Basic System Profile

CAR 2 CAR Communication Consortium

About the C2C-CC

Enhancing road safety and traffic efficiency by means of Cooperative Intelligent Transport Systems and Services (C-ITS) is the dedicated goal of the CAR 2 CAR Communication Consortium. The industrial driven, non-commercial association was founded in 2002 by vehicle manufacturers affiliated with the idea of cooperative road traffic based on Vehicle-to-Vehicle Communications (V2V) and supported by Vehicle-to-Infrastructure Communications (V2I). Today, the Consortium comprises 88 members, with 18 vehicle manufacturers, 39 equipment suppliers and 31 research organisations.

Over the years, the CAR 2 CAR Communication Consortium has evolved to be one of the key players in preparing the initial deployment of C-ITS in Europe and the subsequent innovation phases. CAR 2 CAR members focus on wireless V2V communication applications based on ITS-G5 and concentrate all efforts on creating standards to ensure the interoperability of cooperative systems, spanning all vehicle classes across borders and brands. As a key contributor, the CAR 2 CAR Communication Consortium works in close cooperation with the European and international standardisation organisations such as ETSI and CEN.

Disclaimer

Document information

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Table 1: Document information

Changes since last version

Title:	Basic System Profile		
Explanatory notes:			
31.08.2018	- Consolidation of requirements after the split of the Basic System profile into 3 documents: Objectives (UID 2035), Features (UID 2036) and Profile (UID 2037) in the previous release. - Improvement of position and timing requirements - Extension of the release bundle by the Protection Profile V2X Hardware Security Module (UID 2056). - Cleanup of security requirements in the Profile (UID 2037) - Extraction of references into a separate document: Reference list (UID 2052) - Update to new versions and cleanup of referenced standards	Release Management	Steering Committee
Date	**Changes**	**Edited by**	**Approved**

Table 2: Changes since last version

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1 Introduction

Other (informational) **RS_BSP_147**

The European architecture for Cooperative Intelligent Transport System (C-ITS), outlined in [EN 302 665], defines four ITS sub-systems: vehicle, roadside, personal and central. For all of that sub-systems a common ITS-S reference architecture is described, which offers different implementation options. Each option is further defined by one or more standards, contributed by different Standards Developing Organizations (SDOs).

For interoperability, each sub-system requires a specific set of standards, called system profile, defining in which way possible options are implemented. Thus the system profile describes external interfaces matching those of other sub-systems where communication is intended.

Interoperability again can be distinguished between two types:

- Inter-sub-system interoperability i.e. sub-systems implementing the system profile can communicate/understand each other
- Intra-sub-system interoperability (interoperability of components within an ITS subsystem), i.e., the sub-system consists of completely interchangeable components

Each type of interoperability provides benefits for the system, but comes with a certain effort to achieve this interoperability.

Inter-sub-system interoperability requires a precise definition of the external interfaces, but can leave room for different implementations within the sub-system, which encourages innovation and competitive differentiation.

Intra-sub-system interoperability requires a much higher degree of standardization within the sub-system, and allows customers to select among the best suppliers for each individual component within the sub-system. If intra-sub-system interoperability is not achieved, customers can only order complete sub-systems.

2 Scope

Other (informational) **RS_BSP_146**

The present document provides all requirements related to the features of a C2C-CC Basic System (see [C2CCC FEA]) to enable Inter-sub-system interoperability.

In terms of C2C-CC each requirement details a feature (which again details an objective) and provides its implementation details. Requirements itself are not further detailed by C2C-CC, thus requirements are the lowest level of specification provided by C2C-CC. As lowest layer of specification requirements are basis for testing, which follows the backward link: If all requirements of a feature are tested, the featured can be assumed as “tested” and if all features of an objective are assumed as “tested” the objective itself can be assumed as “tested”.

In some cases requirements are written in a way which let the implementation open, for example if they refer very specific parts of a vehicle. Those requirements have to be further detailed by anybody implementing that requirement. Beside this special requirements all other requirements can be further detailed too.

3 Conventions to be used

3.1 Modal verbs terminology

Other (informational) **RS_BSP_152**

In this document the following verbal forms are used:

- **Must:** indicates an absolute requirement of the specification due to legal issues
- **Must not:** indicates an absolute prohibition of the specification due to legal issues
- **Shall:** indicates an absolute requirement of the specification
- **Shall not:** indicates an absolute prohibition of the specification
- **Should:** indicates a recommendation. It means that there may exist valid reasons in particular circumstances to ignore a particular item, but the full implications must be understood and carefully weighed before choosing a different course.
- **Should not:** indicates that something is not recommended. It means that there may exist valid reasons in particular circumstances when the particular behavior is acceptable or even useful, but the full implications should be understood and the case carefully weighed before implementing any behavior described with this label.
- **May:** indicates that something is permitted/possible
- **Can:** indicates that something is possible/capable
- **Cannot:** indicates that something is not possible/capable
- **Will / will not:** indicates the inevitable behavior of the described system
- **Is / is not:** indicates facts

3.2 Item identification

Other (informational) **RS_BSP_422**

Each item of this document has its unique identifier starting with "RS_BSP_" as prefix. For any review annotations, remarks and/or questions please refer to this unique ID rather than chapter or page numbers!

3.3 Provisions from referenced documents

Other (informational) **RS_BSP_153**

Unless otherwise specified in the present document, the normative requirements included in the referenced documents supporting the required functionality of the C2C-CC Basic System shall apply. The verbal forms for the definition of provisions of referenced documents are defined either inside the document, or generally by the SDO (standardization organization) or the organization providing them. For example normative requirements in ETSI documents are indicated by the verbal form “shall”.

In case of more than one option in the standard, this document specifies which one is the recommended choice to ensure interoperability and/or sufficient performance. This document supplements the standards in case where standards are open for interpretation or believed not to contain all necessary requirements to ensure interoperability and/or sufficient performance.

This document might also supplement standards in cases where, for performance reasons, it is believe that more stringent requirements than the minimum requirements in the standard shall be applied to ensure sufficient performance.

3.4 Requirements quality

Other (informational) **RS_BSP_424**

All Requirements shall have the following properties:

- **Redundancy:** Requirements shall not be repeated within one requirement or in other requirements
- **Clearness:** All requirements shall allow one possibility of interpretation only. Only technical terms of the glossary may be used. Furthermore, it must be clear from the requirement, what object the statement is a requirement on. Examples:
  - The <...> module shall/should/may ...
  - The <...> module's environment shall ...
  - The <...> configuration shall...
  - The function <...> shall ...
  - The hardware shall ...
- **Atomicity:** Each Requirement shall only contain one requirement. A Requirement is atomic if it cannot be split up in further requirements.
- **Testability:** Requirements shall be testable by analysis, review or test.
- **Traceability:** The source and status of a requirement shall be visible at all times.
- **Formulation:** All requirements shall be formulated so that they can be interpreted without the surrounding context (for example: "the function Xyz..." instead of "this function...").

4 Definitions and abbreviations

4.1 Definitions

Definition **RS_BSP_149**

A *C2C-CC Basic System* is a C-ITS vehicle sub-system as outlined in [C2CCC FEA].

Definition **RS_BSP_428**

Vehicle states comprise absolute position, heading and velocity at a certain point in time.

