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TECHNICAL SPECIFICATION

**Intelligent Transport Systems (ITS);
Profile for LTE-V2X
Direct Communication**

Reference

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Foreword

This Technical Specification (TS) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

Modal verbs terminology

In the present document "**shall**", "**shall not**", "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the [ETSI Drafting Rules](#) (Verbal forms for the expression of provisions).

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Introduction

Several initiatives had been started to introduce vehicular communication technology for different use cases into different international standards and industry organizations, which were previously focusing only on ITS-G5. At the same time, some regulatory bodies are currently considering to mandate C-ITS technologies in order to foster its deployments.

While LTE-V2X standards are already finalized in 3GPP Rel. 14 and are expected to be deployed for "Day 1" use cases, there are still many options on how to configure and parameterize the LTE-V2X systems. In order to provide a common standard interpretation, there is a need for corresponding system profiles, which outline the basic system settings and environments.

In Europe, Basic System Profiles (BSPs) have been developed by the Car-2-Car Communication Consortium (C2C-CC) and the EU funded C-ROADS Platform project, assuming ITS-G5 with IEEE specifications as radio access technology for V2V and V2I communication. Though many aspects of the existing BSPs could be reused, there are some modifications needed in order to allow applicability for LTE-V2X, which are addressed in the present document.

The objective of the present document is to specify a profile for LTE-V2X by making references to the C2C-CC Basic System Profile (BSP) and the C-ROADS Roadside ITS-G5 System Profile (RSP) and specifying the differences, in order to use LTE-V2X for the envisioned "Day 1" use cases provided in these documents. In order for the present document to be useful for its intended purpose and to make full use of it, the C2C-CC and C_ROADS documents need to be acquired separately. Where portions of the C2C-CC and C-ROADS documents are not suggested to be modified, replaced or deleted in creating implementations of the LTE-V2X implementations by the present document, those portions are considered to apply to LTE-V2X.

Since the C2C-CC and C-ROADS documents are not under the control of ETSI, the present document contains only incremental changes that need to be applied, referring to the corresponding items that are to be replaced or not applicable for LTE-V2X. The considered changes are based on Release 1.5.0 of C2C-CC BSP [8] and C2C-CC Feat [9] as well as Release 1.6 of C-ROADS RSP [13] and C-ROADS MSP [14]. Initial work has been done in 5GAA PC5 BSP [i.1] and 5GAA PC5 RSP [i.2] based on earlier releases. The present document may be revised in the future to take into account later releases of C2C and C-ROADS deliverables.

C2C-CC documents C2C-CC Trig [10] describing C-ITS triggering conditions, as well as C-ROADS documents C-ROADS Serv [15] and C-ROADS Func [16] describing C-ITS service and functional requirements, respectively, are already applicable to LTE-V2X.

1 Scope

The scope of the present document is to identify a common set of standards and specify configuration parameter values and references required for the implementation of direct communication between ITS stations, to achieve interoperable deployment of ITS services via V2V and V2I links.

The scope is limited to communication aspects of ITS stations using the single access layer technology LTE-V2X PC5 mode 4. Additional requirements like triggering conditions, position accuracy, security, and functional safety aspects are out of scope of the present document.

Descriptions, definitions and rules for all layers (Applications, Facilities, Networking & Transport and Access) of the ETSI ITS station reference architecture are considered as needed.

2 References

2.1 Normative references

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

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

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

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

- [1] ETSI EN 303 613: "Intelligent Transport Systems (ITS); LTE-V2X Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".
- [2] ETSI EN 302 636-4-1: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality".
- [3] ETSI EN 302 636-5-1: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocol".
- [4] ETSI TS 103 574: "Intelligent Transport Systems (ITS); Congestion Control Mechanisms for C-V2X PC5 interface; Access layer part".
- [5] Void.
- [6] ETSI TS 136 101: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (3GPP TS 36.101 Release 14)".
- [7] ETSI EN 302 571: "Intelligent Transport Systems (ITS); Radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU".
- [8] C2C-CC: "Basic System Profile", Release 1.5.0.

NOTE: Available at https://www.car-2-car.org/fileadmin/documents/Basic_System_Profile/Release_1.5.0/C2CCC_RS_2037_Profile.pdf.

