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Sub-part 3: Media-dependent functionalities for NR-V2X PC5 and LTE-V2X PC5;
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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 4, sub-part 1 [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 C-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 TS 103 836-4-1 [1]. The present document specifies media-dependent functionalities for GeoNetworking when using the ITS access technology C-V2X [2]. The specification in the present document should be regarded as C-V2X specific extensions of the GeoNetworking protocol specified in ETSI TS 103 836-4-1 [1] and does not represent a distinct protocol entity.

1 Scope

The present document specifies NR-V2X PC5 and LTE-V2X PC5 specific GeoNetworking requirements, including:

- fields of the GeoNetworking address;
- overall packet structure for NR-V2X PC5 and LTE-V2X PC5 access layer technology;
- packet handling.

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 TS 103 836-4-1: "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; Release 2".

[2] ETSI EN 303 798: "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".

[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 138 321: "5G; NR; Medium Access Control (MAC) protocol specification (3GPP TS 38.321 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 138 323: "5G; NR; Packet Data Convergence Protocol (PDCP) specification (3GPP TS 38.323 Release 16)".

[7] ETSI TS 124 386: "LTE; User Equipment (UE) to V2X control function; protocol aspects; Stage 3 (3GPP TS 24.386 Release 16)".

[8] ETSI TS 138 213: "5G; NR; Physical layer procedures for control (3GPP TS 38.213 Release 16)".

[9] 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)".

[10] ETSI TS 138 300: "5G; NR; NR and NG-RAN Overall description; Stage-2 (3GPP TS 38.300 Release 16)".

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 TS 102 723-8: "Intelligent Transport Systems (ITS); OSI cross-layer topics; Part 8: Interface between security entity and network and transport layer; Release 2".

[i.2] ETSI TS 136 322: "LTE; Evolved Universal Terrestrial Radio Access (E-UTRA); Radio Link Control (RLC) protocol specification (3GPP TS 36.322 Release 16)".

3 Definition of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms given in ETSI TS 103 836-4-1 [1] and ETSI EN 303 798 [2] apply.

3.2 Symbols

For the purposes of the present document, the symbols given in ETSI TS 103 836-4-1 [1] apply.

3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI TS 103 836-4-1 [1], ETSI EN 303 798 [2] and the following apply:

C-V2X	Cellular Vehicle-to-Everything (or Cellular-V2X)
GN	GeoNetworking
ITS-S	ITS Station
LTE-V2X	Long Term Evolution based Vehicle-to-Everything
MAC	Medium Access Control
MIB	Management Information Base
NR-V2X	New Radio (5th gen) Vehicle-to-Everything
PC5	Proximity-based Communication (Interface) 5
PDCP	Packet Data Convergence Protocol
PHY	PHYsical layer
PPPP	ProSe Per Packet Priority
SDU	Service Data Unit
SHB	Single Hop Broadcast
SHG	Single-Hop Groupcast
SHU	Single-Hop Unicast
SPS	Semi-Persistent Scheduling
TSG	Topologically-Scoped Groupcast
TSU	Topologically-Scoped Unicast
V2X	Vehicle-to-Everything

4 Overview

The present document specifies the media-dependent functionalities necessary to run the GeoNetworking protocol defined in ETSI TS 103 836-4-1 [1] over the LTE-V2X and NR-V2X access technologies defined in ETSI EN 303 798 [2]. The functionalities are:

- Addressing, data structure extensions and field settings in the GeoNetworking headers for LTE-V2X and NR-V2X, including extensions for improved synchronization: clause 5.
- General requirements: clause 6.
- Security and privacy requirements: clause 7.
- Forwarding algorithms: clause 8.

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

5.1 General

The Networking Services implementation using LTE-V2X and NR-V2X shall use access layer functionality for sidelink communication as defined in ETSI EN 303 798 [2].

5.2 GeoNetworking address

As specified in ETSI TS 103 836-4-1 [1], clause 6, every GeoAdhoc router shall have a unique GeoNetworking address and use the format in Figure 1.

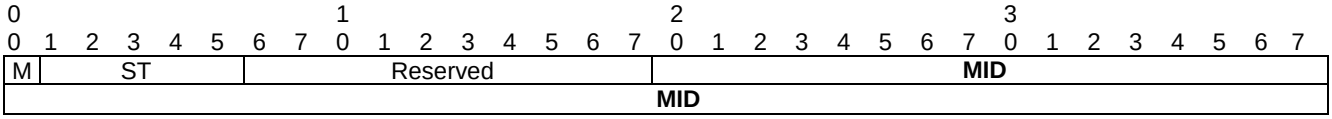

Figure 1: GeoNetworking address format as specified in ETSI TS 103 836-4-1 [1]

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 [3] and ETSI TS 138 321 [4], shall be used for Octets 2-4 of the MID field and Octets 5-7 shall be set to zero.

