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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

Disclaimer

Contents

References

[1] Standardization Template
AUTOSAR_FO_TPS_StandardizationTemplate

[2] Glossary
AUTOSAR_FO_TR_Glossary

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

[4] TS 103 097 V1.3.1:Security Header and Certificate Formats

[5] EN 302 636-4-1 V1.3.1:Vehicular Communication; Geonetworking; Part 4 Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1:Media-Independent Functionality

[6] Certificate Policy for Deployment and Operation of European Cooperative Intelligent Transport Systems (C-ITS), Release 1.1, June 2018

[7] Security Policy & Governance Framework for Deployment and Operation of European Cooperative Intelligent Transport Systems (C-ITS), Release 1, December 2017

[8] TS 102 894-2 V1.3.1:Intelligent Transport Systems (ITS); Users and applications requirements; Applications and facilities layer common data dictionary

[9] EN 302 663 V1.2.1:Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band

[10] TS 102 792 V1.2.1: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

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

[12] EN 302 636-5-1 V2.1.1:Vehicular Communication; Geonetworking; Part 5:Transport Protocols; Sub-part 1:Basic Transport Protocols

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

[14] EN 302 637-2 V1.4.1:Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2:Specification of Cooperative Awareness Basic Service

[15] EN 302 637-3 V1.3.1:Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 3:Specifications of Decentralized Environmental Notification Basic Service

[16] SAE J2945/1_201603:On-Board System Requirements for V2V Safety Commu-

nications

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

[18] TS 103 301 V1.2.1:Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Facilities layer protocols and communication requirements for infrastructure services

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

[20] Requirements on AUTOSAR Features
AUTOSAR_CP_RS_Features

[21] General Specification of Basic Software Modules
AUTOSAR_CP_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

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]).

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:
AT	Authorization Ticket
BSS	Basic service set
BTP	Basic Transport Protocol [1]
C2C-CC	Car2Car communications Consortium
CA	Cooperative awareness
CAM	Cooperative awareness message [2]
CCSA	China Communications Standards Association
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
NTCAS	National Technical Committee of Auto Standardization
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
SPATEM	Signal Phase And Timing Extended Message
TAL	Trust Assurance Level
TC	Traffic class

Abbreviation / Acronym:	Description:
TLM	Traffic Light Maneuver

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 [3], 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 European ETSI

NOTE: The *Authorisation Ticket* (AT) is referred to as *Pseudonym* in this document. The *Enrolment Certificate* is referred to as *Long-Term Certificate* in this document.

4.2.1.1 General

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

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, RS_Main_00280)*

4.2.1.2 Security

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

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 ⌈

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 ⌈

Description:	The V2X system shall use one end-to-end security envelope per message according to [4].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 103 097: 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 ⌈

Description:	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 [4], depending on whether a CAM, DENM or other message is processed.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 103 097: 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) ⌈

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 7.2.1 in [4].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 103 097: 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 ⌈

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 ⌈

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 ⌈

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 ⌈

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

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Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00514*)

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

Description:	The V2X system shall employ the security envelope on its Network layer according to [5]. 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: 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*)

[SRS_V2X_10101] The V2X system shall follow the recommendations of European Certificate Policy and of European Security Policy ⌈

Description:	The V2X system shall follow the recommendations of European Certificate Policy [6] and of European Security Policy [7].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see Certificate Policy for Deployment and Operation of European Cooperative Intelligent Transport Systems (C-ITS) and Security Policy; Governance Framework for Deployment and Operation of European Cooperative Intelligent Transport Systems (C-ITS).

⌋(*RS_Main_00514*)

4.2.1.3 Position and Timing

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

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 ⌈

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 ⌈

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 [8]) 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: Intelligent Transport Systems (ITS); Users and applications requirements; Applications and facilities layer common data dictionary.

⌋*(RS_Main_00285)*

4.2.1.4 System behavior

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

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*)

4.2.1.5 Access Layer

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

Description:	The V2X system's access layer shall be compliant to [9] (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: 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 ⌈

Description:	The V2X system shall use at least the Detect and Avoid method, specified in [10], based on the tolling zone announcement messages.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 102 792: 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 ⌈

Description:	The V2X system's access layer shall be compliant to [11] (Harmonized Channel Specifications).
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see TS 102 724: 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 ⌈

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)*

4.2.1.6 Network and Transport Layer

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

Description:	The V2X system's GeoNetworking shall be compliant to [5]. In addition, Packet Repetition at GeoNetworking level shall not be used.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 636-4-1: 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 ⌈

Description:	The V2X system's Basic Transport Protocol shall be compliant to [12].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 636-5-1: 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 ⌈

Description:	The V2X system shall support circular, rectangular and ellipsoidal geographical areas. Each application will specify one of the above geographical area types which will be indicated through the GeoNetworking header as specified in [5].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 636-4-1: 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 ⌈

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 [13]; 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: Vehicular Communications; Geographical Area Definition.