- [9] C2C-CC: "Features", Release 1.5.0.

NOTE: Available at https://www.car-2-car.org/fileadmin/documents/Basic_System_Profile/Release_1.5.0/C2CCC_RS_2036_Features.pdf.

- [10] C2C-CC: "Triggering Conditions and Data Quality on Adverse Weather", Dangerous Situation, Exchange Of IRCs, Special Vehicle, Stationary Vehicle, and Traffic Jam, SPatMAP, Release 1.5.1.
- NOTE: Available at https://www.car-2-car.org/fileadmin/documents/Basic_System_Profile/Release_1.5.1/C2CCC_RS_2002_AdverseWeather.pdf.
- [11] C2C-CC: "Protection Profile V2X Hardware Security Module", Release 1.5.0.
- NOTE: Available at https://www.car-2-car.org/fileadmin/documents/Basic_System_Profile/Release_1.5.0/C2CCC_PP_2056_HSM.pdf.
- [12] C2C-CC: "References", Release 1.5.0.
- NOTE: Available at https://www.car-2-car.org/fileadmin/documents/Basic_System_Profile/Release_1.5.0/C2CCC_RS_2052_References.pdf.
- [13] C-ROADS, Roadside ITS G5 System Profile, Release 1.6, Version 6.2, Jun 25, 2019.
- NOTE: Available at <https://www.c-roads.eu/platform/about/news/News/entry/show/release-16-of-c-roads-harmonised-c-its-specifications.html>.
- [14] C-ROADS, Mobile Roadside ITS G5 System Profile, Release 1.6, Version 1.1, Oct 28, 2019.
- NOTE: Available at <https://www.c-roads.eu/platform/about/news/News/entry/show/release-16-of-c-roads-harmonised-c-its-specifications.html>.
- [15] C-ROADS, Common C-ITS Service Definitions, Release 1.6, Version 1.6, Feb 4, 2020.
- NOTE: Available at <https://www.c-roads.eu/platform/about/news/News/entry/show/release-16-of-c-roads-harmonised-c-its-specifications.html>.
- [16] C-ROADS, C-ITS Infrastructure Functions and Specifications, Release 1.6, Version 11.1, Dec 18, 2019.
- NOTE: Available at <https://www.c-roads.eu/platform/about/news/News/entry/show/release-16-of-c-roads-harmonised-c-its-specifications.html>.
- [17] C-ROADS Specification for interoperability of backend hybrid C-ITS communication, Release 1.6, Version 1.6, Dec 17, 2019.
- NOTE: Available at <https://www.c-roads.eu/platform/about/news/News/entry/show/release-16-of-c-roads-harmonised-c-its-specifications.html>.
- [18] ETSI TS 136 214: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements (3GPP TS 36.214 Release 14)".
- [19] ETSI TS 136 321: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification (3GPP TS 36.321 Release 14)".

2.2 Informative references

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

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

The following referenced documents are not necessary for the application of the present document but they assist the user with regard to a particular subject area.

[i.1] 5GAA TR S-180179: "5G Automotive Association; Working Group on Standards and Spectrum (WG4); Initial C-V2X System Profile (ICSP) - Amendments to C2C-CC Basic System Profile".

NOTE: Available at https://5gaa.org/wp-content/uploads/2020/02/5GAA_S-180179_TR_ICSP_Initial_C-V2X_System_Profile_v1.1.pdf.

[i.2] 5GAA TR S-180180: "5G Automotive Association; Working Group on Standards and Spectrum; Initial C-V2X System Profile (ICSP) - Amendments to C-ROADS Roadside System Profile".

NOTE: Available at https://5gaa.org/wp-content/uploads/2020/02/5GAA_S-180180_TR_ICSP_Initial_C-V2X_System_Profile_RSU_v1.1-1.pdf.

[i.3] C2C-CC: "Glossary", Release 1.5.0.

NOTE: Available at https://www.car-2-car.org/fileadmin/documents/Basic_System_Profile/Release_1.5.0/C2CCC_TR_2053_Glossary.pdf.

