Cooperative Mobility Services Plugtests;
Helmond, Netherlands;
14 - 18 November 2011

ETSI

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Sous-Préfecture de Grasse (06) N° 7803/88

Contents

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Foreword

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

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

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

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

1 Scope

This document forms the guidelines to lead the technical organization of the 1st Cooperative Mobility Services Plugtests event, in Helmond, from 14 to 18 November 2011. This document is intended to be upgraded for future interoperability events.

This document describes:

- The testbed architecture showing which ITS systems and components are involved and how they are going to interwork
- The configurations used during test sessions, including the parameter values of the different layers (PHY, MAC, NWT, …)
- The interoperability test descriptions, which are describing the scenarios, which the participants will follow to perform the tests

2 References

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

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

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

2.1 Normative references

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

[1] 802.11-2007 and IEEE802.11p-2010 IEEE Standard for Information technology— Telecommunications and information exchange between systems— Local and metropolitan area networks— Specific requirements Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications and Amendment 6: Wireless Access in Vehicular Environments.

[2] ETSI TS 102 636-4-1 (V1.1.1): "Intelligent Transport System (ITS); Vehicular communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to multipoint communications; Sub-part 1: Media independent functionalities".

[3] ETSI TS 102 636-5-1 (V1.1.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocol".

[4] ETSI TS 102 637-2 (V1.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[5] ETSI TS 102 637-3 (V1.1.1): "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service".

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

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] Intelligent Transport Systems (ITS); V2V Application; Part 1: Co-operative Awareness Application (CAA)

3 Abbreviations

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

CAM	Cooperative Awareness Message
CPS	Central Position Server
DENM	Decentralized Environmental Notification Message
EUT	Equipment Under Test
GPSD	Daemon that receives data from a GPS receiver. It provides a unified interface to receivers of different types, and allows concurrent access by multiple applications
GN	GeoNetworking
ITS-S	ITS Station. Can be either RIS or VIS. This acronym is used when the role of the ITS Station is not relevant for the scope of the test. Note: When the role is relevant for the test, then RIS or VIS is used.
MAC	Media Access Control layer of the access layers
PHY	The Physical layer of the access layers
RIS	ITS Roadside Station
VIS	ITS Vehicle Station

4 Conventions

4.1 Interoperability test process

4.1.1 Introduction

The goal of interoperability test is to check that devices resulting from protocol implementations are able to work together and provide the functionalities provided by the protocols. As necessary, one meesage may be checked during a test, when a successful functional verification may result from an incorrect behaviour for instance. Detailled protocol checks are part of the conformance testing process and are thus avoided during the Interoperablity tests.

The test session will be mainly executed between 2 devices from different vendors. For some test purposes, it may be necessary to have more than 2 devices involved. Each device can play different roles (VIS, RIS) during the test sessions. The information about the test configuration like the number of devices or the roles required are indicated in the test description tables below.

4.1.2 The test description proforma

The test descriptions are provided in proforma tables following the the format described in [6]. The following different test events are considered furing the test execution:

- A **stimulus** corresponds to an event that enforces an EUT to proceed with a specific protocol action, like sending a message for instance.
- A **verify** consists of verifying that the EUT behaves according to the expected behaviour (for instance the EUT behaviour shows that it receives the expected message).
- A **configure** corresponds to an action to modify the EUT configuration.
- A **check** ensures the receipt of protocol messages on reference points, with valid content. This "check" event type corresponds to the interoperability testing with conformance check method.

See the test description tables applying to the CMS interoperability testing below.

For the execution of the interoperability test sessions, the following conventions apply:

- Every 'Check' step of a test description should be perfomed using a trace created by a monitor tool (see clause 'Tooling' below) and may be skipped due to time restricitions.
- The GPS trace defines the speed of the vehicles. It is assumed that the implementations use dynamically this data in their Facility and GN layer implementations
- Use of triggers for the GN scenarios: The GN scenarios use CAM, DENM triggers to keep as much as possible the notion of an integrated end – 2 end test
- The UC scenarios focus on information fields and values which are relevant for the given functions. By sending pre-defining CAM and DENM messages the correct decoding and interpretation is tested. Also, clarification will be gained on how and with which values to use CAM and DENM parameters (such as cause code and sub cause codes) are used.

4.2 Tooling

- Message monitoring solutions (sniffer devices) are provided during the Plugtests event, to log and decode messages
- All log filers created by the sniffer device can be consulted by participants for debugging purposes
- Except for the "check" events, the the verification of the message conformity is not part of the Interoperability test process
- Participant may also use their own tool for logging and analyzing messages for the "check" purposes

4.3 Test Description naming convention

Table 1: TD naming convention

TD/<root>/<gr>/<nn>		
<root> = root	CN	Connectivity
	GN	Geo Networking
	CAM	CAM
	DENM	DENM
	UC	Use Case specific
<gr> = group	BEA	Beaconing
	PING	IP connectivity
	GBC	Geo Broadcast
	FWD	Forwarding
	DAD	Duplicate Address Detection
	SHB	Single Hop Broadcast
<nn> = sequential number		01 to 99

4.4 Test Summary – Mandatory Tests

Table 2: Mandatory Tests

1	TD_GN_BEA_01	Detection of neighbour
2	TD_GN_SHB_01	Broadcasting of CAM messages is correctly handeled
3	TD_GN_GBC_01	DENM message is processed inside its Destination Area
4	TD_GN_GBC_02	Number of re-broadcasts is correctly handled during DENM flooding
5	TD_GN_GBC_03	DENM message is not processed outside its Destination Area
6	TD_GN_GBC_04	Geo-broadcast message caching is correctly implemented
7	TD_GN_DAD_01	Resolution of duplicate Gn address scenario
8	TD_CAM_01	CAM messages with basicVehicle profile are interoperable
9	TD_CAM_02	CAM messages with emergencyVehicle profile are interoperable
10	TD_CAM_03	CAM messages with publicTransportVehicle profile are interoperable
11	TD_CAM_04	CAM messages with basicRIS profile are interoperable
12	TD_DENM_01	DENM re-transmissions are correctly received within the DENM lifetime
13	TD_DENM_02	DENM re-transmissions are not received after the DENM lifetime
14	TD_DENM_04	DENM expiry handling is correctly implemented
15	TD_UC_01	CAM messages generate and interpret the vehicle location parameter correctly
16	TD_UC_02	DENM messages generate and interpret the vehicle location parameter correctly
17	TD_UC_03	DENM messages can include parameters needed by ‘Roadworks warning’ application
18	TD_UC_04	CAM messages can include parameters needed by ‘Traffic jam ahead warning’ and ‘Slow vehicle warning’ application
19	TD_UC_05	DENM messages can include parameters needed by ‘Traffic jam ahead warning’
	TD_UC_06	DELETED
20	TD_UC_07	DENM messages can include parameters needed by ‘Car Breakdown warning’ application

4.5 Test Summary – Optional Tests

Table 3: Optional Tests

1	TD_GN_FWD_01	DENM message is correctly forwarded to its Destination Area
2	TD_GN_FWD_02	DENM message is correctly geo-routed towards its Destination Area
3	TD_GN_FWD_03	DENM message geo-routing is correctly handeled when no suitable forwarder exists
4	TD_DENM_03	DENM information is kept alive as expected during its lifetime
5	TD_UC_08	CAM messages can include parameters needed by ‘Approaching emergency vehicle’ application
6	TD_UC_09	DENM messages can include parameters needed by ‘Approaching emergency vehicle’ application
7	TD_UC_10	DENM messages can include parameters needed by ‘Weather Warning (Wind)’ application
8	TD_UC_11	DENM messages can include parameters needed by ‘Emergency electronic break lights’ application
	TD_UC_12	DELETED
9	TD_UC_13	DENM messages can include parameters needed by ‘Post crash warning’ application
10	TD_UC_14	DENM messages can include parameters needed by ‘Obstacle warning’ application
11	TD_UC_15	DENM messages can include parameters needed by ‘Wrong way driving in gas stations’ application
12	TD_UC_16	CAM messages can include parameters needed by ‘Motor cycle warning’ application
13	TD_UC_17	DENM messages can include parameters needed by ‘Slow vehicle warning’application

4.6 DENM Relevance Area – GN Destination Area

The test configurations (see clause 6.7) define GN Destination Areas. However, the test descriptions (see clause 7 and 8) use , where applicable, in their test objectives the term of DENM Relevance Area. For the purpose of this document it is assumed that the DENM Relevance area is equal to the GN Destination Area. Please note that there can be in the future some DENM Relevance Area descriptions, which make the DENM Relevance Area smaller than the GN Destination Area. But that is not defined in the current standards yet.

