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TECHNICAL SPECIFICATION

Intelligent Transport Systems (ITS);
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Conformance test specifications for Vulnerable Road Users (VRU) awareness service;
Part 2: Test Suite Structure and Test Purposes (TSS & TP);
Release 2

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is part 2 of a multi-part deliverable. Full details of the entire series can be found in part 1 [2].

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

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1 Scope

The present document provides the Test Suite Structure and Test Purposes (TSS & TP) for Vulnerable Road Users (VRU) Awareness Basic Service as defined in ETSI TS 103 300-3 [1] in compliance with the relevant requirements and in accordance with the relevant guidance given in ISO/IEC 9646-7 [i.5].

The ISO standard for the methodology of conformance testing (ISO/IEC 9646-1 [i.2] and ISO/IEC 9646-2 [i.3]) as well as the ETSI rules for conformance testing (ETSI ETS 300 406 [i.6]) are used as a basis for the test methodology.

2 References

2.1 Normative references

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

Referenced documents which are not found to be publicly available in the expected location might be found in the ETSI docbox.

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

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

[1] ETSI TS 103 300-3 (V2.2.1): "Intelligent Transport Systems (ITS); Vulnerable Road Users (VRU) awareness; Part 3: Specification of VRU awareness basic service; Release 2 ".

[2] ETSI TS 104 018-1 (2.1.1): " Intelligent Transport Systems (ITS); Testing; Conformance test specifications for Vulnerable Road Users (VRU) awareness service; Part 1: Test requirements and Protocol Implementation Conformance Statement (PICS) pro forma; Release 2".

2.2 Informative references

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

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

The following referenced documents may be useful in implementing an ETSI deliverable or add to the reader's understanding, but are not required for conformance to the present document.

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

[i.2] ISO/IEC 9646-1 (1994): "Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 1: General concepts".

[i.3] ISO/IEC 9646-2 (1994): "Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 2: Abstract Test Suite specification".

[i.4] ISO/IEC 9646-6 (1994): "Information technology — Open Systems Interconnection — Conformance testing methodology and framework — Part 6: Protocol profile test specification".

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

[i.6] ETSI ETS 300 406 (1995): "Methods for testing and Specification (MTS); Protocol and profile conformance testing specifications; Standardization methodology".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI TS 103 300-3 [1], ISO/IEC 9646-6 [i.4] and ISO/IEC 9646-7 [i.5] apply.

3.2 Symbols

Void.

3.3 Abbreviations

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

ATS	Abstract Test Suite
BTP	Basic Transport Protocol
BV	valid test events for Behaviour tests
CAM	Cooperative Awareness Messages
CPM	Collective Perception Message
GN	GeoNetworking
ISO	International Organization for Standardization
ITS	Intelligent Transportation Systems
ITS-AID	ITS Application Identifier
ITS-S	Intelligent Transport System - Station
IUT	Implementation Under Test
LF	Low Frequency
MSGF	Message Format
PDU	Protocol Data Unit
PICS	Protocol Implementation Conformance Statement
PIXIT	Partial Protocol Implementation eXtra Information for Testing
SSP	Service Specific Permissions
TI	Timer tests
TP	Test Purposes
TS	Test Suite
TSS	Test Suite Structure
VAM	VRU Awareness Message
VBS	VRU Basic Service
VRU	Vulnerable Road User

4 Test Suite Structure (TSS)

4.1 Structure for VBS tests

Table 1 shows the VBS Test Suite Structure (TSS) including its subgroups defined for conformance testing.

Table 1: TSS for VBS

Root	Group	category
VAM	Message format	Valid
	Interface to the GeoNetworking/BTP stack	Valid
	Interface to the ITS-S security entity	Valid
	Transition triggering between clustering states	Valid
	Frequency/Periodicity range of VAMs	Valid and Timer
	Transmitting VAMs	Valid
	Triggering conditions	Valid
	Security constraints	Valid

The test suite is structured as a tree with the root defined as DEN. The tree is of rank 2 with the first rank a functional area and the second rank is the standard ISO conformance test categories.

4.2 Test groups

4.2.1 Introduction

The test suite has a total of three levels. The first level is the root. The second level separates the root into various functional areas. The third level is the standard ISO conformance test categories.

4.2.2 Root

The root identifies the Vulnerable Road Users (VRU) awareness service given in ETSI TS 103 300-3 [1].

4.2.3 Groups

This level contains height functional areas identified as:

- Message format
- Interface to the GeoNetworking/BTP stack
- Interface to the ITS-S security entity
- Transition triggering between clustering states
- Frequency/Periodicity range of VAMs
- Transmitting VAMs
- Triggering conditions
- Security constraints

4.2.4 Categories

This level contains the standard ISO conformance test categories behaviour: valid events and Timer.

5 Test Purposes (TP)

5.1 Introduction

5.1.1 TP definition conventions

The TP definition is built according to ETSI EG 202 798 [i.1].

5.1.2 TP Identifier naming conventions

The identifier of the TP is built according to Table 2.

Table 2: TP naming convention

TP/<root>/<gr>/<x>/<nn> or TP/<root>/<gr>/<x>/<nn>-<v>	Abbreviation	Description
<root> = root	VBS	
<gr> = group	MSGF	Message format
	IFGN	Interfaces - GeoNetworking
	INSE	Interfaces - security entity
	CLTR	Clustering
	FRPE	Frequency / periodicity range of VAMs
	TRAN	Transmission
	TRCN	Triggering conditions
	SECC	Security constraints
<x> = type of testing	BV	Behaviour: Valid event tests
	TI	Timer tests
<nn> = sequential number		01 to 99
<v> = variant		01 to 99

5.1.3 Rules for the behaviour description

The description of the TP is built according to ETSI EG 202 798 [i.1].

ETSI TS 103 300-3 [1] does not use the finite state machine concept. As consequence, the 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.

5.1.4 Sources of TP definitions

All TPs have been specified according to ETSI TS 103 300-3 [1].

5.1.5 Mnemonics for PICS reference

To avoid an update of all TPs when the PICS document is changed, Table 3 introduces mnemonics name and the correspondence with the real PICS item number.

The PICS item column refers to tables and items of ETSI TS 104 018-1 [2]. The 'PICS item' as defined in ETSI TS 104 018-1 [2] shall be used to determine the test applicability.

Table 3: Mnemonics for PICS reference

Mnemonic	PICS item
PICS_VAM_GENERATION	A.1/1
PICS_VAM_TRANSMISSION	A.1/2
PICS_PROFILE_PEDESTRIAN	A.3/1
PICS_PROFILE_BICYCLIST	A.3/2
PICS_PROFILE_MOTORCYCLIST	A.3/3
PICS_PROFILE_ANIMAL	A.3/4
PICS_CLUSTERING	A.4/1
PICS_SECURITY	A.5/1
PICS_ELEVATED_HAZARD_SITUATION	A.7/1
PICS_ITS_G5	A.2/1

5.1.6 VRU roles and clustering states

A VRU can be in two different roles (VRU_ROLE_ON and VRU_ROLE_OFF). They are defined in ETSI TS 103 300-3 [1] in Table 1. The VBS can take on different clustering states (VRU-IDLE, VRU-ACTIVE-STANDALONE, VRU-ACTIVE-CLUSTER-LEADER, VRU-Passive) that are defined in ETSI TS 103 300-3 [1], Table 5.

