

**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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Table of Contents

1	Scope	4
2	References	4
2.1	Normative References.....	4
2.2	Informative References	4
3	Definitions and abbreviations	5
3.1	Definitions.....	5
3.2	Abbreviations.....	5
4	Prerequisites and Test Configurations.....	5
4.1	Test Configurations	5
4.1.1	Functional Blocks	6
4.1.1.1	Global Positioning System (GPS) Simulator	6
4.1.1.2	PC	6
4.1.1.3	DSRC Test Generator/Receiver	6
4.1.1.4	DSRC IUT	6
4.1.2	Test parameters	6
4.1.2.1	Channels	6
4.1.2.2	Data Rate	7
4.1.2.3	Tester Transmit Power	7
4.1.2.4	IUT Transmit Power	7
4.1.2.5	Timeout	8
4.1.2.6	WSM Max Data Length.....	8
4.1.2.7	Transmission Rates	8
4.1.2.8	Messages.....	8
4.1.2.9	PSID.....	8
4.1.2.10	IP transmission and reception	9
4.2	Feature Restriction	9
4.3	Rules for the behavior description.....	10
4.3.1	States in Initial Conditions	10
5	Test Suite Structure (TSS)	11
5.1	Structure for Network Services tests	11
5.1.1	Root	11
5.1.2	Groups.....	11
5.1.3	Sub-Groups	11
5.1.4	Categories	11
6	Test Purposes (TP)	11
6.1	Introduction.....	11
6.1.1	TP definition conventions	11
6.1.2	TP Identifier naming conventions	12
6.1.3	Sources of TP definitions	12

6.2	Test purposes for 1609.4	13
6.2.1	1609.4 Receive Channel Access Mode Validation	13
6.2.1.1	TP-16094-RXT-MDE -BV-01	13
6.2.1.2	TP-16094-RXT-MDE-BV-02	13
6.2.2	16094 Transmit Access Mode Validation	14
6.2.2.1	TP-16094-TXT-MDE-BV-01	14
6.2.2.2	TP-16094-TXT-MDE-BV-02	14
6.2.3	1609.4 Transmit IPv6 Validation	15
6.2.3.1	TP-16094-TXT-IP6-BV-01	15
6.2.4	1609.4 Performance Validation	15
6.2.4.1	TP-16094-TXT-PER-BV-01	15
6.2.4.2	TP-16094-TXT-PER-BV-02	16
6.2.4.3	TP-16094-TXT-PER-BV-03	17
	Appendix A: Traceability Matrix	17
	Appendix B: PIXIT proforma	19
	B.1 System Specific Information	19
	Revision History	20

1 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.22222

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.

2 References

2.1 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] P1609.12™/D5 (Oct 2015) Draft Standard for Wireless Access in Vehicular Environments (WAVE) - 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 /D6 (2016) Standard for Wireless Access in Vehicular Environments – Networking Services

2.2 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".

3 Definitions and abbreviations

3.1 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.

3.2 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

4 Prerequisites and Test Configurations

4.1 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 the figure below.

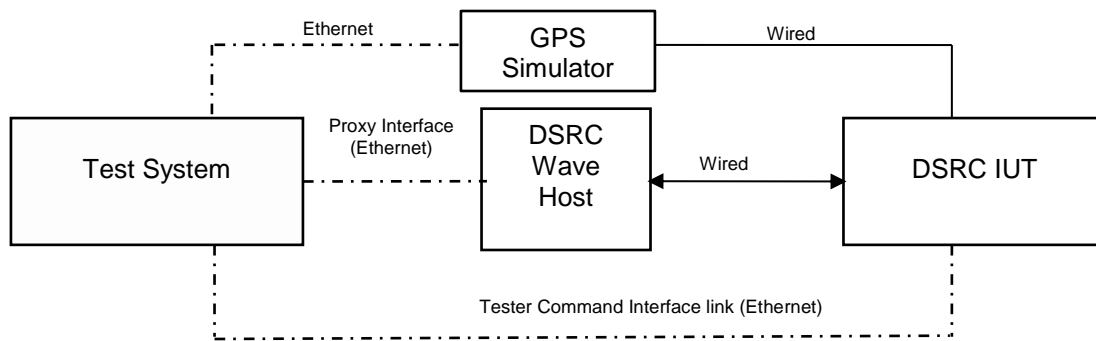


Figure 1: Test Configuration 1 (TC1)

4.1.1 Functional Blocks

Following are the functional blocks used in the above diagram.

4.1.1.1 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.

4.1.1.2 PC

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

4.1.1.3 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.