5 Test Bed Architecture

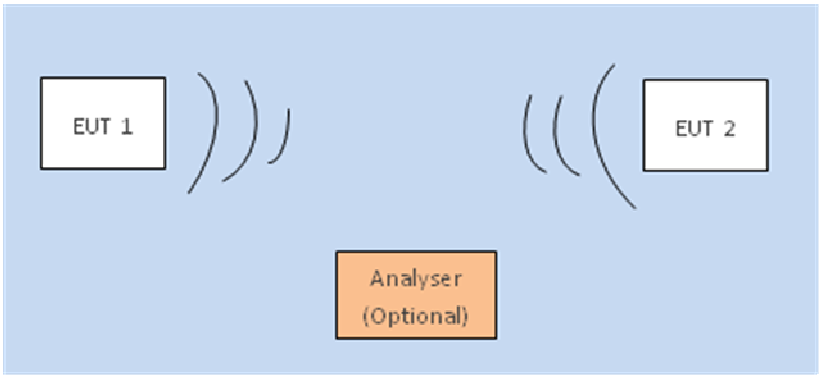

Figure 1: Basic Face 2 Face Configuration

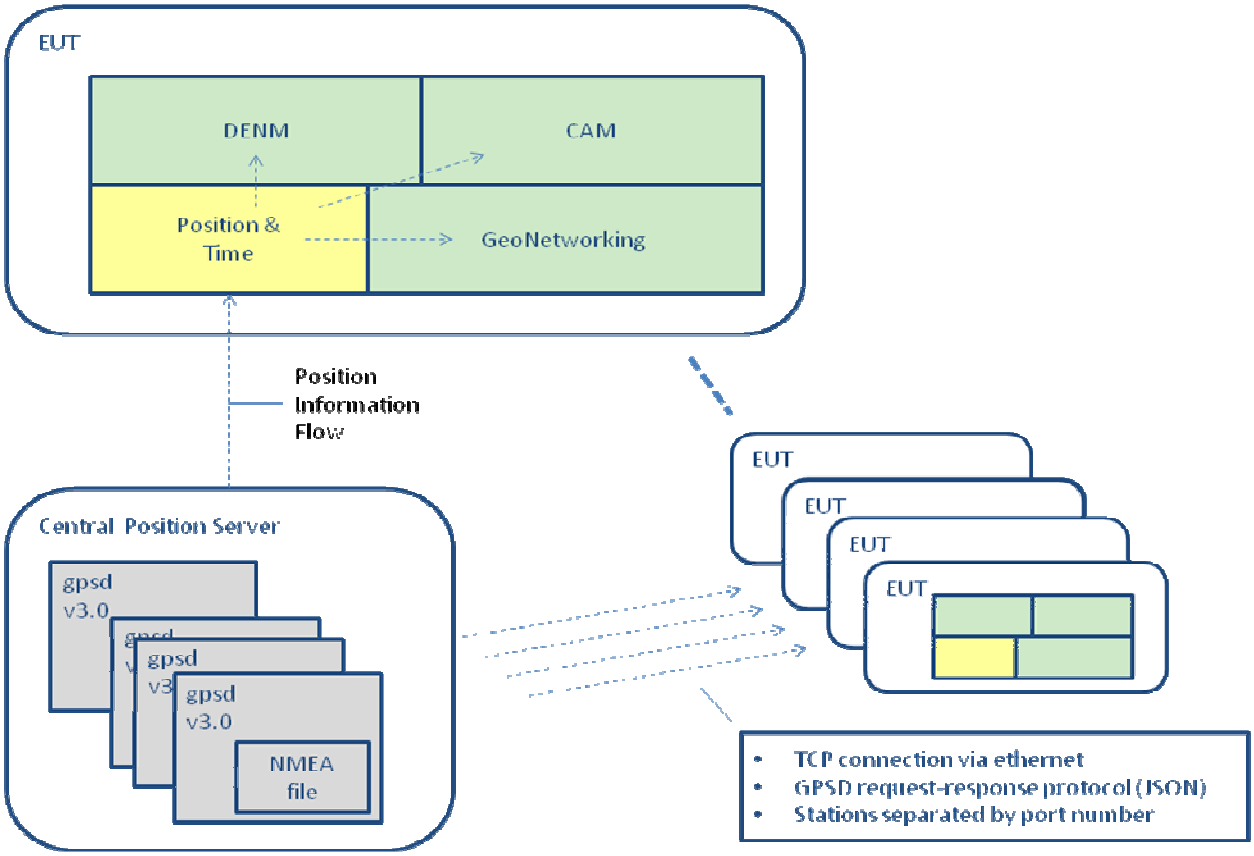

Figure 2: Central Position Server

6 Basic Configuration

6.1 PHY

The PHY layer of the communication system is based on IEEE802.11p-2010. This section only fixes the parameters to be used and, optionally, values that differ from this standard, when necessary for interoperability.

Table 4: PHY Parameters

Parameter	Value	Remarks
Center Frequency	5.900 GHz (CH 180) CCH	Optional 5.9 GHz. The choice of the channel depends on the results of interoperability and propagation tests.
Channel Bandwidth	10 MHz	
Max Transmit Power	20 dBm	Recommended value.
Default Rate	6 Mb/s	
Antenna type	omni directional	

6.2 MAC

6.2.1 Frame Format

Only data frames of subtype 0000 and 1000 (Data and QoS Data) are used. STAs must be able to process both subtypes.

6.2.2 Source MAC Addresses

Each supplier shall use a fixed MAC address.

6.3 LLC

6.3.1 Ether type

The ether type 0x0707 shall be used to indicate a GeoNetworking packet.

6.4 GN

Unless specified differently, the devices shall be in auto-address configuration mode (MIB attribute itsGnLocalAddrConfMethod is set to AUTO (0)).

6.5 BTP Port Mapping

BTP - B shall not be used.

BTP - A shall be used with the following mapping:

Table 5: BTP Port Mapping

	Src port	Dst port
CAM	don't care	1
DENM	don't care	2

6.7 Geographic Parameters

This section defines the different test configurations GEO_CFG_nn. Each test configuration describes

- geo positions (Please note that the geo positions are for information only. The geo positions used for testing are provided by the GPSD)
- destination area (where applicable). Please refer to clause 4.6 on definition of DENM Relevance Area and GN Destination Area
- geo configuration

The GPSD may vary any of the input coordinates within approximately ± 5 meters: this shall not cause any difference with the expected test results. Such variation may reflect the slight change in each real position measurement data.

When parallel test sessions are being executed, all the indicated latituted/longitude coordinates shall be applied an offset of N times 1 degree (corresponding to about N times 100 km distance). This way tests conducted in parallel will not interfere even if EUTs in parallel test sessions can hear each other.

The destination area

6.7.1 Single hop messaging (GEO_CFG_01)

Table 6: Geo Positions

Role	Lat	Lon
EUT 1 (originator)	51.4716071144902 N	5.60912770081777 E
EUT 2	51.4714725806061 N	5.60842987805713 E
...		

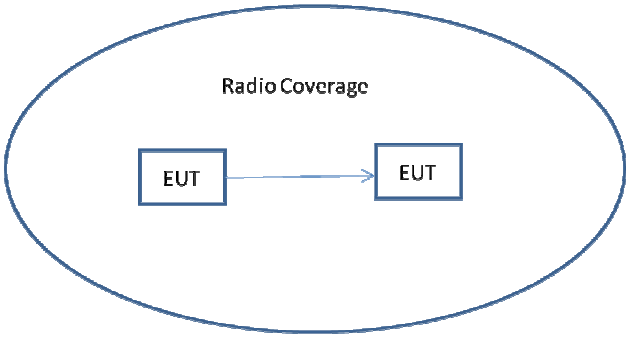

Figure 3: Geo Configuration

6.7.2 Distribution within Destination Area (GEO_CFG_02)

Table 7: Geo Positions

Role	Lat	Lon
EUT 1 (originator)	51.4716071144902 N	5.60912770081777 E
EUT 2	51.4714725806061 N	5.60842987805713 E
...		

Table 8: Destination Area

Destination area midpoint Lat – relative to originator	Destination area midpoint Lon – relative to originator	Destination area shape	Length of the long semi-axis	Length of the short semi-axis	Azimuth angle of the long semi-axis
-0.0001	-0.0001	Ellipse	200 m	100 m	90 degrees

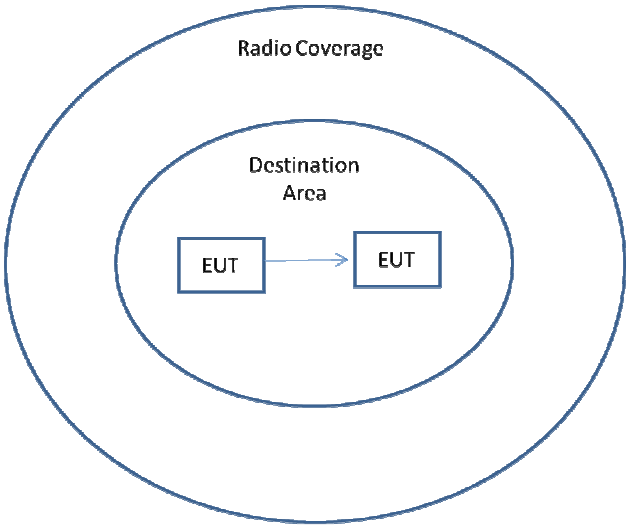

Figure 4: Geo Configuration

6.7.3 Distribution within Destination Area – with originator disappearance (GEO_CFG_03)

Table 9: Geo Positions

Role	Lat	Lon
EUT 1 (originator)	51.4716071144902 N	5.60912770081777 E
EUT 2	51.4714725806061 N	5.60842987805713 E
EUT 3	51.471427196132 N	5.60819751814514 E
...		

Table 10: Destination Area

Destination area midpoint Lat – relative to originator	Destination area midpoint Lon – relative to originator	Destination area shape	Length of the long semi-axis	Length of the short semi-axis	Azimuth angle of the long semi-axis
-0.0001	-0.0001	Ellipse	200 m	100 m	90 degrees

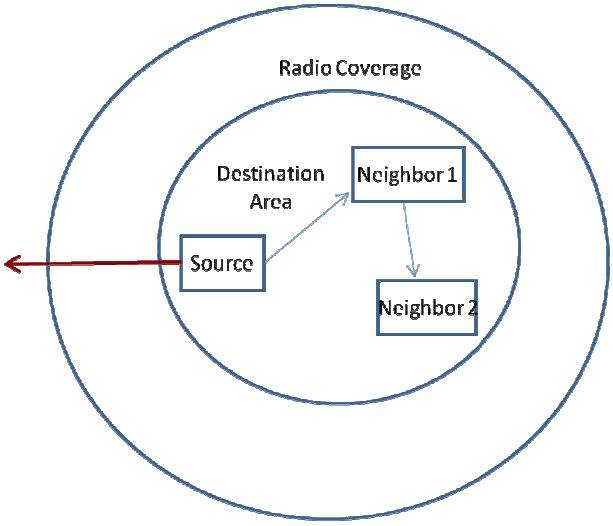

Figure 5: Geo Configuration

Note: The absence of the originator will be achieved through link attenuation, without a change in its geographic coordinates.

6.7.4 Receivers being outside of Destination Area (GEO_CFG_04)

Table 11: Geo Positions

Role	Lat	Lon
EUT 1 (originator)	51.4716071144902 N	5.60912770081777 E
EUT 2	51.4714725806061 N	5.60842987805713 E
...		