Definition **RS_BSP_193**

ITS time is defined as a time based on TAI (Temps Atomique International, International Atomic Time), a high-precision atomic coordinate time standard. Epoch of this time is set to 1.1.2004, 00:00 UTC, timestamps (as defined in [TS 102 894-2]) are counted as milliseconds since epoch.

Definition **RS_BSP_429**

Information provided with a confidence level of 95 % means that the true value (e.g. position of a reference measurement system) is inside the range specified by the estimated value plus/minus the confidence interval (given by the confidence value) in 95% of the data points in a given statistic base.

Definition **RS_BSP_200**

For horizontal position a confidence area is used instead of a single confidence interval. The confidence area is described as ellipse specified via a major axis, minor axis and orientation of the major axis relative to the north direction as defined in RS_BSP_191.

Definition **RS_BSP_430**

The s*tation clock* is defined as a clock representing ITS time (see RS_BSP_193) in a C2C-CC Basic System.

Definition **RS_BSP_211**

Sky obstruction is defined as the fraction of the half-hemisphere values that are obstructed for GNSS satellites due to mountains, buildings, trees, etc.

Other (informational) **RS_BSP_450**

Definitions for *authorization tickets*, *enrolment credentials* and *authorization status repository* can be found in:

- [TS 102 940]
- [TS 102 941]
- [TS 102 731]

4.2 Abbreviations

Other (informational) **RS_BSP_150**

AA	Authorization Authority
AT	Authorization Ticket
BSP	Basic System Profile
BTP	Basic Transport Protocol
C2C-CC	Car2Car Communications Consortium
CAM	Cooperative Awareness Message
CBR	Channel Busy Ratio
C-ITS	Cooperative Intelligent Transport System
CL	Channel Load
CS	Charging Spot
DCC	Decentralized Congestion Control
DENM	Decentralized event notification message
DP	DCC profile
DPID	DCC profile identifier
EV	Electric Vehicle
GBC	GeoBroadcast
GN	GeoNetworking
GNSS	Global Navigation Satellite System
IEEE	Institute of Electrical and Electronics Engineers
ITS	Intelligent Transport System
ITS-AID	ITS - Application Object Identifier
LT	Lifetime
LTC	Long-Term Certificate
MAC	Medium Access Control
OEM	Original Equipment Manufacturer
PAI	Position Accuracy Indicator
PC	Pseudonym Certificate
PCA	Pseudonym Certification Authority (synonym in ETSI standards: Authorization Authority (AA))
PKI	Public key infrastructure
POI	Point of Interest
QPSK	Quadrature phase-shift keying
RCA	Root Certification Authority
SCF	Store Carry Forward
SDO	Standards Developing Organization
SHB	Single Hop Broadcast

SSP	Service Specific Permissions
TAI	Temps Atomique International
TAL	Trust Assurance Level
TC	Traffic class
UTC	Coordinated Universal Time
WG	Working Group
WGS	World Geodetic System

Table 3: Abbreviations

5 Requirement specifications

5.1 Security

Other (informational) **RS_BSP_455**

The following section shall be read in the context of the European C-ITS Certificate Policy [C-ITS CP] and C-ITS Security Policy [C-ITS SP] as in general it is assumed that the C2C-CC Basic System is compliant to those policies. Therefore the requirements stated below are valid in addition to the requirements that can be found in those policies. A duplication of requirements is avoided for consistency reasons.

Requirement **RS_BSP_158**

When the C2C-CC Basic System is externally powered, it shall verify that it is operating in the vehicle with which it has been paired in the factory or in an authorized repair shop. If such correct functioning condition cannot be verified, the Basic System shall be deactivated preventing it from sending messages (i.e. deactivate at least the radio transmission level of the Basic System).

Details:

Tested by:

Requirement **RS_BSP_168**

The C2C-CC Basic System shall check the timestamp in the security envelope compared to the reception time and accept only CAMs in the last time of *pSecCamToleranceTime* and other messages within the last time of *pSecMessageToleranceTime*.

NOTE: Due to the tolerance of the ITS station times, the C2C-CC Basic System can accept messages 2 * *pPotiMaxTimeDiff* in the future (due to clock allowed deviation).

Details:

Tested by:

Requirement **RS_BSP_169**

The C2C-CC Basic System shall check the distance from the sender position - in the security envelope, if available - and forward only messages with a distance from the sender of equal or less than *pSecMaxAcceptDistance*.

NOTE: 6 km = 6 hops * 1000 meter.

Details:

Tested by:

Requirement **RS_BSP_163**

The “verification” of a message shall comprise at least cryptographic verification of the message’s signature.

Details:

Tested by:

Requirement **RS_BSP_164**

The C2C-CC Basic System shall only forward verified messages in the ITS G5 network.

Details:

Tested by:

Requirement **RS_BSP_160**

The C2C-CC Basic System shall use one and only one end-to-end security envelope per message according to [TS 103 097] and [EN 302 636-4-1].

Details:

Tested by:

Requirement **RS_BSP_406**

The end-to-end security envelope shall be generated according to the security profiles specified in clause 7.1.1, 7.1.2, and 7.1.3 in [TS 103 097], depending on whether a CAM, DENM or other message is processed.

Details:

Tested by:

Requirement **RS_BSP_407**

The signature in the end-to-end security envelope shall be generated using a private key corresponding to a valid authorization ticket according to clause 7.2.1 in [TS 103 097].

Details:

Tested by:

Requirement **RS_BSP_170**

The C2C-CC Basic System shall sign sending messages by using digital signatures and certificates based on ECDSA-256 using the elliptic curve NIST P-256 as defined in [TS 103 097].

NOTE: [C-ITS CP] additionally requires implementation of the elliptic curve brainpool P256r1 to sign messages.

Details:

Tested by:

Requirement **RS_BSP_178**

Authorization ticket preloading in the vehicle shall not exceed *pSecMaxPreloadTime*, i.e. all certificates in a vehicle shall have a validity range that spans at most *pSecMaxPreloadTime* altogether.

Details:

Tested by:

Requirement **RS_BSP_180**

The authorization ticket validity periods shall be defined by the AA (Authorization Authority) in conformance to the rules of the RCA (Root Certification Authority).

Details:

Tested by:

Requirement **RS_BSP_411**

In case that an C2C-CC Basic System has no valid authorization ticket for signing messages, it shall stop transmitting messages that use the security profiles specified in [TS 103 097], clause 7.1.1, 7.1.2, and 7.1.3.

Details:

Tested by:

Requirement **RS_BSP_412**

The driver shall be informed if no valid authorization ticket is available.

Details:

Tested by:

Requirement **RS_BSP_413**

The driver shall be informed if no valid enrollment credential is available.

Details:

Tested by:

Requirement **RS_BSP_177**

The authorization ticket used by the C2C-CC Basic System shall change every time when the vehicle's ignition is switched on except if the system gets restarted within a period of *pSecRestartBlockingTime*, the authorization ticket shall not be changed.

Details:

Tested by:

Requirement **RS_BSP_409**

The authorization ticket change after turning on ignition shall be performed within a grace period of *pSecRestartDelay*.

Details:

Tested by:

Requirement **RS_BSP_181**

If the C2C-CC Basic System detects a collision of the least significant 32 bit of the "Certificate digest" / "hashedId8" with the "Certificate digest" / "hashedId8" of another ITS station (or C2C-CC Basic System), it shall initiate a change of its authorization ticket if the certificate corresponding to the other "Certificate digest" / "hashedId8" is valid, if no such collision has triggered the current authorization ticket.

