ETSI TS 102 636-4-3 V1.1.1 (2020-08)

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 LTE-V2X

Reference
DTS/ITS-00364

Keywords
addressing, ITS, network, point-to-multipoint,
point-to-point, protocol

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Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

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

The present document is part 4, sub-part 3 of a multi-part deliverable. Full details of the entire series can be found in part 1 [i.1].

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

The GeoNetworking protocol is a network protocol that provides packet routing in an ad hoc network. It makes use of geographical positions for packet transport. GeoNetworking supports the communication among individual ITS-Ss as well as the distribution of packets in geographical areas.

GeoNetworking can be executed over different ITS access technologies for short-range wireless technologies, such as ITS-G5 or LTE-V2X. In order to reuse the GeoNetworking protocol specification for multiple ITS access technologies, the specification is separated into media-independent and media-dependent functionalities. Media-independent GeoNetworking functionalities are those which are common to all ITS access technologies for short-range wireless communication and are specified in ETSI EN 302 636-4-1 [1]. The present document specifies media-dependent functionalities for GeoNetworking when using the ITS access technology LTE-V2X [2]. The specification in the present document should be regarded as LTE-V2X specific extensions of the GeoNetworking protocol specified in ETSI EN 302 636-4-1 [1] and does not represent a distinct protocol entity.

1 Scope

The present document specifies the media-dependent functionalities for GeoNetworking [1] over LTE-V2X [2] as a network protocol for ad hoc routing in vehicular environments.

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.

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

[1] ETSI EN 302 636-4-1 (V1.4.1): "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".

[2] ETSI EN 303 613 (V1.1.1): "Intelligent Transport Systems (ITS); LTE-V2X Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".

[3] ETSI TS 136 323 (V14.5.0): "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Packet Data Convergence Protocol (PDCP) specification (3GPP TS 36.323 version 14.5.0 Release 14)".

[4] ETSI TS 124 386 (V14.0.0): "LTE; User Equipment (UE) to V2X control function; protocol aspects; Stage 3 (3GPP TS 24.386 version 14.0.0 Release 14)".

[5] ETSI TS 136 321: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification (3GPP TS 36.321 Release 14)".

[6] ETSI TS 136 300 (V14.12.0): "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 version 14.12.0 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.

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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 302 636-1 (V1.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 1: Requirements".

[i.2] ETSI TS 103 574 (V1.1.1): "Intelligent Transport Systems (ITS); Congestion Control Mechanisms for C-V2X PC5 interface; Access layer part".

[i.3] ETSI TS 102 723-8 (V1.1.1): "Intelligent Transport Systems (ITS); OSI cross-layer topics; Part 8: Interface between security entity and network and transport layer".

[i.4] ETSI TS 102 687 (V1.2.1): "Intelligent Transport Systems (ITS); Decentralized Congestion Control Mechanisms for Intelligent Transport Systems operating in the 5 GHz range; Access layer part".

[i.5] ETSI TS 136 322 (V14.1.0), "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Link Control (RLC) protocol specification (3GPP TS 36.322 version 14.1.0 Release 14)".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 302 636-4-1 [1], ETSI EN 303 613 [2], ETSI TS 103 574 [i.2] apply.

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI EN 302 636-4-1 [1], ETSI EN 302 663 [2], ETSI TS 103 574 [i.2], ETSI TS 102 687 [i.4] apply.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 302 636-4-1 [1], ETSI EN 303 613 [2], ETSI TS 103 574 [i.2], ETSI TS 102 687 [i.4] and the following apply:

GN	GeoNetworking
MIB	Management Information Base
PDCP	Packet Data Convergence Protocol
PPPP	ProSe Per Packet Priority
SDU	Service Data Unit
SHB	Single Hop Broadcast
SPS	Semi-Persistent Scheduling

4 Overview

The present document specifies the media-dependent functionalities necessary to run the GeoNetworking protocol defined in ETSI EN 302 636-4-1 [1] over the LTE-V2X access technology defined in ETSI EN 303 613 [2]. The functionalities are:

- Addressing, data structure extensions and field settings in the GeoNetworking headers for LTE-V2X, including extensions for improved synchronization: clause 5.
- Process on receive and transmit: clause 6.
- Security and privacy considerations: clause 7.
- Forwarding algorithms: clause 8.

5 Addressing, data structure extensions and field settings for LTE-V2X

5.1 General

The Networking Services implementation using LTE-V2X shall use access layer functionality for sidelink communication as defined in ETSI EN 303 613 [2].

