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2017-12-08	4.3.1	AUTOSAR Release Management	• Editorial changes
2016-11-30	4.3.0	AUTOSAR Release Management	• Initial Release

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Bibliography

[1] Standardization Template
AUTOSAR_TPS_StandardizationTemplate

[2] Glossary
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[3] EN 302 663 V1.2.0: Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band

[4] EN 302 636-5-1 V1.2.0: Vehicular Communication; Geonetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocols

[5] EN 302 637-2 V1.3.0: Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service

[6] TS 102 792 V1.1.1: Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (CEN DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range

[7] TS 102 724 V1.1.1: Intelligent Transport Systems (ITS); Harmonized Channel Specifications for Intelligent Transport Systems operating in the 5 GHz frequency band

[8] TS 102 687 V1.1.1: Decentralized Congestion Control Mechanisms for Intelligent Transport Systems operating in the 5 GHz range; Access layer part

[9] EN 302 637-3 V1.2.0: Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service

[10] TS 102 894-2 V1.1.1: Intelligent Transport Systems (ITS); Users and applications requirements; Applications and facilities layer common data dictionary

[11] EN 302 931 V1.1.1: Vehicular Communications; Geographical Area Definition

[12] EN 302 636-4-1 V1.2.0: Vehicular Communication; Geonetworking; Part 4 Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality

[13] TS 102 941 V1.1.1: Trust and Privacy Management

[14] TS 103 097 V1.2.1: Security Header and Certificate Formats

[15] TS 102 940 V1.1.1: ITS Communications Security Architecture and Security Management

[16] EN 302 665 V1.1.1: Intelligent Transport Systems (ITS); Communications Architecture

[17] C2C-CC White Paper Information quality/event detection

[18] VSC-A Final Report: [Online] Available: http://www.nhtsa.gov/DOT/NHTSA/NVS/Crash Avoidance/Technical Publications/2011/811492B.pdf

[19] C-Roads Profile V1.2: C-ITS Infrastructure Functions and Specifications

[20] TS 103 301 V1.1.1: Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Facilities layer protocols and communication requirements for infrastructure services

[21] C2C-CC White Paper Decentralized Congestion Control (DCC) for Day One

[22] Requirements on AUTOSAR Features
AUTOSAR_RS_Features

[23] General Specification of Basic Software Modules
AUTOSAR_SWS_BSWGeneral

1 Scope of Document

This document specifies requirements on Vehicle-2-X communication. It shall be used as a basis for each requirements document inside the Vehicle-2-X stack.

2 Conventions to be used

The representation of requirements in AUTOSAR documents follows the table specified in [TPS_STDT_00078].

2.1 Document Conventions

The representation of requirements in AUTOSAR documents follows the table specified in [TPS_STDT_00078], see Standardization Template, chapter Support for Traceability ([1]).

The verbal forms for the expression of obligation specified in [TPS_STDT_00053] shall be used to indicate requirements, see Standardization Template, chapter Support for Traceability ([1]).

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as follows.

Note that the requirement level of the document in which they are used modifies the force of these words.

- MUST: This word, or the adjective "LEGALLY REQUIRED", means that the definition is an absolute requirement of the specification due to legal issues.
- MUST NOT: This phrase, or the phrase "MUST NOT", means that the definition is an absolute prohibition of the specification due to legal issues.
- SHALL: This phrase, or the adjective "REQUIRED", means that the definition is an absolute requirement of the specification.
- SHALL NOT: This phrase means that the definition is an absolute prohibition of the specification.
- SHOULD: This word, or the adjective "RECOMMENDED", 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: This phrase, or the phrase "NOT RECOMMENDED", 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: This word, or the adjective "OPTIONAL", means that an item is truly optional. One vendor may choose to include the item because a particular marketplace requires it or because the vendor feels that it enhances the product while another vendor may omit the same item.

An implementation, which does not include a particular option, SHALL be prepared to interoperate with another implementation, which does include the option, though perhaps with reduced functionality. In the same vein an implementation, which does include a particular option, SHALL be prepared to interoperate with another implementation, which does not include the option (except, of course, for the feature the option provides.)

2.2 Requirements structure

Each module specific chapter contains a short functional description of the Basic Software Module. Requirements of the same kind within each chapter are grouped under the following headlines (where applicable):

Functional Requirements:

- Configuration (which elements of the module need to be configurable)
- Initialization
- Normal Operation
- Shutdown Operation
- Fault Operation
- ...