Details:

Tested by:

Requirement **RS_BSP_182**

All addresses and identifiers of other layers transmitted over the ITS G5 wireless channel (such

as StationId in CAM/DENM, GeoNetworking Source Address, MAC Source Address), shall be changed when the security entity changes its authorization ticket.

Details:

Tested by:

Requirement **RS_BSP_185**

Facilities layer shall clear the own station's path history cache (used to fill into new messages) when the security entity changes its authorization ticket identity.

Details:

Tested by:

Requirement **RS_BSP_184**

Applications shall be able to block the authorization ticket change indefinitely, if the vehicle does not move, i.e. PathPoint position information does not change. In other cases, applications shall only be able to block it for at most *pSecChangeBlockingMaxTime*.

Exception:

- Validity of the authorization ticket expired
- Collision of "Certificate digest" / "hashedId8"

Details:

Tested by:

Requirement **RS_BSP_401**

The GN Source Address shall be constructed as follows:

- Set the field M (bit 0) to *pSecGnSourceAddressType*.
- Set the field ST (bits 1 to 5) to the station type of the ITS-S. The station type in the GN source address shall be identical to the station type in CAMs/DENMs.
- Set all bits of the field SCC (bits 6 to 15) to *pSecGnScc*.
- Set the field MID (bits 16 to 63) to the value of the MAC address.

Details:

Tested by:

Requirement **RS_BSP_183**

All identifiers according to RS_BSP_182 (MAC Source Address, StationId in CAM/DENM, GN Source Address) shall be derived from the "Certificate digest" / "hashedId8".The required number of least significant bytes of the "Certificate digest" / "hashedId8" shall be used as respective identifier.

Details:

Tested by:

Requirement **RS_BSP_328**

The security services in Table 4 shall be supported, but are defined by the manufacturer.

Obtain and update authorization tickets
Obtain, update and publish enrolment credentials
Update local authorization status repository

Table 4: Manufacturer dependent security service

Details:

Tested by:

Requirement **RS_BSP_341**

The minimal acceptable trust level for mobile ITS station implementations is *pSecMinTal*.

Details:

Tested by:

Requirement **RS_BSP_342**

Each TAL is mapped to a subject assurance representation according to [TS 103 097] as specified in Table 5.

TAL	Subject assurance (Hex value)
0	0x00
1	0x20
2	0x40
3	0x60
4	0x80

Table 5: Mapping between TAL and subject assurance representations

Details:

Tested by:

5.2 Positioning and Timing

Requirement **RS_BSP_190**

The vehicle states (see RS_BSP_428) shall be consistent. Therefore, heading and velocity shall refer to the exact same time as the absolute position (e.g. GenerationDeltaTime in CAMs).

NOTE: Any inaccuracies that might result from time-related effects should be taken into account in the accuracies of the state variables.

Details:

Tested by:

Requirement **RS_BSP_191**

The C2C-CC Basic System shall use World Geodetic System 84 (WGS84) as reference coordinate system as specified in [TS 102 894-2].

Altitude information shall be interpreted as height above WGS84 Ellipsoid.

NOTE 1: Alternative altitude interpretations using Geoid definitions (e.g. relative to mean sea level) shall not be used.

NOTE 2: Based on the drift of European Terrestrial Reference System (ETRS89), which is fixed to the continental plate of Europe, of 2.5cm/year in WGS84 it needs to be noted that Vehicle ITS-Ss need to be aware what referencing system is used. When an enhanced referencing system such as an RTK enhanced system is used for high precision location referencing this shift may need to be compensated.

Details:

Tested by:

Requirement **RS_BSP_192**

The C2C-CC Basic System shall interpret “heading” as the direction of the horizontal velocity vector. The starting point of the velocity vector shall be the ITS Vehicle Reference Point as defined in [EN 302 637-2] B.19 "referencePosition".

NOTE: Alternative heading interpretations referring to the vehicle body orientation shall not be used.

NOTE: This definition implies that straight backward driving results in 180° difference between heading and vehicle body orientation.

Details:

Tested by:

Requirement **RS_BSP_194**

ITS-S time shall be the basis for all time stamps in all transmitted messages of the C2C-CC Basic System.

Details:

Tested by:

Requirement **RS_BSP_195**

When some sensors used for estimating vehicle states (see RS_BSP_428, e.g. GNSS and vehicle sensors) are not available, the vehicle states estimation shall be continued (e.g. by means of extrapolation). The confidence intervals of all vehicle states shall be calculated considering the actual status of the sensors used.

Details:

Tested by:

Requirement **RS_BSP_197**

A C2C-CC Basic System shall update the vehicle states (see RS_BSP_428) at least with a frequency of *pPotiUpdateRate* when it is active.

Details:

Tested by:

Requirement **RS_BSP_431**

The accuracy estimations shall yield valid 95 % confidence values, according to definitions in RS_BSP_429 and RS_BSP_200.

Details:

Tested by:

Requirement **RS_BSP_432**

Timestamps in messages shall be based on station clock (see RSP_BSP_430).

Details:

Tested by:

Requirement **RS_BSP_207**

The difference between station clock (see RSP_BSP_430) and time base shall be estimated. If the maximum difference of |Station clock time - time base| >= *pPotiMaxTimeDiff*, it does not allow the (ITS) system to be active.

NOTE: A precise timestamp is needed not only for time synchronization but also implies that system states are valid at precisely that point in time, i.e., that the vehicle states (see RS_BSP_428 and RS_BSP_190) stay consistent.

Details:

Tested by:

Requirement **RS_BSP_444**

When coming to a standstill, the system shall report the last known heading value (vehicle direction of motion). The value shall be unlatched when returning to motion.

Details:

Tested by:

Requirement **RS_BSP_445**

At system startup, the system may report a stored heading value as the initial startup value.

Details:

Tested by:

5.3 System Behavior

Requirement **RS_BSP_214**

The C2C-CC Basic System shall operate the Cooperative Awareness Basic Service when it is in a safety-related context as defined in RS_BSP_216.

NOTE: Operation of the Cooperative Awareness Basic Service includes the transmission of cooperative awareness messages (CAMs) if all conditions for CAM generation are fulfilled.

Details:

Tested by:

Requirement **RS_BSP_215**

Traces and path history data shall only be generated when position confidence and ITS time information are available as specified in RS_BSP_205 and RS_BSP_206.

Details:

Tested by:

Requirement **RS_BSP_216**

By default, a C2C-CC Basic System shall be considered to be within the safety-related context, as long as the vehicle is participating in public traffic under normal driving conditions.

In some specific situations, the safety-related context may be deactivated for the C2C-CC Basic System under a deactivation condition. This condition has to be verified by a vehicle occupant or an in-vehicle system.

Details:

Tested by:

Requirement **RS_BSP_242**

The C2C-CC Basic System shall manage CAM transmission in such a way, that no outdated CAM (a newer CAM is available) messages will be transmitted even if DCC is limiting the transmission rate.

Details:

Tested by:

5.4 Access Layer

Requirement **RS_BSP_433**

The C2C-CC Basic System's access layer shall be compliant to [EN 302 571].

Details:

Tested by:

Requirement **RS_BSP_225**

The C2C-CC Basic System shall use the control channel G5-CCH in the ITS-G5A frequency band, as specified in [EN 302 663] Table 3.