5.2 Test purposes for VBS

5.2.1 Message format

TP Id	TP/VBS/MSGF/BV-01
Test objective	Check that protocolVersion is set to 3 and messageID is set to 16
Reference	ETSI TS 103 300-3 [1], clause 7.2
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing ITS PDU header
containing protocolVersion
indicating value 3
and containing messageID
indicating value 16
}
}	

TP Id	TP/VBS/MSGF/BV-02
Test objective	Check that the generation time in the VAM is the time of reference position since ITS epoch modulo 2^{16}
Reference	ETSI TS 103 300-3 [1], clause 7.2
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing generation time
indicating reference position time in milliseconds since ITS epoch mod 2^{16}
}
}	

NOTE: Current Time - 5 s < Time of Reference Position < Current Time + 5 s	

TP Id	TP/VBS/MSGF/BV-03
Test objective	Check that StationType only takes supported values
Reference	ETSI TS 103 300-3 [1], clause 7.3.1
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing VamAwarness
containing BasicContainer
containing StationType
indicating pedestrian or
indicating cyclist or
indicating moped or
indicating motorcycle or
indicating lightVruVehicle or
indicating animal
}
}	

TP Id	TP/VBS/MSGF/BV-04
Test objective	Check that the reference point is the ground position of the center of the front side of the bounding box of the VRU
Reference	ETSI TS 103 300-3 [1], clause 7.3.1
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM generation requested
}
then {
VAM is sent
containing VamAwarness
containing BasicContainer
containing ReferencePosition
containing reference position
indicating ground position of the center of the front side of the bounding box
}
}	

NOTE: Test case not automatically testable. To be tested manually.	

TP Id	TP/VBS/MSGF/BV-05
Test objective	Check that the curvature includes the curvatureValue which is the inverse of the VRU curve radius and the turning direction of the curve
Reference	ETSI TS 103 300-3 [1], clause 7.3.3
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU is following a curve with radius RADIUS and turning direction DIRECTION
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing VamAwarness
containing VruHighFrequencyContainer
containing curvature
containing curvatureValue
indicating DIRECTION * 1/(RADIUS *10000)
}
}	

NOTE: DIRECTION can be 1 (left) or -1 (right)	

TP Id	TP/VBS/MSGF/BV-06
Test objective	Check that the yawRate includes the yawRateValue
Reference	ETSI TS 103 300-3 [1], clause 7.3.3
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has a yaw rate of YAW_RATE
 	
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing VamAwarness
containing VruHighFrequencyContainer
containing yawRate
containing yawRateValue
indicating value YAW_RATE
}
}	

NOTE: Yaw rate YAW_RATE represents rotation around the z-axis, a negative value indicates clockwise rotation and a positive value counter-clockwise.	

TP Id	TP/VBS/MSGF/BV-07
Test objective	Check that the lateralAcceleration indicates the lateral acceleration perpendicular to the heading direction
Reference	ETSI TS 103 300-3 [1], clause 7.3.3
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has a lateral acceleration of LAT_ACC
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing VamAwarness
containing VruHighFrequencyContainer
containing lateralAcceleration
indicating value LAT_ACC
}
}	

TP Id	TP/VBS/MSGF/BV-08
Test objective	Check that the vruLanePosition describes a lane on the road, a lane off the road or an island between two lanes
Reference	ETSI TS 103 300-3 [1], clause 7.3.3
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU in lane LANE
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing VamAwarness
containing VruHighFrequencyContainer
containing simpleLanePosition
indicating lane LANE
}
}	

TP Id	TP/VBS/MSGF/BV-09
Test objective	Check that the orientation defines the angle between the longitudinal axis and WGS84 north
Reference	ETSI TS 103 300-3 [1], clause 7.3.3
PICS Selection	PICS_VAM_GENERATION, PICS_PROFILE_BICYCLIST or PICS_PROFILE_MOTORCYCLIST
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has heading HEADING
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing VamAwarness
containing vruHighFrequencyContainer
containing orientation
containing headingValue
indicating value HEADING
}
}	

NOTE: Heading h represents angle between longitudinal axis and WGS84 north.	

TP Id	TP/VBS/MSGF/BV-10
Test objective	Check that the rollAngle includes the angle between the ground plane and the vehicle's y-axis as well as the angle accuracy and that no values between 500 and 3 100 are used
Reference	ETSI TS 103 300-3 [1], clause 7.3.3
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has roll angle heading of ROLL_ANGLE with heading confidence of CONFIDENCE
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing VamAwarness
containing vruHighFrequencyContainer
containing rollAnlge
containing headingValue
indicating value ROLL_ANGLE
and containing headingConfidence
indicating value CONFIDENCE < 500 and CONFIDENCE > 3100
}
}	

TP Id	TP/VBS/MSGF/BV-11
Test objective	Check that the deviceUsage uses values between 0 and 8
Reference	ETSI TS 103 300-3 [1], clause 7.3.3
PICS Selection	PICS_VAM_GENERATION, PICS_PROFILE_PEDESTRIAN
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU in profile pedestrian (1)
and VRU has deviceUsage D
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing VamAwarness
containing vruHighFrequencyContainer
containing deviceUsage
indicating value D
}
}	

TP Id	TP/VBS/MSGF/BV-12
Test objective	Check that the profileAndSubprofile contains the profile and sub-profile of the VRU if the VRU LF container is present
Reference	ETSI TS 103 300-3 [1], clause 7.3.4
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has profile PROFILE and sub-profile SUBPROFILE
 	
}	

Expected behaviour	

ensure that {
when {
VAM is generated
and VRU LF container is present
}
then {
VAM is sent
containing VamAwarness
containing vruLowFrequencyContainer
containing profileAndSubprofile
indicating value included in PROFILE
containing sub-profile
indicating value included in SUBPROFILE
}
}	

NOTE: The conditions for including the LF container are tested in TP/VBS/FRPE/BV-03 and TP/VBS/FRPE/BV-04.	