Non-Functional Requirements:

- Timing Requirements
- Resource Usage
- Usability
- Output for other WPs (e.g. Description Templates, Tooling,...)
- ...

3 Acronyms and abbreviations

The glossary below includes acronyms and abbreviations relevant to the V2x-stack that are not included in the AUTOSAR Glossary [2].

Abbreviation / Acronym:	Description:
BSS	Basic service set
BTP	Basic Transport Protocol [1]
C2C-CC	Car2Car communications Consortium
CA	Cooperative awareness
CAM	Cooperative awareness message [2]
CS	Charging Spot
DCC	Decentralized Congestion Control
DENM	Decentralized event notification message [3]
DP	DCC profile
DPID	DCC profile identifier
DSRC	Dedicated Short Range communications
EDCA	Enhanced distributed channel access
EV	Electric Vehicle
GBC	GeoBroadcast
GLOSA	Green Light Optimized Speed Advisory
GN	GeoNetworking
GPS	Global positioning system
HSM	Hardware security module
HST	Header Sub-type
HT	Header Type
ITS	Intelligent Transport Systems
ITS-S	ITS Station
IVIM	Infrastructure to Vehicle Information Message
LF	Low frequency
LLC	Logical Link Control
LT	Lifetime
LTCA	Long-Term Certificate Authority
MAC	Medium Access Control
MAPEM	MAP (topology) Extended Message
MHP	Maximum Hop limit
NDL	Network Design limits
NH	Next Hop
PCA	Pseudonym Certificate Authority
PHY	Physical layer
PKI	Public key infrastructure
POI	Point of Interest
PTD	Probe Traffic Data
RLT	Road and Lane Topology
SCF	Store Carry Forward
SHB	Single Hop Broadcast
SPAT	Signal Phase and Timing
SPAT	Signal Phase And Timing
SPATEM	Signal Phase And Timing Extended Message
TAL	Trust Assurance Level
TC	Traffic class
TLM	Traffic Light Maneuver

Abbreviation / Acronym:	Description:

Table 3.1: Acronyms and Abbreviations

4 Requirements Specification

This chapter describes all requirements driving the work to define Vehicle-2-X communication.

4.1 Functional Overview

The European architecture for Cooperative Intelligent Transport System (C-ITS), outlined in [16], 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. Given the C2C-CC plans of a fast and wide deployment, it is important to start the internal development and purchasing processes within the different OEMs as soon as possible. Given this timeframe, the C2C-CC aims for inter-sub-system interoperability, and not for intra-sub-system interoperability.

4.2 Functional Requirements

The requirements in this section all concern how the Access layer interacts with the other modules inside the *Wireless/Off-board communication stack*. The AUTOSAR architecture defines all interactions to occur over a *standardized interface*.

4.2.1 General

[SRS_V2X_00010] The implementation of the V2X system shall follow additional guidance given by C2C-CC requirements ⌈

Type:	Valid
Description:	The AUTOSAR modules implementing the V2X system shall follow additional guidance given by C2C-CC requirements
Rationale:	Requirements part of the original C2C-CC Basic System Profile ease the implementation of day-1 scenarios
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

4.2.2 Security

[SRS_V2X_00163] The ”verification” of a message shall comprise at least cryptographic verification of the message’s signature ⌈

Type:	Valid
Description:	The ”verification” of a message shall comprise at least cryptographic verification of the message’s signature.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00514*)

[SRS_V2X_00164] The V2X system shall only forward verified messages ⌈

Type:	Valid
Description:	The V2X system shall only forward verified messages in the ITS-G5 network.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00514*)

[SRS_V2X_00160] The V2X system shall use end-to-end security for communication to external entities ⌈

Type:	Valid
Description:	The V2X system shall use one end-to-end security envelope per message according to [14].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 103 097 V1.2.1: Security Header and Certificate Formats.

⌋(*RS_Main_00514*)

[SRS_V2X_00406] The end-to-end security envelope shall be generated depending on the message type ⌈

Type:	Valid
Description:	The end-to-end security envelope shall be generated according to the security profiles specified in clause 7.1, 7.2, and 7.3 in [14], depending on whether a CAM, DENM or other message is processed.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 103 097 V1.2.1: Security Header and Certificate Formats.