Details:

Tested by:

Requirement **RS_BSP_226**

RF output power of the C2C-CC Basic System shall be adjustable.

Details:

Tested by:

Requirement **RS_BSP_434**

The C2C-CC Basic System's access layer shall be compliant to [EN 302 663].
Details:
Tested by:

Requirement **RS_BSP_228**

The C2C-CC Basic System shall use a transfer rate of *pAlDataRateCch* on G5-CCH.
Details:
Tested by:

Requirement **RS_BSP_397**

The C2C-CC Basic System shall also support *pAlDataRateCchLow* and *pAlDataRateCchHigh* transfer rates on G5-CCH (for future use).
Details:
Tested by:

Requirement **RS_BSP_398**

The C2C-CC Basic System shall support the broadcast mode.
Details:
Tested by:

Requirement **RS_BSP_435**

The C2C-CC Basic System's access layer shall be compliant to [TS 102 724].
Details:
Tested by:

Requirement **RS_BSP_235**

The C2C-CC Basic System shall support the following DCC-Profiles defined inside [TS 102 724]: DP0, DP1, DP2 and DP3.
These four DCC-Profiles shall use the following DCC-Profile Identification (DPID) values:

- DP0, used only for DENMs with TC = 0
- DP1: used for DENMs with TC = 1
- DP2: used for CAMs with TC = *pCamTrafficClass*
- DP3: used for forwarded DENMs and other low priority messages

Details:
Tested by:

Requirement **RS_BSP_436**

The C2C-CC Basic System's DCC mechanism shall comply with [TS 102 687].
Details:
Tested by:

Requirement **RS_BSP_238**

The following settings of the C2C-CC Basic System shall be used, if the reactive DCC algorithm outlined in Clause 5.3 of [TS 102 687] is implemented:

State	*CBR*	*Packet rate (R)*	T_{off}
Relaxed	< 30 %	20 Hz	50 ms
Active_1	30 % to 39 %	10 Hz	100 ms
Active_2	40 % to 49 %	5 Hz	200 ms
Active_3	50 % to 65 %	4 Hz	250 ms
Restricted	> 65 %	1 Hz	1000 ms

Table 6: Mapping of CBR values to state

NOTE: Table 6 corresponds to Table A.2 in [TS 102 687] and this table is based on CAM and DENM dissemination for day one applications with an average T_{on} of 500 µs.

Details:

Tested by:

Requirement **RS_BSP_240**

The following smoothing function of channel busy ratio (CBR) values shall be performed if the C2C-CC Basic System uses the reactive DCC algorithm outlined in Clause 5.3 of [TS 102 687]:

CBR_now = (CBR(n)+CBR(n-1))/2

NOTE: Where 'n' and 'n-1' are respectively the current and previous CBR sampling period.

NOTE: CBR assessment is a mandatory feature outlined in Clause 4.2.10 of [EN 302 571].

Details:

Tested by:

Requirement **RS_BSP_241**

The ITS-S shall support information traffic shaping or selective forwarding following a best effort principle.

NOTE: Traffic shaping is relevant for relayed DENMs sent on DP3, as anticipated in some situations – such as severe traffic congestion or other extreme vehicular network scenarios – the DENM load might increase substantially. In such cases, the ITS-S is allowed to forgo the forwarding of received DENMs.

Details:

Tested by:

Requirement **RS_BSP_243**

The C2C-CC Basic System shall, at a minimum, be able to generate and transmit the number of messages as determined by the value of the highest CAM generation rate (i.e. 10 Hz) and, if detection algorithms are used, then increased by the minimum required DENM generation rate derived from those triggering conditions.

Details:

Tested by:

Requirement **RS_BSP_244**

The C2C-CC Basic System shall abide by the following maximum message rates:

- For the relaxed state: the sum of all messages sent on DP1, DP2 and DP3 while in relaxed state shall not surpass $R_{max\_relaxed}$ = 16.7 messages per second. Message bursts are allowed for DP0 with R_{Burst} = 20 messages per second, with a maximum duration of T_{Burst} = 1 seconds, and may only take place every $T_{BurstPeriod}$ = 10 seconds. Thus, adding DP0 messages, the maximum message rate amounts to $R_{max\_relaxed}$ = 36.7 messages per second.
- For active states: the maximum message rate for each state is given in Table 6 (RS_BSP_238).
- For the restrictive state the maximum message rate per C2C-CC Basic System station is set to 2.2 messages per second, i.e., the inverse of T_{TX_MAX} = 460 ms.

Details:

Tested by:

Requirement **RS_BSP_245**

The C2C-CC Basic System shall support per-packet transmission power control.

NOTE: P_{Tx} may depend on the current DCC state (i.e., relaxed, active or restrictive) and on DCC-Profile (i.e, DP0, DP1, etc.).

Details:

Tested by:

Requirement **RS_BSP_246**

The C2C-CC Basic System shall reduce its transmission power to P_{Toll} = *pDccPToll* as soon as the *protected communication zone* is entered, and without changing any other DCC transmission parameters as per Table 6 (RS_BSP_238). DP0 messages are excluded from this restriction.

NOTE: The C2C-CC Basic System has to implement mitigation as described in RS_BSP_458 or RS_BSP_459.

Details:

Tested by:

Requirement **RS_BSP_458**

In case the C2C-CC Basic System is not equipped with a CEN-DSRC radio detector as described in [TS 102 792] (detailed in in clause 5.2.5), the C2C-CC Basic System shall maintain a list of actual protected zone positions (detailed in clause 5.5.1). This list shall be composed of:

- a set of protection zones as listed in the “latest version” (available when the vehicle is developed) of the ASECAP database. Optionally the C2C-CC Basic System may include update mechanisms of the database;
- a set of protection zones as identified by the reception of the CEN-DSRC mitigation CAMs (detailed in clause 5.2.5 and clause 5.2.2.3) and

- a temporarily protection zone as identified by the reception of the CEN-DSRC mitigation CAMs (detailed in clause 5.2.2.2).

Details:

Tested by:

Requirement **RS_BSP_459**

In case the C2C-CC Basic System is equipped with a CEN-DSRC radio detector mitigation shall be applied as described in [TS 102 792] (detailed in in clause 5.2.5) and the C2C-CC Basic System shall generate CAMs in accordance to [TS 102 792] (detailed in clause 5.5.1).

Details:

Tested by:

Requirement **RS_BSP_460**

In case the C2C-CC Basic System is not equipped with a CEN-DSRC radio detector, mitigation shall be applied in accordance with [TS 102 792] based on the list as defined in RS_BSP_458 and received CAMs from other road users which have implemented RS_BSP_459.

Clarification [TS 102 792] clause 5.2.5: A mobile ITS station should mitigate each time to the nearest tolling station center position. In case several positions are given in the same area, the mobile ITS station should respond to each center positions possibly in a sequence. Protected Zones with identical protectedZone ID may be seen as a single station. In case the ASECAP database and the CEN-DSRC mitigation CAMs contains a valid protection zone with the identical protectedZone ID mitigation shall be done only based on the CEN-DSRC mitigation CAM content.

Details:

Tested by:

5.5 Networking and Transport Layer

Requirement **RS_BSP_437**

The C2C-CC Basic System's media-independent part of GeoNetworking shall be compliant to [EN 302 636-4-1].

