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1 Scope of Document

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

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]).

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 market-place 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 implemen-

tation, 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 Chinese V2X communication that are not included in the AUTOSAR Glossary [2].

Abbreviation / Acronym:	Description:
AID	Application Identifier
BSM	Basic Safety Message
CBR	Channel Busy Ratio
CCSA	China Communications Standards Association
CR	Channel Occupancy Ratio
DSMP	Dedicated Short Message Protocol
GCJ-02	A coordinated system formulated by Ministry of Natural Resources of the People's Republic of China
GNSS	Global Navigation Satellite System
LTE	Long Term Evolution
LTE-V2X	LTE Vehicle to Everything
OBU	On Board Unit
PC5	The reference point between the UEs (User equipment) used for control and user plane for ProSe (Proximity-based Services) Direct Communication for V2X Service
PH	Path History
PKI	Public Key Infrastructure
PPPP	ProSe Per-Packet Priority
RSI	Road Side Information
RSM	Road Side Message
RSU	Road Side Unit
SPAT	Signal Phase and Timing Message
UE	User Equipment
UTC	Universal Time Coordinated
V2I	Vehicle to Infrastructure
V2N	Vehicle to Network
V2P	Vehicle to Pedestrian
V2V	Vehicle to Vehicle
V2X	Vehicle to Everything

Table 3.1: Acronyms and Abbreviations

4 Requirements Specification

This document describes all requirements driving the work to define the whole concept of Chinese Vehicle-2-X communication. It divides into two parts. Functional requirements of concept part 1 for CnV2xMsg and CnV2xNet are listed in:

- 4.2.1 General
- 4.2.2 Position and Time
- 4.2.4 Network layer
- 4.2.5 Message Layer
- 4.2.6 Security

Functional requirements of concept part 2 for CnV2xSec, CnV2xMgt, CV2x driver are listed in:

- 4.2.1 General
- 4.2.3 Access Layer
- 4.2.6 Security

4.1 Functional Overview

China adopts C-V2X (cellular based V2X) technology to implement intelligent connected vehicles and intelligent transportation system, enable vehicle-to-vehicle (V2V), vehicle-to-infrastructure (V2I), vehicle-to-network (V2N), and vehicle-to-pedestrian (V2P) applications, and improve road safety, traffic efficiency, and information entertainment services.

The LTE V2X-based wireless communications system framework is specified in [3], functional entities and interfaces are defined. The UE entity includes two main types: an on-board unit (OBU) and a roadside unit (RSU). The layered protocol stack consists of the access layer, network layer, and message layer. Each layer is defined by one or more standards, mainly contributed by CCSA [4].

The access layer supports the PC5 mode 3 and mode 4. The PC5 interface uses the GNSS as the optimal synchronization source to ensure time synchronization between the receiver and transmitter during communication.

The network layer consists of the data entity and management entity. The data entity mainly includes an adaptation layer and a dedicated short message protocol layer (DSMP). The adaptation layer provide transmission adaptation function between access layer and DSMP. The management entity is used for system configuration and maintain, transmitting management data flows between devices through the data entity.

The message layer connects to the network layer and supports specific user applications. The message layer supports various types of V2X messages, including message sets defined on Day 1 use cases: BSM, RSM, RSI, SPAT and MAP.

4.2 Functional Requirements

4.2.1 General

[CP_SRS_CnV2X_00100]{DRAFT} The implementation of Chinese V2X communication shall follow technical requirements given by CCSA and NTCAS [

Description:	The AUTOSAR modules implementing the Chinese V2X communication shall follow technical requirements given by CCSA and NTCAS
Rationale:	Requirements of CCSA technical specification and NTCAS Basic System Profile ease the implementation of day-1 scenarios
Dependencies:	–
Use Case:	–
Supporting Material:	–

]([RS_Main_00280](#))

4.2.2 Position and Time

[CP_SRS_CnV2X_00201]{DRAFT} The Chinese V2X communication shall use UTC time as the reference clock [

Description:	The Chinese V2X communication shall use UTC time as the reference clock.
Rationale:	The Chinese V2X communication uses clock synchronized to UTC to support position and time estimation, message sending and receiving and safety requirements.
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00202]{DRAFT} The Chinese V2X communication's reference clock shall meet accuracy requirements [

Description:	The Chinese V2X communication's reference clock shall be accurate to within vTimeAccuracy (1ms) of the UTC reference.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00203]{DRAFT} The Chinese V2X communication shall use GCJ-02 coordinate system as the reference coordinate [

Description:	The vehicle position (Position Reference) reported in a BSM shall be a point (latitude, longitude and elevation) projected onto the surface of the roadway (road plane) with reference to the GCJ-02 coordinate system and its reference ellipsoid. This point is the center of the rectangle on the road plane.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00204]{DRAFT} The Chinese V2X communication's vehicle position shall meet accuracy requirements [

Description:	The position of transmitting a BSM shall be accurate to within vPosAccuracy (1.5m) of the vehicle's actual 2-D horizontal Position Reference over 68% of test measurements under Open Sky Test Conditions.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