[i.4] ETSI TS 136 300: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA) and Evolved Universal Terrestrial Radio Access Network (E-UTRAN); Overall description; Stage 2 (3GPP TS 36.300 Release 14)".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in C2C-CC BSP [8], C-ROADS RSP [13], C-ROADS MSP [14] and the following apply:

C-ITS basic system: cooperative ITS system employing radio communication technologies to exchange messages between ITS stations

hybrid system: system combining direct communication over a PC5 interface and network communication over a Uu interface

LTE-V2X Basic System: C-ITS vehicle or roadside sub-system as outlined in C2C-CC Feat [9], C-ROADS Serv [15] and employing C-V2X technologies according to ETSI TS 136 300 [i.4] Release 14, where the PC5 link is used for direct communication instead of ITS-G5 and the Uu interface is used for V2X communication via cellular network infrastructure

3.2 Symbols

Void.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in C2C-CC Glossary [i.3] and the following apply:

3GPP	3 rd Generation Partnership Project
5GAA	5G Automotive Association
AM	Item identifier prefix for amendments provided in the present document
BSP	Basic System Profile
C2C-CC	Car-2-Car Communication Consortium
CBR	Channel Busy Ratio
C-ROADS	EU funded platform for C-ITS deployments
C-V2X	Cellular Vehicle-to-Everything
DCC	Distributed Congestion Control for ITS-G5
GN	Geo Networking
HSM	Hardware Security Module
ICSP	Initial C-V2X System Profile
IEEE	Institute of Electrical and Electronics Engineers
ITS-G5	Short range V2X system using IEEE 802.11 access technology
LTE-V2X	Long Term Evolution C-V2X system

NOTE: Defined in ETSI EN 303 613 [1].

MAC	Medium Access Control
MSP	Mobile Roadside Unit System Profile
OBU	On-Board Unit (C-ITS vehicle sub-system)
PC5	3GPP direct communication interface (sidelink)
PDCP	Packet Data Convergence Protocol
PHY	Physical Layer
PPPP	ProSe Per Packet Priority
RLC	Radio Link Control
RSP	Roadside Unit System Profile
RSU	Roadside Unit (C-ITS roadside sub-system)
Uu	3GPP network communication interface
V2X	Vehicle-to-Everything Communication

4 General Requirements

4.1 Introduction

The present document contains individual requirement items which are assigned with unambiguous references starting with "AM_BSP_", and "AM_RSP_", and "AM_MSP_" as prefix for OBU and, RSU and Mobile-RSU requirements, respectively. The unique identifier is useful as a reference for any comments/questions instead of referring to sections or page numbers. This follows the same principles as was applied in previous work from C2C-CC and C-ROADS.

In the present document, references to corresponding items of C2C-CC BSP [8], C-ROADS RSP [13], and C-ROADS MSP [14] are denoted with the prefix "RS_BSP_", "RS_RSP_", and "RS_MSP_" respectively, or with the corresponding section number of the reference document as needed. Throughout the present document, if an item is replaced, the unique identifier is appended by a bracket term indicating the identifier it replaces, e.g. "(replaces RS_BSP_123)".

4.2 AM_BSP_010

If not otherwise stated in the present document, the requirements from C2C-CC BSP [8], C2C-CC Feat [9], C2C-CC Trig [10], C2C-CC HSM [11], C-ROADS RSP [13], C-ROADS MSP [14], C-ROADS Func [16], C-ROADS Hyb [17], and C-ROADS Serv [15] shall be adopted for LTE-V2X systems. Version numbers of references given in C2C-CC [12] shall not apply, i.e. latest versions shall apply.

For the purpose of adapting the ITS-G5 specific requirements in the C2C-CC and C-ROADS documents to a LTE-V2X Basic System, all references to the terms "C2C-CC Basic System" in these documents shall be replaced with a generic term "C-ITS Basic System". Furthermore, the term "C-ITS" shall be used as a generic replacement for the terms "Wi-Fi™ ITS-G5" and "ITS-G5" used in C2C-CC and C-ROADS documents. In addition, the term "congestion control" shall be used as a generic replacement for the term "DCC" in C2C-CC and C-ROADS documents.

NOTE: In the present document, the general term "C-ITS Basic System" is used to denote an LTE-V2X Basic System employing direct communication over a PC5 mode 4 interface.