TP Id	TP/VBS/MSGF/BV-13
Test objective	Check that the sizeClass contains size information of the VRU
Reference	ETSI TS 103 300-3 [1], clause 7.3.4
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has sizeClass SC
}	

Expected behaviour	

ensure that {
when {
VAM is generated
and VRU LF container is present
}
then {
VAM is sent
containing VamAwarness
containing vruLowFrequencyContainer
containing sizeClass
indicating value SC
}
}	

TP Id	TP/VBS/MSGF/BV-14
Test objective	Check that exteriorLights is present for VRU profile 2
Reference	ETSI TS 103 300-3 [1], clause 7.3.4
PICS Selection	PICS_VAM_GENERATION, PICS_PROFILE_BICYCLIST
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU in profile bicyclist (2)
}	

Expected behaviour	

ensure that {
when {
VAM is generated
and VRU LF container is present
}
then {
VAM is sent
containing VamAwarness
containing vruLowFrequencyContainer
containing exteriorLights
}
}	

TP Id	TP/VBS/MSGF/BV-15
Test objective	Check that clusterProfiles is not set to zeros if VRU has profile 1, 2 or 4
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING, PICS_PROFILE_PEDESTRIAN or PICS_PROFILE_BICYCLISTor PICS_PROFILE_ANIMAL
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU is part of cluster
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing VamAwarness
containing vruClusterInformationContainer
containing clusterProfiles
not indicating value 0000
}
}	

TP Id	TP/VBS/MSGF/BV-16
Test objective	Check that clusterLeaveReason indicates clusterLeaderLost when the cluster leader is lost
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-PASSIVE
and VRU has last received a cluster VRU from cluster leader at time T1
}	

Expected behaviour	

ensure that {
when {
timeClusterContinuity has passed since T1
}
then {
VAM is sent
containing VamAwarness
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterLeaveReason
indicating clusterLeaderLost (1)
}
}	

TP Id	TP/VBS/MSGF/BV-17
Test objective	Check that clusterLeaveReason indicates clusterDisbandedByLeader when the cluster leader breaks up the cluster
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-PASSIVE
}	

Expected behaviour	

ensure that {
when {
VRU receives VAM
containing vruClusterOperationContainer
containing clusterBreakupInfo
from cluster leader
}
then {
VAM is sent
containing VamAwarness
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterLeaveReason
indicating clusterDisbandedByLeader (2)
}
}	

TP Id	TP/VBS/MSGF/BV-18
Test objective	Check that clusterLeaveReason indicates outOfClusterBoundingBox when the VRU moves out of the cluster bounding box
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-PASSIVE
and VRU has received a cluster VAM from cluster leader
containing vruClusterInformationContainer
containing clusterBoundingBoxShape
indicating Shape S
}	

Expected behaviour	

ensure that {
when {
the IUT is alerted about new reference position value P
and P is not inside S
}
then {
VAM is sent
containing VamAwarness
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterLeaveReason
indicating outOfClusterBoundingBox (3)
}
}	

TP Id	TP/VBS/MSGF/BV-19
Test objective	Check that clusterLeaveReason indicates outOfClusterSpeedRange when the VRU is out of the cluster speed range
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-PASSIVE
and VRU has received a cluster VAM from cluster leader
containing vruHighFrequencyContainer
containing speed
containing speedValue
indicating value SPEED_1
}	

Expected behaviour	

ensure that {
when {
the IUT is alerted about new own speed value SPEED_2
and abs(SPEED_2 - SPEED_1) > maxClusterVelocityDifference
}
then {
VAM is sent
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterLeaveReason
indicating outOfClusterSpeedRange (4)
}
}	

TP Id	TP/VBS/MSGF/BV-20
Test objective	Check that clusterLeaveReason indicates joiningAnotherCluster when the VRU is joining another cluster
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-PASSIVE
}	

Expected behaviour	

ensure that {
when {
VBS has received a VAM from another cluster leader
containing vruClusterInformationContainer
containing clusterId
indicating CId
}
then {
VAM is sent
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterLeaveReason
indicating joiningAnotherCluster (5)
and containing clusterJoinInfo
containing clusterId
indicating CId
}
}	

NOTE: The conditions for joining the other cluster are the same as in TP/VBS/CLTR/BV-05.	

TP Id	TP/VBS/MSGF/BV-21
Test objective	Check that clusterLeaveReason indicates CancelledJoin when the joining is cancelled
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VBS has started joining the cluster
}	

Expected behaviour	

ensure that {
when {
VBS has received a VAM from a cluster leader
containing vruClusterInformationContainer
containing clusterCardinalitySize
indicating value > maxClusterSize
}
then {
VAM is sent
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterLeaveReason
indicating CancelledJoin (6)
}
}	

TP Id	TP/VBS/MSGF/BV-22
Test objective	Check that clusterLeaveReason indicates FailedJoin when the joining is cancelled
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VBS has started joining the cluster
}	

Expected behaviour	

ensure that {
when {
VBS has received a VAM from a cluster leader
containing vruClusterInformationContainer
containing clusterCardinalitySize
indicating value > maxClusterSize
}
then {
VAM is sent
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterLeaveReason
indicating FailedJoin (7)
}
}	

TP Id	TP/VBS/MSGF/BV-23
Test objective	Check that clusterLeaveReason indicates SafetyCondition when another cluster VRU comes too close
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
another VRU in the cluster has come closer than MSLaD laterally
and another VRU in the cluster has come closer than MSLoD longitudinally
and another VRU in the cluster has come closer than MSVD vertically
}
then {
VAM is sent
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterLeaveReason
indicating SafetyCondition (8)
}
}	

TP Id	TP/VBS/MSGF/BV-24
Test objective	Check that clusterBreakupReason indicates clusteringPurposeCompleted when the clustering purpose is completed
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
the clustering purpose is completed
}
then {
VAM is sent
containing vruClusterInformationContainer
containing clusterId
containing vruClusterOperationContainer
containing clusterBreakupInfo
indicating value clusteringPurposeCompleted (1)
}
}	

TP Id	TP/VBS/MSGF/BV-25
Test objective	Check that clusterBreakupReason indicates outOfClusterBoundingBox when the cluster leader moves out of the cluster bounding box
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has sent a cluster VAM
containing vruClusterInformationContainer
containing clusterBoundingBoxShape
indicating Shape S
}	

Expected behaviour	

ensure that {
when {
the IUT is alerted about new reference position value P
and P is not inside S
}
then {
VAM is sent
containing vruClusterInformationContainer
containing clusterId
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterBreakupReason
indicating value leaderMovedOutOfClusterBoundingBox (2)
}
}	

TP Id	TP/VBS/MSGF/BV-26
Test objective	Check that clusterBreakupReason indicates joiningAnotherCluster when the cluster leader is joining another cluster
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VBS has received a VAM from another cluster leader
containing vruClusterInformationContainer
containing clusterId
indicating value CId
}
then {
VAM is sent
containing vruClusterInformationContainer
containing clusterId
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterBreakupReason
indicating value joiningAnotherCluster (3)
and containing clusterJoinInfo
containing clusterId
indicating value CId
}
}	

NOTE: The conditions for joining the other cluster are the same as in TP/VBS/CLTR/BV-05.	