]([RS_Main_00280](#))

4.2.3 Access Layer

[CP_SRS_CnV2X_00301]{DRAFT} The Access layer of Chinese V2X Communication shall be compliant to CCSA specification of Air Interface for LTE-based Vehicular Communication [

Description:	The Access layer of Chinese V2X Communication shall be compliant to [6] providing service for communicating with other OBU or RSU by using LTE-based Vehicular communication technology, operating in the frequency band 5905 MHz to 5925 MHz
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [6]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00302]{DRAFT} The Access layer of Chinese V2X Communication shall use GNSS as the preferred synchronization source for direct communication [

Description:	If GNSS is available, the synchronization source for direct communication shall use GNSS; If GNSS is unavailable, access layer shall select other synchronization sources according to [6].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [6]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00303]{DRAFT} The access layer of Chinese V2X Communication shall support the ability to provide congestion control related parameters to Network layer [

Description:	Access layer shall provide at least one of the following parameters to upper layers: <ul style="list-style-type: none"> • The current measurement value of CBR; • The current recommended value of Max data rate that meets the CR limit requirement.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [6]

]([RS_Main_00280](#))

4.2.4 Network Layer

[CP_SRS_CnV2X_00401]{DRAFT} The network layer of Chinese V2X communication shall support a CCSA compliant Network layer protocol of LTE-based vehicular communication [

Description:	The Network Layer protocols of Chinese V2X communication, including Dedicated short message protocol and Adaptation Layer Protocol, shall be compliant to [4].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [4]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00402]{DRAFT} The network layer of Chinese V2X communication shall Select and maintain Source Layer-2 ID and Destination Layer-2 ID [

Description:	Network layer shall select and maintain 24-bit Source Layer-2 Id and Destination Layer-2 ID.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00403]{DRAFT} The network layer of Chinese V2X communication shall provide the mapping between packet priority and PPPP [

Description:	When transmitting a packet, adaptation sub-layer shall map the packet priority to PPPP and indicate it to access layer; when receiving a packet, adaptation sub-layer shall map PPPP to packet priority and indication it to DSMP sub-layer.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [4]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00404]{DRAFT} The network layer of Chinese V2X communication shall provide CBR or Max data rate to message Layer [

Description:	When received CBR or max data rate from lower layer, network layer shall provide the parameters to message layer.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [4]

]([RS_Main_00280](#))

4.2.5 Message Layer

[CP_SRS_CnV2X_00501]{DRAFT} BSM basic service of Chinese V2X message layer shall be compliant to CCSA Specification of Message layer of LTE-based vehicular communication [

Description:	The ChineseV2X Communication's BSM service shall be compliant to [7].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [7]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00502]{DRAFT} The message layer of Chinese V2X communication shall meet the minimum criteria for data transmission when sending BSM messages [

Description:	If at any time the BSM basic service cannot formulate a BSM that meets the minimum transmission criteria, the BSM basic service shall stop transmitting BSMs until the criteria are met.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00503]{DRAFT} The message layer of Chinese V2X communication shall support critical BSM messages [

Description:	The critical BSM shall be generated and sent once a critical event condition is triggered.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00504]{DRAFT} The message layer of Chinese V2X communication shall support priority setting for different types of BSMs [

Description:	When sending a regular BSM message (without carrying critical flags), Message layer shall set the Priority of the BSM to 112. When sending a critical BSM message (carrying critical flags), Message layer shall set the Priority of the BSM to 208.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [4]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00505]{DRAFT} The message layer of Chinese V2X communication shall support Frequency management for regular BSM [

Description:	The frequency management mechanism for regular BSM shall be compliant to [5]
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00506]{DRAFT} The message layer of Chinese V2X communication shall generate and send path histories in BSMs [

Description:	The message layer of Chinese V2X communication shall generate and send path histories in BSMs.
Rationale:	–
Dependencies:	–



△

Use Case:	–
Supporting Material:	See [5]

](RS_Main_00280)

[CP_SRS_CnV2X_00507]{DRAFT} The message layer of Chinese V2X communication shall manage BSM transmission in such a way that no outdated BSM will be transmitted [

Description:	The message layer shall manage BSM transmission in such away, that no outdated BSM will be transmitted.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

](RS_Main_00280)

[CP_SRS_CnV2X_00508]{DRAFT} The message layer of Chinese V2X communication shall support receiving RSI messages [

Description:	The RSI message decoding and handling shall be compliant to [7]
Rationale:	A RSI provides multiple Traffic Event information and traffic sign information, also contain RSU information.
Dependencies:	–
Use Case:	–
Supporting Material:	See [7]

](RS_Main_00280)

[CP_SRS_CnV2X_00509]{DRAFT} The message layer of Chinese V2X communication shall support receiving RSM messages [

Description:	The RSM message decoding and handling shall be compliant to [7]
Rationale:	A RSM provides the basic safety status of multiple traffic participants, including RSUs, Vehicles, non-motor vehicles and pedestrians.
Dependencies:	–
Use Case:	–
Supporting Material:	See [7]

](RS_Main_00280)