5.2 GeoNetworking address

As specified in ETSI EN 302 636-4-1 [1], clause 6, every GeoAdhoc router shall have a unique GeoNetworking address and use the format in figure 1.

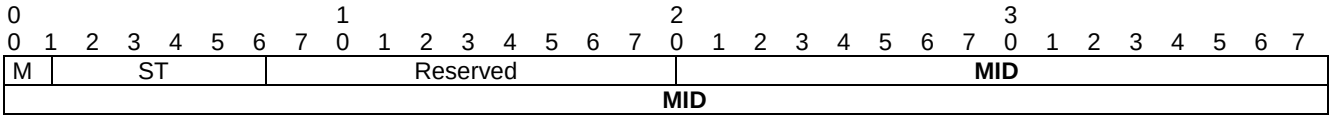

Figure 1: GeoNetworking address format as specified in ETSI EN 302 636-4-1 [1]

For the MID field in the GeoNetworking address. the 24-bit Source or Destination Layer 2 ID as specified in the MAC protocol specification, ETSI TS 136 321 [5], shall be used for Octets 2-4 of the MID field and Octets 5-7 shall be set to zero.

5.3 Field settings in the GeoNetworking header

5.3.1 General

The present clause specifies setting and encoding of GN header fields specific for LTE-V2X access technology, i.e.:

- Traffic Class (TC) field in the *Common Header* (clause 5.3.2);
- Timing advance and position for improved synchronization.

5.3.2 Field settings in the *Common Header*

As specified in ETSI EN 302 636-4-1 [1], the *Common Header* consists of the fields shown in figure 2. The traffic class identifier (TC ID) is transmitted in the *TC* field.

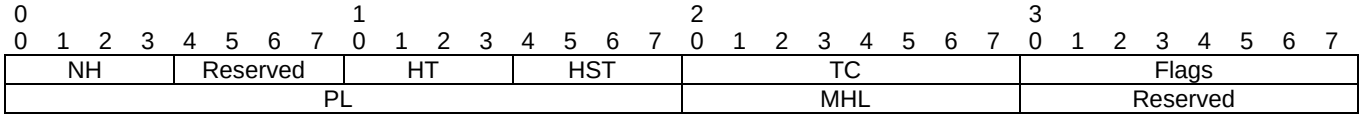

Figure 2: *Common Header* format as specified in ETSI EN 302 636-4-1 [1]

As specified in ETSI EN 302 636-4-1 [1], clause 9.7.2, the *TC* field consists of three sub-fields, i.e. SCF, channel offload and TC ID (see table 1).

Table 1: *TC* field in the Common Header

Field #	Field name	Octet/bit position		Type	Unit	Description
		First	Last			
1-4	See ETSI EN 302 636-4-1 [1], table 4.					
5	*TC*	Octet 2 Bit 0	Octet 2 Bit 7	Three sub-fields: 1 bit selector, 1 bit selector, 6 bit selector	n/a	Traffic class that represents facility layer requirements on packet transport. Bit 0: **SCF** Flag indicating whether the packet shall be buffered when no neighbour exists (store-carry-forward). Bit 1: **Channel Offload** Flag indicating whether the packet can be offloaded to another channel. Bit 2 to Bit 7: **TC ID** TC ID as specified in the present document.
6-9	See ETSI EN 302 636-4-1 [1], table 4.					

The mapping between TC ID and PPPP is specified in ETSI EN 303 613 [2], table B.7 in annex B.

5.3.3 Field settings in the *Extended Header* of the SHB packet

As specified in ETSI EN 302 636-4-1 [1], clause 9.8.4, the SHB packet header carries a 4-byte, reserved field for media-dependent functionality (figure 3).

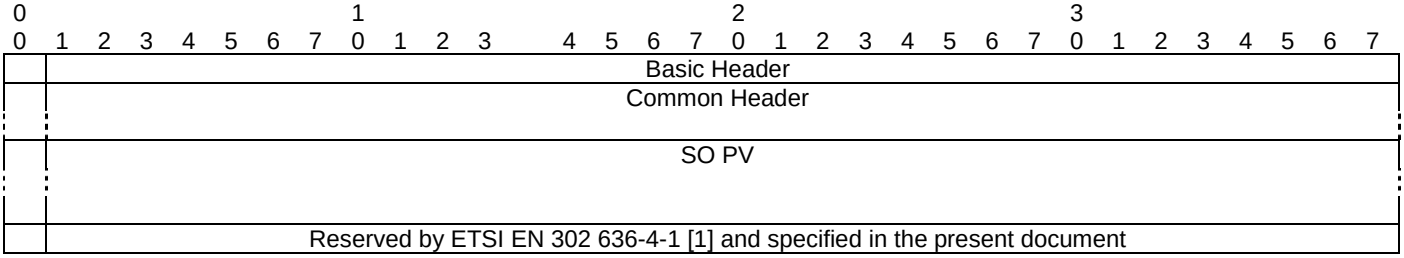

Figure 3: The SHB packet header format as specified in ETSI EN 302 636-4-1 [1]

The present document replaces a part of the field *Reserved* in table 13 in ETSI EN 302 636-4-1 [1] with the field *Version* (see table 2). The fields of *Version* and *Media-dependent data* shall be encoded as shown in table 2 and table 3.