Table 12: Destination Area

Destination area midpoint Lat – relative to originator	Destination area midpoint Lon – relative to originator	Destination area shape	Length of the long semi-axis	Length of the short semi-axis	Azimuth angle of the long semi-axis
0	0	Ellipse	100 m	20 m	0 degrees

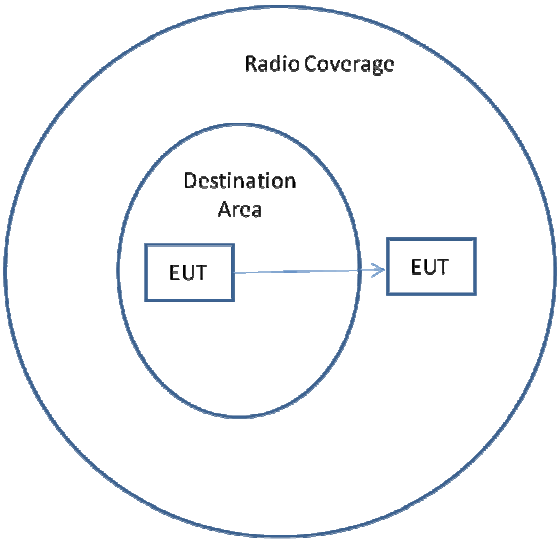

Figure 6: Geo Configuration

6.7.5 First receiver appearing in Destination Area (GEO_CFG_05)

Table 13: Geo Positions

Role	Lat	Lon
EUT 1 (originator)	51.4716071144902 N	5.60912770081777 E
EUT 2 (receiver)	51.4714725806061 N	5.60842987805713 E

Table 14: Destination Area

Destination area midpoint Lat – relative to originator	Destination area midpoint Lon – relative to originator	Destination area shape	Length of the long semi-axis	Length of the short semi-axis	Azimuth angle of the long semi-axis
-0.0001	-0.0001	Ellipse	200 m	100 m	90 degrees

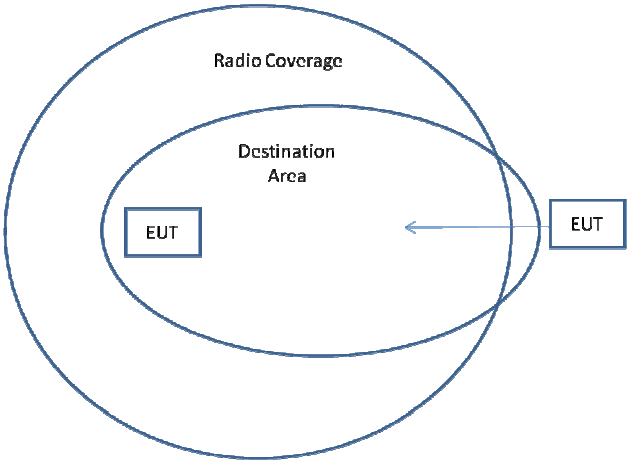

Figure 7: Geo Configuration

Note: The appearance of receivers will be achieved through link attenuation, without a change in its geographic coordinates.

6.7.6 New receivers appearing in Destination Area (GEO_CFG_06)

Table 15: Geo Positions

Role	Lat	Lon
EUT 1 (originator)	51.4716071144902 N	5.60912770081777 E
EUT 2	51.4714725806061 N	5.60842987805713 E
EUT 3	51.471427196132 N	5.60819751814514 E
...		

Table 16: Destination Area

Destination area midpoint Lat – relative to originator	Destination area midpoint Lon – relative to originator	Destination area shape	Length of the long semi-axis	Length of the short semi-axis	Azimuth angle of the long semi-axis
-0.0001	-0.0001	Ellipse	200 m	100 m	90 degrees

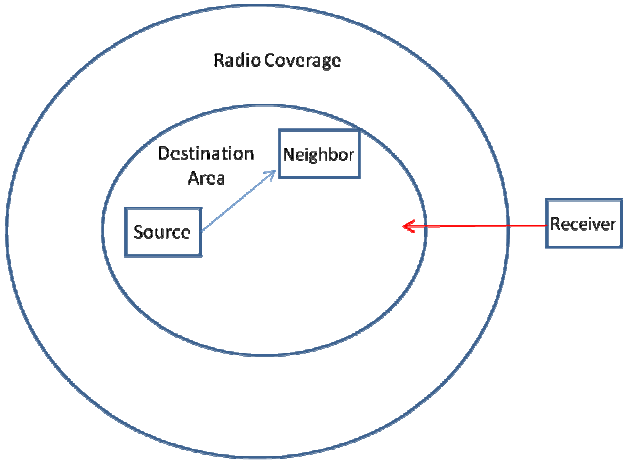

Figure 8: Geo Configuration

Note: The appearance of receivers will be achieved through link attenuation, without a change in its geographic coordinates

6.7.7 Line forwarding towards Destination Area (GEO_CFG_07)

Table 17: Geo Positions

Role	Lat	Lon
IRS (originator)	51.4713380467220 N	5.60773205529688 E
IVS 1 (forwarder)	51.4714725806061 N	5.60842987805713 E
IVS 2 (receiver)	51.4716071144902 N	5.60912770081777 E

Table 18: Destination Area

Destination area midpoint Lat – relative to originator	Destination area midpoint Lon – relative to originator	Destination area shape	Length of the long semi-axis	Length of the short semi-axis	Azimuth angle of the long semi-axis
0.0002690677	0.0013956455	Ellipse	100 m	20 m	10 degrees

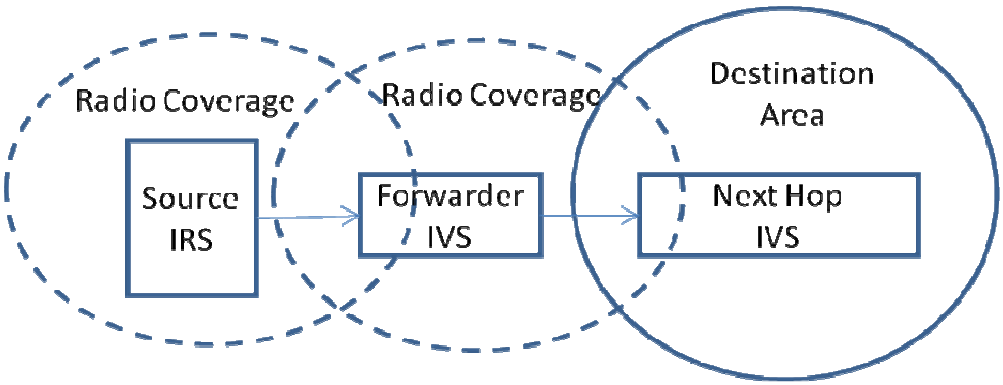

Figure 9: Geo Configuration

6.7.8 Forwarder getting into the direction of Destination Area (GEO_CFG_08)

Table 19: Geo Positions

Role	Lat	Lon
IVS 1 (source)	51.4713380467220 N	5.60773205529688 E
Position of IVS 2 (forwarder) at the start of the test	51.4710689789671 N	5.60703423251263 E
Position of IVS 2 (forwarder) 10 seconds later	51.4713380467220 N	5.60842987805713 E

Table 20: Destination Area

Destination area midpoint Lat – relative to originator	Destination area midpoint Lon – relative to originator	Destination area shape	Length of the long semi-axis	Length of the short semi-axis	Azimuth angle of the long semi-axis
0.0002690677	0.0013956455	Ellipse	100 m	20 m	10 degrees

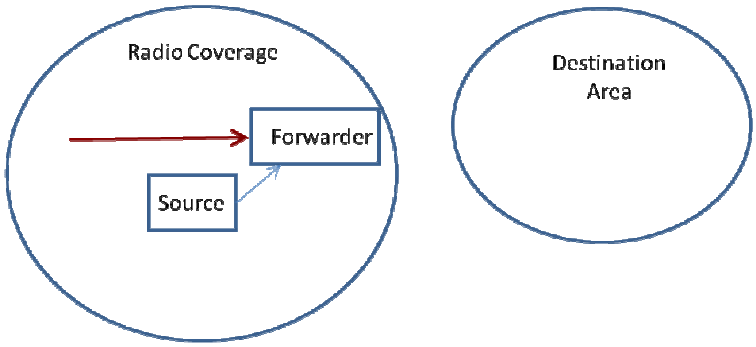

Figure 10: Geo Configuration

6.7.9 Forwarder remaining away from the direction of Destination Area (GEO_CFG_09)

Table 21: Geo Positions

Role	Lat	Lon
IVS 1 (source)	51.4713380467220 N	5.60773205529688 E
Position of IVS 2 (forwarder) at the start of the test	51.4710689789671 N	5.60703423251263 E
Position of IVS 2 (forwarder) 10 seconds later	51.4716071144902 N	5.60703423251263 E

Table 22: Destination Area

Destination area midpoint Lat – relative to originator	Destination area midpoint Lon – relative to originator	Destination area shape	Length of the long semi-axis	Length of the short semi-axis	Azimuth angle of the long semi-axis
0.0002690677	0.0013956455	Ellipse	100 m	20 m	10 degrees