4.1.1.4 DSRC IUT

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

4.1.2 Test parameters

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

Note:

- a) All the WSM messages transmitted from the IUT will be of a broadcast type unless otherwise specified.
- b) 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.

4.1.2.1 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 as CH1, CH2, <i>pChannel</i>	10MHz channels: 172, 174, 176, 178, 180, 182, 184 20MHz channels: 175, 181	172, 174, etc.	[2]

Set *pChannel* to each supported channel.

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

4.1.2.2 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
<i>pDataRate</i>	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]

Set *pDataRate* to each supported data rate.

4.1.2.3 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.

4.1.2.4 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 document is 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: $\text{MaxTxPowerCap} + \text{vTxPwrRange} - \text{vRPM}_{\text{Max}} + \text{MinSectorAntGain} - \text{CLoss}$

Assuming

$$\text{vTxPwrRange} = 10\text{dBm [1].}$$

$$\text{vRPM}_{\text{Max}} = 20\text{dBm [1].}$$

$$\text{MinSectorAntGain} - \text{CLoss} = 0 \text{ (for module testing at connector port)}$$

4.1.2.5 Timeout

The TIMEOUT interval is 100ms unless otherwise specified.

Rationale: This is two times the channel switching interval.

4.1.2.6 WSM Max Data Length

Default value for *WsmMaxDataLength* is 1400 bytes.

4.1.2.7 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 (<i>pWSMRepeatRate</i>)	TP-16094-RXT-MDE-BV-01, TP-16094-TXT-MDE-BV-01	20 messages per second (20 Hz)
Repeat Rate for WSM transmissions (<i>pWSMRepeatRate</i>)	TP-16094-RXT-MDE-BV-02, TP-16094-TXT-MDE-BV-02, TP-16094-TXT-PER-BV-01, TP-16094-TXT-PER-BV-02	10 messages per second (10 Hz)
Repeat Rate for WSA transmissions (<i>pWSARepeatRate</i>)	TP-16094-TXT-IPv6-BV-01, TP-16094-TXT-PER-BV-01, TP-16094-TXT-PER-BV-02	10 messages per second (10 Hz)

Message repeat rates used in [7] uses the message repeat rate as the number of messages per 5 sec interval. When *pWSARepeatRate* or *pWSMRepeatRate* 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 SUT 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 messages (per 5 seconds).

4.1.2.8 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).

4.1.2.9 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]

4.1.2.10 IP transmission and reception

For IP datagrams, WSA with the required ServiceInfo, ChannelInfo and WRA transmitted by the Wave Host as defined in Table 4-6 shall be used to configure the IUT for IPv6 Communication with the Test System.

Table 4-6 WSA_IProuting

Information Element	Value/Remark	Comment
WSA_IProuting ::= SEQUENCE {		
version SEQUENCE {		
messageID	saMessage	
rsvAdvPrtVersion	3 (WSA version 3)	
headerOptionIndicator	0b0111	
}		
body SEQUENCE {	Any valid value	
serviceInfos SEQUENCE {		
serviceID	0pEF-FF-FF-FE	PSID values defined in table 4.5
channelIndex	firstEntry	1st entry in Channel Info Segment
chOptions SEQUENCE {	Any valid value	
}		
channelInfos SEQUENCE {	Any valid value	
routingAdvertisement SEQUENCE{		
lifetime	Any valid value	Duration of the test
ipPrefix	Any valid value	Supports generation of global IPv6
ipPrefixLength	Any valid value	
defaultGateway	Any valid value	IPv6 address of the WAVE Host
primaryDns	Any valid value	
extensions SEQUENCE {		
{ extensionId	14 (Gateway MAC)	
Value	Any valid value	
}		
}		
}		

4.2 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

4.3 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.