For broadcast, the Destination Layer 2 ID shall be set to all "1"s unless the facilities layer standard specifies otherwise.

For groupcast, the Destination Layer 2 ID is either a service-specific or a group-specific Destination Layer 2 ID:

- The service-specific Destination Layer 2 ID is defined by a relevant facilities layer standard, and it is used for both application layer connection-less groups (i.e. connection-less groupcast) and application layer managed groups (i.e. connection-oriented groupcast). The service-specific Destination Layer 2 ID shall be used for the entire procedure of application layer connection-less groups (i.e. connection-less groupcast), and for the group management procedure of application layer managed groups (i.e. connection-oriented groupcast).
- The group-specific Destination Layer 2 ID is used for application layer managed groups (i.e. connection-oriented groupcast) only, and it is selected by an instance of a relevant application via the group management procedure. The group-specific Destination Layer 2 ID shall be used for the following procedure of the group management procedure of application layer managed groups (i.e. connection-oriented groupcast).

NOTE: Groupcast is only supported by NR-V2X.

For unicast, the Destination Layer 2 ID is either a service-specific or a link-specific Destination Layer 2 ID:

- The service-specific Destination Layer 2 ID is defined by a relevant facilities layer standard. The service-specific Destination Layer 2 ID shall be used for the unicast link establishment procedure.
- The link-specific Destination Layer 2 ID is selected by an instance of a relevant application via the unicast link establishment. The link-specific Destination Layer 2 ID shall be used for the following procedure of the unicast link establishment procedure.

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 and NR-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 TS 103 836-4-1 [1], clause 9.7, the *Common Header* consists of the fields shown in Figure 2.

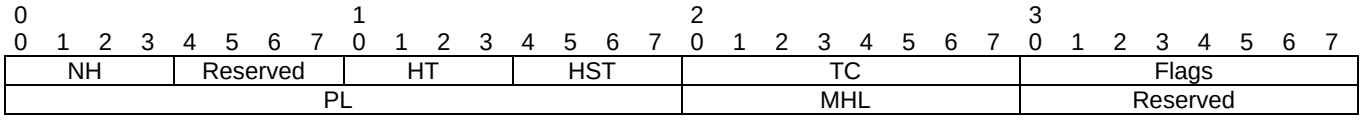

Figure 2: *Common Header* format as specified in ETSI TS 103 836-4-1 [1]

As specified in ETSI TS 103 836-4-1 [1], clauses 9.7.2 and 9.7.4, the *HT* and *HST* fields carry 4 bits respectively to identify the type and sub-type of the GeoNetworking header. The present document extends the *HT* and *HST* fields in Table 9 in ETSI TS 103 836-4-1 [1] for LTE-V2X and NR-V2X as shown in Table 1.

Table 1: Extension of GeoNetworking Header Types and Header Sub-Types

Header Type (HT)	Header Sub-Type (HST)	Encoding	Description
TSU		7	Topologically-Scoped Unicast (TSU)
	SINGLE_HOP	0	Single-Hop Unicast (SHU)
	MULTI_HOP	1	Multi-Hop TSU
TSG		8	Topologically-Scoped Groupcast (TSG)
	SINGLE_HOP	0	Single-Hop Groupcast (SHG)
	MULTI_HOP	1	Multi-Hop TSG
NOTE: See ETSI TS 103 836-4-1 [1], Table 9 for other HT or HST values.			

For non-geographic based single-hop transports, the *HT* and *HST* fields shall be set to SHB, SHG, and SHU for broadcast, groupcast and unicast respectively. SHU and SHG packet headers shall be identical to the SHB packet header as defined in clause 9.8.4 of ETSI TS 103 836-4-1 [1] and the extensions defined in clause 5.3.3 of the present document.

The Traffic Class Identifier (TC ID) is transmitted in the *TC* field. As specified in ETSI TS 103 836-4-1 [1], clauses 9.7.2 and 9.7.5, the *TC* field consists of three sub-fields, i.e. SCF, Reserved and TC ID (see Table 2).

Table 2: *TC* field in the Common Header

Field #	Field name	Octet/bit position		Type	Unit	Description
		First	Last			
1-4	See ETSI TS 103 836-4-1 [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: **Reserved** Bit 2 to Bit 7: **TC ID** TC ID as specified in the present document.
6-9	See ETSI TS 103 836-4-1 [1], Table 4.					

The mapping between TC ID and Priority is specified in Table 3.

Table 3: Mapping between TC ID and Priority (PPPP)

TC ID	PPPP
0	1
1	2
2	3
3	4
4	5
5	6
6	7
7	8
NOTE: Mapping between TC ID values and messages are specified in profile standards.	

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

As specified in ETSI TS 103 836-4-1 [1], clause 9.8.4, the SHB header consists of the fields shown in Figure 3.