5 Requirement Specifications for OBUs

5.1 Applicable Items

5.1.1 General requirements

The following requirements shall be applied for an LTE-V2X Basic System and shall amend C2C-CC BSP [8].

5.1.2 AM_BSP_012

AM_BSP_012 replaces RS_BSP_434 of C2C-CC BSP [8].

The LTE-V2X Basic System's access layer shall be conformant with ETSI EN 303 613 [1] and make use of the Hybrid Automatic Repeat Request (HARQ) mechanism according to ETSI TS 136 321 [19] with parameter setting `allowedRetxNumberPSSCH=n1` for one retransmission, as long as this does not impact requirements AM_BSP_015 and AM_BSP_020.

5.1.3 AM_BSP_014

AM_BSP_014 replaces RS_BSP_235 of C2C-CC BSP [8].

For "Day 1" applications, the LTE-V2X Basic System shall support the mapping of Traffic Classes (TC) to PPPP levels as defined in table B.7 of ETSI EN 303 613 [1].

5.1.4 AM_BSP_015

AM_BSP_015 replaces RS_BSP_436 of C2C-CC BSP [8].

The congestion control mechanism of a LTE-V2X Basic System shall be conformant with ETSI TS 103 574 [4].

5.1.5 AM_BSP_016

AM_BSP_016 replaces RS_BSP_238 of C2C-CC BSP [8].

The LTE-V2X Basic System shall use the parameters as defined in table 1 of ETSI TS 103 574 [4] for the congestion control mechanism in the access layer.

5.1.6 AM_BSP_017

AM_BSP_017 replaces RS_BSP_240 of C2C-CC BSP [8].

LTE-V2X Basic System shall perform CBR measurements as defined in clause 5.1.30 of ETSI TS 136 214 [18].

5.1.7 AM_BSP_020

AM_BSP_020 replaces RS_BSP_246 of C2C-CC BSP [8].

When the LTE-V2X Basic System enters a protected communication zone, the LTE-V2X Basic System shall set its power $P_{\text{regulatory,c}}$ according to ETSI TS 136 101 [6] and apply the mitigation techniques as described in RS_BSP_458 or RS_BSP_459 without changing any other congestion control parameters. This requirement shall not be applied to messages with TC=0.

5.1.8 AM_BSP_022

AM_BSP_022 replaces RS_BSP_267 of C2C-CC BSP [8].

When forwarding packets, the LTE-V2X Basic System shall use the PPPP level as profiled in AM_BSP_014.

5.1.9 AM_BSP_023

AM_BSP_023 replaces RS_BSP_270 of C2C-CC BSP [8].

All GeoNetworking frames sent by the LTE-V2X Basic System shall use the packet header fields as given in clause D.2 of ETSI EN 303 613 [1].

5.1.10 AM_BSP_027

AM_BSP_027 replaces RS_BSP_225 of C2C-CC BSP [8].

A LTE-V2X Basic System shall use a sub-band dedicated for C-ITS according to ETSI EN 302 571 [7] for all messages.

5.1.11 AM_BSP_028

AM_BSP_028 replaces RS_BSP_245 of C2C-CC BSP [8].

Transmission power control shall be applied as specified in ETSI TS 103 574 [4].

5.1.12 AM_BSP_029

AM_BSP_029 amends RS_BSP_443 of C2C-CC BSP [8].

For LTE-V2X Basic System, parameters of RS_BSP_443 shall be adopted, unless otherwise specified in this item.

Parameter `pGnInterfaceType` shall be set to "LTE-V2X".

For LTE-V2X Basic System, HARQ retransmission shall be set according to AM_BSP_012 and congestion control parameters shall be set according to AM_BSP_015.

The following parameters are not applicable to LTE-V2X Basic System:

- `pAIDataRateCch`, `pAIDataRateCchHigh`, `pAIDataRateCchLow`, `pDccPToll`, `pGnEtherType`

5.2 Non-Applicable Items

The following items from C2C-CC BSP [8] are not applicable to LTE-V2X Basic System or are covered by appropriate other items:

- `RS_BSP_228`, `RS_BSP_397`, `RS_BSP_293`, `RS_BSP_435`

6 Requirement Specifications for RSUs

6.1 Applicable Items

6.1.1 General requirements

The following requirements shall be applied for a LTE-V2X Basic System. They amend C-ROADS RSP [13] and C-ROADS MSP [14].