⌋(*RS_Main_00514*)

[SRS_V2X_00407] The signature in the end-to-end security envelope shall be generated using a private key corresponding to a valid authorization ticket (pseudonym certificate) ⌈

Type:	Valid
Description:	The signature in the end-to-end security envelope shall be generated using a private key corresponding to a valid authorization ticket (pseudonym certificate) according to clause 7.4.1 in [14].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 103 097 V1.2.1: Security Header and Certificate Formats.

⌋(*RS_Main_00514*)

[SRS_V2X_00174] The V2X system shall support key origin authentication for the new (long-term or pseudonym) public keys that are provided in certificate signing requests ⌈

Type:	Valid
Description:	The V2X system shall support key origin authentication for the new (long-term or pseudonym) public keys that are provided in certificate signing requests.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00514*)

[SRS_V2X_00412] The V2X system shall inform the driver about the expiration of the pseudonym certificates ⌈

Type:	Valid
Description:	The driver shall be informed in advance about the expiration of the pseudonym certificates.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00514*)

[SRS_V2X_00413] The V2X system shall inform the driver about the expiration of the Long Term Certificates ⌈

Type:	Valid
Description:	The driver shall be informed in advance about the expiration of the Long Term Certificates.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00514*)

[SRS_V2X_00184] The V2X system shall allow applications to block the pseudonym change ⌈

Type:	Valid
Description:	Applications shall be able to block the pseudonym change indefinitely, if the vehicle is stationary. In other cases, applications shall only be able to block it for at most vSECMaxChangeBlockingTime. Exception: • Validity of the pseudonym expired • Collision of pseudonym identifiers
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00514*)

[SRS_V2X_00161] The V2X system shall employ the security envelope on its Network layer ⌈

Type:	Valid
Description:	The V2X system shall employ the security envelope on its Network layer according to [12]. The security envelope covers GN Common and Extended Headers, GN Basic Header is not content of the envelope.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 636-4-1 V1.2.0: Vehicular Communication; Geonetworking; Part 4 Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality.

⌋(*RS_Main_00514*)

4.2.3 Position and Timing

[SRS_V2X_00190] The V2X system shall handle vehicle states in a consistent manner ⌈

Type:	Valid
Description:	The vehicle states, i.e. position, time, heading and velocity, shall be consistent. Vehicle state values are consistent if they refer to the same position and time instant.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

[SRS_V2X_00207] The difference between Station clock and time base shall be estimated ⌈

Type:	Valid
Description:	The difference between Station clock and time base shall be estimated. If the maximum difference of abs(Station clock time - time base) = > vPoTiMaxTimeDiff, it does not allow the (ITS) system to be active.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

[SRS_V2X_00193] The V2X system shall use ITS time as time base ⌈

Type:	Valid
Description:	The V2X system shall use ITS time as time base. 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 [10]) are counted as milliseconds since epoch
Rationale:	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 stay consistent
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 102 894-2 V1.1.1: Intelligent Transport Systems (ITS); Users and applications requirements; Applications and facilities layer common data dictionary.

⌋(*RS_Main_00285*)

4.2.4 System behavior

[SRS_V2X_00214] The V2X system shall allow applications to deactivate transmission of CAMs ⌈

Type:	Valid
Description:	The application is allowed to deactivate the transmission of CAMs only in special non-safety related contexts. The default operation mode is always working in a safety relevant context
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

4.2.5 Access Layer

[SRS_V2X_00391] The V2X system's access layer shall be ITS-G5 compliant ⌈

Type:	Valid
Description:	The V2X system's access layer shall be compliant to [3] (ITS-G5) providing services for communicating with other ITS-S by using ITS-G5, operating in the frequency band 5855 MHz to 5925 MHz.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 663 V1.2.0: Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band.

⌋(*RS_Main_00285*)

[SRS_V2X_00232] The V2X system shall cooperate with tolling zone stations in vicinity ⌈

Type:	Valid
Description:	The V2X system shall use at least the Detect and Avoid method, specified in [6], based on the tolling zone announcement messages.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 102 792 V1.1.1: Intelligent Transport Systems (ITS); Mitigation techniques to avoid interference between European CEN Dedicated Short Range Communication (CEN DSRC) equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range.

