

Final draft **ETSI EN 303 798** V2.1.0 (2024-06)



**Intelligent Transport Systems (ITS);
LTE-V2X and NR-V2X Access layer specification
for Intelligent Transport Systems operating
in the 5 GHz frequency band;
Release 2**

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ETSI

650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - APE 7112B
Association à but non lucratif enregistrée à la
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Foreword

This final draft European Standard (EN) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS), and is now submitted for the Vote phase of the ETSI EN Approval Procedure.

Proposed national transposition dates

Date of latest announcement of this EN (doa):	3 months after ETSI publication
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	6 months after doa
Date of withdrawal of any conflicting National Standard (dow):	6 months after doa

Modal verbs terminology

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Introduction

The present document outlines the access layer of the Sidelink (PC5 interface) of cellular based Vehicle to Everything communication technology specified in ETSI TS 138 300 [21], which can be operated in the 5,9 GHz frequency band allocated in Europe. NR-V2X and LTE-V2X access layers consist of RRC layer, PDCP layer, RLC layer, MAC layer and Physical layer. A NAS layer is also introduced as part of the access layer in the present document for the provision of control. The present document includes requirements for congestion control and for CEN DSRC protection.

The present document does not override regional regulations. The regional regulations apply.

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1 Scope

The present document defines the physical layer, the data link layer and radio resource configuration, grouped into the access layer of the ITS station reference architecture ETSI TS 103 898 [i.2]. The access layer technology that is specified in the present document refers to what is known as the sidelink or PC5 interface of cellular V2X for the following frequency bands:

- Operation in frequency band dedicated to ITS for safety related applications in the frequency range 5,875 GHz to 5,925 GHz.
- Operation in frequency bands dedicated to ITS non-safety applications in the frequency range 5,855 GHz to 5,875 GHz.

The present document is a revision of ETSI EN 303 613 [i.1], and extends the LTE-V2X access layer specification to include NR-V2X.

Whether LTE-V2X or NR-V2X is used for message transmission in an ITS channel is determined by a system level configuration and outside the scope of the present document.

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.

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

- [1] [ETSI TS 136 331](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Resource Control (RRC); Protocol specification (3GPP TS 36.331 Release 16)".
- [2] [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 16)".
- [3] [ETSI TS 136 321](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification (3GPP TS 36.321 Release 16)".
- [4] [ETSI TS 136 322](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Link Control (RLC) protocol specification (3GPP TS 36.322 Release 16)".
- [5] [ETSI TS 136 323](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) specification (3GPP TS 36.323 Release 16)".
- [6] [ETSI TS 136 211](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical channels and modulation (3GPP TS 36.211 Release 16)".
- [7] [ETSI TS 136 212](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Multiplexing and channel coding (3GPP TS 36.212 Release 16)".
- [8] [ETSI TS 136 213](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer procedures (3GPP TS 36.213 Release 16)".