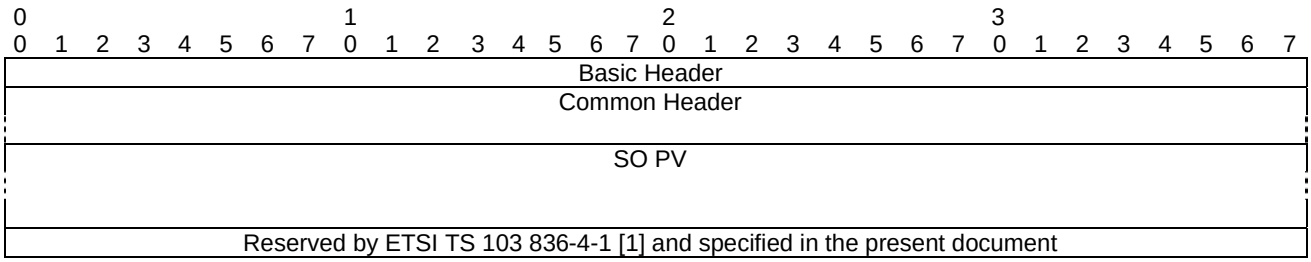

Figure 3: The SHB packet header format as specified in ETSI TS 103 836-4-1 [1]

The SHB packet header carries a 4-byte, reserved field for media-dependent functionality as shown in Figure 3. The present document replaces a part of the field *Reserved* in Table 13 in ETSI TS 103 836-4-1 [1] with the field *Version* (see Table 4). The fields of *Version* and *Media-dependent data* shall be encoded as shown in Table 4 and Table 5.

Table 4: Fields of the SHB packet header

Field #	Field name	Octet/bit position		Type	Unit	Description
		First	Last			
1-3	See ETSI TS 103 836-4-1 [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 5.
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.

Table 5: *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 6 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 4 and Table 5.

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 6.

Table 6: *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.		

5.4 Interface and primitive parameters

For LTE-V2X and NR-V2X, in addition to the GN data service primitives described in ETSI TS 103 836-4-1 [1], additional parameters are needed to be passed to the access layer. For the unicast and groupcast, the destination ID should be passed to the access layer.

For the groupcast for an application layer connection-less group (i.e. connection-less groupcast), QoS range should be also passed to the access layer. For the groupcast for an application layer managed group (i.e. connection-oriented groupcast), the member ID and group size should be passed to the access layer. The additional parameters to the GN-DATA.request described in ETSI TS 103 836-4-1 [1] are as follows:

```
GN-DATA.request (
            ...
            Destination L2ID,
            Group size,     (optional)
            Member ID List, (optional)
            QoS range       (optional)
            )
```

The *Destination L2ID* parameter indicates a service-specific Destination Layer 2 ID, a group-specific Destination Layer 2 ID, or a link-specific Destination Layer 2 ID as described in clause 5.2. The *Destination L2ID* parameter is a bit string of 24-bit.

The *Group size* and *Member ID List* parameters are provided only for the connection-oriented groupcast. The *Group size* parameter identifies the number of members of an application layer managed group and it is an integer value. The *Member ID List* parameter is a list of *Member ID*s. The *Member ID* is an identifier uniquely identifying a member of an application layer managed group and that is managed by the application or facilities layer.

The *QoS range* parameter specifies a range value of the connection-less groupcast, and is only provided for the connection-less groupcast. It is in the unit of meters.

6 General Requirements

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 [5] and ETSI TS 138 323 [6] 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 [7] and shall be set to value 0b00000011 for the ETSI-ITS stack.

For each MAC PDU transmission from an ITS Station via LTE-V2X, the V field of the MAC header as defined in ETSI TS 136 321 [3] 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.2].

For each MAC PDU transmission from an ITS Station via NR-V2X, the MAC subheader shall conform to the ETSI TS 138 321 [4] and the corresponding PHY procedures shall conform to the ETSI TS 138 213 [8].

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 [7].

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 requirements

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 [3], ETSI TS 138 321 [4], ETSI TS 136 300 [9], clause 23.14 and ETSI TS 138 300 [10].

When `itsGnLocalAddrConfMethod` is set to ANONYMOUS, the GeoNetworking protocol subscribes to the *IDCHANGE-SUBSCRIBE* service at the security entity (ETSI TS 136 321 [3], ETSI TS 138 321 [4] and ETSI TS 102 723-8 [i.1]). 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

The following applies to NR-V2X and LTE-V2X.

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 TS 103 836-4-1 [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 TS 103 836-4-1 [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 and NR-V2X

The GeoNetworking protocol constants as specified in ETSI TS 103 836-4-1 [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 and NR-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 TS 103 836-4-1 [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 }
   itsGnNRV2X            OBJECT IDENTIFIER ::= { itsGnMgmt 8 }


-- ****************************************************************************
-- * 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 }

-- ****************************************************************************
-- * GN NR-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%"
::= { itsGnNRV2X 1 }
```

History

Document history		
V2.1.1	October 2023	Publication