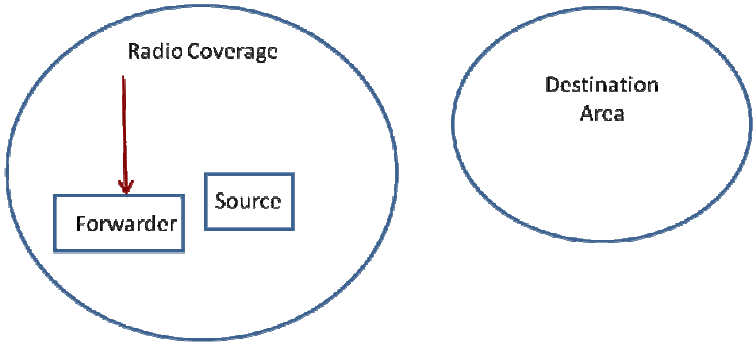

Figure 11: Geo Configuration

6.8 CPS parameters

Public IP address of CPS server CPS IP@ = 195.169.128.39

Local IP address of CPS server CPS IP@ = 10.200.0.3

Table 23: CPS Parameters

CFG	TD ID	Role	Test Session 1 CPS IP@:port	Test Session N CPS IP@:port	Motion Path	Usage of RF Test Bench
GEO_CFG_01	TD_GN_BEA_01	Source	1941	N941		
		Receiver	1942	N942		
	TD_GN_SHB_01	Source	1941	N941		
		Receiver	1942	N942		
	TD_GN_DAD_01	Source	1941	N941		
		Forwarder	1942	N942		
	TD_CAM_01	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_CAM_02	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_CAM_03	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_CAM_04	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_01	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_02	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_03	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_04	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_05	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_07	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_08	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_09	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_10	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_11	Source	1941	N941		

		Receiver 1	1942	N942		
	TD_UC_13	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_14	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_15	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_16	Source	1941	N941		
		Receiver 1	1942	N942		
	TD_UC_17	Source	1941	N941		
		Receiver 1	1942	N942		
GEO_CFG_02	TD_GN_GBC_01	Source	1941	N941		
		Receiver	1942	N942		
	TD_GN_GBC_02	Source	1941	N941		YES
		Receiver 1	1942	N942		
		Receiver 2	1943	N943		
GEO_CFG_03	TD_DENM_03	Source	1941	N941		YES
		Neighbor 1	1942	N942		
		Neighbor 2	1943	N943		
GEO_CFG_04	TD_GN_GBC_03	Source	1941	N941		
		Receiver 1	1942	N942		
GEO_CFG_05	TD_GN_GBC_04	Source	1941	N941		YES
		Receiver 1	1942	N942		
	TD_DENM_04	Source	1941	N941		YES
		Receiver 1	1942	N942		
GEO_CFG_06	TD_DENM_01	Source	1941	N941		YES
		Neighbor	1942	N942		
		Receiver	1943	N943		
	TD_DENM_02	Source	1941	N941		YES
		Neighbor	1942	N942		
		Receiver	1943	N943		
GEO_CFG_07	TD_GN_FWD_01	Source	1944	N944		YES
		Forwarder	1942	N942		
		Next Hop	1941	N941		
GEO_CFG_08	TD_GN_FWD_02	Source	1944	N944	YES	
		Forwarder	1945	N945		
GEO_CFG_09	TD_GN_FWD_03	Source	1944	N944	YES	
		Forwarder	1946	N946		

6.9 CAM frequency

Unless otherwise stated the CAM frequency shall be set to 1 Hz.

7 GN Scenarios

7.1 GN Beaconing

7.1.1 Detection of neighbour

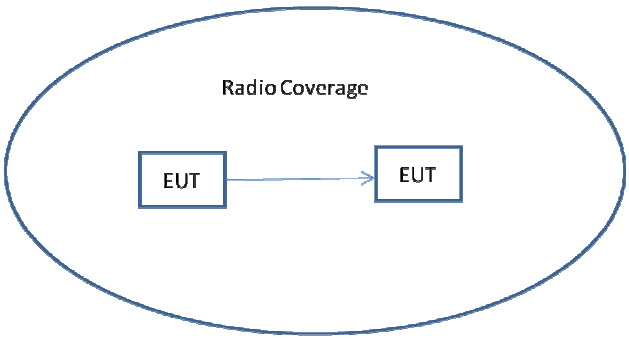

Figure 12: Geo Configuration

Interoperability Test Description			
Identifier:	TD_GN_BEA_01		
Objective:	Detection of neighbour		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3.1, 9.3.3		
Pre-test conditions:	• 2 or more ITS-S devices • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source ITS-S sends beacons
	2	verify	Receiver ITS-S detects its neighbour
	3	check	Received beacon contains Position Vector indicating geographical position (Longitude/Latitude/Altitude) according to the provided position feed input

7.2 CAM message transmission

7.2.1 Exchange of CAM messages

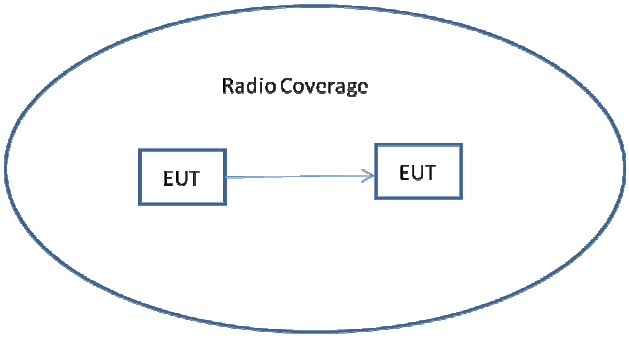

Figure 13: Geo Configuration

Interoperability Test Description			
Identifier:	TD_GN_SHB_01		
Objective:	Broadcasting of CAM messages is correctly handeled		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3, Table F.1 [4] 7.2		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range • Each ITS-S device has sent at least 1 beacon		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a CAM message
	2	verify	Receiver devices receive a Single Hop Broadcast (SHB) packet containing CAM message.
	3	check	Received SHB packet is carried by a link layer packet containing the link layer destination address indicating broadcast MAC address
	4	verify	Receiver passes received CAM message to its Facility layer
	5	verify	Steps 2 to 4 are repeated within the CAM messaging frequency range

7.3 DENM message transmission

7.3.1 EUT inside DENM Relevance area (no duplicate checking)

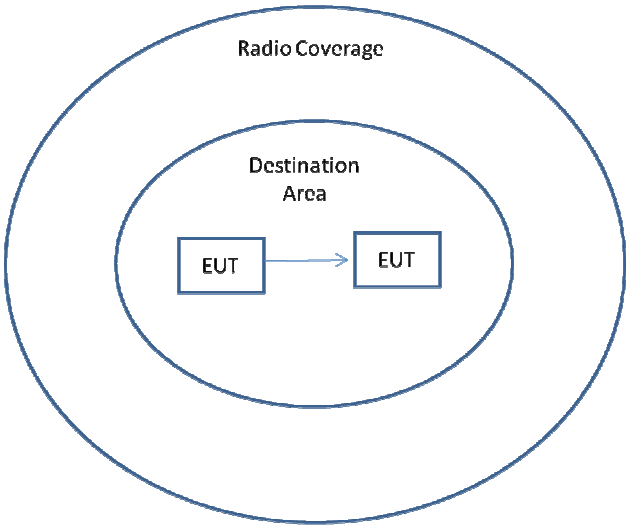

Figure 14: Geo Configuration

Interoperability Test Description			
Identifier:	TD_GN_GBC_01		
Objective:	DENM message is processed inside its Destination Area		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its destination area including all the Receiver devices (see figure above) • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range • Each ITS-S device has sent at least 1 beacon or 1 CAM		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices receive a GeoBroadcast packet containing DENM message
	3	check	Received GeoBroadcast packet is carried by a link layer packet containing the link layer destination address indicating broadcast MAC address
	4	verify	Receiver passes DENM message to its Facility layer

7.3.2 Duplicate Packet Detection (checking the re-broadcasting limit within the DENM relevance area)

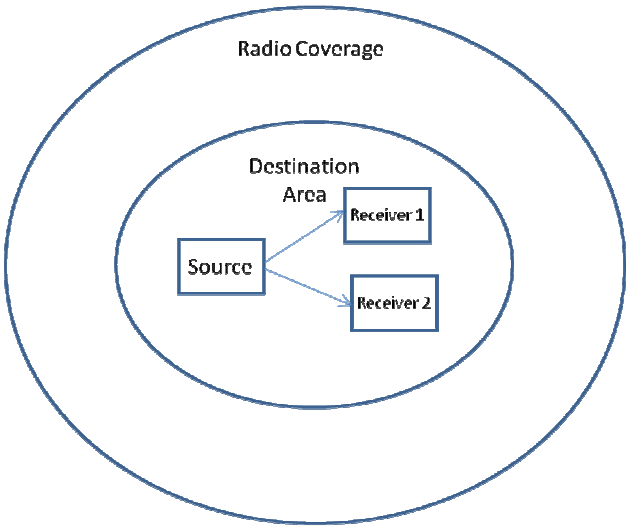

Figure 15: Geo Configuration

Note: This configuration is a variation of configuration 2 whereby a second receive rhas been added.

Interoperability Test Description			
Identifier:	TD_GN_GBC_02		
Objective:	Number of re-broadcasts is correctly handled during DENM flooding		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2, B.7		
Pre-test conditions:	• 3 or more ITS-S devices (Source, Receiver devices) • Configure in Source device - DENM message which has its destination area including all the Receiver devices (see figure above) - and expiryTime > 1 minute • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range • Each ITS-S device has sent at least 1 beacon or 1 CAM		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices receive several GeoBroadcast packet containing DENM message. The number of received GeoBroadcast packets equals 1 (Source broadcast) + the number of receiver devices minus 1 (received re-broadcasts).
	3	verify	Receiver passes only a single DENM message to its Facility layer

7.3.3 EUT outside DENM Relevance area

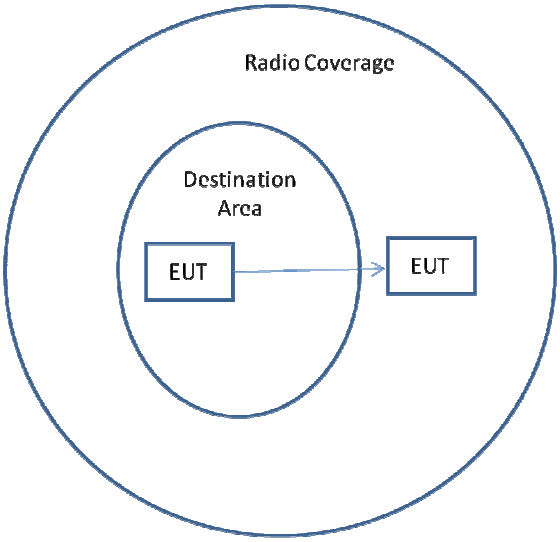

Figure 16: Geo Configuration

Interoperability Test Description			
Identifier:	TD_GN_GBC_03		
Objective:	DENM message is not processed outside its Destination Area		
Configuration:	GEO_CFG_04		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its destination area not including any of the Receiver devices (see figure above) • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range • Each ITS-S device has sent at least 1 beacon or 1 CAM		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices receive a GeoBroadcast packet containing DENM message
	3	check	Received GeoBroadcast packet is carried by a link layer packet containing the link layer destination address indicating broadcast MAC address
	4	verify	Receiver does not pass any DENM message to its Facility layer