⌋(*RS_Main_00285*)

[SRS_V2X_00451] The V2X system's access layer shall be compliant to the ETSI Harmonized Channel Specifications ⌈

Type:	Valid
Description:	The V2X system's access layer shall be compliant to [7] (Harmonized Channel Specifications).
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 102 724 V1.1.1: Intelligent Transport Systems (ITS); Harmonized Channel Specifications for Intelligent Transport Systems operating in the 5 GHz frequency band.

⌋(*RS_Main_00285*)

[SRS_V2X_00245] The V2X system shall support per-packet transmission power control ⌈

Type:	Valid
Description:	The V2X system shall support per-packet transmission power control. NOTE: PTx may depend on the current state (i.e., relaxed, active or restrictive) and on DCC_Profile (i.e, DP0, DP1, etc).
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

4.2.6 Network and Transport Layer

[SRS_V2X_00531] The V2X system's Networking Layer shall support addressing based on geographic coordinates ⌈

Type:	Valid
Description:	The V2X system's GeoNetworking shall be compliant to [12] without Packet Repetition
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 636-4-1 V1.2.0: Vehicular Communication; Geonetworking; Part 4 Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality.

⌋(*RS_Main_00285*)

[SRS_V2X_00631] The V2X system shall support an ETSI compliant Basic Transport Protocol ⌈

Type:	Valid
Description:	The V2X system's Basic Transport Protocol shall be compliant to [4].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 636-5-1 V1.2.0: Vehicular Communication; Geonetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocols.

⌋(*RS_Main_00285*)

[SRS_V2X_00279] The V2X system shall support circular, rectangular and ellipsoidal geographical areas ⌈

Type:	Valid
Description:	The V2X system shall support circular, rectangular and ellipsoidal geographical areas. Each use case defined in [17] must specify one of the above geographical area types and indicated through the GeoNetworking header as specified in [12].
Rationale:	–
Dependencies:	–
Use Case:	–

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Supporting Material:	see C2C-CC White Paper Information quality/event detection. EN 302 636-4-1 V1.2.0: Vehicular Communication; Geonetworking; Part 4 Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality.

⌋(*RS_Main_00285*)

[SRS_V2X_00280] The V2X system shall use high-accuracy methods to calculate the distance between two coordinates ⌈

Type:	Valid
Description:	When a V2X system calculates the distance between two positions using GNSS coordinates (e.g. for PathDeltaPoints or in case of circular relevance area), it is recommended that the great-circle or orthodromic distance method is used. 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 [11]; for this purpose it is recommended to use the Local Tangent Plane method, or another method delivering the same accuracy.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 931 V1.1.1: Vehicular Communications; Geographical Area Definition.

⌋(*RS_Main_00285*)

4.2.7 Facility Layer

[SRS_V2X_00711] The V2X system's CA basic service shall be compliant to ETSI Specification of Cooperative Awareness Basic Service ⌈

Type:	Valid
Description:	The V2X system's CA basic service shall be compliant to [5].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 637-2 V1.3.0Â : Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service.

⌋(*RS_Main_00285*)

[SRS_V2X_00291] The V2X system shall only send messages with valid postion and time ⌈

Type:	Valid
Description:	A V2X system shall transmit CAM messages as long as position and time information are available and within specified limits. That means: • Under optimal GNSS conditions and normal driving dynamics, the confidence values shall be equal to or lower than the following values in at least 95% of datasets. • The Station clock shall be within 20 ms to ITS time, i.e. Delta t = abs(Station clock time - ITS time) < 20 ms.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

[SRS_V2X_00741] The V2X system's DEN basic service shall be compliant to ETSI Specifications of Decentralized Environmental Notification Basic Service ⌈

Type:	Valid
Description:	The V2X system's DEN basic service shall be compliant to [9].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 637-3 V1.2.0Â : Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service.

⌋(*RS_Main_00285*)

[SRS_V2X_00301] The V2X system's Facility Layer shall handle DENM repetition ⌈

Type:	Valid
Description:	The DENM repetition shall be done by the DEN basic service as specified in [9].
Rationale:	–
Dependencies:	–
Use Case:	–

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Supporting Material:	see EN 302 637-3 V1.2.0Â : Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3: Specifications of Decentralized Environmental Notification Basic Service.