6.1.2 AM_RSP_014

AM_RSP_014 replaces Sections 3.1.1 and 3.1.2 of C-ROADS RSP [13] and C-ROADS MSP [14].

The access layer of a LTE-V2X Basic System shall comprise of a message protocol stack, which includes Physical (PHY), Medium Access Control (MAC), Radio Link Control (RLC), and Packet Data Convergence Protocol (PDCP) layers according to AM_RSP_015.

Spectrum usage in the 5 855 MHz to 5 925 MHz frequency band shall be applied according to AM_RSP_016.

A congestion control mechanism to mitigate interference in tolling zones and to accommodate high loading scenarios shall be applied according to AM_RSP_018, respectively.

6.1.3 AM_RSP_015

AM_RSP_015 replaces section 3.1.4 of C-ROADS RSP [13].

The LTE-V2X Basic System's access layer shall conform to AM_BSP_012 and employ congestion control according to AM_BSP_015.

6.1.4 AM_RSP_016

AM_RSP_016 replaces RS_RSP_011 of C-ROADS RSP [13].

A LTE-V2X Basic System shall use a sub-band dedicated for C-ITS according to ETSI EN 302 571 [7] for all messages.

6.1.5 AM_RSP_017

AM_RSP_017 replaces RS_RSP_072 of C-ROADS RSP [13].

The LTE-V2X Basic System's access layer shall be compliant to the ETSI EN 302 571 [7].

6.1.6 AM_RSP_018

AM_RSP_018 replaces sections 3.1.6 and 3.1.7 of C-ROADS RSP [13].

The congestion control mechanism of a LTE-V2X Basic System shall be compliant to ETSI TS 103 574 [4].

The LTE-V2X Basic System shall support the mapping of Traffic Classes (TC) to PPPP levels as defined in table B.7 of ETSI EN 303 613 [1].

6.1.7 AM_RSP_019

AM_RSP_019 replaces section 3.2.1 of C-ROADS RSP [13] and C-ROADS MSP [14].

For LTE-V2X Basic System, the network and transport layer shall comply with the specifications ETSI EN 302 636-4-1 [2] and ETSI EN 302 636-5-1 [3], covering the media-independent functionality and the basic transport protocols, respectively.

6.1.8 AM_RSP_021

AM_RSP_021 replaces RS_RSP_035 of C-ROADS RSP [13].

The GeoNetworking (GN) parameter itsGnIfType shall be set to "LTE-V2X" according to ETSI EN 302 636-4-1 [2].

6.1.9 AM_RSP_022

AM_RSP_022 replaces RS_RSP_050 of C-ROADS RSP [13].

All GeoNetworking frames sent by the LTE-V2X Basic System shall use the packet header fields as given in clause D.2 of ETSI EN 303 613 [1].

6.2 Non-Applicable Items

The following items from C-ROADS RSP [13] and C-ROADS MSP [14] are not applicable to LTE-V2X Basic System and are excluded from the LTE-V2X Profile:

- RS_RSP_018, RS_RSP_027, RS_RSP_070, RS_RSP_094

Annex A (informative): Change History

Date	Version	Information about changes
2019-12-20	0.0.1	Initial document
2020-01-15	0.0.2	Modifications made during WG2
2020-01-16	0.0.3	Comments from Lecit srl and proposed resolutions
2020-04-21	0.0.4	Cleanup after agreed changes from WG2 Meeting and updates for latest C2C-CC Release 1.5.0 and C-ROADS Release 1.6
2020-07-02	0.0.5	Correct normative and informative referencing
2020-07-02	0.0.6	Cleanup definitions
2020-07-03	0.0.7	Update to accommodate agreed changes discussed in ITS#39 Closing Plenary
2020-08-02	0.0.8	Implementation of comments made during remote consensus ITS(20)DEC215 and ETSI secretariat

History

Document history		
V1.1.1	September 2020	Publication
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