Table 2: Fields of the SHB packet header

Field #	Field name	Octet/bit position		Type	Unit	Description
		First	Last			
1-3	See ETSI EN 302 636-4-1 [1], table 13.					
4	*Version*	Octet 36 Bit 0	Octet 36 Bit 3	4 bit unsigned integer	n/a	Identifies the media-dependent operation as specified in table 3.
5	*Media-dependent data*	Octet 36 Bit 4	Octet 39	28 bit unsigned integer	n/a	Used for media-dependent operations indicated by the *Version* field. If not used (i.e. the *Version* field is set to 0), it shall be set to 0.

NOTE: The present document specifies fields in the *Extended Header* only for the SHB packet header and not for other packet header types.

Table 3: *Version* field of the GeoNetworking SHB packet header

Version	Encoding	Description
0	0	Not equipped or unavailable.
1	1	Time synchronization is supported, the 28 bit *Media-dependent data* field, i.e. Field#5, is sub-divided into 4 bit and 24 bit fields, and the 4 bit of the *Media-dependent data* field shall be used for the *Compact Time Confidence* as specified in table 4 in clause 5.3.4.
NOTE: All other values are reserved for future usage.		

5.3.4 Timing synchronization extension

Timing synchronization confidence shall be added to the GN messages as shown in table 2 and table 3.

3GPP Specifications define three synchronization sources for C-V2X:

- GNSS.
- Serving cell/PCell (eNB DL timing).
- SyncRef UE (SLSS/PSBCH).

The timing synchronization extension is used to improve synchronization quality in scenarios of no GNSS or network coverage.

The *Compact Time Confidence (CTC)* provides the absolute accuracy of the reported timing values in the SDU with a predefined confidence level, i.e. 95 % as specified in table 4.

Table 4: *CTC* of the *Media-dependent data* field

Compact Time Confidence (CTC)	Encoding	Description
time-000-000-005	0	Better than 0,000,005 seconds
time-000-000-004	1	Better than 0,000,004 seconds
time-000-000-003	2	Better than 0,000,003 seconds
time-000-000-002	3	Better than 0,000,002 seconds
time-000-000-001	4	Better than 0,000,001 seconds (one microsecond)
time-000-000-000-5	5	Better than 0,000,000,5 seconds
time-000-000-000-4	6	Better than 0,000,000,4 seconds
time-000-000-000-3	7	Better than 0,000,000,3 seconds
NOTE: All other values are reserved for future usage.		

6 Processing on Receive and Transmit

6.1 Processing on transmit

For transmission of a GN packet, the SDU Type field of the PDCP header as defined in ETSI TS 136 323 [3] shall be set to 0b011 (i.e. Non-IP), and the Non-IP Type field indicates the V2X message family as defined in ETSI TS 124 386 [4] and shall be set to value 0b00000011for the ETSI-ITS stack.

For each MAC PDU transmission from an ITS Station, the V field of the MAC header as defined in ETSI TS 136 321 [5] shall be set to 0b0011 if the DST field is 24-bit groupcast identifier and shall be set to 0b0100 if the DST field is a 24-bit unicast identifier. If the V field is set to 0b0011 the PDU shall be sent using RLC Unacknowledged Mode (UM), while if the V field is set to 0b0100 the PDU may be sent using RLC UM or RLC Acknowledged Mode (AM), where RLC UM and RLC AM are defined in ETSI TS 136 322 [i.5].

For broadcast GeoNetworking packets, the Destination Layer 2 ID shall be set to all "1"s.

6.2 Processing on receive

Processing on receive for MAC, RLC, and PDCP layers is in accordance with the corresponding protocol specification and with ETSI TS 124 386 [4].

NOTE: An ITS Station may selective process or discard (i.e. filter) MAC PDUs received via C-V2X based on the value of the DST field of the MAC header.

