT to transmit WSMs |  |
| 12 | Verify | Test Equipment receives WSMs | PASS / FAIL |

# Appendix A: Traceability Matrix

This Section shows traceability from the requirements identified by PICS from IEEE 1609.4 [2] to the Test Purposes defined in this document.

For each element in the PICS table, the Support profile is identified based on the information provided in SAE J2945/1 [1]. The following support profiles include:

* V2V – mandatory features required for in-vehicle safety applications requiring transmission or reception of signed BSM messages.
* SCMS – Items marked SCMS are required if IPv6 communication over DSRC is supported, e.g. for communication with security service SCMS and to download security certificates from SCMS.

V2V and SCMS profiles are derived from SAE J2945/1 [1].

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **1609.4 PICS** | **Features** | **References** | **Status** | **Support** | **TP ID** | **TP Description** |
| M2, M2.1, M3, M3.1 | Continuous mode operation | [2] 5.2, 6.3.1, 5.2.1, 5.2.3 | O4, O | V2V: USA, channel 172, Class C  SCMS: USA, channels 172, 174, 176, 180, 182, 184, Class C | TP-80211-RXT-MDE-BV-01 | Transmit WSMs in continuous mode and verify IUT receives the transmitted messages. |
| TP-80211-TXT-MDE-BV-01 | Verify that the IUT will transmit WSMs in continuous mode on a selected channel |
| M4.2 | Alternate mode operation | [2] 6.3.2 | O | SCMS | TP-80211-RXT-MDE-BV-02 | Transmit WSMs in alternate mode and verify IUT receives the transmitted messages. |
| TP-80211-TXT-MDE-BV-02 | Verify that the IUT will transmit WSMs in alternate mode on channels CH1 and CH2 |
| M5.6 | IPv6 | [2] 5.3.4 | O3 | SCMS | TP-16094-TXT-IP6-BV-01 | Verify transmission of IPv6 message in service channel from IUT |
| M6.3, M4.2 | Supports both transmitting WSM and receiving IPv6 on alternate channels | [2] 5.3.4 | O3 | V2V, SCMS | TP-16094-TXT-PER-BV-01 | Transmit WSM messages from IUT while receiving IPv6 messages in service channel and verify proper transmission of WSM & reception of IPv6 messages |
| M5.6, M4.2 | Supports both transmitting IPv6 and WSM on alternate channels | [2] 5.3.4 | O3 | V2V, SCMS | TP-16094-TXT-PER-BV-02 | Transmit WSM messages from IUT while transmitting IPv6 messages in service channel and verify proper transmission of WSM & IPv6 messages |
| M5.5 | Send WSM | [2] 5.3.3 | O | Optional | TP-16094-TXT-PER-BV-03 | Transmit WSM from IUT and verify channel identifier refer to a valid channel. |

# Appendix B: PIXIT proforma

### B.1 System Specific Information

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Identifier | Comment | Type | Default value | Supported values |
| PX\_IP\_address\_IUT | IP address of IUT |  |  |  |
| PX\_IP\_address\_TS | IP address of Test System |  |  |  |
| PX\_TCP\_port\_IUT | TCP port used by Certification Interface to receive request from Test System. |  |  |  |
| PX\_TCP\_port\_TS | TCP port used by TS to listen for IUT indications and responses |  |  |  |
|  |  |  |  |  |

# Revision History

|  |  |  |
| --- | --- | --- |
| V0.1.0 | 12/08/2015 | Initial Draft |
| V.0.2.0 | 12/29/2015 | Updated traceability matrix. |
| V.0.3.0 | 01/15/2016 | Updated test parameters. |
| V.0.4.0 | 22/02/2016 | Added a test purpose; revised the document. |
| V.0.5.0 | 03/11/2016 | Changes to reflect the contents of the latest ASN.1 document |
| V.0.6.0 | 03/23/2016 | Major update following the walkthrough with industry experts |
| V1.0 | 9/15/2016 | Updated following CAMP review |
| V1.2 | 4/26/2017 | Added a row to Table 4‑3, Repeat Rate. This row defines WSA repeat rate at 10Hz.  Revised test cases for IPv6 based on IUT IPv6 configuration using WSA  TP-16094-TXT-IP6-BV-01  TP-16094-TXT-PER-BV-01  TP-16094-TXT-PER-BV-02 |
| V1.3 | Aug 2017 | Revised test cases for IPv6 based on IUT IPv6 configuration using TxProfile  TP-16094-TXT-IP6-BV-01  TP-16094-TXT-PER-BV-01  TP-16094-TXT-PER-BV-02  Updates in clauses 4.1.2.1, 4.1.2.7, 4.1.2.10 |

◙ End of Document ◙