⌋(*RS_Main_00285*)

4.2.1.7 Facility Layer

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

Description:	The V2X system's CA basic service shall be compliant to [14].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 637-2: 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 ⌈

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 ⌈

Description:	The V2X system's DEN basic service shall be compliant to [15].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 637-3Â : 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 ⌈

Description:	The DENM repetition shall be done by the DEN basic service as specified in [15].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 637-3Â : 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 ⌈

Description:	The traces and path histories used by the V2X system shall be generated using the Design Method One as specified in [16] Appendix A.5.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see SAE J2945/1, Appendix A.5: PATH HISTORY REFERENCE DESIGN

⌋(*RS_Main_00285*)

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

Description:	The IVI message decoding and handling shall be compliant to [17] and [18]
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: 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 ⌈

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: 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 ⌈

Description:	The MAP message decoding and handling shall be compliant to [17] and [18]
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: 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 ⌈

Description:	The SPAT extended message decoding and handling shall be compliant to [17] and [18]
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 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

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Dependencies:	–
Use Case:	–
Supporting Material:	see ETSI TS 103 301: Facilities layer protocols and communication requirements for infrastructure services and C-Roads C-ITS Infrastructure Functions and Specifications release 1.2

⌋(*RS_Main_00285*)

4.2.1.8 Management specifications

[SRS_V2X_00242] The V2Xsystem shall manage CAM transmission in such a way, that no outdated CAM will be transmitted ⌈

Description:	The V2Xsystem shall manage CAM transmission in such a way, that no outdated CAM will be transmitted. (e. g. this can happen when DCC is limiting the transmission rate and meanwhile a newer CAM is available).
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

⌋(*RS_Main_00285*)

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

Description:	The V2X system shall set the LifeTime field of all GBC packets to the minimum, rounded down, of ValidityDuration, RepetitionInterval and itsGnMaxPacketLifetime, with ValidityDuration and RepetitionInterval values as requested by the application and itsGnMaxPacketLifetime value as specified in [5], Annex H.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	see EN 302 636-4-1: 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 ⌈

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 ⌈

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 ⌈

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 ⌈

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:	–

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Supporting Material:	–

⌋(*RS_Main_00285*)

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

Description:	The V2X system's Decentralized Congestion Control (DCC) mechanism shall be compliant to [19]
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 ⌈

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*)

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

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*)

4.2.2 Remote Access Layer

[SRS_V2X_25001] The V2X stack shall support a Remote Access Layer ⌈

Description:	It shall be possible to separate the V2X access layer function from the V2X stack and locate them in two different control or processing units or logical domains. This requires a communication between the V2X stack and the remote access layer. The protocol shall be defined.
Rationale:	Separating the access layer from the V2X stack allows a region-independent implementation of a logical device. This device can be lightweight and therefore placed anywhere on a vehicle, e.g. on the top of the roof. This may have advantages to power dissipation and reduces the heat.
Dependencies:	–
Use Case:	Eases the location of the remote logical unit where antenna is located.
Supporting Material:	–

⌋*(RS_Main_01004, RS_Main_00410)*

[SRS_V2X_25002] The protocol between the Remote Access Layer and the V2X stack shall be backward compatible and support different technologies for radio networks. ⌈

Description:	Currently, there are two standards known for V2X communication: ITS-G5 and LTE-PC5. The protocol for the communication between the Remote Access Layer and the V2X stack shall support both technologies. From the protocol data it should be clear, which technology is used so that a Remote Access Layer that may support several radio communication technologies can clearly distinguish, which one shall be used. Furthermore, the protocol shall be backward compatible. If parameters are added or removed, this should be clearly identified and supported by the protocol.
Rationale:	More than one radio communication can be supported by a Remote Access Layer. Radio communication may change in the future. For long term stability, changes in the protocol shall be supported, especially to support carry-over systems.
Dependencies:	–
Use Case:	Maintainability: If new features are added to the protocol, older versions of the protocol stack shall still be supported.
Supporting Material:	–