Details:

Tested by:

Requirement **RS_BSP_250**

All default constants and parameters of the C2C-CC Basic System profile not defined or overwritten in the current document shall be set as specified in Annex G of [EN 302 636-4-1].

Details:

Tested by:

Requirement **RS_BSP_251**

GN shall only be used with itsGnSecurity set to *pGnSecurity*.

Details:

Tested by:

Requirement **RS_BSP_252**

GN shall only be used with itsGnLocalAddrConfMethod set to *pGnAddrConfMode*.

Details:

Tested by:

Requirement **RS_BSP_255**

GN parameter itsGnMaxGeoAreaSize shall be set to *pGnMaxAreaSize*.

Details:

Tested by:

Requirement **RS_BSP_416**

Packet repetition shall not be performed by GN and the corresponding steps in the packet handling procedures in [EN 302 636-4-1] clause 9.3 shall not be executed.

The parameter 'Maximum repetition time' of the service primitive GN-DATA.request is not applicable. Also, the GN protocol constant itsGnMinPacketRepetitionInterval is not applicable

Details:

Tested by:

Requirement **RS_BSP_414**

GN shall only be used with itsGnIfType set to *pGnInterfaceType*.

Details:

Tested by:

Requirement **RS_BSP_256**

The C2C-CC Basic System shall use Single Hop Broadcast (SHB) headers as defined in [EN 302 636-4-1] on all CAM packets it sends.

Consequently, the GeoNetworking common header shall use a value of *pGnShbHtField* for the HT field, and a value of *pGnShbHstField* for the HST field when transmitting SHB packets.

Details:

Tested by:

Requirement **RS_BSP_257**

The C2C-CC Basic System shall use GeoBroadcast (GBC) headers as defined in [EN 302 636-4-1] on all DENM packets it sends.

Consequently, the GeoNetworking common header shall use a value of *pGnGbcHtField* for the HT field when transmitting DENM packets.

For the HST field only the following values shall be used (see [EN 302 636-4-1]):

- 0 for circular areas,
- 1 for rectangular areas, and

- 2 for ellipsoidal areas

NOTE: The BSP specifies handling of Single Hop Broadcast (SHB) and GeoBroadcast (GBC) packets (RS_BSP_256 and RS_BSP_257, respectively). As the handling of other GN packet types defined in [EN 302 636-4-1] are not specified in the BSP, the BSP does not prevent implementing them.

Details:

Tested by:

Requirement **RS_BSP_258**

The C2C-CC Basic System shall set the LifeTime field of all SHB packets in the following manner:

- Set the sub-field multiplier to *pGnShbLifeTimeMultiplier* and the sub-field base to *pGnShbLifeTimeBase*.

Details:

Tested by:

Requirement **RS_BSP_259**

The C2C-CC Basic System shall set the LifeTime field of all GBC packets to the minimum of ValidityDuration and RepetitionInterval (LifeTime=min(ValidityDuration, RepetitionInterval)), where ValidityDuration and RepetitionInterval are defined inside [C2CCC tc Docs]. The value of the LifeTime field shall not exceed the itsGnMaxPacketLifetime, specified in [EN 302 636-4-1], Annex G.

Details:

Tested by:

Requirement **RS_BSP_260**

The C2C-CC Basic System shall buffer GBC packets when no neighbours are available (store-carry-forward). Consequently, the SCF bit of the TC (Traffic Class) field of GBC packets shall be set to *pGnGbcScf*.

Details:

Tested by:

Requirement **RS_BSP_262**

The C2C-CC Basic System is not required to offload packets to another channel. Consequently, the channel offload bit of the TC (Traffic Class) field should be set to *pGnChannelOffLoad*.

Details:

Tested by:

Requirement **RS_BSP_263**

The C2C-CC Basic System shall only use the DCC profiles specified in RS_BSP_235. Consequently, the DCC Profile ID bits of the TC (Traffic Class) field shall only use the DPID values defined in RS_BSP_235.

Details:
Tested by:

Requirement **RS_BSP_264**

The C2C-CC Basic System shall set the itsGnIsMobile bit of the Flags field to *pGnIsMobile*.

Details:
Tested by:

Requirement **RS_BSP_265**

The C2C-CC Basic System shall set the GN Hoplimit parameter as follows:

- 0, if the destination area is a circle with radius <= 100 m
- 1, if the destination area is a circle with radius <= 200 m
- 2, if the destination area is a circle with radius <= 500 m
- 3 otherwise

Details:
Tested by:

Requirement **RS_BSP_266**

The C2C-CC Basic System shall support multi-hop operation mode. The C2C-CC Basic System shall implement the forwarding algorithm specified [EN 302 636-4-1] Annex E.3.

Details:
Tested by:

Requirement **RS_BSP_267**

When forwarding packets, the C2C-CC Basic System shall use the DCC profile DP3 as defined in [TS 102 724] and profiled in RS_BSP_235.

Details:
Tested by:

Requirement **RS_BSP_268**

The C2C-CC Basic System shall use duplicate packet detection on the networking and transport layer. Consequently, the algorithm specified in [EN 302 636-4-1] Annex A.2 and A.3 shall be used for detecting duplicate packets.

Details:
Tested by:

Requirement **RS_BSP_270**

All GeoNetworking frames sent by the C2C-CC Basic System shall use the EtherType value *pGnEtherType* as listed by the IEEE Registration Authority at http://standards.ieee.org/develop/regauth/ethertype/eth.txt

Details:
Tested by:

Requirement **RS_BSP_438**

The C2C-CC Basic System's Basic Transport Protocol shall be compliant to [EN 302 636-5-1].

Details:

Tested by:

Requirement **RS_BSP_273**

The C2C-CC Basic System shall employ BTP-B headers. Consequently, the GeoNetworking common header shall use a value of *pGnBtpNh* for the NH field.

Details:

Tested by:

Requirement **RS_BSP_274**

The C2C-CC Basic System shall set the destination port info field to the value *pBtpDestPortInfo*.

Details:

Tested by:

Requirement **RS_BSP_275**

Inside the BTP-B header, the C2C-CC Basic System shall set the destination port to the value *pBtpCamPort* for CAMs.

Details:

Tested by:

Requirement **RS_BSP_276**

Inside the BTP-B header, the C2C-CC Basic System shall set the destination port to the value *pBtpDenmPort* for DENMs.

Details:

Tested by:

Requirement **RS_BSP_279**

The C2C-CC Basic System shall support circular, rectangular and ellipsoidal geographical areas as defined in [EN 302 931]. Each use case defined in [C2CCC tc Docs] must specify one of the above geographical area types and indicated through the GeoNetworking header as specified in [EN 302 636-4-1].

Details:

Tested by:

Requirement **RS_BSP_280**

When a C2C-CC Basic System calculates the distance between two positions using GNSS coordinates (e.g. for PathDeltaPoints or in case of circular relevance area), the great-circle method shall be used.

NOTE: Thereby, care shall be taken to avoid large rounding errors on low-precision floating point systems; these can be avoided, e.g., with the haversine formula. In case the relevance area is an ellipse or a rectangle, then the cartesian coordinates of the area center and of the current position need to be calculated for assessing whether to hop the packet as specified in [EN 302 931]; for this purpose it is recommended to use the Local Tangent Plane method, or another method delivering the same accuracy.

