# ETSI EN 302 636-4-1 V1.4.1 (2020-01)

**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**

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# Foreword

This European Standard (EN) has been produced by ETSI Technical Committee Intelligent Transport Systems (ITS).

The present document is part 4, sub-part 1 of a multi-part deliverable. Full details of the entire series can be found in part 1 [2].

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# Modal verbs terminology

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# Introduction

The GeoNetworking protocol is a network layer 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 stations 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 and infrared. The ITS access technologies for short-range wireless technologies have many technical commonalities, but also differences. 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 functionalities are those which are common to all ITS access technologies for short-range wireless communication to be used for GeoNetworking. The media-dependent functionalities extend the media-independent functionality for a specific ITS access technology. Therefore, the GeoNetworking protocol specification consists of the standard for media-independent functionality and at least one standard for media-dependent functionality. However, it should be noted that the media-dependent extensions do not represent distinct protocol entities.

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# 1 Scope

The present document specifies the media-independent functionality of the GeoNetworking protocol.

# 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 EN 302 665 (V1.1.1): "Intelligent Transport Systems (ITS); Communications Architecture".

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

[3] ETSI EN 302 636-2 (V1.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 2: Scenarios".

[4] ETSI EN 302 636-3 (V1.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 3: Network architecture".

[5] Void.

[6] ETSI EN 302 636-5-1 (V1.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 5: Transport Protocols; Sub-part 1: Basic Transport Protocol".

[7] ETSI EN 302 636-6-1 (V1.2.1): "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 6: Internet Integration; Sub-part 1: Transmission of IPv6 Packets over GeoNetworking Protocols".

[8] ETSI EN 302 931 (V1.1.1): "Intelligent Transport Systems (ITS); Vehicular Communications; Geographical Area Definition".

[9] ETSI TS 102 731: "Intelligent Transport Systems (ITS); Security; Security Services and Architecture".

[10] ETSI TS 103 097: "Intelligent Transport Systems (ITS); Security; Security header and certificate formats".

[11] ETSI TS 102 894-2: "Intelligent Transport Systems (ITS); Users and applications requirements; Part 2: Applications and facilities layer common data dictionary".

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[i.1] Void.

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

[i.3] ETSI TS 102 940: "Intelligent Transport Systems (ITS); Security; ITS communications security architecture and security management".

[i.4] Void.

[i.5] IETF RFC 2578: "Structure of Management Information Version 2 (SMIv2)".

[i.6] National Imagery and Mapping Agency (NIMA), US Department of Defense: "World Geodetic System 1984 - Its Definition and Relation with Local Geodetic Systems", Third Edition - Amendment 1, NIMA TR 8350.2.

[i.7] IETF RFC 2579: "Textual Conventions for SMIv2".

[i.8] IEEE 802.3:2008™: "IEEE Standard for Information Technology - Telecommunications and information exchange between systems-Local and metropolitan area networks - Specific requirements - Part 3: Carrier Sense Multiple Access with Collision Detection (CSMA/CD) Access Method and Physical Layer Specifications".

[i.9] ETSI TS 102 965: "Intelligent Transport Systems (ITS); Application Object Identifier (ITS-AID); Registration".

[i.10] ETSI TS 103 613: "Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems using LTE Vehicle to everything communication in the 5,9 GHz frequency band".

[i.11] ETSI TS 102 636-4-2: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 2: Media-dependent functionalities for ITS-G5".

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# 3 Definition of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in ETSI EN 302 665 [1], ETSI EN 302 636-3 [4], ETSI EN 302 636-6-1 [7] and the following apply:

**destination:** receiver that processes a packet and delivers it to upper protocol entities, but does not relay the packet to other GeoAdhoc routers

**forwarder:** GeoAdhoc router that processes a packet and relays it to other GeoAdhoc routers

**GeoAdhoc router:** ad hoc router that implements the GeoNetworking protocol

**local position vector:** position vector for the local GeoAdhoc router

**media dependent procedures:** packet handling steps that are specific to the access layer technology over which the GeoNetworking packet will be transmitted

**neighbour:** GeoAdhoc router in direct (single-hop) communication range

**packet:** GeoNetworking PDU

**packet transport type:** method of handling GeoNetworking packets

**position accuracy indicator:** binary that indicates whether a position is within a specific confidence interval

**position vector:** position information of a GeoAdhoc router represented by a tuple of address, timestamp, geographical position, speed, heading and corresponding accuracy information