TP Id	TP/VBS/MSGF/BV-27
Test objective	Check that clusterBreakupReason indicates enteringLowriskareaBasedonMAPs when the cluster leader is entering a low-risk area
Reference	7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
a MAP is received indicating the current position is in a low risk area
}
then {
VAM is sent
containing vruClusterInformationContainer
containing clusterId
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterBreakupReason
indicating value enteringLowriskareaBasedonMAPs (4)
}
}	

TP Id	TP/VBS/MSGF/BV-28
Test objective	Check that clusterBreakupReason indicates receptionOfCPMcontainingCluster when a CPM containing a cluster is received
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
a CPM is received that contains a cluster
}
then {
VAM is sent
containing vruClusterInformationContainer
containing clusterId
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterBreakupReason
indicating value receptionOfCPMcontainingCluster (5)
}
}	

TP Id	TP/VBS/MSGF/BV-29
Test objective	Check that clusterIdChangeTimeInfo indicates the time the cluster leader intents to change the cluster ID
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is generated
and VRU is changing cluster ID
}
then {
VAM is sent
containing vruClusterOperationContainer
containing clusterIdChangeTimeInfo
indicating planned ID change time
}
}	

TP Id	TP/VBS/MSGF/BV-30
Test objective	Check that the ClusterLeaveReason is systematically set to 0 if the reason for breaking up or leaving the cluster cannot be matched with the other reasons (1-8)
Reference	ETSI TS 103 300-3 [1], clause 7.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-PASSIVE
}	

Expected behaviour	

ensure that {
when {
VAM is generated
and VRU is leaving the cluster
and no other reason applicable to the given 8
}
then {
VAM is sent
containing vruClusterOperationContainer
containing clusterLeaveInfo
containing clusterId
and containing clusterLeaveReason
indicating value 0
}
}	

TP Id	TP/VBS/MSGF/BV-31
Test objective	Check that the VruMotionPredictionContainer includes the pathHistory of type PathHistory consisting of up to 40 past points
Reference	ETSI TS 103 300-3 [1], clause 7.3.6
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has n PathPoints
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing vruMotionPredictionContainer
containing pathHistory
containing n <= 40 PathPoints
containing pathPosition
}
}	

TP Id	TP/VBS/MSGF/BV-32
Test objective	Check that the VruMotionPredictionContainer includes the path prediction of type PathPredicted consisting of up to 15 future points, confidence values and time instances
Reference	ETSI TS 103 300-3 [1], clause 7.3.6
PICS Selection	PICS_VAM_GENERATION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has n VruPathPoints
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing vruMotionPredictionContainer
containing pathPrediction
containing n <= 15 times PathPointPredicted
containing horizontalPositionConfidence
and containing pathDeltaTime
}
}	

TP Id	TP/VBS/MSGF/BV-33
Test objective	Check that the vruMotionPredictionContainer includes the safe distance indication that includes timeToCollision
Reference	ETSI TS 103 300-3 [1], clause 7.3.6
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU has detected a possible collision
and VRU has timeToCollision of TTC
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing vruMotionPredictionContainer
containing safeDistance
containing VruSafeDistanceIndication
containing timeToCollision
indicating value TTC
}
}	

TP Id	TP/VBS/MSGF/BV-34
Test objective	Check that the vruMotionPredictionContainer includes the accelerationChangeIndication of type AccelerationChangeIndication containing accelOrDecel and actionDeltaTime
Reference	ETSI TS 103 300-3 [1], clause 7.3.6
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU accelerates or decelerates for time period DELTA_TIME
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing vruMotionPredictionContainer
containing accelerationChangeIndication
containing accelOrDecel
indicating accelerate / decelerate
and containing actionDeltaTime
indicating value DELTA_TIME
}
}	

TP Id	TP/VBS/MSGF/BV-35
Test objective	Check that the vruMotionPredictionContainer includes the headingChangeIndication of type HeadingChangeIndication containing the dircetion and actionDeltaTime
Reference	ETSI TS 103 300-3 [1], clause 7.3.6
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU changes heading to direction d for a time period DELTA_TIME
 	
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing vruMotionPredictionContainer
containing headingChangeIndication
containing direction
indicating value d
and containing actionDeltaTime
indicating value DELTA_TIME
}
}	

TP Id	TP/VBS/MSGF/BV-36
Test objective	Check that the vruMotionPredictionContainer includes the stabilityChangeIndication of type StabilityChangeIndication containing the lossProbability and actionDeltaTime
Reference	ETSI TS 103 300-3 [1], clause 7.3.6
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU changes stability by lossProbability P_L for a time period DELTA_TIME
 	
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing vruMotionPredictionContainer
containing stabilityChangeIndication
containing lossProbability
indicating value P_L
and containing actionDeltaTime
indicating value DELTA_TIME
}
}	

TP Id	TP/VBS/MSGF/BV-37
Test objective	Check that profile 3 VRUs only transmit a VRU special vehicle container in the CAM instead of full VAM
Reference	7.4
PICS Selection	PICS_VAM_GENERATION, PICS_PROFILE_MOTORCYCLIST
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VRU in profile motorcyclist (3)
}	

Expected behaviour	

ensure that {
when {
IUT is triggered to send awareness message
}
then {
CAM is sent
containing specialVehicleContainer
containing vruSpecialVehicleContainer
containing vruSubProfileMotorcyclist
and containing sizeClass
and no VAM is generated
}
}	

5.2.2 Interface to the GeoNetworking/BTP stack

TP Id	TP/VBS/IFGN/BV-01
Test objective	Check that the BTP header type B and the destination port is passed if the value is not provided by the ITS-S configuration
Reference	ETSI TS 103 300-3 [1], clause 5.3.3.3
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and data being passed from the VBS to GeoNetworking/BTP
and BTP type is not provided by the ITS-S configuration
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
Message is sent
containing BTP header
indicating type B
and containing destination port
indicating value 2018
}
}	

TP Id	TP/VBS/IFGN/BV-02
Test objective	Check that the GN packet transport type is GeoNetworking SHB and passed if the value is not provided by the ITS-S configuration
Reference	ETSI TS 103 300-3 [1], clause 5.3.3.3
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and data being passed from the VBS to GeoNetworking/BTP
and BTP type is not provided by the ITS-S configuration
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
Message is sent
containing GeoNetworking header
containing Common Header
containing Header Type
indicating SHB
}
}	

TP Id	TP/VBS/IFGN/BV-03
Test objective	Check that the GN security profile is passed if the value is not provided by the ITS-S configuration
Reference	ETSI TS 103 300-3 [1], clause 5.3.3.3
PICS Selection	PICS_VAM_GENERATION, PICS_SECURITY
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and GN security profile is activated
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
Message is sent
using GN secured packet
}
}	

TP Id	TP/VBS/IFGN/BV-03
Test objective	Check that the GN Traffic class is the same value as for the CAM
Reference	ETSI TS 103 300-3 [1], clause 5.3.3.3
PICS Selection	PICS_VAM_GENERATION
Initial conditions	
with { VBS in state VRU-ACTIVE-STANDALONE or VBS in state VRU-ACTIVE-CLUSTER-LEADER and data being passed from the VBS to GeoNetworking/BTP 	
Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
Message is sent
containing GeoNetworking header
containing Common Header
containing Traffic Class
indicating value TC = 2
}
}	

TP Id	TP/VBS/IFGN/BV-05
Test objective	Check that the GN Maximum packet lifetime does not exceed 1 000 ms
Reference	ETSI TS 103 300-3 [1], clause 5.3.3.3
PICS Selection	PICS_VAM_GENERATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and data being passed from the VBS to GeoNetworking/BTP
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
Message is sent
containing GeoNetworking header
containing Basic Header
containing Lifetime
indicating value <= 1000 ms
}
}	