⌋(*RS_Main_00285*)

[SRS_V2X_00318] The V2X system's Facility Layer shall generate traces and path histories ⌈

Type:	Valid
Description:	The traces and path histories used by the V2X system shall be generated using the Design Method One as specified in [18] Appendix B-2.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see VSC-A Final Report: [Online]. Available: http://www.nhtsa.gov/DOT/NHTSA/NVS/Crash%20Avoidance/Technical%20Publications/2011/81

⌋(*RS_Main_00285*)

[SRS_V2X_10001] The V2X system's Facility layer shall support receiving IVI messages ⌈

Type:	Valid
Description:	The IVI message decoding and handling shall be compliant to [19] and [20]
Rationale:	An IVIM supports mandatory and advisory road signage such as contextual speeds and road works warnings. Use Case: IVIM either provides information of physical road signs such as static or variable road signs, virtual signs or road works (ETSI TS 103 301) IVIM either provides information of physical road signs such as static or variable road signs, virtual signs or road works (ETSI TS 103 301)
Dependencies:	–
Use Case:	–
Supporting Material:	see ETSI TS 103 301 V1.1.1: Facilities layer protocols and communication requirements for infrastructure services and C-Roads C-ITS Infrastructure Functions and Specifications release 1.2

⌋(*RS_Main_00285*)

[SRS_V2X_10002] The implementation of the V2X system shall follow additional guidance given by C-Roads requirements ⌈

Type:	Valid
Description:	The AUTOSAR modules implementing the V2X system shall follow additional guidance given by C-Roads requirements
Rationale:	Requirements part of the original infrastructure service profile ease the implementation of day-1 scenarios
Dependencies:	–
Use Case:	–
Supporting Material:	see ETSI TS 103 301 V1.1.1: Facilities layer protocols and communication requirements for infrastructure services and C-Roads C-ITS Infrastructure Functions and Specifications release 1.2

⌋(*RS_Main_00285*)

[SRS_V2X_10003] The V2X system's Facility layer shall support receiving MAPEM messages ⌈

Type:	Valid
Description:	The MAP message decoding and handling shall be compliant to [19] and [20]
Rationale:	A MAPEM provides a digital topological map, which defines the topology of an infrastructure area MAPEM includes the lane topology for e.g. vehicles, bicycles, parking, public transportation and the paths for pedestrian crossings and the allowed maneuvers within an intersection area or a road segment. (ETSI TS 103 301) MAPEM is used in the context of RLT service and is used in combination of SPATEM for GLOSA
Dependencies:	–
Use Case:	–
Supporting Material:	see ETSI TS 103 301 V1.1.1: Facilities layer protocols and communication requirements for infrastructure services and C-Roads C-ITS Infrastructure Functions and Specifications release 1.2

⌋(*RS_Main_00285*)

[SRS_V2X_10004] The V2X system's Facility layer shall support receiving SPAT extended messages ⌈

Type:	Valid
Description:	The SPAT extended message decoding and handling shall be compliant to [19] and [20]
Rationale:	A SPATEM provides in real-time information about the operational states of the traffic light controller, the current signal state, the residual time of the state before changing to the next state, the allowed maneuvers and aids with crossing

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	△ The TLM service includes safety-related information for supporting traffic participants (vehicles, pedestrians, etc.) to execute safe maneuvers in an intersection area. The goal is to enter and exit an intersection ”conflict area” in a controlled way. (ETSI 103 301) . SPATEM is used in the context of TLM service and is used in combination of MAPEM for GLOSA
Dependencies:	–
Use Case:	–
Supporting Material:	see ETSI TS 103 301 V1.1.1: Facilities layer protocols and communication requirements for infrastructure services and C-Roads C-ITS Infrastructure Functions and Specifications release 1.2

⌋(*RS_Main_00285*)

4.2.8 Management specifications

[SRS_V2X_00239] The V2X DCC mechanism shall be configurable ⌈

Type:	Valid
Description:	The V2X system shall implement the DCC State Machine in such a way that the parameters in that table can be modified in later releases
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

[SRS_V2X_00242] The V2X system shall manage CAM generation such that no CAM messages will be dropped ⌈

Type:	Valid
Description:	The V2X system shall manage CAM generation such that no CAM messages shall be dropped; in other words, CAMs shall be generated at the rate at which they are forwarded to MAC layer. CAM messages shall not be held in the DCC_Access queues but forwarded directly to MAC layer.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

[SRS_V2X_00259] The V2X system shall manage the life time of all DENM packets ⌈

Type:	Valid
Description:	The V2X 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 [17]. The value of the LifeTime field shall not exceed the itsGnMaxPacketLifetime, specified in [12], Annex G.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see C2C-CC White Paper Information quality/event detection. EN 302 636-4-1 V1.2.0: Vehicular Communication; Geonetworking; Part 4 Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality.