**receiver:** GeoAdhoc router that processes a packet, delivers its data to upper protocol entities

**sender:** GeoAdhoc router that has sent the GeoNetworking packet

**source:** GeoAdhoc router that originates a GeoNetworking packet

**traffic class:** identifier assigned to a GeoNetworking packet that expresses its requirements on data transport

## 3.2 Symbols

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

| | |
|---|---|
| GEO_MAX | Maximum size of the GeoNetworking packet header |
| H(GN_ADDR) | Heading of the ITS-S GN_ADDR |
| LAT | Latitude |
| LL_ADDR | Link layer address that identifies the ITS-S at the link layer protocol entity in the ITS Access Layer |
| LL_ADDR_NH | Link layer address of the next hop |
| LONG | Longitude |
| LS_PENDING | Location Service pending flag |
| MTU_AL | MTU of the ITS Access Layer |
| PAI(POS, GN_ADDR) | Position accuracy indicator for geographical position POS of the ITS-S GN_ADDR |
| PDR(GN_ADDR) | Packet data rate (exponential moving average) |
| POS(GN_ADDR) | Geographical position of the ITS-S GN_ADDR |
| PV(GN_ADDR) | Position vector of the ITS-S GN_ADDR |
| RAND[x,y] | Function that returns a random (integer) number from a uniform distribution in the given interval [x,y] |
| S(GN_ADDR) | Speed of the ITS-S GN_ADDR |
| SN_MAX | Largest possible value of the sequence number |
| SN(P) | Value of the sequence number field carried in a GeoNetworking packet |
| T(LocTE) | Lifetime of an entry in the location table |
| TO_CBF_MIN | Timeout; minimum duration a packet is buffered in the CBF cache |
| TO_CBF_MAX | Timeout; maximum duration a packet is buffered in the CBF cache |
| TST(GN_ADDR) | Last timestamp received from a GeoAdhoc router |
| TST(P) | Value of the timestamp field carried in a GeoNetworking packet |
| TST(TAI) | Number of elapsed TAI milliseconds since 2004-01-01 00:00:00.000 UTC |

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in ETSI EN 302 665 [1], ETSI EN 302 636-3 [4], ETSI EN 302 636-6-1 [7] and the following apply:

| | |
|---|---|
| ASN | Abstract Syntax Notation |
| BC | BroadCast |
| BTP | Basic Transport Protocol |
| CBF | Contention-Based Forwarding |
| DAD | Duplicate Address Detection |
| DE | Destination |

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| | |
|---|---|
| DPC | Duplicate Packet Counter |
| DPL | Duplicate Packet List |
| DPD | Duplicate Packet Detection |
| EMA | Exponential Moving Average |
| EPV | Ego Position Vector |
| FIFO | First In First Out |
| GAC | Geographically-Scoped Anycast |
| GBC | Geographically-Scoped Broadcast |
| GF | Greedy Forwarding |
| GN | GeoNetworking |
| GN_ADDR | GeoNetworking ADDRess |
| GN6ASL | GeoNetworking to IPv6 Adaptation Sub-Layer |
| GN6-SDU | GN6 Service Data Unit |
| GN-PDU | GeoNetworking Protocol Data Unit |
| GN-SDU | GeoNetworking Service Data Unit |
| GUC | Geographically-Scoped Unicast |
| HST | Header Sub-Type |
| HT | Header Type |
| LL | Link Layer |
| LocT | Location Table |
| LocTE | Location Table Entry |
| LPV | Local Position Vector |
| LS | Location Service |
| LT | LifeTime |
| LTE | Long Term Evolution |
| MAC | Medium Access Control |
| MFR | Most Forward within Radius |
| MHL | Maximum Hop Limit |
| MHVB | Multi-Hop Vehicular Broadcast |
| MIB | Management Information Base |
| MID | MAC ID |
| MTU | Maximum Transmit Unit |
| NH | Next Header |
| PAI | Position Accuracy Indicator |
| PCI | Protocol Control Information |
| PDR | Packet Data Rate |
| PDU | Protocol Data Unit |
| PL | Payload Length |
| POS | POSition |
| PV | Position Vector |
| RHL | Remaining Hop Limit |
| RTC | Retransmit Counter |
| SCF | Store Carry & Forward |
| SDU | Service Data Unit |
| SE | SEnder |
| SHB | Single Hop Broadcast |
| SN | Sequence Number |
| SO | SOurce |
| SPV | Short Position Vector |
| SSP | Service Specific Permissions |
| ST | Station Type |
| TAI | Temps Atomique International (International Atomic Time) |
| TC | Traffic Class |
| TC ID | Traffic Class Identifier |
| TSB | Topologically Scoped Broadcast |
| T-SDU | Transport Service Data Unit |
| TST | TimeSTamp |
| UC | UniCast |
| V2X | Vehicle-to-Everything |
| UTC | Universal Time Coordinated |
| WGS | World Geodetic System |

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# 4 Services provided by the GeoNetworking protocol

The GeoNetworking protocol is a network protocol that resides in the ITS networking & transport layer. It shall meet the requirements as specified in ETSI EN 302 665 [1]. It is executed in the ad hoc router (ETSI EN 302 636-3 [4]), specifically in the GeoAdhoc router. It provides the transport of packets in the ITS ad hoc network (ETSI EN 302 636-3 [4]). It shall support the requirements specified in ETSI EN 302 636-1 [2] and the scenarios specified in ETSI EN 302 636-2 [3].