5.2.3 Interface to the ITS-S security entity (IF.SF)

TP Id	TP/VBS/IFSE/BV-01
Test objective	Check that the VBS temporarily stops generating VAMs when it is notified of a pending identifier change
Reference	ETSI TS 103 300-3 [1], clause 5.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_SECURITY
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
identifier change requested by security entity
}
then {
VBS stops generating VAMs during the change procedure
}
}	

TP Id	TP/VBS/IFSE/BV-02
Test objective	Check that an identifier change is inhibited during an elevated hazard situation
Reference	ETSI TS 103 300-3 [1], clause 5.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_SECURITY, PICS_ELEVATED_HAZARD_SITUATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VBS is in elevated hazard situation
}	

Expected behaviour	

ensure that {
when {
identifier change requested by security entity
}
then {
VBS does not change identifier
}
}	

TP Id	TP/VBS/IFSE/BV-03
Test objective	Check that an identifier change is possible after an elevated hazard situation has passed
Reference	ETSI TS 103 300-3 [1], clause 5.3.5
PICS Selection	PICS_VAM_GENERATION, PICS_SECURITY, PICS_ELEVATED_HAZARD_SITUATION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VBS is in elevated hazard situation
and identifier change is requested by security entity
}	

Expected behaviour	

ensure that {
when {
elevated hazard situation has passed
}
then {
VBS changes identifier
}
}	

5.2.4 Transmitting VAMs

TP Id	TP/VBS/TRAN/BV-01
Test objective	Check that a VRU in VRU-ACTIVE-STANDALONE sends individual VAMs
Reference	ETSI TS 103 300-3 [1], clause 6.3
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
not containing vruClusterInformationContainer
and not containing vruClusterOperationContainer
}
}	

TP Id	TP/VBS/TRAN/BV-02
Test objective	Check that a VRU in VRU-ACTIVE-CLUSTER-LEADER sends cluster VAMs
Reference	ETSI TS 103 300-3 [1], clause 6.3
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VAM is sent
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRAN/BV-03
Test objective	Check that a VRU in VRU-PASSIVE sends individual VAMs containing VruClusterOperationContainer when leaving the VRU cluster
Reference	ETSI TS 103 300-3 [1], clause 6.3
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-PASSIVE
}	

Expected behaviour	

ensure that {
when {
VRU is triggered to leave cluster
}
then {
VAM is sent
containing vruClusterOperationContainer
and not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRAN/BV-04
Test objective	Check that a VRU in VRU-ACTIVE-STANDALONE sends individual VAMs containing VruClusterOperationContainer while joining a VRU cluster
Reference	ETSI TS 103 300-3 [1], clause 6.3
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
}	

Expected behaviour	

ensure that {
when {
VRU determines to join cluster
}
then {
VAM is sent
containing vruClusterOperationContainer
and not containing vruClusterInformationContainer
}
}	

5.2.5 Transition triggering between clustering states

TP Id	TP/VBS/CLTR/BV-01
Test objective	Check that a VBS starts sending VAMs when the state changes from VRU-IDLE to VRU-ACTIVE-STANDALONE
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.2
PICS Selection	PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-IDLE
}	

Expected behaviour	

ensure that {
when {
state changes to VRU-ACTIVE-STANDALONE
}
then {
VBS sends VAMs
not containing vruClusterOperationContainer
}
}	

TP Id	TP/VBS/CLTR/BV-02
Test objective	Check that the cluster size is set to minClusterSize and the VRU profile field is set to the VRU profile
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.2
PICS Selection	PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VBS has VRU profile p
}	

Expected behaviour	

ensure that {
when {
VBS determining to form a cluster
}
then {
VBS sends VAM
containing vruClusterInformationContainer
containing clusterProfiles
indicating value p
and containing clusterCardinalitySize
indicating value minClusterSize
}
}	

TP Id	TP/VBS/CLTR/BV-03
Test objective	Check that a VBS in VRU-ACTIVE-STANDALONE stops the transmission of VAMs when changing to VRU-IDLE
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.2
PICS Selection	PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
}	

Expected behaviour	

ensure that {
when {
state changes to VRU-IDLE
}
then {
VBS stops sending VAMs
}
}	

TP Id	TP/VBS/CLTR/BV-04
Test objective	Check that a cluster breaking VRU stops sending cluster VAMs
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.2
PICS Selection	PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
and breakup indication has been sent
}	

Expected behaviour	

ensure that {
when {
VBS breaking up cluster
}
then {
VBS stops sending cluster VAMs
}
}	

TP Id	TP/VBS/CLTR/BV-05
Test objective	Check that a VRU sends an indication of joining a cluster for timeClusterJoinNotification including the identified cluster and time at which it stops sending individual VAMs
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.2
PICS Selection	PICS_CLUSTERING

Initial conditions

```
with {
    VBS in state VRU-ACTIVE-STANDALONE
}
```

Expected behaviour

```
ensure that {
    when {
        VBS has received a VAM from a cluster leader
            containing basicContainer
                containing referencePosition
                    indicating Position
                    and distance(Position, EgoPosition) < maxClusterDistance
            and containing vruHighFreuquencyContainer
                containing speed
                    containing speedValue
                        indicating value
                        and abs(value – EgoSpeed) < maxClusterVelocityDifference
            and containing vruClusterInformationContainer
                containing clusterId
                    indicating Cid
                and containing clusterCardinalitySize
                    indicating value < maxClusterSize
    }
    then {
        VBS sends VAM
        for timeClusterJoinNotification
            not containing vruClusterInformationContainer
            and containing clusterOperationContainer
                containing clusterJoinInfo
                    containing clusterId
                        indicating CId
                    and containing joinTime
    }
}
```

TP Id	TP/VBS/CLTR/BV-06
Test objective	Check that a VBS sends individual VAMs after a cancelled-join odder failed-join including the same station ID as before and the cluster leave notification for timeClusterLeaveNotification
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.2
PICS Selection	PICS_CLUSTERING

Initial conditions

```
with {
    VBS in state VRU-ACTIVE-STANDALONE
    and cancelled-join has occurred
    or
    failed-join has occurred
    and stationID is value sID
}
```

Expected behaviour

```
ensure that {
    when {
        VBS generates VAM
    }
    then {
        VBS sends VAM
            not containing vruClusterInformationContainer
            and containing ITS PDU header
                containing stationID
                    indicating sID
    }
}
```

TP Id	TP/VBS/CLTR/BV-07
Test objective	Check that a VRU leaving a cluster indicates the identified cluster and the reason for timeClusterLeaveNotification
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.2
PICS Selection	PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-PASSIVE
}	

Expected behaviour	

ensure that {
when {
VRU leaving cluster CL1
}
then {
VBS sends VAMs
for timeClusterLeaveNotification
containing vruClusterOperationContainer
containing vruClusterInformationContainer
containing clusterId
indicating CL1
}
}	

TP Id	TP/VBS/CLTR/BV-08
Test objective	Check that a VRU that left a cluster uses different identifiers from before joining the cluster as long as it has not experienced a cancelled-join or failed-join
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.2
PICS Selection	PICS_CLUSTERING
Initial conditions	

with {
VRU has previously sent individual VAMs with stationID sID_{-1}
and VRU has joined a cluster
and VBS in state VRU-PASSIVE
}	

Expected behaviour	

ensure that {
when {
VRU is triggered to leave the cluster
}
then {
VBS sends VAMs
not containing vruOperationContainer
and containing ITS PDU Header
containing stationID
indicating value sID != sID_{-1}
and state changes to VRU-ACTIVE-STANDALONE
}
}	

NOTE: The conditions for leaving the cluster are tested in TP/VBS/MSGF/BV-24 and TP/VBS/MSGF/BV-28.	

