SLOVENSKI STANDARD
SIST EN 302 636-4-1 V1.3.1:2017

01-oktober-2017

Inteligentni transportni sistemi (ITS) - Komunikacije med vozili - Geomreženje - 4. del: Geografsko naslavljanje in podajanje pri komunikacijah točka-točka in točka-več točk - 1. poddel: Medijsko neodvisna funkcionalnost

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

Ta slovenski standard je istoveten z: ETSI EN 302 636-4-1 V1.3.1 (2017-08)

ICS:

35.240.60	Uporabniške rešitve IT v prometu	IT applications in transport

SIST EN 302 636-4-1 V1.3.1:2017 en

ETSI EN 302 636-4-1 V1.3.1 (2017-08)

Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media-Independent Functionality

Reference
REN/ITS-00349

Keywords
autonomic networking, ITS, network, safety

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Contents

Intellectual Property Rights 7

Foreword 7

Modal verbs terminology 7

Introduction 8

1 Scope 9

2 References 9
2.1 Normative references 9
2.2 Informative references 10

3 Definitions, symbols and abbreviations 10
3.1 Definitions 10
3.2 Symbols 11
3.3 Abbreviations 11

4 Services provided by the GeoNetworking protocol 12

5 Format convention 13

6 GeoNetworking address 14
6.1 General 14
6.2 GeoNetworking address format 14
6.3 Fields of the GeoNetworking address 15

7 Security and privacy 15

8 Data structures 16
8.1 Location table 16
8.1.1 General 16
8.1.2 Minimum data elements of a *Location Table Entry* 16
8.1.3 Maintenance of the Location Table 17
8.2 Ego Position Vector 17
8.2.1 General 17
8.2.2 Minimum data elements 17
8.2.3 Maintenance 17
8.3 Sequence number 17
8.3.1 General 17
8.3.2 Maintenance 18
8.4 Location service packet buffer 18
8.4.1 General 18
8.4.2 Buffer size 18
8.4.3 Maintenance 18
8.5 Forwarding packet buffer 19
8.5.1 General 19
8.5.2 Buffer size 19
8.5.3 Maintenance 19

9 GeoNetworking packet structure and formats 20
9.1 Overview 20
9.2 Packet structure 20
9.2.1 General 20
9.2.2 Overall packet structure 20
9.2.3 Maximum Transmit Unit 21
9.3 GeoNetworking header structure 21
9.4 GeoNetworking *Secured Packet* 21
9.5 Position vectors 21
9.5.1 Overview 21
9.5.2 *Long Position Vector* 22
9.5.2.1 Structure 22

9.5.2.2 Fields 22
9.5.3 *Short Position Vector* 22
9.5.3.1 Structure 22
9.5.3.2 Fields 23
9.6 *Basic Header* 23
9.6.1 Composition of the *Basic Header* 23
9.6.2 Fields of the *Basic Header* 24
9.6.3 Encoding of the *NH* field in the *Basic Header* 24
9.6.4 Encoding of the LT field 24
9.7 *Common Header* 25
9.7.1 Composition of the *Common Header* 25
9.7.2 Fields of the *Common Header* 25
9.7.3 Encoding of the *NH* field in the *Common Header* 26
9.7.4 Encoding of the *HT* and *HST* fields 26
9.7.5 Encoding of the *TC* field 27
9.8 GeoNetworking packet header types 27
9.8.1 Overview 27
9.8.2 GUC packet header 27
9.8.2.1 Composition of the GUC packet header 27
9.8.2.2 Fields of the GUC packet header 28
9.8.3 TSB packet header 28
9.8.3.1 Composition of the TSB packet header 28
9.8.3.2 Fields of the TSB packet header 29
9.8.4 SHB packet header 29
9.8.4.1 Composition of the SHB packet header 29
9.8.4.2 Fields of the SHB packet header 30
9.8.5 GBC/GAC packet header 30
9.8.5.1 Composition of the GBC/GAC packet header 30
9.8.5.2 Fields of the GBC/GAC packet header 31
9.8.6 BEACON packet header 31
9.8.6.1 Composition of the BEACON packet header 31
9.8.6.2 Fields of the BEACON packet header 32
9.8.7 LS Request packet header 32
9.9.7.1 Composition of the LS Request packet header 32
9.8.7.2 Fields of the LS Request packet header 33
9.8.8 LS Reply packet header 33
9.8.8.1 Composition of the LS Reply packet header 33
9.8.8.2 Fields of the LS Reply packet header 34