The GeoNetworking protocol provides services to upper protocol entities, i.e. the ITS Transport Protocol, such as the Basic Transport Protocol (BTP) as specified in ETSI EN 302 636-5-1 [6], and the GeoNetworking to IPv6 Adaptation Sub-Layer (GN6ASL) as specified in ETSI EN 302 636-6-1 [7]. The services are provided via the GN_SAP using service primitives of different types that carry parameters and the PDU of the upper protocol entity, i.e. T/GN6 PDU (see figure 1). A PDU of the transport protocols is considered as SDU in the GeoNetworking protocol. The SDU is complemented with Protocol Control Information (PCI) and transmitted as GN PDU to the peer entity.

In order to provide its packet transport services, the GeoNetworking protocol uses the services of the ITS Access Layer.

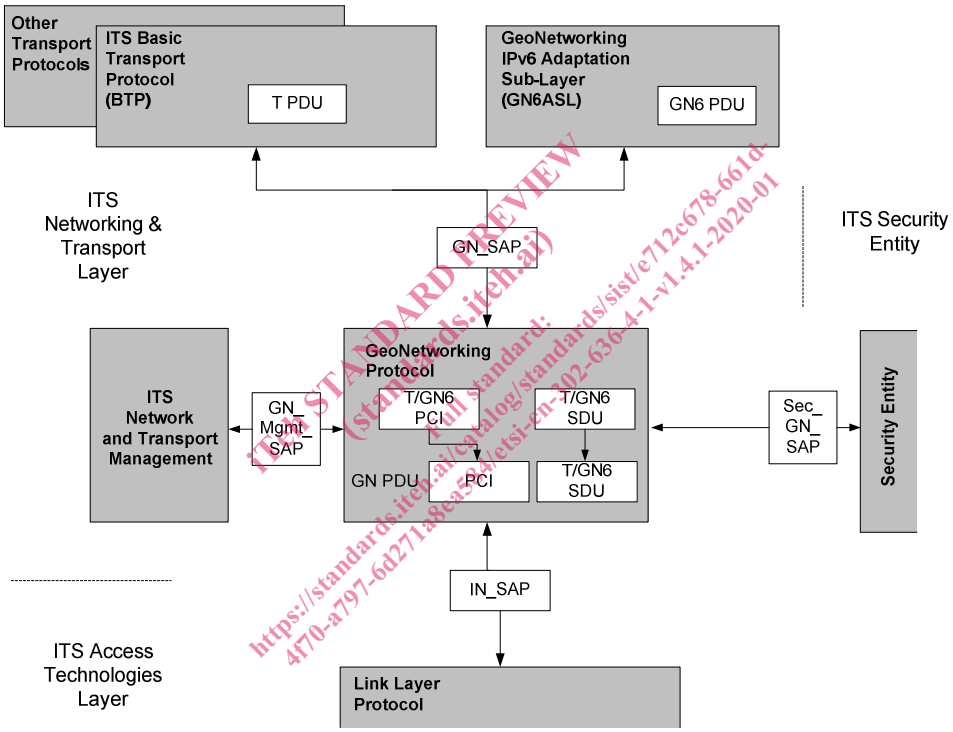


**Figure 1: Service primitives, SDUs and PDUs relevant for the GeoNetworking protocol**

Figure 1 illustrates the interfaces and SAPs of the ITS networking & transport layer as specified in ETSI EN 302 636-3 [4]. The present document specifies the internal GN_SAP between the GeoNetworking protocol and the ITS transport protocol, such as the Basic Transport Protocol (BTP) as specified in ETSI EN 302 636-5-1 [6], the GeoNetworking IPv6 Adaptation Sub-Layer (GN6ASL) as defined in ETSI EN 302 636-6-1 [7] and other transport protocols, the GN_Mgmt_SAP between the GeoNetworking protocol and the *ITS Networking & Transport Layer Management*, as well as the Sec_GN_SAP between the GeoNetworking protocol and the ITS Security.

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Full standard:
https://standards.iteh.ai/catalog/standards/sist/e712c678-661d-4f70-a797-6d271a8ea534/etsi-en-302-636-4-1-v1.4.1-2020-01