⌋*(RS_Main_00011)*

[SRS_V2X_25003] The Remote Access Layer and the V2X stack shall exchange control and payload information to accomplish radio network communication. ⌈

Description:	Splitting up the V2X stack and the Remote Access Layer requires exchange of the message payload to be sent on the radio network plus control information required by the V2X stack and the Remote Access Layer to operate on the radio-controlled network.
Rationale:	The payload of the V2X message does not contain radio control information. Thus, the required data need to be added to the protocol frame.
Dependencies:	–
Use Case:	Separate data processing from data transportation. Provision of control data without message payload allows to configure the radio access layer.
Supporting Material:	–

⌋*(RS_Main_00310)*

4.2.3 V2X Data Manager

[SRS_V2X_26001] The V2X system shall provide selected information from a V2X message to the application layer and/or to the vehicle network. ⌈

Description:	The V2X system shall allow to provide selected information from a V2X message to the application layer and/or the vehicle network.
Rationale:	Not all information of a V2X message is relevant for applications in a vehicle network. Provision of reduced information can enhance the performance of a system (less data to copy).
Dependencies:	–
Use Case:	An OEM wants to provide selected information from the V2X system to the vehicle network.
Supporting Material:	–

⌋*(RS_Main_00190)*

[SRS_V2X_26002] Transformation of V2X message elements shall be possible ⌈

Description:	Data elements that are provided through a V2X message shall be converted if necessary into a format common to all regions to ease the portability of applications. This step is optional.
Rationale:	V2X message elements can be provided from different V2X stacks that has the same meaning, but with different scaling. Or an information (as VariableDataPrototype) required on the vehicle network is composed of several data items from a V2X message (e.g. on one specific V2X stack). To provide a unified value to the vehicle network, the received data item is transformed into a unified value for the vehicle network.
Dependencies:	–

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Use Case:	Vehicle speed of BSM (China) and CAM (EU) has different scaling: BSM uses 0.02 m/s and CAM uses 0.01 m/s. But the signal provided to the vehicle network may have always the same scaling, e.g. 1 m/s.
Supporting Material:	–

⌋(*RS_Main_00120*)

[SRS_V2X_26003] It shall be possible to forward V2X messages to the vehicle network as a whole ⌈

Description:	The V2X system shall allow to forward the whole V2X message to the network. No ASN.1 decoding is required in this case. However, security operation shall be applied prior to the sending and only those messages shall be sent that are successfully verified.
Rationale:	Message contents could be unpacked and used efficiently on dedicated ECUs that do not necessarily operate the V2X stack.
Dependencies:	–
Use Case:	A navigation or ADAS system may want to use MAP and SPAT information for navigation.
Supporting Material:	–

⌋(*RS_Main_00190, RS_Main_00514*)

[SRS_V2X_26004] All elements of a V2X object shall have the same V2X message as source ⌈

Description:	All elements of a V2X object shall be obtained from one V2X message. This is important for data consistency.
Rationale:	The elements of a V2X object shall belong to the same message so that information is reliable.
Dependencies:	–
Use Case:	The speed, direction and position of a vehicle at one point in time should be made available to the network.
Supporting Material:	–

⌋(*RS_Main_00430*)

[SRS_V2X_26005] Modules in the V2X stack shall provide interfaces for module initialization ⌈

Description:	Modules in the V2X stack shall provide an interface for initialization of all states and all global variables of that module. Before initialization, the V2X stack is inactive
Rationale:	Basic functionality

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Dependencies:	–
Use Case:	ECU initialization
Supporting Material:	–

⌋(*RS_Main_00651*)

[SRS_V2X_26006] The V2X Data Manager shall provide mathematical operations to re-scale V2X message elements ⌈

Description:	The V2X Data Manager shall allow to build data points that are derived from one or more V2X message elements (from one V2X message). Mathematical calculations may be applied to re-scale these data points. This allows to define a catalog of elements.
Rationale:	Data points from V2X messages (V2X message elements) from different V2X regional stacks with similar meaning but different scaling can be harmonized. In addition, it would be possible to re-scale V2X message elements that are provided to the vehicle network in adequate scalings.
Dependencies:	–
Use Case:	
Supporting Material:	–

⌋(*RS_Main_00060*, *RS_Main_00430*)

[SRS_V2X_26010] Regional V2X stack implementation shall support selective distribution of V2X message data through V2X Data Manager ⌈

Description:	The regional V2X stack shall provide interfaces to the V2X Data Manager to support the selective distribution of V2X message elements.
Rationale:	Support the AUTOSAR Layered Software Architecture.
Dependencies:	–
Use Case:	
Supporting Material:	–

⌋(*RS_Main_00400*)

4.3 Non-Functional Requirements (Qualities)

No content.