4.3.1 States in Initial Conditions

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

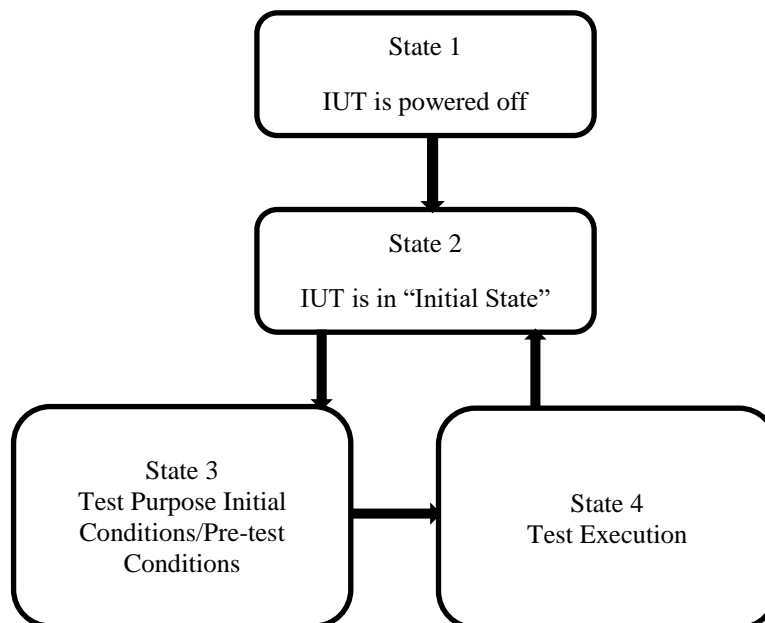
- Test Environment and Test System has reached room temperature (21 degrees Celsius +/- 5 degrees).
- The IUT is polled until the device is ready for operation.
- The IUT is not transmitting or receiving messages over DSRC link.
- The IUT is not exchanging any IP traffic.
- The IUT is provisioned with 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.



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

5 Test Suite Structure (TSS)

5.1 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.

5.1.1 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).

5.1.2 Groups

This level contains two message types identified as:

Transmit tests
Receive tests

5.1.3 Sub-Groups

This level contains functional areas identified as:

Channel Access Mode tests
Performance tests
IPv6 tests

5.1.4 Categories

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

6 Test Purposes (TP)

6.1 Introduction

6.1.1 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.

6.1.2 TP Identifier naming conventions

TP identifiers are built according to

Table 6-2.

Identifier	TP-<root>-<gr>-<sgr>-<x>-<nn> or 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

6.1.3 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.

6.2 Test purposes for 1609.4

6.2.1 1609.4 Receive Channel Access Mode Validation

6.2.1.1 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 ‘ <i>pChannel</i> ’	
2	Configure	Test Equipment to transmit WSMs in continuous channel mode on ‘ <i>pChannel</i> ’ with ‘ <i>pDataRate</i> ’ at ‘ <i>pWSMRepeatRate</i> ’.	
3	Stimulus	Test Equipment to continuously transmit WSM messages	
4	Verify	IUT receives WSM messages available on ‘ <i>pChannel</i> ’ at every ‘ <i>pWSMRepeatRate</i> ’.	PASS / FAIL
5	Procedure	Repeat steps 1-4 for each supported value of ‘ <i>pDataRate</i> ’ in Table 4-2	
6	Procedure	Repeat steps 1-5 for each supported value of ‘ <i>pChannel</i> ’ in Table 4-1	
7	Configure	The IUT to initial state	

6.2.1.2 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 ‘ <i>pDataRate</i> ’ at ‘ <i>pWSMRepeatRate</i> ’	
4	Configure	Test Equipment to transmit WSM2s in alternating channel mode on ‘CH2’ with ‘ <i>pDataRate</i> ’ at ‘ <i>pWSMRepeatRate</i> ’	
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 ‘ <i>pDataRate</i> ’ in Table 4-2	
9	Procedure	Repeat steps 1-8 for each supported value of ‘CH1’, ‘CH2’ in Table 4-1	

10	Configure	The IUT to initial state.	
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6.2.2 16094 Transmit Access Mode Validation

6.2.2.1 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 ‘ <i>pChannel</i> ’	
2	Configure	IUT to transmit WSMs continuously in continuous channel mode on ‘ <i>pChannel</i> ’ and ‘ <i>pDataRate</i> ’ at ‘ <i>pWSMRepeatRate</i> ’	
3	Stimulus	The IUT to transmit WSMs.	
4	Verify	The Test Equipment received WSMs every <i>pWSMRepeatRate</i> .	PASS / FAIL
5	Stimulus	The IUT to stop transmitting.	
6	Procedure	Repeat steps 1-5 for each supported value of ‘ <i>pDataRate</i> ’ in Table 4-2	
7	Procedure	Repeat steps 1-6 for each supported value of ‘ <i>pChannel</i> ’ in Table 4-1	
8	Configure	The IUT to initial state	

6.2.2.2 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 <i>pWSMRepeatRate</i> .	PASS / FAIL
7	Verify	The Test Equipment receives WSM2 messages available on 'CH2' every <i>pWSMRepeatRate</i> .	PASS / FAIL
8	Stimulus	IUT to stop transmitting WSM1 and WSM2 messages.	
9	Procedure	Repeat steps 1-8 for each supported value of ' <i>pDataRate</i> ' in Table 4-2	
10	Procedure	Repeat steps 1-9 for each supported value of 'CH1', 'CH2' in Table 4-1	
11	Configure	The IUT to initial state	