- [9] [ETSI TS 136 214](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Physical layer; Measurements (3GPP TS 36.214 Release 16)".
- [10] [ETSI TS 123 285](#): "Universal Mobile Telecommunications System (UMTS); LTE; Architecture enhancements for V2X services (3GPP TS 23.285 Release 16)".
- [11] [ETSI TS 124 385](#): "LTE; V2X services Management Object (MO) (3GPP TS 24.385 Release 16)".
- [12] [ETSI TS 124 386](#): "LTE; User Equipment (UE) to V2X control function; protocol aspects; Stage 3 (3GPP TS 24.386 Release 16)".
- [13] [ETSI TS 136 101](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); User Equipment (UE) radio transmission and reception (3GPP TS 36.101 Release 16)".
- [14] [ETSI TS 136 133](#): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Requirements for support of radio resource management (3GPP TS 36.133 Release 16)".
- [15] [ETSI TS 124 301](#): "Universal Mobile Telecommunications System (UMTS); LTE; 5G; Non-Access-Stratum (NAS) protocol for Evolved Packet System (EPS); Stage 3 (3GPP TS 24.301 Release 16)".
- [16] [ETSI TS 136 413](#): "LTE; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 Application Protocol (S1AP) (3GPP TS 36.413 Release 16)".
- [17] [ETSI TS 136 414](#): "LTE; Evolved Universal Terrestrial Radio Access Network (E-UTRAN); S1 data transport (3GPP TS 36.414 Release 16)".
- [18] [ETSI 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".
- [19] [ETSI TS 103 574](#): "Intelligent Transport Systems (ITS); Congestion Control Mechanisms for C-V2X PC5 interface; Access layer part; Release 2".
- [20] [ETSI TS 138 331](#): "5G; NR; Radio Resource Control (RRC); Protocol specification (3GPP TS 38.331 Release 16)".
- [21] [ETSI TS 138 300](#): "5G; NR; NR and NG-RAN Overall description; Stage-2 (3GPP TS 38.300 Release 16)".
- [22] [ETSI TS 138 321](#): "5G; NR; Medium Access Control (MAC) protocol specification (3GPP TS 38.321 Release 16)".
- [23] [ETSI TS 138 322](#): "5G ; NR; Radio Link Control (RLC) protocol specification (3GPP TS 38.322 Release 16)".
- [24] [ETSI TS 138 323](#): "5G; NR; Packet Data Convergence Protocol (PDCP) specification (3GPP TS 38.323 Release 16)".
- [25] [ETSI TS 138 211](#): "5G ; NR; Physical channels and modulation (3GPP TS 38.211 Release 16)".
- [26] [ETSI TS 138 212](#): "5G; NR; Multiplexing and channel coding (3GPP TS 38.212 Release 16)".
- [27] [ETSI TS 138 213](#): "5G; NR; Physical layer procedures for control (3GPP TS 38.213 Release 16)".
- [28] [ETSI TS 138 214](#): "5G; NR; Physical layer procedures for data (3GPP TS 38.214 Release 16)".
- [29] [ETSI TS 138 215](#): "5G; NR; Physical layer measurements (3GPP TS 38.215 Release 16)".
- [30] [ETSI TS 138 101-1](#): "5G; NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone (3GPP TS 38.101-1 Release 16)".
- [31] [ETSI TS 138 133](#): "5G; NR; Requirements for support of radio resource management (3GPP TS 38.133 Release 16)".
- [32] [ETSI TS 124 501](#): "5G; Non-Access-Stratum (NAS) protocol for 5G System (5GS); Stage 3 (3GPP TS 24.501 Release 16)".

- [33] [ETSI TS 138 413](#): "5G; NG-RAN; NG Application Protocol (NGAP) (3GPP TS 38.413 Release 16)".
- [34] [ETSI TS 138 414](#): "5G; NG-RAN; NG data transport (3GPP TS 38.414 Release 16)".
- [35] [ETSI TS 103 723](#): "Intelligent Transport Systems (ITS); Profile for LTE-V2X Direct Communication".
- [36] [ETSI TS 123 287](#): "5G; Architecture enhancements for 5G System (5GS) to support Vehicle-to-Everything (V2X) services (3GPP TS 23.287 Release 16)".
- [37] [ETSI TS 103 836-4-3](#): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 3: Media-dependent functionalities for NR-V2X PC5 and LTE-V2X PC5; Release 2".