Details:

Tested by:

5.6 Facility Layer

Requirement **RS_BSP_439**

The C2C-CC Basic System's CA basic service shall be compliant to [EN 302 637-2].

Details:

Tested by:

Requirement **RS_BSP_285**

The path history field inside the CAM low frequency container shall be generated according to the method specified in RS_BSP_318 and shall contain a PathHistory data element covering a minimum distance of *pCamTraceMinLength* (K_PHDISTANCE_M parameter in [SAE J2945/1], Appendix A.5).

An exception to the minimum covered distance by PathHistory shall be only made if either of the following conditions is fulfilled:

- The vehicle has not yet physically covered the distance with its current authorization ticket (e.g., after vehicle startup or right after authorization ticket change when driving)
- The maximum number of PathPoints is used while the overall length covered by the PathHistory still does not reach *pCamTraceMinLength*.

NOTE: This may happen, when the road topology contains curves with small radius. In this case, the inter distance between consecutive PathPoints is reduced.

Only in the above two cases the vehicle may send PathHistory information covering a distance below *pCamTraceMinLength*.

Details:

Tested by:

Requirement **RS_BSP_286**

The PathHistory in CAMs shall cover at most *pCamTraceMaxLength*.

Details:

Tested by:

Requirement **RS_BSP_287**

The PathHistory in CAMs shall include PathDeltaTime in every PathPoint. The PathHistory shall describe a list of actually traveled geographical locations leading to the current vehicle Position, sorted by the time the Positions were reached by the vehicle with the first point being

the closest in time to the current time.

Details:

Tested by:

Requirement **RS_BSP_288**

In cases where the C2C-CC Basic System does not move, i.e. PathPoint position information does not change, the PathDeltaTime of the first PathPoint shall still be updated with every CAM.

Details:

Tested by:

Requirement **RS_BSP_289**

When the C2C-CC Basic System does not move, i.e. PathPoint position information does not change, for a duration longer than the maximum value of PathDeltaTime (specified in [TS 102 894-2]) the PathDeltaTime of the first PathPoint in the CAM shall be fixed to the maximum value.

Details:

Tested by:

Requirement **RS_BSP_290**

The CA basic service shall be active as long as C2C-CC Basic System is in the safety-related context as specified RS_BSP_216. As long as the CA basic service is active, CAMs shall be generated according to the generation rules defined in [EN 302 637-2].

Details:

Tested by:

Requirement **RS_BSP_291**

A C2C-CC Basic System shall transmit CAM messages as long as position and time information are available and within the specified limits in RS_BSP_205 and RS_BSP_206.

Details:

Tested by:

Requirement **RS_BSP_292**

The traffic class value for CAM messages shall be set to *pCamTrafficClass*.

Details:

Tested by:

Requirement **RS_BSP_293**

The parameter T_GenCam_Dcc (see [EN 302 637-2]) shall be set to the value of the minimum time between two transmissions, T_{off}, as given by the DCC Mechanism (see Table 6, RS_BSP_238).

Details:

Tested by:

Requirement **RS_BSP_297**

The adjustable N_GenCam parameter (see [EN 302 637-2]) specified in the CAM Generation Frequency Management shall be set to *pCamGenNumber* for the C2C-CC Basic System.

Details:

Tested by:

Requirement **RS_BSP_440**

The C2C-CC Basic System's DEN basic service shall be compliant to [EN 302 637-3].

Details:

Tested by:

Requirement **RS_BSP_301**

The DENM repetition shall be done by the DEN basic service as specified in [EN 302 637-3].

Details:

Tested by:

Requirement **RS_BSP_302**

The path history field inside the DEN messages shall be generated according to the method specified RS_BSP_318 and shall contain Trace data elements covering a minimum distance of *pDenmTraceMinLength* (K_PHDISTANCE_M parameter in [SAE J2945/1], Appendix A.5).

An exception to the minimum covered distance by Traces shall be only made if either of the following conditions is fulfilled:

- The vehicle has not yet physically covered the distance with its current authorization ticket (e.g., after vehicle startup or right after authorization ticket change when driving)
- The maximum number of PathPoints is used while the overall length covered by the PathHistory still does not reach *pDenmTraceMinLength*.

NOTE: This may happen, when the road topology contains curves with small radius. In this case, the inter distance between consecutive PathPoints is reduced.

Only in the above two cases the vehicle may send Traces information covering a distance below *pDenmTraceMinLength*.

Details:

Tested by:

Requirement **RS_BSP_303**

The Traces in the DENMs shall cover at most *pDenmTraceMaxLength*.

Details:

Tested by:

Requirement **RS_BSP_304**

A C2C-CC Basic System shall use the DENM traces as follows:

The first trace element shall describe a time-ordered list of actually traveled geographical locations leading to the event position, as specified in RS_BSP_287.

NOTE: DENMs received from infrastructure stations might not follow this specification.

Details:

Tested by:

Requirement **RS_BSP_305**

The PathDeltaTime data elements of the PathPoints in the first DENM traces element shall only be updated if the DENM is updated. Furthermore, the cases in which DENM Updates are triggered shall be specified on a case-by-case basis in the corresponding Triggering Conditions, see [C2CCC tc Docs].

Details:

Tested by:

Requirement **RS_BSP_306**

In cases where the event detecting vehicle does not move, i.e. PathPoint position information does not change, the PathDeltaTime of the first PathPoint of the first DENM traces element shall still be updated with every DEN_Update.

NOTE: This is only the case for stationary events where the detecting vehicle is identical to the event, e.g. a stationary vehicle warning. For dynamic events, e.g. dangerous situations, or events, where the event is not identical to the vehicle, e.g. adverse weather warning, this is not the case.

Details:

Tested by:

Requirement **RS_BSP_307**

When the C2C-CC Basic System does not move, i.e. PathPoint position information does not change, for a duration longer than the maximum value of PathDeltaTime (specified in [TS 102 894-2]), the PathDeltaTime of the first PathPoint in the first DENM trace element shall be fixed to the maximum value.

Details:

Tested by:

Requirement **RS_BSP_308**

Additional PathHistory elements may be present in the DENM traces. However, unlike the first element, these shall describe alternative routes to the event location. These routes may or may not be available at the time of detecting the event. In the alternative routes, the PathPoints shall be position-ordered (i.e. shortest-path routes) and they shall not include the PathDeltaTime.

Details:

Tested by:

Requirement **RS_BSP_315**

The C2C-CC Basic System shall only generate DENMs as described in [C2CCC tc Docs].

Details:

Tested by:

Requirement **RS_BSP_313**

The data elements which constitute the content of the CAM and DENM shall be compliant to [TS 102 894-2] and use the coordinate system specified in RS_BSP_321 and RS_BSP_191.

Details:

Tested by:

Requirement **RS_BSP_318**

The traces and path histories used by the C2C-CC Basic System shall be generated using the Design Method One as specified in [SAE J2945/1], Appendix A.5. The C2C-CC Basic System shall use this generation method with the following settings:

- K_PHALLOWABLEERROR_M = *pTraceAllowableError*, where PH_ActualError < K_PHALLOWABLEERROR_M
- Maximum distance between concise path points, K_PH_CHORDLENGTHTHRESHOLD = *pTraceMaxDeltaDistance*
- K_PH_MAXESTIMATEDRADIUS = REarthMeridian
- K_PHSMALLDELTAPHI_R = *pTraceDeltaPhi*
- REarthMeridian = *pTraceEarthMeridian* (according to IUGG - International Union of Geodesy and Geophysics), used for great-circle or orthodromic distance calculation:

$$PH\_ActualChordLength = REarthMeridian * \cos^{-1}[$$
$$\cos(lat_1)\cos(lat_2)\cos(long_1 - long_2) + \sin(lat_1)\sin(lat_2)]$$

Details:

Tested by:

Requirement **RS_BSP_321**

The C2C-CC Basic System shall use a coordinate system compliant to [ISO 8855], section 2.13.