7.3.4 EUT receiving a cached DENM message

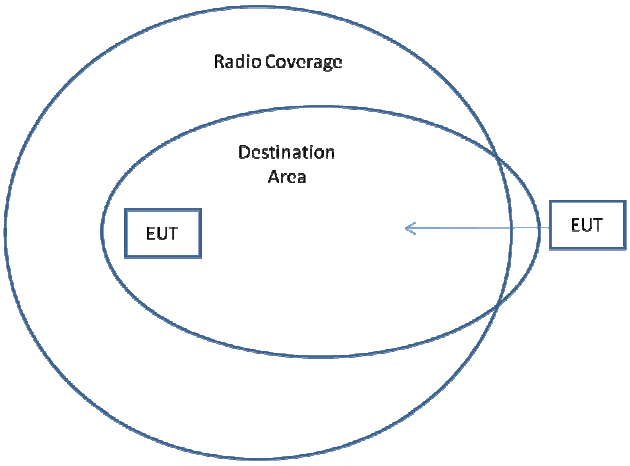

Figure 17: Geo Configuration

Interoperability Test Description			
Identifier:	TD_GN_GBC_04		
Objective:	Geo-broadcast message caching is correctly implemented		
Configuration:	GEO_CFG_05		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2, B.6		
Pre-test conditions:	• 2 ITS-S devices (Source and Receiver) installed in RF testbench, connected through antenna cable with controllable link attenuator on it • Set itsGnMaxPacketLifetime parameter to 600 s (default value) • Wait until itsGnLifetimeLocTE to ensure that LocationEntry table is consistent • Configure in Source device - DENM message which has its destination area extending beyond the radio coverage range (see figure above) - and expiryTime set to 5 seconds - DENM transmission frequency set to 1,1 Hz • Configure the positions of the ITS-S devices according to the table above • Raise the attenuation on the connection, so that the two devices are off-link.		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	stimulus	After the DENM lifetime expires, but before the expiry of itsGnMaxPacketLifetime timer; lower the attenuation on the connection, so that the two devices are on the same link
	3	verify	Receiver devices receive all the 6 cached GeoBroadcasts containing the DENM message
	4	verify	Receiver passes all received DENM messages to its Facility layer

Note: Formula to calculate the total number of packets: f = 1,1 Hz equals T = 900 ms; 5000 ms / 900 ms ~ 5 ; total number of packets = 5 + initial packet sent at t_0 = 6 packets

7.3.5 Forwarding outside GeoArea

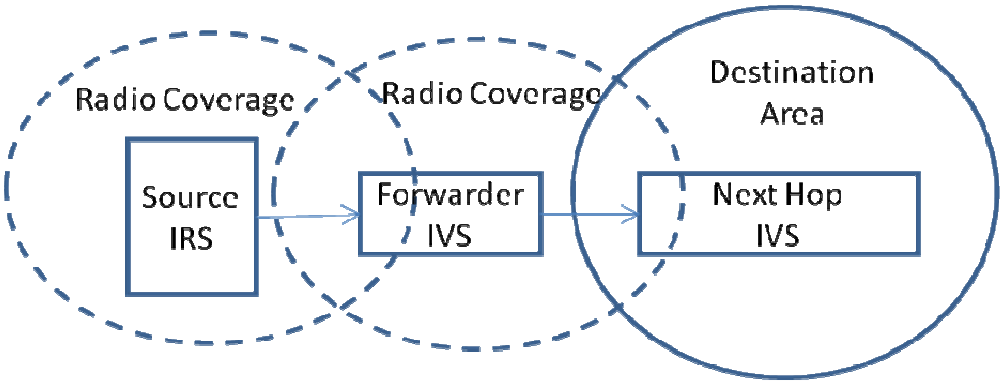

Figure 18: Geo Configuration

Interoperability Test Description			
Identifier:	TD_GN_FWD_01		
Objective:	DENM message is correctly forwarded to its Destination Area		
Configuration:	GEO_CFG_07		
References:	[2] 9.2.3, Table F.1 [4] 5.1		
Pre-test conditions:	• 3 ITS-S devices (Source, Forwarder and Next Hop) installed in RF testbench • Wait until itsGnLifetimeLocTE to ensure that LocationEntry table is consistent • Configure in Source device DENM message which has its destination area in the direction of the Next Hop device and which does not include the Source and Forwarder (see figure above) • Configure the positions of the ITS-S devices according to the table above • Each ITS-S device has sent at least 1 beacon or 1 CAM		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Forwarder receives GeoBroadcast packet containing DENM message
	3	check	Received GeoBroadcast packet is carried by a link layer packet containing the link layer destination address indicating the Forwarder MAC address
	4	verify	Forwarder does not pass DENM message to its Facility layer
	5	verify	Next Hop receives GeoBroadcast packet containing DENM message
	6	check	Received GeoBroadcast packet is carried by a link layer packet containing the link layer destination address indicating the Next Hop MAC address
	7	verify	Next Hop passes DENM message to its Facility layer
	8	check	Next Hop sends a GeoBroadcast packet carried by a link layer packet containing the link layer destination address indicating broadcast MAC address

7.3.6 GeoRouting towards Destination Area

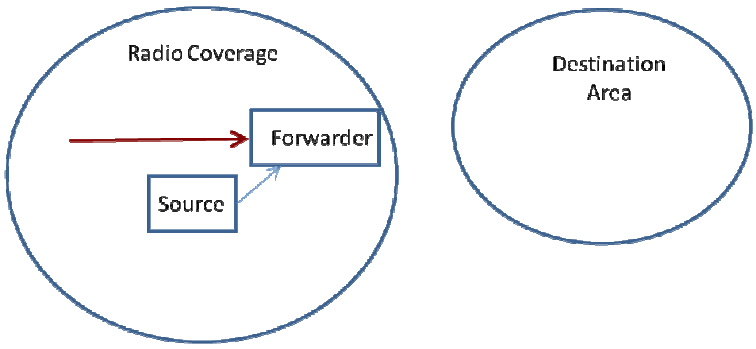

Figure 19: Geo Configuration

Interoperability Test Description			
Identifier:	TD_GN_FWD_02		
Objective:	DENM message is correctly geo-routed towards its Destination Area		
Configuration:	GEO_CFG_08		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2		
Pre-test conditions:	• 2 ITS-S devices (Source, Forwarder) • Set itsGnMaxPacketLifetime parameter to 600 s (default value) • Wait until itsGnLifetimeLocTE to ensure that LocationEntry table is consistent • Configure in Source device DENM message which has its destination area opposite to the starting direction of the Forwarder device and which does not include the Source device (see figure above) • Configure the positions of the ITS-S devices according to the table above, involving the programmed position tracing, which shall trace out during 1 minute. • Each ITS-S device has sent at least 1 beacon or 1 CAM		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Forwarder does not receive a GeoBroadcast packet while it is in the opposite direction from the Destination area
	3	stimulus	At some point along the pre-programmed path, the Forwarder device's alignment becomes in the direction of the Destination area; i.e. its position becomes less distant from the Destination area than the position of the Source
	4	verify	Forwarder receives GeoBroadcast packet containing DENM message
	5	check	Received GeoBroadcast packet is carried by a link layer packet containing the link layer destination address indicating the Forwarder MAC address
	6	verify	Forwarder does not pass DENM message to its Facility layer

7.3.7 No suitable Forwarder towards Destination Area

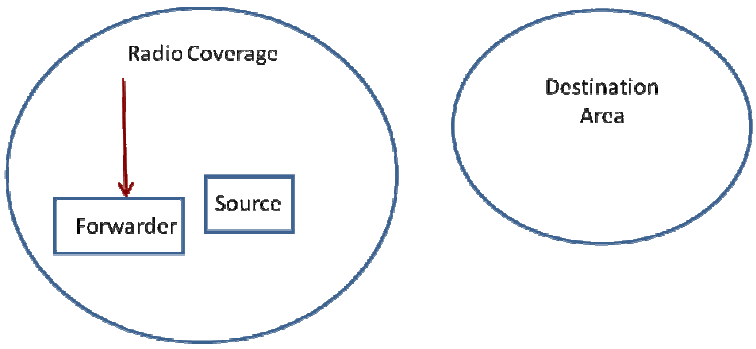

Figure 20: Geo Configuration

Interoperability Test Description			
Identifier:	TD_GN_FWD_03		
Objective:	DENM message geo-routing is correctly handeled when no suitable forwarder exists		
Configuration:	GEO_CFG_09		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2		
Pre-test conditions:	• 2 ITS-S devices (Source, Forwarder) • Set itsGnMaxPacketLifetime parameter to 600 s (default value) • Wait until itsGnLifetimeLocTE to ensure that LocationEntry table is consistent • Configure in Source device DENM message which has its destination area opposite to the starting direction of the Forwarder device and which does not include the Source device (see figure above) • Configure the positions of the ITS-S devices according to the table above, involving the programmed position tracing, which shall trace out during 1 minute. • Each ITS-S device has sent at least 1 beacon or 1 CAM		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Forwarder does not receive a GeoBroadcast packet at all, as its path stays always more distant from the Destination area than the position of the Source

7.4 Duplicate Address Detection

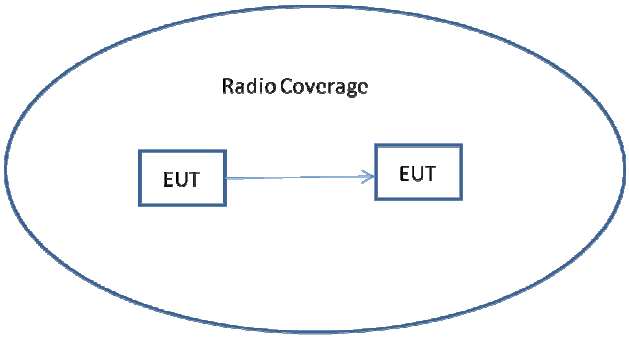

Figure 21: Geo Configuration

Interoperability Test Description			
Identifier:	TD_GN_DAD_01		
Objective:	Resolution of duplicate Gn address scenario		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3.1, 9.2.1.4		
Pre-test conditions:	• 2 ITS-S devices (Source, Forwarder) • Set Gn address configuration method of ITS-S devices to use managed configuration (MIB attribute itsGnLocalAddrConfMethod is set to MANAGED (1)) • Configure the Gn addresses of each ITS-S device to be the same one (10000001) • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**

Interoperability Test Description			
	1	stimulus	Each ITS-S sends beacons or CAM
	2	verify	Starting from the second beacon or CAM, each ITS-S detects its neighbour(s) having a different Gn address from its own one

8 Facility Scenarios

8.1 CAM message transmission

The following configuration applies to all tests in this chapter.