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] ETSI EN 303 613: "Intelligent Transport Systems (ITS); LTE-V2X Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".
- [i.2] ETSI TS 103 898: "Intelligent Transport Systems (ITS); Communications Architecture; Release 2".
- [i.3] 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".
- [i.4] [Commission Implementing Decision \(EU\) 2020/1426 of 7 October 2020](#) on the harmonised use of radio spectrum in the 5 875-5 935 MHz frequency band for safety-related applications of intelligent transport systems (ITS) and repealing Decision 2008/671/EC.
- [i.5] [ECC/DEC/\(08\)01](#): "The harmonised use of Safety-Related Intelligent Transport Systems (ITS) in the 5875-5935 MHz frequency band". Approved 14 March 2008. Latest updated 18 November 2022.
- [i.6] [ECC Recommendation \(08\)01](#): "Use of the band 5855-5875 MHz for Intelligent Transport Systems (ITS)". Approved 21 February 2008. Amended 3 July 2015.

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI TS 103 898 [i.2] and the following apply:

channel busy ratio: portion of sub-channels in the resource pool whose S-RSSI measured by the ITS station exceed a (pre-)configured threshold sensed over last 100 ms

NOTE: This definition is access layer dependant and is specified in ETSI TS 136 214 [9] and is different to the definition in ETSI EN 302 571 [i.3].

channel occupancy ratio: fraction of the total number of sub-channels *used* by the ITS station for its transmissions out of the total number of *configured* (granted) sub-channels over a measurement period of 1 000 ms

NOTE: This definition is access layer dependant and is specified in ETSI TS 136 214 [9].

PC5: interface between the ITS stations used for C-V2X sidelink communication

Resource Block (RB): 7 consecutive symbols in the time domain and 12 consecutive subcarriers in the frequency domain

resource pool: set of resources that can be used for PSCCH and PSSCH

NOTE: Resource pool is defined with the help of start RB, number of sub-channels, size of sub-channel and available subframes.

sidelink: radio link between the ITS stations for C-V2X direct communication

sub-channel: set of contiguous physical resource blocks

3.2 Symbols

For the purposes of the present document, the following symbols apply:

IN	Interface between access layer and networking & transport layer
IN-SAP	Interface between access layer and network & transport layer
MF	Interface between management entity and facilities layer
MI	Interface between management entity and access layer
MN	Interface between management entity and networking & transport layer
MS	Interface between management entity and security entity
NF	Interface between networking & transport layer and facilities layer
SF	Interface between security entity and facilities layer
SI	Interface between security entity and access layer
SN	Interface between security entity and networking & transport layer

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

3GPP	3 rd Generation Partnership Project
ACK	ACKnowledgement
AM	Acknowledged Mode
ARFCN	Absolute Radio-Frequency Channel Number
ASN.1	Abstract Syntax Notation One
BSR	Buffer Status Report
BW	BandWidth
BWP	BandWidth Part
CBR	Channel Busy Ratio
CEN	Comité Européen de Normalisation
CID	Context IDentifier
CN	Core Network
CR	Channel occupancy Ratio
CSI	Channel State Information
C-V2X	Cellular Vehicle to Everything
DFN	Direct Frame Number
DL	DownLink
DMRS	DeModulation Reference Signal
DRB	Data Radio Bearer
DSRC	Dedicated Short Range Communications
DTX	Discontinuous Transmission
eNB	enhance Node B
E-UTRA	Evolved Universal Terrestrial Radio Access
E-UTRAN	Evolved Universal Terrestrial Radio Access Network