TP Id	TP/VBS/CLTR/BV-09
Test objective	Check that a cluster leader indicates a cluster ID change for timeClusterIdChangeNotification before the change
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.3
PICS Selection	PICS_CLUSTERING

Initial conditions

```
with {
    VBS in state VRU-ACTIVE-CLUSTER-LEADER
    and is triggered to change cluster ID
    and VBS has sent VAM
        containing vruClusterInformationContainer
            containing clusterID
                indicating cID1
        and containing vruClusterOperationContainer
                containing clusterIdChangeTimeInfo
                    indicating value x
}
```

Expected behaviour

```
ensure that {
    when {
        IUT is sending
    }
    then {
        VBS sends multiple VAMs
        during timeClusterIdChangeNotification
            containing vruClusterInformationContainer
            and containing vruClusterOperationContainer
                containing clusterIdChangeTimeInfo
    }
}
```

TP Id	TP/VBS/CLTR/BV-10
Test objective	Check that a cluster leader sends a cluster VAM with the new ID as soon as possible
Reference	ETSI TS 103 300-3 [1], clause 5.4.2.3
PICS Selection	PICS_CLUSTERING

Initial conditions

```
with {
    VBS in state VRU-ACTIVE-CLUSTER-LEADER
    and change ID notification has been sent
}
```

Expected behaviour

```
ensure that {
    when {
        IUT is changing cluster ID
    }
    then {
        VBS sends VAMs
            containing vruClusterInformationContainer
                containing clusterId
                    indicating new cluster ID
    }
}
```

5.2.6 Triggering conditions

TP Id	TP/VBS/TRCN/BV-01
Test objective	Check that the first time individual VAM is generated immediately after VBS activation
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VBS activation has occurred
and VBS has sent no VAM yet
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-02
Test objective	Check that a VAM is generated immediately if a VRU is in VRU-IDLE and enters VRU-ACTIVE-STANDALONE
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-IDLE
}	

Expected behaviour	

ensure that {
when {
state changes to VRU-ACTIVE-STANDALONE
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-03
Test objective	Check that a VAM is generated immediately if a VRU is in VRU-PASSIVE, leaves the cluster and enters VRU-ACTIVE-STANDALONE
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-PASSIVE
}	

Expected behaviour	

ensure that {
when {
VRU leaves cluster
and state changes to VRU-ACTIVE-STANDALONE
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-04
Test objective	Check that a VAM is generated immediately if a VRU is in VRU-PASSIVE, determines the cluster leader is lost and enters VRU-ACTIVE-STANDALONE
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-PASSIVE
}	

Expected behaviour	

ensure that {
when {
cluster leader is lost
and state changes to VRU-ACTIVE-STANDALONE
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-05
Test objective	Check that a VAM is generated immediately if a VRU is in VRU-ACTIVE-CLUSTER-LEADER, breaks up the cluster and enters VRU-ACTIVE-STANDALONE
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VRU breaks up cluster
and state changes to VRU-ACTIVE-STANDALONE
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-06
Test objective	Check that consecutive individual VAM transmissions occur at an interval equal or larger than T_GenVam
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VAM has been transmitted at time t_1
not containing vruClusterInformationContainer
}	

Expected behaviour	

ensure that {
when {
VAM is transmitted at time t_2
not containing vruClusterInformationContainer
}
then {
$t_2 - t_1$ >= T_Gen_Vam
}
}	

TP Id	TP/VBS/TRCN/BV-07
Test objective	Check that consecutive VAM transmissions occur when T_GenVamMax is exceeded
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VAM has been transmitted at time t_1
and no other VAM has been sent since then
}	

Expected behaviour	

ensure that {
when {
T_GenVamMax is exceeded
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-08
Test objective	Check that consecutive individual VAM transmissions occur when the Euclidian absolute distance between the current estimated VRU reference point position and the last estimated VRU reference point position exceeds minReferencePointPositonChangeThreshold
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VAM has been transmitted at time t_1
not containing vruClusterInformationContainer
and containing basicContainer
containing referencePosition P_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_GenVam is exceeded
and the IUT is alerted about new position value P_2
and Euclidean distance (P_1, P_2) > minReferencePointPositonChangeThreshold
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-09
Test objective	Check that consecutive individual VAM transmissions occur when the difference between the current estimated VRU reference point ground speed and the last estimated VRU reference point ground speed exceeds minGroundSpeedChangeThreshold
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION

Initial conditions

with {
VBS in state VRU-ACTIVE-STANDALONE
and VAM has been transmitted at time t_1
not containing vruClusterInformationContainer
and containing vruHighFrequencyContainer
containing speed
containing speedValue
indicating v_1
and the IUT not having sent any other VAM
}

Expected behaviour

ensure that {
when {
T_GenVam is exceeded
and the IUT is alerted about new speed value v_2
and abs(v_2 - v_1) > minGroundSpeedChangeThreshold
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}

TP Id	TP/VBS/TRCN/BV-10
Test objective	Check that consecutive individual VAM transmissions occur when the difference between the orientation of the vector of the current estimated ground velocity of the reference point of the VRU and the estimated orientation of the vector of the ground velocity of the reference point of the VRU lastly included in an individual VAM exceeds minGroundVelocityOrientationChangeThreshold
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION

Initial conditions

with {
VBS in state VRU-ACTIVE-STANDALONE
and VAM has been transmitted at time t_1
not containing vruClusterInformationContainer
and containing vruHighFrequencyContainer
containing heading
containing headingValue
indicating h_1
and the IUT not having sent any other VAM
}

Expected behaviour

ensure that {
when {
T_GenVam is exceeded
and the IUT is alerted about new heading value h_2
and abs(h_2 - h_1) > minGroundVelocityOrientationChangeThreshold
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}