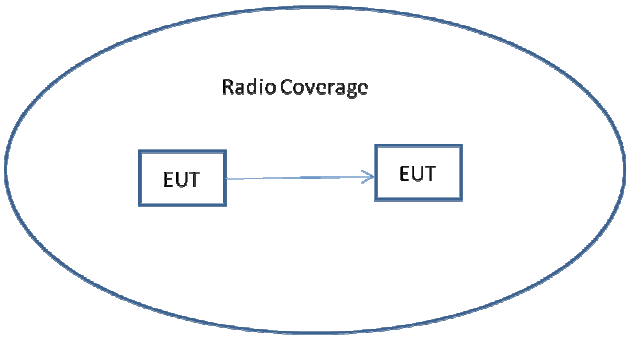

Figure 22: Geo Configuration

8.1.1 Exchange of basicVehicle profiled CAM messages

Interoperability Test Description			
Identifier:	TD_CAM_01		
Objective:	CAM messages with basicVehicle profile are interoperable		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3, Table F.1 [4] 7.2		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure the Source device to operate with basicVehicle profile • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a CAM message
	2	verify	Receiver devices process the CAM as a valid message

Interoperability Test Description			

	3	check	Received CAM message has basicVehicle profile, meaning checking the following underlined values:
			cam {
			stationID,
			stationCharacteristics {
			true,
			true,
			true,
			},
			referencePosition {},
			camParameters {
			vehicleCommonParameters {},
			profileDependent:basicVehicle
			}
			}

	4	verify	Steps 2 to 3 are repeated at the CAM frequency of 1 Hz

8.1.2 Exchange of emergencyVehicle profiled CAM messages

Interoperability Test Description			
Identifier:	TD_CAM_02		
Objective:	CAM messages with emergencyVehicle profile are interoperable		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3, Table F.1 [4] 7.2		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure the Source device to operate with emergencyVehicle profile • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a CAM message
	2	verify	Receiver devices process the CAM as a valid message

	3	check	Received CAM message has emergencyVehicle profile, meaning checking the following underlined values:
			cam {
			stationID,
			stationCharacteristics {
			true,
			false,
			true,
			},
			referencePosition {},
			camParameters {
			vehicleCommonParameters {},
			profileDependent:emergencyVehicle
			}
			}

	4	verify	Steps 2 to 3 are repeated at the CAM frequency of 1 Hz

8.1.3 Exchange of publicTransportVehicle profiled CAM messages

Interoperability Test Description			
Identifier:	TD_CAM_03		
Objective:	CAM messages with publicTransportVehicle profile are interoperable		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3, Table F.1 [4] 7.2		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure the Source device to operate with publicTransportVehicle profile • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a CAM message
	2	verify	Receiver devices process the CAM as a valid message

	3	check	Received CAM message has publicTransportVehicle profile, meaning checking the following underlined values:
			cam {
			stationID,
			stationCharacteristics {
			true,
			false,
			true,
			},
			referencePosition {},
			camParameters {
			vehicleCommonParameters {},
			profileDependent:publicTransportVehicle
			}
			}

	4	verify	Steps 2 to 3 are repeated at the CAM frequency of 1 Hz

8.1.4 Exchange of basicRIS profiled CAM messages

Interoperability Test Description			
Identifier:	TD_CAM_04		
Objective:	CAM messages with basicRIS profile are interoperable		
Configuration:	GEO_CFG_01		
References:	[2] clause 9.2.3, Table F.1 [4] 7.2		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure the Source device to operate with basicRIS profile • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**

Interoperability Test Description			
	1	stimulus	Source is requested to send a CAM message
	2	verify	Receiver devices process the CAM as a valid message

	3	check	Received CAM message has basicRIS profile, meaning checking the following underlined values:
			cam {
			stationID,
			stationCharacteristics {
			false,
			false,
			false,
			},
			referencePosition {},
			camParameters OMIT
			}

	4	verify	Steps 2 to 3 are repeated at the CAM frequency of 1 Hz

8.2 DENM message transmission

8.2.1 EUT driving into DENM Relevance area within the DENM lifetime

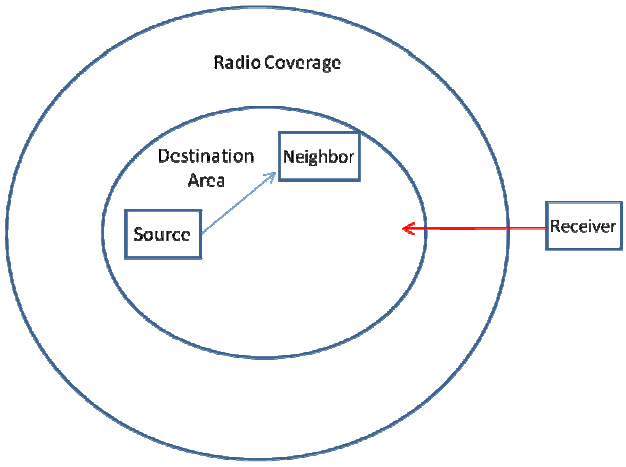

Figure 23: Geo Configuration

Note: Neighbor is necessary in this configuration in order to avoid that DENM messages get cached.

Interoperability Test Description			
Identifier:	TD_DENM_01		
Objective:	DENM re-transmissions are correctly received within the DENM lifetime		
Configuration:	GEO_CFG_06		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2, B.6, B.7		
Pre-test conditions:	• 3 ITS-S devices (Source, Receiver, Neighbor devices) installed in RF testbench, connected through antenna cable with manually controllable link attenuator on it • Configure in Source device DENM message which has its destination area extending beyond the radio coverage range (see figure above), DENM repetition frequency set to 1 Hz, and expiryTime set to some minutes in the future • Configure the positions of the ITS-S devices according to the table above • Raise the attenuation on the Source-Receiver connection, so that the two devices are off-link • Lower the attenuation on the Source-Neighbor connection, so that the two devices are on the same link • Each ITS-S device has sent at least 1 beacon or 1 CAM		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	stimulus	Lower the Source-Receiver attenuation before DENM lifetime expires, so that the two devices are on the same link.
	3	verify	Receiver devices receive a GeoBroadcast packet containing DENM message.
	4	verify	Receiver passes the DENM message to its Facility layer, where it is processed as a valid message
	5	verify	Steps 3 and 4 are repeated at the frequency defined by the 'frequency' parameter of the DENM message

8.2.2 EUT driving into DENM Relevance area after the DENM lifetime

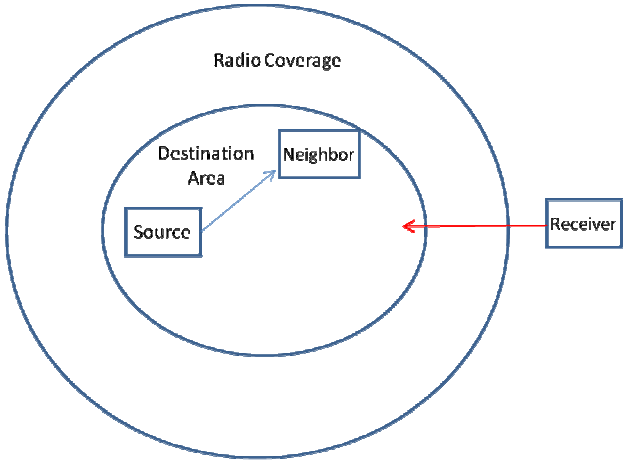

Figure 24: Geo Configuration

Note: Neighbor is necessary in this configuration in order to avoid that DENM messages get cached.