6.2.3 1609.4 Transmit IPv6 Validation

6.2.3.1 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			
<ul style="list-style-type: none">The IUT is in initial state as per sec 4.3.1			
Test Sequence			
Step	Type	Description	Verdict
1	Configure	The Wave Host is transmitting WSA_IProuting as defined in table 4.5 containing ‘IP routing’ service at pWSARRepeatRate.	
2	Configure	The IUT received WSAs, generated an indication of the available service ‘IP routing’.	
3	Configure	The IUT to transmit IPv6 messages using channel and datarate as contained in the WSA_IProuting message.	
4	. Stimulus	IUT to transmit unicast IPv6 UDP messages to the Test Equipment global IPv6 address	
5	Verify	Test Equipment receives IPv6 messages on the designated WSA_IProuting message channel and datarate..	PASS / FAIL
6	Configure	The IUT to initial state	

6.2.4 1609.4 Performance Validation

6.2.4.1 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 Wave Host is transmitting WSA_IProuting as defined in table 4.5 containing 'IP routing' service at <i>pWSARepeatRate</i> .	
2	Configure	The IUT to receive IPv6 messages on the channel defined in the WSA	
3	Configure	The Test Equipment to transmit IPv6 UDP packets to the IUT in alternating channel mode on the channel defined in the WSA at <i>pWSMRepeatRate</i> .	
4	Stimulus	Test Equipment to transmit IPv6 UDP packets to the IUT on the channel defined in the WSA.	
5	Configure	The Test Equipment to receive WSM messages on 'CH1' with 'vDataRate'.	
6	Configure	The IUT to transmit WSMs continuously in alternating channel mode on 'CH1' with ' <i>pDataRate</i> ' at <i>pWSMRepeatRate</i> .	
7	Stimulus	IUT to transmit WSMs on 'CH1'	
8	Verify	Test Equipment receives WSM messages on 'CH1' every <i>pWSMRepeatRate</i> .	PASS / FAIL
9	Verify	IUT receives IPv6 messages on the channel defined in the WSA	PASS / FAIL
10	Procedure	Repeat Steps 5-9 for each supported <i>pDataRate</i> in Table 4-2	
11	Procedure	Repeat Steps 5-10 for each supported <i>pChannel</i> in Table 4-1	
12	Stimulus	IUT to stop transmitting WSMs.	
13	Configure	The IUT to initial state	

6.2.4.2 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			
<ul style="list-style-type: none">The IUT is in initial state as per sec 4.3.1			
Test Sequence			
Step	Type	Description	Verdict
1	Configure	The Wave Host is transmitting WSA_IProuting as defined in table 4.5 containing ‘IP routing’ service at $pWSARepeatRate$.	
2	Configure	Test Equipment to receive IPv6 messages on the channel defined in the WSA.	
3	Configure	The Test Equipment to receive WSM messages on ‘CH1’	
4	Configure	The IUT to transmit IPv6 UDP packets to the Test Equipment continuously on the channel defined in the WSA with parameters defined in the WSA at a repeat rate of $pWSMRepeatRate$	
5	Stimulus	IUT to transmit IPv6 UDP packets to the Test Equipment on the channel defined in the WSA.	
6	Configure	The IUT to transmit WSMs continuously on ‘CH1’ with ‘ $pDataRate$ ’ at $pWSMRepeatRate$.	
7	Stimulus	IUT to transmit WSMs on ‘CH1’	
8	Verify	Test Equipment receives WSM messages on ‘CH1’ every $pWSMRepeatRate$.	PASS / FAIL
9	Verify	Test Equipment receives IPv6 messages on the channel defined in the	PASS / FAIL

		WSA every $pWSMRepeatRate$.	
10	Stimulus	IUT to stop transmitting WSMs and IPv6 messages.	
11	Procedure	Repeat steps 6-10 for each supported value of ' $pDataRate$ ' in Table 4-2	
12	Procedure	Repeat steps 6-11 for each supported value of 'CH1' in Table 4-1	
13	Configure	The IUT to initial state	

6.2.4.3 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			
<ul style="list-style-type: none">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 a channel 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 on the same channel configured in step 9	
11	Stimulus	The IUT to transmit WSMs	
12	Verify	Test Equipment receives WSMs	PASS / FAIL
13	Configure	The IUT to initial state	

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
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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	TP-80211-RXT-MDE-BV-01	Transmit WSMs in continuous mode and verify IUT receives the transmitted messages.
				SCMS: USA, channels 172, 174, 176, 180, 182, 184, Class C	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.
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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

■ End of Document ■