FR1	FRequency 1
FR2	FRequency 2
GBR	Guaranteed Bit Rate
GFBR	Guaranteed Flow Bit Rate
gNB	5G Node B
GNSS	Global Navigation Satellite System
HARQ	Hybrid Automatic Repeat ReQuest
ID	IDentity
IE	Information Element
IP	Internet Protocol
ITS	Intelligent Transport Systems
LCP	Link Control Protocol
LTE-V2X	Long Term Evolution based Vehicle-to-Everything
M/R	Mandatory/Recommended
MAC	Medium Access Control
MCS	Modulation and Coding Scheme
MCS-RB	Modulation and Coding Scheme - Resource Blocks
MFBR	Maximum Flow Bit Rate
MIB-SL	Master Information Block - SideLink
N/A	Not Applicable
NAS	Non-Access Stratum
NR	New Radio
NR-V2X	New Radio (5 th generation) Vehicle to Everything
NS	Network Signalling value
PC5	Proximity-based Communication (Interface) 5
PDCP	Packet Data Convergence Protocol
PDU	Protocol Data Unit
PHY	PHYSical layer
PPPP	ProSe Per-Packet Priority
PQI	PC5 QoS Identifier
PRB	Physical Resource Block
ProSe	Proximity-based Service
PSBCH	Physical Sidelink Broadcast CHannel
PSCCH	Physical Sidelink Control CHannel
PSFCH	Physical Sidelink Feedback CHannel
PSSCH	Physical Sidelink Shared CHannel
PTRS	Phase Tracking Reference Signal
PUCCH	Physical Uplink Control CHannel
PUSCH	Physical Uplink Shared CHannel
QAM	Quadrature Amplitude Modulation
QoS	Quality of Service
RAN	Radio Access Network
RB	Resource Block
RLC	Radio Link Control
RLF	Radio Link Failure
RoHC	Robust Header Compression
RRC	Radio Resource Control
RS	Reference Signal
RSRP	Reference Signal Received Power
RSSI	Received Signal Strength Indication
RSU	Road Side Unit
RX	Receive
SCI	Sidelink Control Information
SCS	Sub Carrier Spacing
SDAP	Service Data Adaptation Protocol
SDU	Service Data Unit
SFN	Sub Frame Number
SLSS	SideLink Synchronization Signal
SL-SSB	SideLink Synchronization Signal Block
SN	Sequence Number
SPS	Semi Persistent Scheduling
S-PSS	(Sidelink) Primary Synchronization Signal

SSID	Service Set ID
S-SSS	(Sidelink) Secondary Synchronization Signal
SyncRef UE	Synchronization Reference User Equipment
TB	Transport Block
TDD	Time Division Duplex
TX	Transmit
UCI	Uplink Control Information
UE	User Equipment
UL	UpLink
UM	Unacknowledged Mode
V2X	Vehicle-to-Everything

4 General requirements

4.1 Architecture

The ITS station architecture specified in ETSI TS 103 898 [i.2] is in Figure 4.1.1. LTE-V2X as defined in ETSI TS 136 300 [2] and NR-V2X as defined in ETSI TS 138 300 [21] are two of the access layer technologies of the ITS station architecture.

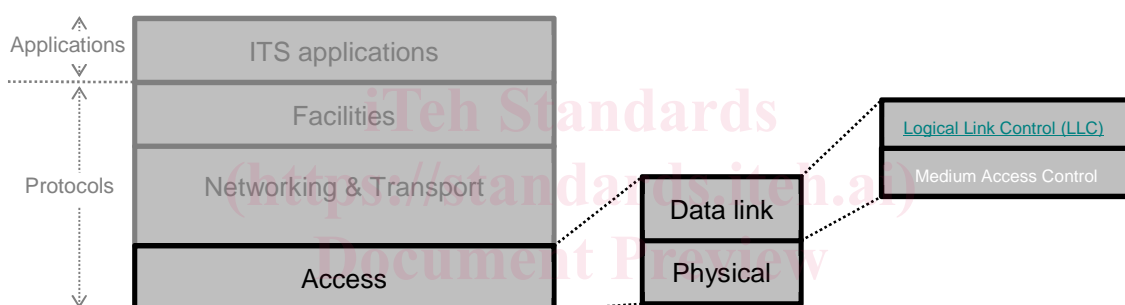


Figure 4.1.1: Access Layer in the ITS station architecture

A C-V2X access layer is shown in Figure 4.1.2.