Interoperability Test Description			
Identifier:	TD_DENM_02		
Objective:	DENM re-transmissions are not received after the DENM lifetime		
Configuration:	GEO_CFG_06		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2, B.6, B.7		
Pre-test conditions:	• 3 ITS-S devices (Source, Receiver, Neighbor devices) installed in RF testbench, connected through antenna cable with manually controllable link attenuator on it • Configure in Source device DENM message which has its destination area extending beyond the radio coverage range (see figure above), DENM repetition frequency set to 1 Hz, and expiryTime set to some seconds in the future • Configure the positions of the ITS-S devices according to the table above • Raise the attenuation on the Source-Receiver connection, so that the two devices are off-link • Lower the attenuation on the Source-Neighbor connection, so that the two devices are on the same link • Each ITS-S device has sent at least 1 beacon or 1 CAM		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	stimulus	Lower the Source-Receiver attenuation after the DENM lifetime expires, so that the two devices are on the same link
	3	verify	Receiver devices does not receive any GeoBroadcast packet containing DENM message

8.2.3 Keeping DENM information alive after removal of the source (optional feature)

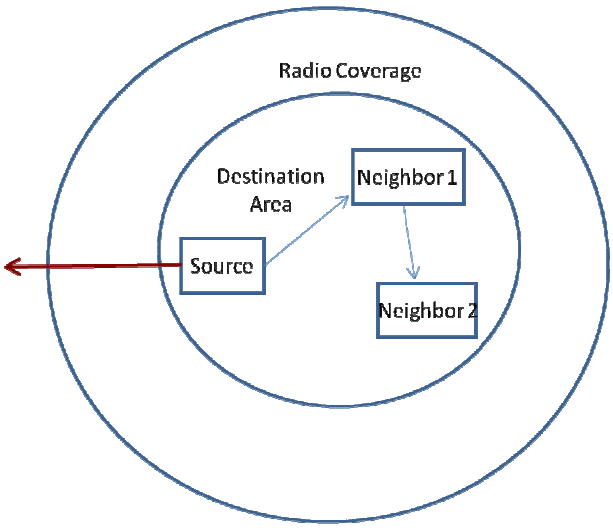

Figure 25: Geo Configuration

Interoperability Test Description			
Identifier:	TD_DENM_03		
Objective:	DENM information is kept alive as expected during its lifetime		
Configuration:	GEO_CFG_03		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2, B.6, B.7, C.5 (informative)		
Pre-test conditions:	• 3 ITS-S devices (Source, Neighbor 1 and 2 devices) installed in RF testbench, connected through antenna cable with manually controllable link attenuator on it • Configure in Source device DENM message which has its destination area extending over all three ITS-S devices (see figure above), DENM repetition frequency set to 1 Hz, and expiryTime set to some minutes in the future • Configure the positions of the ITS-S devices according to the table above • Lower the attenuation on the Source-Neighbor connections, so that all ITS-S devices are on the same link • Each ITS-S device has sent at least 1 beacon or 1 CAM		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	stimulus	Raise the Source-Neighbor attenuation before DENM expiry time, so that the Source device becomes off-link from the two Neighbor devices, while the two Neighbor devices remain on the same link
	3	verify	One of the Neighbor devices receives from the other Neighbor device a GeoBroadcast packet containing DENM message
	4	verify	Receiving Neighbor passes the received DENM message to its Facility layer, where it is processed as a valid message
	5	verify	Steps 3 and 4 are repeated at the frequency defined by the 'frequency' parameter of the DENM message, until the DENM lifetime expiration

8.2.4 EUT receiving an expired DENM message

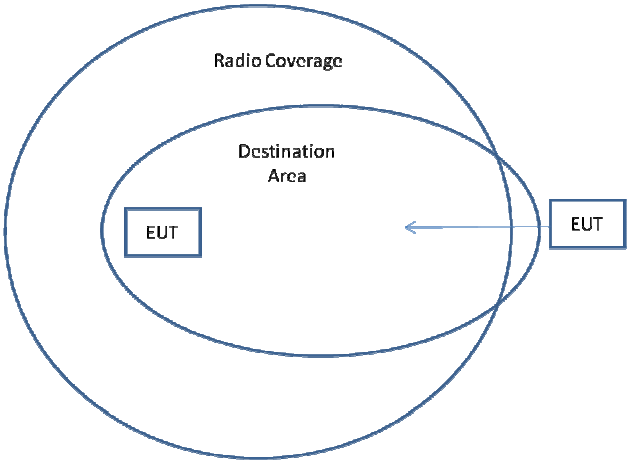

Figure 26: Geo Configuration

Interoperability Test Description			
Identifier:	TD_DENM_04		
Objective:	DENM expiry handling is correctly implemented		
Configuration:	GEO_CFG_05		
References:	[2] 9.2.3, Table F.1 [5] 6.1.3.2, B.6		
Pre-test conditions:	• 2 ITS-S devices (Source and Receiver) installed in RF testbench, connected through antenna cable with controllable link attenuator on it • Set itsGnMaxPacketLifetime parameter to 600 s (default value) • Wait until itsGnLifetimeLocTE to ensure that LocationEntry table is consistent • Configure in Source device - DENM message which has its destination area extending beyond the radio coverage range (see figure above) - and expiryTime set to 5 seconds - DENM transmission frequency set to 1,1 Hz • Configure the positions of the ITS-S devices according to the table above • Raise the attenuation on the connection, so that the two devices are off-link.		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	stimulus	After the DENM lifetime expires, but before the expiry of itsGnMaxPacketLifetime timer; lower the attenuation on the connection, so that the two devices are on the same link
	3	verify	Receiver devices receive all the 6 cached GeoBroadcasts containing the DENM message
	4	verify	The Facility layer of the receiver device detects that DENM messages are expired (because of their expired lifetime)

Note 1: TD_GN_GBC_04 shall be run successfully before the execution of this tests.

Note 2: Formula to calculate the total number of packets: f = 1,1 Hz equals T = 900 ms; 5000 ms / 900 ms ~ 5; total number of packets = 5 + initial packet sent at t_0 = 6 packets

8.3 Applications

The following tests are covered by DRIVE-C2X and ETSI CAA requirements. The following configurations apply to all tests in this chapter.

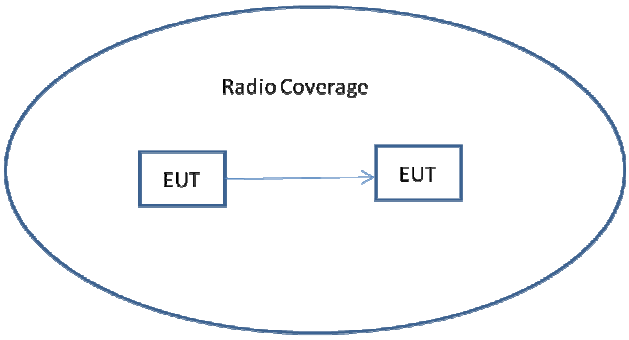

Figure 27: Geo Configuration for CAM tests

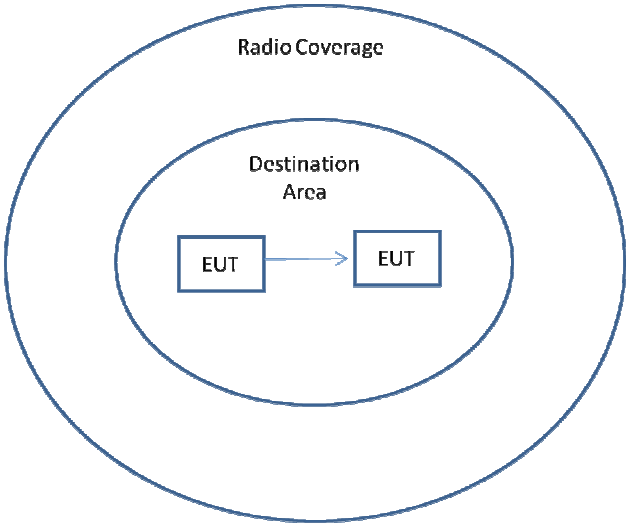

Figure 28: Geo Configuration for DENM tests

8.3.1 CAM and DENM location parameters used in all applications

Interoperability Test Description			
Identifier:	TD_UC_01		
Objective:	EUTs generate and interpret the vehicle location parameter of the CAM message correctly		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3, Table F.1 [4] 7.1, Annex A		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a CAM message
	2	verify	Receiver devices process the CAM as a valid message

	3	check	Received CAM message has the following underlined values according to the GPS input:
			cam {
			stationID,
			stationCharacteristics {},
			referencePosition {
			longitude,
			latitude,
			elevation,
			heading,
			...
			},
			camParameters {},
			profileDependent {}
			}
			}

	4	verify	Steps 2 to 3 are repeated within the CAM messaging frequency range

Interoperability Test Description			
Identifier:	TD_UC_02		
Objective:	EUTs generate and interpret the vehicle location parameter of the DENM message correctly		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.15		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device a DENM message corresponding to any event, and set the eventPosition structure equal to the actual vehicle position • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

	3	check	Received DENM message has the following underlined values according to the preconfigured input:
			denm {
			management {},
			situation {},
			location {
			eventPosition:eventPositionCurrentDefinition {
			refPosition {
			longitude,
			latitude,
			elevation,
			heading,
			...
			} ,
			...
			}
			}
			}

8.3.2 DENM parameters in support of 'Roadworks warning'

Interoperability Test Description			
Identifier:	TD_UC_03		
Objective:	DENM messages include parameters needed by 'Roadworks warning' application		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {3,0} • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

Interoperability Test Description			

	3	check	Received DENM message has the following underlined values according to the preconfigured input:
			denm {
			management {},
			situation {
			situation,
			severity,
			...
			},
			location {}
			}

8.3.3 CAM and DENM parameters in support of 'Traffic jam ahead warning' or 'Slow vehicle warning'

Interoperability Test Description			
Identifier:	TD_UC_04		
Objective:	CAM messages include parameters needed by 'Traffic jam ahead warning' or 'Slow vehicle warning' application		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3, Table F.1 [4] 7.1, Annex A		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a CAM message
	2	verify	Receiver devices process the CAM as a valid message

	3	check	Received CAM message has the following underlined values according to the GPS input:
			cam {
			stationID,
			stationCharacteristics {},
			referencePosition {},
			camParameters {
			vehicleCommonParameters {
			vehicleSpeed,
			vehicleSpeedConfidence,
			...
			},
			profileDependent {}
			}
			}

	4	verify	Steps 2 to 3 are repeated within the CAM messaging frequency range

Interoperability Test Description			
Identifier:	TD_UC_05		
Objective:	DENM messages include parameters needed by 'Traffic jam ahead warning'		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {1,0} • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

	3	check	Received DENM message has the following underlined values according to the preconfigured input:
			denm {
			management {},
			situation {
			situation,
			severity,
			...
			},
			location {}
			}

8.3.4 DENM parameters in support of 'Car Breakdown warning'

Interoperability Test Description			
Identifier:	TD_UC_07		
Objective:	DENM messages include parameters needed by 'Car Breakdown warning' application		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11, B.24		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {31,0} and its last 5 position waypoints in the 'trace' parameter • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