5 Requirements Tracing

The following table references the features specified in [20] and links to the fulfillments of these.

Requirement	Description	Satisfied by
[RS_Main_00011]	Mechanisms for Reliable Systems	[SRS_V2X_25002]
[RS_Main_00060]	Standardized Application Communication Interface	[SRS_V2X_26006]
[RS_Main_00120]	AUTOSAR shall provide means to assure interoperability of AUTOSAR implementations (ICC1 level) on application level (RTE) and bus level	[SRS_V2X_26002]
[RS_Main_00190]	Non-AUTOSAR Software Integration	[SRS_V2X_26001] [SRS_V2X_26003]
[RS_Main_00280]	Standardized Automotive Communication Protocols	[SRS_V2X_00010]
[RS_Main_00285]	AUTOSAR shall support protocols for Intelligent Transportation Systems	[SRS_V2X_00010] [SRS_V2X_00189] [SRS_V2X_00190] [SRS_V2X_00193] [SRS_V2X_00207] [SRS_V2X_00214] [SRS_V2X_00232] [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_00310]	AUTOSAR shall support hierarchical Application Software design methods	[SRS_V2X_25003]
[RS_Main_00400]	AUTOSAR shall provide a layered software architecture	[SRS_V2X_26010]
[RS_Main_00410]	AUTOSAR shall provide specifications for routines commonly used by Application Software to support sharing and optimization	[SRS_V2X_25001]
[RS_Main_00430]	AUTOSAR shall support established automotive communication standards	[SRS_V2X_26004] [SRS_V2X_26006]
[RS_Main_00514]	System Security Support	[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] [SRS_V2X_10101] [SRS_V2X_26003]
[RS_Main_00651]	AUTOSAR shall support mirroring of CAN, LIN, and FlexRay to CAN, Flex Ray, Ethernet, or proprietary networks	[SRS_V2X_26005]
[RS_Main_01004]	AUTOSAR shall support standards for wireless off-board communication	[SRS_V2X_25001]

Table 5.1: RequirementsTracing

6 References

6.1 Related specification

AUTOSAR provides a General Specification on Basic Software modules [21, 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.

A Change history of AUTOSAR traceable items

A.1 Traceable item history of this document according to AUTOSAR Release R23-11

A.1.1 Added Requirements in R23-11

none

A.1.2 Changed Requirements in R23-11

Number	Heading
[SRS_V2X_26006]	The V2X Data Manager shall provide mathematical operations to re-scale V2X message elements

Table A.1: Changed Requirements in R23-11

A.1.3 Deleted Requirements in R23-11

none

A.2 Traceable item history of this document according to AUTOSAR Release R22-11

A.2.1 Added Requirements in R22-11

Number	Heading
[SRS_V2X_25001]	The V2X stack shall support a Remote Access Layer
[SRS_V2X_25002]	The protocol between the Remote Access Layer and the V2X stack shall be backward compatible and support different technologies for radio networks.
[SRS_V2X_25003]	The Remote Access Layer and the V2X stack shall exchange control and payload information to accomplish radio network communication.
[SRS_V2X_26001]	The V2X system shall provide selected information from a V2X message to the application layer and/or to the vehicle network.
[SRS_V2X_26002]	Transformation of V2X message elements shall be possible
[SRS_V2X_26003]	It shall be possible to forward V2X messages to the vehicle network as a whole
[SRS_V2X_26004]	All elements of a V2X object shall have the same V2X message as source

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Number	Heading
[SRS_V2X_26005]	Modules in the V2X stack shall provide interfaces for module initialization
[SRS_V2X_26006]	The V2X Data Manager shall provide mathematical operations to re-scale V2X message elements
[SRS_V2X_26010]	Regional V2X stack implementation shall support selective distribution of V2X message data through V2X Data Manager

Table A.2: Added Requirements in R22-11

A.2.2 Changed Requirements in R22-11

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

Table A.3: Changed Requirements in R22-11

A.2.3 Deleted Requirements in R22-11

none

A.2.4 Added Constraints in R22-11

none

A.2.5 Changed Constraints in R22-11

none

A.2.6 Deleted Constraints in R22-11

none