In detail this means that the X and Y axes are parallel to the ground plane, the Z axis is aligned vertically upwards, the Y axis points to the left of the vehicle's forward direction, and the X axis points towards vehicle’s forward driving direction.

Details:

Tested by:

Requirement **RS_BSP_447**

The C2C-CC Basic System shall provide the received valid SSP and ITS-AID as part of the valid certificate to the FAC layer ([EN 302 636-5-1] annex A Parameter "permissions").

Details:

Tested by:

5.7 Hardware Related Requirements

Requirement **RS_BSP_202**

The 95 % confidence value (see RS_BSP_429 and RS_BSP_200) shall be valid in each scenario listed in RS_BSP_209. This implies that in a confidence value assessment test (which can be offline) a statistic averaging over all states and scenarios is not appropriate.

Instead, a sliding window containing the vehicle states (see RS_BSP_428) of the last *pPotiWindowTime* seconds shall be used as the statistic base.

NOTE: the proposed confidence validation mechanism using the sliding window is typically performed off-line, as post-processing of collected test data. It is not required that the C2C-CC Basic System performs confidence validation on-line, i.e. while in safety-related context.

NOTE: The sliding window approach has the following advantages over separate statistics for each scenario:

- Transitions between scenarios are included.
- Confidence is valid “now” instead of “over lifetime”. “Error bursts” (many invalid confidence values in a short timeframe) are not allowed.
  - This enhances the usefulness of the confidence value for applications.
  - This requires a fast detection of accuracy degradation inside POTI.
- The precise definition of test data has no effect on confidence validation parameters. Requirement however is: Test data contains all scenarios listed in section RS_BSP_209.
- No further statistic calculations needed. Coverage of all relevant states is given by the scenarios. Coverage of the relevant time will be ensured by the definition of test data in WG Conformance Assessment.
- The interval length is similar to typical (environment and driving condition) scenario lengths (city tunnel, standing at traffic light, driving maneuvers …).
- 5 % of the interval is similar to typical short term effects (driving under a bridge,…).

Details:

Tested by:

Requirement **RS_BSP_205**

Under optimal GNSS conditions and regular driving dynamics (as defined in RS_BSP_449), the confidence values shall be equal to or lower than the following values in at least 95 % of 3D position data points in a dataset:

- horizontal position confidence of 5 m
- vertical position confidence of 15 m

In other scenarios, the requirement degradations in RS_BSP_209 apply. This requirement ensures the usefulness of information sent.

NOTE: Altitude Accuracy will be quantized quite roughly for CAM/DENM, e.g. “within 1/2/5/10/20/50/100/200 m”.

Details:

Tested by:

Requirement **RS_BSP_206**

The station clock (see RS_BSP_430) shall be within *pPotiMaxTimeDiff* to ITS time, i.e. Delta t = |station clock time – ITS time| < *pPotiMaxTimeDiff*.

Details:

Tested by:

Definition **RS_BSP_449**

A vehicle is considered to be under regular driving dynamics when

- The vehicle has passed its initial startup phase
- The vehicle is being used as foreseen by the manufacturer
- Normal control of the vehicle shall be possible (e.g. the vehicle is not directly involved in an accident, road surface shall allow normal tire grip)
- The following conditions (values) apply for passenger cars:
  - Vehicle lateral acceleration shall be < 1.9 m/s^2 AND
  - Vehicle longitudinal acceleration shall be > -2.4 m/s^2 (deceleration) AND
  - Vehicle longitudinal acceleration shall be < 2.5 m/s^2 AND
  - Vehicle speed shall be <= minimum of (130 km/h, Vmax)

NOTE: This is intended to be used for confidence requirements of the vehicle state.

Requirement **RS_BSP_209**

A C2C-CC Basic System shall be able to provide useful vehicle state estimations (see RS_BSP_428) also in challenging scenarios. To account for inevitable degradations, required confidence values are defined for different scenarios in the following Table 7.

'C' is the maximum of semiMajorConfidence and semiMinorConfidence, see also RS_BSP_200. The condition for 'C' shall be fulfilled in 95% of data points in the dataset of the given scenario.

NOTE: One possibility to conduct these tests is a HiL testbed. Thereby, the C2C-CC (by way of the WG Conformance Assessment) could collect and administer a test database to which C2C-CC members can contribute and access data. This would allow members to test their systems across a large set of scenarios, without the need to physically collect all the data in the field, thus saving costs.

NOTE: The definition of “sky obstruction” is provided in RS_BSP_211.

NOTE: The criteria shall be met under the following slope dynamics for the analyzed trace fraction:

- average slope <= 4% and maximum slope <= 15%

NOTE: As a precondition, each scenario shall be started with one minute of driving under open sky and normal driving conditions.

NOTE: No C values indicate that the scenario shall be tested to ensure that the reported confidence interval is valid but no limit is given.

ID	Scenario	Definition	Acceptance
Environment under normal driving conditions			

S1	Open sky	Sky is less than 20% obstructed, with vehicle moving with normal driving dynamics, normal road conditions	C < 5m
S2	Tunnel	No GNSS Satellite is visible for at least 30 s and 250 m (v_{min}=30 km/h), GNSS signal reflection at entrance and end of tunnel	C < 15m
S3	Parking house	No direct visible GNSS Satellites, but connection by reflexions, T > 60 s, v_{max} < 20 km/h, minimum 2 x 90 ° curves and s > 100 m, 2 ramps in the entrance and exit area	any value is allowed
S4	Half open sky	Sky is 30-50% obstructed (obstruction concentrated on one side of the car) for more than 30 s, Driving conditions as S1	C < 7m
S5	Forest	Sky is 30-50% obstructed by objects including trees higher than the antenna for more than 30 s.	C < 10m
S6	Mountains (valley)	Sky is 40-60% obstructed by high mountain(s) , Driving conditions as S1	C < 10m
S7	City	In a 300 s drive, the sky was 30-50% obstructed (short periods of less than 30-50% obstructions allowed), frequent GNSS signal reflection at buildings, including short losses of GNSS signal (i.e. less than 4 satellites) Driving conditions as S1	C < 14m
S8	Mild urban	Sky is 20 - 40 % obstructed, t > 60 s, s > 400 m, Driving conditions as S1 with stops, trees and/or buildings, as well as alleys	C < 10m
Driving conditions under open sky			
S9	Dynamic driving	Testdrive with longitudinal accelerations of more than -6 m/s² and lateral accelerations of > (±) 5 m/s²	C < 7m
S10	Static	Vehicle standing still for 30 min	C < 5m
S11	Rough road	Testdrive on dirt road with pot holes, v= 20-50 km/h	C < 10m
S12	Icy road	Testdrive with longitudinal accelerations of more than -0.5 m/s² and lateral accelerations of > (±) 0.5m/s² , μ < 0.15,	C < 7m
S13	High speed	V= minimum of (130 km/h, Vmax) on dry road for 30 s	C < 5m

Table 7: Scenarios

Details:

Tested by:

Requirement **RS_BSP_448**

Under optimal GNSS conditions and regular driving dynamics as defined in RS_BSP_449, the speed confidence values shall be equal to or lower than the following values in at least 95% of data points in a dataset:

- 2 km/h for speeds between 5 km/h and 45 km/h
- 1 km/h for speeds greater than 45 km/h

NOTE: Per Confidence definition, the speed error (delta between ground truth and reported speed value) must not exceed the reported speed confidence in at least 95% of data points in a dataset, see RS_BSP_429.