⌋(*RS_Main_00285*)

[SRS_V2X_00693] The V2X system shall provide functionality for generating traces and path histories ⌈

Type:	Valid
Description:	The V2X system shall provide functionality for generating traces and path histories.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

[SRS_V2X_00176] The V2X system shall change pseudonyms ⌈

Type:	Valid
Description:	The V2X system shall change pseudonyms in order to support privacy. NOTE: Changing of pseudonyms can be blocked.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00514*)

[SRS_V2X_00405] The V2X basic system shall support services for confidentiality ⌈

Type:	Valid
Description:	The V2X system shall support services for confidentiality within the communication with the PKI entities.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00514*)

[SRS_V2X_00189] The V2X system shall be able to estimate vehicle states ⌈

Type:	Valid
Description:	The V2X system shall be able to estimate vehicle states absolute position, heading, velocity and time reliably as long as the system is active. The vehicle state estimation shall include confidence values for position, heading and velocity, as a standardized description of the estimation accuracy.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

[SRS_V2X_00322] The V2X system shall provide services to avoid channel congestion of the shared media ⌈

Type:	Valid
Description:	The V2X system's Decentralized Congestion Control (DCC) mechanism shall be compliant to [21]
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see C2C-CC White Paper Decentralized Congestion Control (DCC) for Day One.

⌋(*RS_Main_00285*)

[SRS_V2X_00323] The V2X system shall provide mitigation techniques to avoid disturbing other services operating at nearby frequencies ⌈

Type:	Valid
Description:	The V2X system shall provide mitigation techniques to avoid disturbing other services operating at nearby frequencies (i.e. CEN DSRC).
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*, *RS_Main_00505*)

[SRS_V2X_00511] The V2X system shall provide services for communication to multiple, geographically scattered and movable entities ⌈

Type:	Valid
Description:	The V2X system shall provide services for transmitting, receiving and forwarding messages to multiple, geographically scattered and movable entities.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

4.3 Non-Functional Requirements (Qualities)

5 Requirements Tracing

The following table references the features specified in [22] and links to the fulfillments of these.

Feature	Description	Satisfied by

[RS_Main_00285]	No description	[SRS_V2X_00010] [SRS_V2X_00189] [SRS_V2X_00190] [SRS_V2X_00193] [SRS_V2X_00207] [SRS_V2X_00214] [SRS_V2X_00232] [SRS_V2X_00239] [SRS_V2X_00242] [SRS_V2X_00245] [SRS_V2X_00259] [SRS_V2X_00279] [SRS_V2X_00280] [SRS_V2X_00291] [SRS_V2X_00301] [SRS_V2X_00318] [SRS_V2X_00322] [SRS_V2X_00323] [SRS_V2X_00391] [SRS_V2X_00451] [SRS_V2X_00511] [SRS_V2X_00531] [SRS_V2X_00631] [SRS_V2X_00693] [SRS_V2X_00711] [SRS_V2X_00741] [SRS_V2X_10001] [SRS_V2X_10002] [SRS_V2X_10003] [SRS_V2X_10004]
[RS_Main_00505]	No description	[SRS_V2X_00323]
[RS_Main_00514]	AUTOSAR shall support the development of secure systems	[SRS_V2X_00160] [SRS_V2X_00161] [SRS_V2X_00163] [SRS_V2X_00164] [SRS_V2X_00174] [SRS_V2X_00176] [SRS_V2X_00184] [SRS_V2X_00405] [SRS_V2X_00406] [SRS_V2X_00407] [SRS_V2X_00412] [SRS_V2X_00413]

6 References

6.1 Related specification

AUTOSAR provides a General Specification on Basic Software modules [23, SWS BSW General], which is valid for all BSW modules.

Thus, the specification SWS BSW General shall be considered as additional and required specification for Vehicle-2-X communication modules.