TP Id	TP/VBS/TRCN/BV-11
Test objective	Check that consecutive individual VAM transmissions occur when the difference between the current estimated trajectory interception probability with vehicle(s) or other VRU(s) and the trajectory interception probability with vehicle(s) or other VRU(s) lastly reported in an individual VAM exceeds minTrajectoryInterceptionProbChangeThreshold
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VAM has been transmitted at time t_1
not containing vruClusterInformationContainer
and containing vruMotionPredictionContainer
containing trajectoryInterceptionIndication
containing trajectoryInterceptionProbability
indicating p_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_GenVam is exceeded
and the IUT is alerted about new trajectory interception probability value p_2
and abs(p_2 - p_1) > minTrajectoryInterceptionProbChangeThreshold
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-12
Test objective	Check that consecutive individual VAM transmissions occur when one or more other VRUs are simultaneously coming closer than Minimum Safe Lateral Distance (MSLaD) laterally, closer than Minimum Safe Longitudinal Distance (MSLoD) longitudinally and closer than Minimum Safe Vertical Distance (MSVD) vertically
Reference	ETSI TS 103 300-3 [1], clause 6.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VAM has been transmitted at time t_1
not containing vruClusterInformationContainer
and VAM has been received from other VRU
containing basicContainer
containing referencePosition P_1
containing latitude
indicating lat_1
and containing longitude
indicating lon_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_GenVam is exceeded
and the IUT is alerted about new reference position value P_1
containing latitude value lat_2
and containing longitude value lon_2
and $abs(lat_2 - lat_1) < MSLaD$
and $abs(lon_2 - lon_1) < MSLoD$
and Euclidean distance $(P_1, P_2) < MSVD$
}
then {
VBS sends VAM
not containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-13
Test objective	Check that a VRU cluster VAM is generated immediately after a VRU in VRU-ACTIVE-STANDALONE determines to form a VRU cluster
Reference	ETSI TS 103 300-3 [1], clause 6.4.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
}	

Expected behaviour	

ensure that {
when {
VRU forms a cluster
}
then {
VBS sends VAM
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-14
Test objective	Check that consecutive cluster VAM transmissions occur when the Euclidean absolute distance between the current estimated VRU reference point position and the last estimated VRU reference point position exceeds minReferencePointPositonChangeThreshold
Reference	ETSI TS 103 300-3 [1], clause 6.4.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VAM has been transmitted at time t_1
containing vruClusterInformationContainer
and containing basicContainer
containing referencePosition P_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_GenVam is exceeded
and the IUT is alerted about new position value P_2
and Euclidean distance (P_1, P_2) > minReferencePointPositonChangeThreshold
}
then {
VBS sends VAM
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-15
Test objective	Check that consecutive cluster VAM transmissions occur when the difference between the current estimated ground speed of the reference point of the VRU cluster and the estimated absolute speed of the reference point lastly included a VRU cluster VAM exceeds minGroundSpeedChangeThreshold
Reference	ETSI TS 103 300-3 [1], clause 6.4.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in statestate VRU-ACTIVE-CLUSTER-LEADER
and VAM has been transmitted at time t_1
containing vruClusterInformationContainer
and containing vruHighFrequencyContainer
containing speed
containing speedValue
indicating v_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_GenVam is exceeded
and the IUT is alerted about new speed value v_2
and abs(v_2 - v_1) > minGroundSpeedChangeThreshold
}
then {
VBS sends VAM
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-16
Test objective	Check that consecutive cluster VAM transmissions occur when the difference between the orientation of the vector of the current estimated ground velocity of the reference point of the VRU cluster and the estimated orientation of the vector of the ground velocity of the reference point lastly included in a VRU cluster VAM exceeds minGroundVelocityOrientationChangeThreshold
Reference	ETSI TS 103 300-3 [1], clause 6.4.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VAM has been transmitted at time t_1
containing vruClusterInformationContainer
and containing vruHighFrequencyContainer
containing heading
containing headingValue
indicating h_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_GenVam is exceeded
and the IUT is alerted about new heading value h_2
and abs(h_2 - h_1) > minGroundVelocityOrientationChangeThreshold
}
then {
VBS sends VAM
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-17
Test objective	Check that consecutive cluster VAM transmissions occur when difference between the current estimated trajectory interception probability with vehicle(s) or other VRU(s) and the trajectory interception probability with vehicle(s) or other VRU(s) lastly reported in a cluster VAM exceeds minTrajectoryInterceptionProbChangeThreshold
Reference	ETSI TS 103 300-3 [1], clause 6.4.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in statestate VRU-ACTIVE-CLUSTER-LEADER
and VAM has been transmitted at time t_1
containing vruClusterInformationContainer
and containing vruMotionPredictionContainer
containing trajectoryInterceptionIndication
containing trajectoryInterceptionProbability
indicating p_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_GenVam is exceeded
and the IUT is alerted about new probability value p_2
and abs(p_2 - p_1) > minGroundVelocityOrientationChangeThreshold
}
then {
VBS sends VAM
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-18
Test objective	Check that consecutive cluster VAM transmissions occur when the cluster type has been changed after previous VAM generation event
Reference	ETSI TS 103 300-3 [1], clause 6.4.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VAM has been transmitted
containing vruClusterInformationContainer
and cluster type has been changed
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VBS sends VAM
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-19
Test objective	Check that consecutive cluster VAM transmissions occur when more than a pre-defined number of new VRUs has joined the VRU cluster after transmission of previous VRU cluster VAM
Reference	ETSI TS 103 300-3 [1], clause 6.4.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VAM has been transmitted
containing vruClusterInformationContainer
containing clusterCardinalitySize
indicating value S_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_Gen_Vam is exceeded
and the IUT alerted of a new cluster size S_2
and $S_2 - S_1 > T\_ClusterJoinMax$
}
then {
VBS sends VAM
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-20
Test objective	Check that consecutive cluster VAM transmissions occur when more than a pre-defined number of members has left the VRU cluster after transmission of previous VRU cluster VAM
Reference	ETSI TS 103 300-3 [1], clause 6.4.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VAM has been transmitted
containing vruClusterInformationContainer
containing clusterCardinalitySize
indicating value S_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_Gen_Vam is exceeded and the IUT alerted of a new cluster size S_2
and $S_1 – S_2 > T\_ClusterLeaveMax$
}
then {
VBS sends VAM
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-21
Test objective	Check that consecutive cluster VAM transmissions occur when one or more non-member VRUs are simultaneously coming closer than Minimum Safe Lateral Distance (MSLaD) laterally, closer than Minimum Safe Longitudinal Distance (MSLoD) longitudinally and closer than Minimum Safe Vertical Distance (MSVD) vertically
Reference	ETSI TS 103 300-3 [1], clause 6.4.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VAM has been transmitted at time t_1
containing vruClusterInformationContainer
and VAM has been received from other VRU
containing basicContainer
containing referencePosition P_1
containing latitude
indicating lat_1
and containing longitude
indicating lon_1
and the IUT not having sent any other VAM
}	

Expected behaviour	

ensure that {
when {
T_Gen_Vam is exceeded
and the IUT is alerted about new reference position value P_2
containing latitude value lat_2
and containing longitude value lon_2
and $abs(lat_2 - lat_1) < MSLaD$
and $abs(lon_2 - lon_1) < MSLoD$
and Euclidean distance (P_1, P_2) < MSVD
}
then {
VBS sends VAM
containing vruClusterInformationContainer
}
}	

TP Id	TP/VBS/TRCN/BV-22
Test objective	Check that a consecutive cluster VAM transmission is skipped if the time since the last VAM, the position change, the speed change and the heading change do not exceed the defined thresholds
Reference	ETSI TS 103 300-3 [1], clause 6.4.3
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VAM has been transmitted at time t_1
containing vruClusterInformationContainer
and VAM has been received from other VRU
containing basicContainer
containing referencePosition P_1
and containing vruHighFrequencyContainer
containing speed
containing speedValue
indicating value v_1
and containing heading
containing headingValue
indicating value h_1
and the IUT not having sent any other VAM
and [current time] - t_1 <= numSkipVamsForRedundancyMitigation * T_GenVamMax
}	