Subsequent to successful lower layer processing on receive, if the SDU Type field of the PDCP header was set to 0b011 and the Non-IP Type field was set to the value 0b00000011, the SDU shall be delivered up to the GN protocol for further processing.

7 Security and Privacy considerations

The security entity shall have the ability to trigger SPS resource reselection. This enables the security entity to coordinate SPS resource selection with pseudonym change. Since the selected SPS resources act as a short-lived identifier, it is useful to change the SPS resource at the same time as carrying out pseudonym change to reduce an eavesdropper's ability to track a transmitter across that pseudonym change. The SPS mechanism shall be as defined in ETSI TS 136 321 [5] and ETSI TS 136 300 clause 23.14 [6].

When `itsGnLocalAddrConfMethod` is set to ANONYMOUS, the GeoNetworking protocol subscribes to the *IDCHANGE-SUBSCRIBE* service at the security entity (ETSI TS 136 321 [5] and ETSI TS 102 723-8 [i.3]). The Semi-Persistent Scheduling function shall use the same *IDCHANGE-SUBSCRIBE* service, and reset the SPS function when the pseudonym is changed.

8 Forwarding algorithms

GeoNetworking forwarding algorithm selection procedure, Non-area forwarding algorithms and Area forwarding algorithms specified in annex D, annex E and annex F respectively in ETSI EN 302 636-4-1 [1] shall be applied in the present document.

Greedy Forwarding (GF) and Simple area forwarding algorithms should be used as a Non-area and Area forwarding algorithm respectively. For using those algorithms, the GeoNetworking protocol constants `itsGnNonAreaForwardingAlgorithm` shall be set to 1 (GREEDY) and `itsGnAreaForwardingAlgorithm` shall be set to 1 (SIMPLE).

The other forwarding algorithms as defined in ETSI EN 302 636-4-1 [1] may also be used. When the Contention-Based Forwarding (CBF) algorithm is used as the Non-area or Area based forwarding algorithm, the parameter DIST_MAX shall be set to 2 000 meters instead of using the `itsGnDefaultMaxCommunicationRange`, i.e. 1 000 meters.

Annex A (normative): GeoNetworking protocol constants for LTE-V2X

The GeoNetworking protocol constants as specified in ETSI EN 302 636-4-1 [1], annex H "GeoNetworking protocol constants" shall be extended by the protocol constants in table A.1.

The protocol constants represent MIB attributes specified in annex B of the present document.

Table A.1: GeoNetworking protocol constants for LTE-V2X

Item	GeoNetworking protocol constant	Default/initial value	Comment
1	itsGnCompactTimeConfidence	0	Absolute accuracy of the reported timing values in the SDU with a predefined confidence level, i.e. 95 %.

Annex B (informative): Extensions of the GeoNetworking MIB

The ASN.1 encoding of the GeoNetworking MIB, as specified in ETSI EN 302 636-4-1 [1], annex I "ASN.1 encoding of the GeoNetworking MIB", is extended by the `itsGnLTEV2X` sub group and the MIB attribute `itsGnCompactTimeConfidence` as follows:

```
-- ****************************************************************************
-- * SUB GROUPS
-- ****************************************************************************

   itsGnSystem           OBJECT IDENTIFIER ::= { itsGnMgmt 1 }
   itsGnConfig           OBJECT IDENTIFIER ::= { itsGnMgmt 2 }
   itsGnLocationService  OBJECT IDENTIFIER ::= { itsGnMgmt 3 }
   itsGnBeaconService    OBJECT IDENTIFIER ::= { itsGnMgmt 4 }
   itsGnPacketForwarding OBJECT IDENTIFIER ::= { itsGnMgmt 5 }
   itsGnITSG5            OBJECT IDENTIFIER ::= { itsGnMgmt 6 }
   itsGnLTEV2X           OBJECT IDENTIFIER ::= { itsGnMgmt 7 }


-- ****************************************************************************
-- * GN LTE-V2X SUB GROUP
-- ****************************************************************************

itsGnCompactTimeConfidence OBJECT-TYPE
   SYNTAX      Integer{
                        time-000-000-005(0),
                        time-000-000-004(1),
                        time-000-000-003(2),
                        time-000-000-002(3),
                        time-000-000-001(4),
                        time-000-000-000-5(5),
                        time-000-000-000-4(6),
                        time-000-000-000-3(7),
                     }
   MAX-ACCESS  read-only
   STATUS      current
   DESCRIPTION
      "Absolute accuracy of the reported timing values in the SDU with a predefined confidence
       level, i.e. 95%"
::= { itsGnLTEV2X 1 }
```

History

Document history		
V1.1.1	August 2020	Publication