[CP_SRS_CnV2X_00510]{DRAFT} The message layer of Chinese V2X communication shall support receiving SPAT messages [

Description:	The SPAT message decoding and handling shall be compliant to [7]
Rationale:	A SPAT 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, etc. SPAT is used in combination of MAP.
Dependencies:	–
Use Case:	–
Supporting Material:	See [7]

]([RS_Main_00280](#))

[CP_SRS_CnV2X_00511]{DRAFT} The message layer of Chinese V2X communication shall support receiving MAP messages [

Description:	The MAP message decoding and handling shall be compliant to [7]
Rationale:	A MAP provides a digital topological map, which defines the lane topology and the allowed manoeuvres within an intersection area or a road segment.
Dependencies:	–
Use Case:	–
Supporting Material:	See [7]

]([RS_Main_00280](#))

4.2.6 Security

[CP_SRS_CnV2X_00601]{DRAFT} Digital certificate and secure protocol data unit shall be compliant with CCSA Technical Requirement of Security Certificate Management System for LTE-based Vehicular Communication [

Description:	The Chinese V2X communication's digital certificate and secured protocol data unit shall be compliant to [8].
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [8]

]([RS_Main_00170](#))

[CP_SRS_CnV2X_00602]{DRAFT} The Chinese V2X communication shall use SM2 elliptic curve public key algorithm and SM3 cryptographic hash algorithm to generate a signature for each BSMs and attach it to the BSM [

Description:	The Chinese V2X communication shall use SM2 elliptic curve public key algorithm and SM3 cryptographic hash algorithm to generate a signature for each BSMs and attach it to the BSM.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

](RS_Main_00170)

[CP_SRS_CnV2X_00603]{DRAFT} The Chinese V2X Communication shall attach a certificate or certificate digest to every BSM and shall not attach CA certificate of certificate chain [

Description:	<p>The V2X-CN system shall attach a entire certificate in following conditions:</p> <ul style="list-style-type: none"> • The first BSM after the system start up or restart • The first BSM after the certificate has been changed • The BSM that the time interval to the generation of a previous BSM with an attached certificate (not certificate digest) is greater than or equal to vMaxCertDigestInterval (450 ms) • Critical BSMs that critical event flags are set
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	See [5]

](RS_Main_00170)

[CP_SRS_CnV2X_00604]{DRAFT} The Chinese V2X communication shall not transmit BSMs when it has no valid certificates [

Description:	according to [5], When there is no pseudonym certificate that can pass the consistency check, BSM message is not sent
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

](RS_Main_00170)

[CP_SRS_CnV2X_00605]{DRAFT} The Chinese V2X communication shall randomize the identifiers related to BSM to in order to support privacy [

Description:	The Chinese V2X communication shall reinitialize Identifiers in BSM and Source Layer-2 ID randomly when the security certificate changes.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

]([RS_Main_00170](#))

[CP_SRS_CnV2X_00606]{DRAFT} The Chinese V2X communication shall change pseudonym certificates in order to support privacy [

Description:	<p>To preserve privacy, the V2X-CN System shall not use the same certificate for more than vCertChangeInterval (300 s)consecutive minutes, unless one or more of the following exceptions:</p> <ul style="list-style-type: none"> • The System is separated by less than vCertChangeDistance (2.1 km)in absolute distance from the location at which the last certificate change occurred. • One or more Critical Event Flags are set.
Rationale:	–
Dependencies:	–
Use Case:	–
Supporting Material:	–

]([RS_Main_00170](#))

4.3 Non-Functional Requirements (Qualities)

5 Requirements Tracing

The following table references the features specified in [9] and links to the fulfillments of these.

Feature	Description	Satisfied by
[RS_Main_00170]	AUTOSAR shall provide secure access to ECU data and services	[CP_SRS_CnV2X_00601] [CP_SRS_CnV2X_00602] [CP_SRS_CnV2X_00603] [CP_SRS_CnV2X_00604] [CP_SRS_CnV2X_00605] [CP_SRS_CnV2X_00606]
[RS_Main_00280]	Standardized Automotive Communication Protocols	[CP_SRS_CnV2X_00100] [CP_SRS_CnV2X_00201] [CP_SRS_CnV2X_00202] [CP_SRS_CnV2X_00203] [CP_SRS_CnV2X_00204] [CP_SRS_CnV2X_00301] [CP_SRS_CnV2X_00302] [CP_SRS_CnV2X_00303] [CP_SRS_CnV2X_00401] [CP_SRS_CnV2X_00402] [CP_SRS_CnV2X_00403] [CP_SRS_CnV2X_00404] [CP_SRS_CnV2X_00501] [CP_SRS_CnV2X_00502] [CP_SRS_CnV2X_00503] [CP_SRS_CnV2X_00504] [CP_SRS_CnV2X_00505] [CP_SRS_CnV2X_00506] [CP_SRS_CnV2X_00507] [CP_SRS_CnV2X_00508] [CP_SRS_CnV2X_00509] [CP_SRS_CnV2X_00510] [CP_SRS_CnV2X_00511]

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