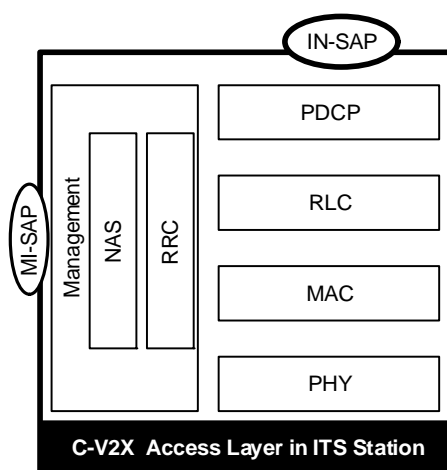


Figure 4.1.2: C-V2X Access Layer protocol stack

An ITS station that includes a cellular V2X sidelink technology as the access layer shall support LTE-V2X sidelink communication as defined in ETSI TS 136 300 [2], or NR-V2X sidelink communication as defined in ETSI TS 138 300 [21], or both. LTE-V2X and NR-V2X are different access layers.

NOTE: The present document specifies LTE-V2X and NR-V2X based on 3GPP Release-16 and contains no backwards compatibility requirements other than those explicitly stated in clause 5.7.5.

4.2 Operating Frequencies

ETSI TS 136 101 [13], clause 5.5G defines the operating band of LTE-V2X.

ETSI TS 138 101-1 [30], clause 5.2E defines the operating bands of NR-V2X.

In Europe, ITS frequency band designation for 5 855 MHz to 5 925 MHz is defined by Commission Implementing Decision (EU) 2020/1426 [i.4], ECC/DEC/(08)01 [i.5] and ECC Recommendation (08)01 [i.6].

Band 47 in ETSI TS 136 101 [13] and band n47 in ETSI TS 138 101-1 [30] correspond to the European ITS spectrum in 5 855 MHz to 5 925 MHz as defined by Commission Implementing Decision (EU) 2020/1426 [i.4], ECC/DEC/(08)01 [i.5] and ECC Recommendation (08)01 [i.6].

NOTE: While deployment of LTE-V2X and NR-V2X in the same channel could be possible, it is not intended and is outside the scope of the present document.

4.3 Transmit and receive requirement

An ITS station using LTE-V2X shall fulfil the transmit and receive requirement defined for Band 47 in ETSI TS 136 101 [13] and ETSI TS 136 133 [14].

An ITS station using NR-V2X shall fulfil the transmit and receive requirement defined for Band n47 in ETSI TS 138 101-1 [30] and ETSI TS 138 133 [31].

4.4 Congestion control

A C-V2X ITS station shall adapt its CR according to the measured Channel Busy Ratio (CBR) in order to comply with the required CR limit, as defined in ETSI TS 103 574 [19]. The CBR measurement window shall be as specified in ETSI TS 103 574 [19] for LTE-V2X and Table A.2.1 row 36 for NR-V2X.

4.5 CEN DSRC protection

An ITS station using LTE-V2X in Band 47 or NR-V2X in Band n47 shall avoid harmful interference to CEN DSRC:

- The ITS station shall be conformant to ETSI TS 102 792 [18].
- If the ITS station is inside the protected zone, it shall adjust its output power level to maximum 10 dBm e.i.r.p. If the ITS station is inside the protected zone, it shall fulfil the spurious emissions limit of maximum -65 dBm/MHz within 5 795 MHz to 5 815 MHz.

The upper layers of the ITS station are responsible for detecting that the ITS station is within proximity of CEN DSRC protection zone according to ETSI TS 102 792 [18] and then sending an indication to access layers to trigger power level adjustment.

5 LTE-V2X access layers

5.1 Physical layer

The physical layer is mainly responsible for encoding/decoding, modulation/demodulation, etc. and shall be as defined in ETSI TS 136 211 [6], ETSI TS 136 212 [7], ETSI TS 136 213 [8] and ETSI TS 136 214 [9].

The minimum set of the essential LTE-V2X information elements defined in ETSI TS 136 331 [1] and their default/initial values shall be as in clause A.1, Tables A.1.1 to A.1.6.