Details:

Tested by:

Requirement **RS_BSP_457**

Under optimal GNSS conditions and regular driving dynamics as defined in RS_BSP_449, the confidence values shall be equal to or lower than the following values in at least 95% of data points in a dataset:

- heading confidence of 3° for speeds between 5km/h and 45km/h
- heading confidence of 2° for speeds greater than 45km/h

NOTE: Per Confidence definition, the heading error (delta between ground truth and reported heading value) must not exceed the reported heading confidence in at least 95% of data points in a dataset, see RS_BSP_429.

Details:

Tested by:

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6 Parameter settings

Definition **RS_BSP_443**

Parameter	Value	Unit	Description	Min. Value	Max. Value	Source Document
pAlDataRateCch	6	Mbit/s	Default data rate for CCH.	3	27	[EN 302 663] [IEEE 802.11]
pAlDataRateCchHigh	12	Mbit/s	Optional higher data rate for CCH than the default one.	3	27	[IEEE 802.11]
pAlDataRateCchLow	3	Mbit/s	Optional lower data rate for CCH than the default one.	3	27	[IEEE 802.11]
pBtpCamPort	2001	n/a	Well-known destination port for CAMs.	0	65535	[EN 302 636-5-1]
pBtpDenmPort	2002	n/a	Well-known destination port for DENMs.	0	65535	[EN 302 636-5-1]
pBtpDestPortInfo	0	n/a	Value for the destination port information.	0	65535	[EN 302 636-5-1]
pCamGenNumber	3	n/a	Number of consecutive generated CAMs without time restrictions.	0	3	[EN 302 637-2]
pCamTraceMaxLength	500	m	Maximal length of a trace in CAMs.	--	--	--
pCamTraceMinLength	200	m	Minimal length of a trace in CAMs.	--	--	--
pCamTrafficClass	2	n/a	Traffic class value CAMs are send with.	0	255	--
pDccCcaThresh	-85	dBm	Minimum sensitivity of the channel	--	-85	[EN 302 571]
pDccMeasuringInterval	100	ms	Value for the interval in which the channel load is provided.	n.a.	n.a.	[EN 302 571]
pDccMinSensitivity	-88	dBm	Value for minimum receiver sensitivity.	--	--	--
pDccProbingDuration	8	µs	Value for the probing sample duration.	n.a.	n.a.	--
pDccPToll	10	dBm	Value for transmission power inside protected communication zones.	<10	=<10 (in radiusof 20m)	[TS 102 792] Version 1.2.1
pDCCSensitivityMargin	3	dB	Value for margin of paremter pDccMinSensitivity.	--	--	--
pDenmTraceMaxLength	1000	m	Maximal length of a trace in DENMs.	--	--	--
pDenmTraceMinLength	600	m	Minimal length of a trace in DENMs.	--	--	--
pGnAddrConfMode	ANONYMOUS (2)	n/a	Configuration method for GN address.	0	2	[EN 302 636-4-1]

pGnBtpNh	2	n/a	Value for the NH field of GN Common Header.	0	3	[EN 302 636-4-1]
pGnChannelOffLoad	0	n/a	Value for the channel offload field.	0	1	[EN 302 636-4-1]
pGnEtherType	0x8947	--	Value for the EtherType to use.	n.a.	n.a.	n.a.
pGnGbcHtField	4	n/a	Value for the HeaderType field in case of GBC.	0	15	[EN 302 636-4-1]
pGnGbcScf	1	n/a	Value for the store-carry-forward field in case of GBC.	0	1	[EN 302 636-4-1]
pGnInterfaceType	ITS-G5 (1)	n/a	Interface type to be used by GN.	0	1	[EN 302 636-4-1]
pGnIsMobile	1	n/a	Defines whether ITS-S is mobile or not.	0	1	[EN 302 636-4-1]
pGnMaxAreaSize	80	km²	Supported area to cover.	1	625	[EN 302 636-4-1]
pGnSecurity	ENABLED (1)	n/a	Defines use of GN security headers.	0	1	[EN 302 636-4-1]
pGnShbHstField	0	n/a	Value for the HeaderSubType field in case of SHB.	0	15	[EN 302 636-4-1]
pGnShbHtField	5	n/a	Value for the HeaderType field in case of SHB.	0	15	[EN 302 636-4-1]
pGnShbLifeTimeBase	1	n/a	Value for the LifeTimeBase field in case of SHB.	0	3	[EN 302 636-4-1]
pGnShbLifeTimeMultiplier	1	n/a	Value for the LifeTimeMultiplier field in case of SHB.	0	63	[EN 302 636-4-1]
pPotiMaxTimeDiff	20	ms	Maximum time difference between station clock and reference time.	--	--	--
pPotiWindowTime	???	s	Size of PoTi sliding window in seconds.	20	120	--
pPotiUpdateRate	10	Hz	Update rate for position and time information.	--	--	--
pSecCamToleranceTime	2	s	Maximum time deviation between time in the security header of the CAM and station clock to accept the CAM	--	--	--
pSecChangeBlockingMaxTime	5	min	Maximum time a authorization ticket change can be blocked, if C2C-CC basic system is moving.	--	--	--
pSecGnScc	0	n/a	Value for the SCC field of the GN address.	0	1023	[EN 302 636-4-1]
pSecGnSourceAddressType	0	n/a	Value for the M field of the GN address (configuration type of the address).	0	1	[EN 302 636-4-1]
pSecMaxAcceptDistance	6	km	Maximum distance between sender and receiver to accept messages.	--	--	--

pSecMaxPreloadTime	3	month	Maximum time for preloading certificates.	--	--	--
pSecMessageToleranceTime	10	min	Maximum time deviation between time in security header of message (other to CAM) and station clock to accept the message.	--	--	--
pSecMinTal	2	TAL level	Value for minimum TAL for an ITS-S.	--	--	--
pSecRestartBlockingTime	10	min	Time between consecutive restarts in which the authorization ticket shall not be changed.	--	--	--
pSecRestartDelay	1	min	Grace period for authorization ticket change after turning on ignition terminal.	--	--	--
pTraceAllowableError	0,47	m	Parameter for calculation of traces, see [SAE J2945/1] for further details.	--	--	--
pTraceDeltaPhi	1	°	Parameter for calculation of traces, see [SAE J2945/1] for further details.	--	--	--
pTraceEarthMeridian	6.378,137	km	Earth mean radius (according to IUGG - International Union of Geodesy and Geophysics). Used for calculation of traces, see [SAE J2945/1] for further details.	--	--	--
pTraceMaxDeltaDistance	22,5	m	Parameter for calculation of traces, see [SAE J2945/1] for further details.	--	--	--

Table 8: Parameter settings