Interoperability Test Description			

	3	check	Received DENM message has the following underlined values according to the preconfigured input, and that the trace location data corresponds to GPS data input:
			denm {
			management {},
			situation {
			situation,
			severity,
			...
			},
			location {
			trace,
			...
			}
			}

8.3.5 CAM and DENM parameters in support of 'Approaching emergency vehicle'

Interoperability Test Description			
Identifier:	TD_UC_08		
Objective:	CAM messages include parameters needed by 'Approaching emergency vehicle' application		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3, Table F.1 [4] 7.1, Annex A		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure the source device to generate CAM messages with emergencyVehicle profile where the the sireneInUse and lightBarInUse parameters both have the 'engaged' value • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a CAM message
	2	verify	Receiver devices process the CAM as a valid message

	3	check	Received CAM message has the following underlined values according to the input values:
			cam {
			stationID,
			stationCharacteristics {},
			referencePosition {},
			camParameters {
			vehicleCommonParameters { },
			profileDependent:emergencyVehicle {
			lightBarInUse,
			sireneInUse,
			emergencyResponseType,
			...
			}
			}
			}

	4	verify	Steps 2 to 3 are repeated within the CAM messaging frequency range

Interoperability Test Description			
Identifier:	TD_UC_09		
Objective:	DENM messages include parameters needed by 'Approaching emergency vehicle' application		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {36,1} • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

	3	check	Received DENM message has the following underlined values according to the preconfigured input:
			denm {
			management {},
			situation {
			situation,
			...
			},
			location {
			eventPosition :eventPositionCurrentDefinition {
			refPosition {
			heading,
			…
			}
			}
			}
			}

8.3.6 DENM parameters in support of 'Weather Warning (Wind)'

Interoperability Test Description			
Identifier:	TD_UC_10		
Objective:	DENM messages include parameters needed by 'Weather Warning (Wind)' application		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {45,1} • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

Interoperability Test Description			

	3	check	Received DENM message has the following underlined values interpreted correctly according to the preconfigured input:
			denm {
			management {},
			situation {
			situation,
			severity,
			...
			},
			location {}
			}

8.3.7 DENM parameters in support of 'Emergency electronic break lights'

Interoperability Test Description			
Identifier:	TD_UC_11		
Objective:	DENM messages include parameters needed by 'Emergency electronic break lights' application		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {63,0}, its last 5 position waypoints in the 'trace' parameter and contains the optional 'vehicleSpeed' and optional 'long acceleration' parameters • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

	3	check	Received DENM message has the following underlined values according to the preconfigured input:
			denm {
			management {},
			situation {
			situation,
			severity,
			vehicleCommonParameters {
			vehicleSpeed,
			longAcceleration,
			...
			}
			.....
			},
			location {
			trace,
			...
			}
			}

8.3.8 DENM parameters in support of 'Post crash warning'

Interoperability Test Description			
Identifier:	TD_UC_13		
Objective:	DENM messages include parameters needed by 'Post crash warning' application		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {2,0} and the 'crashStatus' parameter containing TRUE value is present • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

	3	check	Received DENM message has the following underlined values according to the preconfigured input:
			denm {
			management {},
			situation {
			situation,
			severity,
			vehicleCommonParameters {
			crashStatus,
			...
			},
			...
			},
			location {}
			}

8.3.9 DENM parameters in support of 'Obstacle warning'

Interoperability Test Description			
Identifier:	TD_UC_14		
Objective:	DENM messages include parameters needed by 'Obstacle warning' application		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11, B.24		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {27, 4} and contains the last 5 position waypoints in the 'trace' parameter • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

Interoperability Test Description			

	3	check	Received DENM message has the following underlined values according to the preconfigured input:
			denm {
			management {},
			situation {
			situation,
			severity,
			...
			},
			location {
			trace,
			...
			}
			}

8.3.10 DENM parameters in support of 'Wrong way driving in gas stations'

Interoperability Test Description			
Identifier:	TD_UC_15		
Objective:	DENM messages include parameters needed by 'Wrong way driving in gas stations' application		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {35,0} • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

	3	check	Received DENM message has the following underlined values according to the preconfigured input:
			denm {
			management {},
			situation {
			situation,
			severity,
			...
			},
			location {}
			}

8.3.11 CAM parameters in support of 'Motor cycle warning'

Interoperability Test Description			
Identifier:	TD_UC_16		
Objective:	CAM messages include parameters needed by 'Motor cycle warning' application		
Configuration:	GEO_CFG_01		
References:	[2] 9.2.3, Table F.1 [4] 7.1, Annex A		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure the Source device to operate with basicVehicle profile inside which the vehicleType parameter has the value of 19 • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a CAM message
	2	verify	Receiver devices process the CAM as a valid message

	3	check	Received CAM message has the following underlined values according to the GPS input:
			cam {
			stationID,
			stationCharacteristics {},
			referencePosition {},
			camParameters {
			vehicleCommonParameters {
			vehicleType,
			...
			},
			profileDependent:basicVehicle
			}
			}

	4	verify	Steps 2 to 3 are repeated within the CAM messaging frequency range

8.3.12 DENM parameters in support of 'Slow vehicle warning'

Interoperability Test Description			
Identifier:	TD_UC_17		
Objective:	DENM messages include parameters needed by 'Slow vehicle warning'application		
Configuration:	GEO_CFG_02		
References:	[2] 9.2.3, Table F.1 [5] 6.2.4, B.11		
Pre-test conditions:	• 2 or more ITS-S devices (Source, Receiver devices) • Configure in Source device DENM message which has its 'situation' parameter containing the value {62,0} • Configure the positions of the ITS-S devices according to the table above; these locations are in close proximity so that all devices are within single-hop transmission range		
Test Sequence:	**Step**	**Type**	**Description**
	1	stimulus	Source is requested to send a preconfigured DENM message
	2	verify	Receiver devices process the DENM as a valid message

Interoperability Test Description			

	3	check	Received DENM message has the following underlined values according to the preconfigured input:
			denm {
			management {},
			situation {
			situation,
			severity,
			...
			},
			location {}
			}

Change History

Document history		
0.0.3	01.09.2011	First Draft
0.0.4	14.09.2011	Deletion of PING test and its clause
		Rename from DUT to EUT to comply with ETSI ITS test framework
		BTP port mapping added in basic configuration section
		Address configuration method added in basic configuration section
		TD_GN_FWD_02: in pre test conditions: NextHop device replace by Forwarder device
		TD_GN_FWD_02: step 3 extended
		TD_GN_GBC_01 : new text added in pretest condition: 'Each ITS-S device has sent at least 1 beacon'
		New test TD_GN_FWD_03 added
		New test TD_GN_DAD_01 added
		Rename of section 8.3 to 'Applications'
		TD_UC_03 situation parameter updated to {3,0}
		TD_UC_07 situation parameter updated to {13,1|2}
		TD_UC_09 situation parameter updated to {95,0}
		TD_UC_10 situation parameter updated to {17,1}
		TD_UC_11 situation parameter updated to {99,1}
		TD_UC_14 situation parameter updated to {10, 1|2|3|4|5|6|7}
		TD_UC_15 situation parameter updated to {14, 0}
		TD_UC_16 vehicelType parameter updated to ?
0.0.5	30.09.2011	Clause 6.7 on Geographic parameters added
		Clause 6.8 on CMS parameters added
		TD_GN_DAD_01: modified pre-test condition with inclusion of MAC address
		GPS data tables deleted from each TD
		All TDs updated with reference to GEO_CFG
0.0.6	14.10.2011	Re-write of TD_GN_BEA_01 to align with common style of source and destination
		Addition of chapter 4.4 Test Summary – Mandatory Tests
		Addition of chapter 4.5 Test Summary – Optional Tests
		Addition of chapter 6.8 CPS parameters
		Annex A DRIVE functions deleted
		Configuration change for GN_FWD_02,03 and DAD_01 . radio test bench configuration not needed
		TD_UC_05 split into two tests, since the cause/subcause values are different for 'Traffic jam ahead warning' and 'Slow vehicle warning'. New tests for Slow vehicle warning' is called TD_UC_17
		TD_UC_05 situation parameter updated to {1,0}
		TD_UC_17 situation parameter updated to {26,0}
0.0.7	21.10.2011	Configuration of TD_DENM_01 and TD_DENM_02 modified by adding roles of Source, Receiver
		Clause 6.6 IP network deleted
		All geo cfgs redrawn: Adjustment of number of EUTs; Destination Area usage only
		Clause 6.8: modified CPS parameters with correct roles (Source, Receiver, Forwarde etc)
		Clause 6.5: BTP port B changed to BTP-B. Same change for BTP-A
		Figure and table numbering introduced
		TD_GN_BEA_01 extented to check that the position vector (Longitude/Latitude/Altitude fields) of the received/logged beacon message correspond to the provided position feed input
		TD_CAM_04 step 3 corrected to have CamParameters omitted
		Clause 4.6 added on DENM Relevance Area – GN Destination Area
		Clause 6.7 Definition added that geo positions are for information only and that geo positions are provided by gpsd server
		Replaced all in all tests 'all nodes MAC address' with 'broadcast MAC address'
		In clause 6.8 marked the tests which use motion path
		In clause 6.8 marked the tests which run in test bench
		TD_GN_GBC_01 renamed to TD_GN_SHB_01 and rest of TD_GN_GBC_xx renumbered
		TD_GN_GBC_04 split in 2 tests. Now TD_GN_GBC_04 tests GN only. New DENM test is TD_DENM_04
		In all CAM/DENM tests: 'Receiver devices receive a CAM/DENM message' changed to 'Receiver devices process the CAM/DENM as a valid message'

		In all tests ‘Source sends’ replaced with ‘ Source is requested to send’ (except for TD_GN_BEA_01
0.0.8	09.11.2011	TD_UC_xx aligned with template definitions from DRIVE C2X (especially the cause code definitions)
		Wording ‘interpreted correctly’ removed for all Check Statements.
0.0.9	23.11.2011	Clause 6.9 on CAM frequency added
		Wording of TD_CAM_01,02,03 and 04 changed to ‘Steps 2 to 3 are repeated at the CAM frequency of 1 Hz’