Expected behaviour	

ensure that {
when {
T_Gen_Vam is exceeded
and the IUT is alerted about new reference position value P_2
and Euclidean distance (P_1, P_2) <= minReferencePointPositionChangeThreshold
and the IUT is alerted about a new speed value v_2
and abs(v_2 - v_1) <= minGroundSpeedChangeThreshold
and the IUT is alerted about a new heading value h_2
and abs(h_2 - h_1) <= minGroundValocityOrientationChangeThreshold
}
then {
VBS does not send VAM
}
}	

TP Id	TP/VBS/TRCN/BV-23
Test objective	Check that a consecutive cluster VAM transmission is skipped if information about the ego-VRU has been reported by another ITS-S within T_GenVam
Reference	ETSI TS 103 300-3 [1], clause 6.4.3
PICS Selection	PICS_VAM_TRANSMISSION, PICS_CLUSTERING
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
and VAM has been transmitted at time t_1
containing vruClusterInformationContainer
and information about the ego-VRU has been reported by another ITS-S
}	

Expected behaviour	

ensure that {
when {
T_Gen_Vam is exceeded
}
then {
VBS does not send VAM
}
}	

TP Id	TP/VBS/TRCN/BV-24
Test objective	Check that VAM is time-stamped
Reference	ETSI TS 103 300-3 [1], clause 6.4.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VBS sends VAM
containing generationDeltaTime
}
}	

TP Id	TP/VBS/TRCN/BV-25
Test objective	Check that time required to generate VAM is less than T_AssembleVAM
Reference	ETSI TS 103 300-3 [1], clause 6.4.4.1
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VAM generation is triggered at time t_1
}	

Expected behaviour	

ensure that {
when {
VAM is delivered to the networking & transport layer at time t_2
}
then {
$t_2 - t_1 < T\_AssembleVAM$
}
}	

TP Id	TP/VBS/TRCN/BV-26
Test objective	Check that the VAM reference timestamp corresponds to the time the reference position provided in the BasicContainer
Reference	ETSI TS 103 300-3 [1], clause 6.4.4.2
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is generated
containing basicContainer
containing referencePosition at time t
}
then {
VAM is sent
containing generationDeltaTime
indicating value t +- 5 s
}
}	

TP Id	TP/VBS/TRCN/BV-27
Test objective	Check that the difference between VAM generation time and reference timestamp is less than 32 767 ms
Reference	ETSI TS 103 300-3 [1], clause 6.4.4.2
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
Message is sent
containing GeoNetworking header
containing Secure Header
containing signedData
containing ToBeSignedData
containing HeaderInfo
containing GenerationTime64
and containing VAM
containing generationDeltaTime
indicating value - GenerationTime64 < 32767 ms
}
}	

5.2.7 Frequency/Periodicity range of VAMs

TP Id	TP/VBS/FRPE/TI-01
Test objective	Check that the minimum time elapsed between the start of consecutive VAM generation events is equal or larger than T_Gen_Vam
Reference	ETSI TS 103 300-3 [1], clause 6.2
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VBS has started generating a VAM at time t_1
}	

Expected behaviour	

ensure that {
when {
VBS starts generating a VAM at time t_2
}
then {
$t_2 - t_1$ >= T_Gen_Vam
}
}	

TP Id	TP/VBS/FRPE/BV-02
Test objective	Check that the LF container is included in the first VAM generation
Reference	ETSI TS 103 300-3 [1], clause 6.2
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VBS activation has occurred
and no VAM has been sent yet
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
VBS sends VAM
containing vruLowFrequencyContainer
}
}	

TP Id	TP/VBS/FRPE/BV-03
Test objective	Check that the LF container is included periodically after 2000 ms
Reference	ETSI TS 103 300-3 [1], clause 6.2
PICS Selection	PICS_VAM_TRANSMISSION
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and VBS activation has occurred
and VBS has sent a VAM
containing vruLowFrequencyContainer at time t_1
and VBS has not sent VAM
containing vruHighFrequencyContainer after t_1
}	

Expected behaviour	

ensure that {
when {
VAM is generated at t_2 >= (t_1 + 2 000 ms)
}
then {
VBS sends VAM
containing vruHighFrequencyContainer
}
}	

TP Id	TP/VBS/FRPE/TI-04
Test objective	Check that T_GenVam is set to T_GenVamMax if the value for T_GenVam provided by the VBS management entity is larger than T_GenVamMax in case of ITS-G5
Reference	ETSI TS 103 300-3 [1], clause 6.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_ITS_G5
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and T_GenVam >= T_GenVamMax
and VAM has been sent at time t_1
}	

Expected behaviour	

ensure that {
when {
next VAM is generated at time t_2
}
then {
$t_2 - t_1$ = T_GenVamMax
}
}	

TP Id	TP/VBS/FRPE/TI-05
Test objective	Check that T_GenVam is set to T_GenVamMin if the value for T_GenVam is not provided by the VBS management entity or smaller than T_GenVamMin in case of ITS-G5
Reference	ETSI TS 103 300-3 [1], clause 6.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_ITS_G5
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
and T_GenVam is not provided
or
T_GenVam <= T_GenVamMin
and VAM has been sent at time t_1
}	

Expected behaviour	

ensure that {
when {
next VAM is generated at time t_2
}
then {
$t_2 - t_1$ = T_GenVamMin
}
}	

5.2.8 Security constraints

TP Id	TP/VBS/SECC/BV-02
Test objective	Check that the ITS-AID indicates the application for which permissions are being granted
Reference	ETSI TS 103 300-3 [1], clause 6.5.1
PICS Selection	PICS_VAM_TRANSMISSION, PICS_SECURITY
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is generated
}
then {
Message is sent
containing GeoNetworking header
containing Secure Header
containing signedData
containing certificate
containing Certificate
containing ToBeSigned
containing AppPermissions
}
}	

TP Id	TP/VBS/SECC/BV-04
Test objective	Check that the SSP is a BitmapSsp
Reference	ETSI TS 103 300-3 [1], clause 6.5.2
PICS Selection	PICS_VAM_TRANSMISSION, PICS_SECURITY
Initial conditions	

with {
VBS in state VRU-ACTIVE-STANDALONE
or VBS in state VRU-ACTIVE-CLUSTER-LEADER
}	

Expected behaviour	

ensure that {
when {
VAM is transmitted over BTP with GeoNetworking protocol
}
then {
Message is sent
containing GeoNetworking header
containing Secure Header
containing signedData
containing certificate
containing Certificate
containing ToBeSigned
containing AppPermissions
containing at least one item
containing Bitmap SSP
}
}	

Annex A (informative): Bibliography

- ETSI TS 102 894-2 (V1.2.1): "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary".

History

Version	Date	Status
V2.1.1	July 2025	Publication