10 Protocol operation 34
10.1 General 34
10.2 Network management 35
10.2.1 Address configuration 35
10.2.1.1 General 35
10.2.1.2 Auto-address configuration 35
10.2.1.3 Managed address configuration 35
10.2.1.3.1 General Requirements 35
10.2.1.3.2 Initial address configuration 35
10.2.1.3.3 Address update 35
10.2.1.4 Anonymous address configuration 36
10.2.1.5 Duplicate address detection 36
10.2.2 Ego position vector and time update 37
10.2.2.1 Overview 37
10.2.2.2 Ego Position Vector update 37
10.2.2.3 Time update 37
10.2.3 Beaconing 37
10.2.4 Location service 37
10.3 Packet handling 38
10.3.1 Overview 38
10.3.2 *Basic Header* field settings 39
10.3.3 *Basic Header* processing 39
10.3.4 *Common Header* field settings 41

10.3.5 *Common Header* processing 42
10.3.6 Beacon packet handling 42
10.3.6.1 General 42
10.3.6.2 Source operations 42
10.3.6.3 Receiver operations 44
10.3.7 Location service packet handling 44
10.3.7.1 Source operations 44
10.3.7.1.1 Overview 44
10.3.7.1.2 Operation for initial LS Request 44
10.3.7.1.3 Operation for LS Request re-transmission 45
10.3.7.1.4 Operation for LS Reply 46
10.3.7.2 Forwarder operations 46
10.3.7.3 Destination operations 46
10.3.8 GUC packet handling 48
10.3.8.1 General 48
10.3.8.2 Source operations 48
10.3.8.3 Forwarder operations 50
10.3.8.4 Destination operations 51
10.3.9 TSB packet handling 52
10.3.9.1 General 52
10.3.9.2 Source operations 53
10.3.9.3 Forwarder and receiver operations 54
10.3.10 SHB packet handling 56
10.3.10.1 General 56
10.3.10.2 Source operations 56
10.3.10.3 Receiver operations 57
10.3.11 GBC packet handling 58
10.3.11.1 General 58
10.3.11.2 Source operations 58
10.3.11.3 Forwarder and receiver operations 60
10.3.12 GAC packet handling 62
10.3.12.1 General 62
10.3.12.2 Source operations 62
10.3.12.3 Forwarder and receiver operations 62

Annex A (normative): Duplicate packet detection 64

A.1 General 64

A.2 SN-based duplicate packet detection 64

Annex B (normative): Packet data rate and geographical area size control 65

B.1 Overview 65

B.2 Packet data rate control 65

B.3 Geographical area size control 65

Annex C (normative): Position vector update 66

C.1 Overview 66

C.2 Update of LocT position vector 66

C.3 Update of GeoNetworking packet position vector 67

Annex D (normative): GeoNetworking forwarding algorithm selection procedure 68

Annex E (normative): Non-area forwarding algorithms 69

E.1 Overview 69

E.2 Greedy forwarding algorithm 69

E.3 Non-area contention-based forwarding algorithm 70

Annex F (normative): Area forwarding algorithms 73
F.1 Overview 73
F.2 Simple GeoBroadcast forwarding algorithm 73
F.3 Area contention-based forwarding algorithm 73
F.4 Area advanced forwarding algorithm 76
Annex G (normative): GeoNetworking traffic classification 81
Annex H (normative): GeoNetworking protocol constants 82
Annex I (informative): ASN.1 encoding of the GeoNetworking MIB 84
I.1 Use of modules 84
I.2 ASN.1 module 84
Annex J (informative): GeoNetworking data services 91
J.1 General 91
J.2 *GN-DATA.request* 91
J.3 *GN-DATA.confirm* 92
J.4 *GN-DATA.indication* 92
Annex K (informative): GeoNetworking management services 94
K.1 General 94
K.2 *GN-MGMT.request* 94
K.3 *GN-MGMT.response* 94
Annex L (informative): Interface to the Security entity 95
L.1 Security services used by the GeoNetworking protocol 95
Annex M (informative): Bibliography 96
History 97

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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].

National transposition dates	
Date of adoption of this EN:	21 August 2017
Date of latest announcement of this EN (doa):	30 November 2017
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	31 May 2018
Date of withdrawal of any conflicting National Standard (dow):	31 May 2018

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.

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] 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".

[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".

2.2 Informative references

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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 302 663: "Intelligent Transport Systems (ITS); Access layer specification for Intelligent Transport Systems operating in the 5 GHz frequency band".

[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] ISO/IEC 8802-2:1998: "Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Specific requirements - Part 2: Logical link control".

[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".

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions 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

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
DPC	Duplicate Packet Counter
DPL	Duplicate Packet List
DPD	Duplicate Packet Detection
EMA	Exponential Moving Average
EPV	Ego Position Vector
FCS	Frame Check Sequence
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
LLC	Logic Link Control
LocT	Location Table
LocTE	Location Table Entry
LPV	Local Position Vector
LS	Location Service
LT	LifeTime
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
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
UTC	Universal Time Coordinated
WGS	World Geodetic System

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.

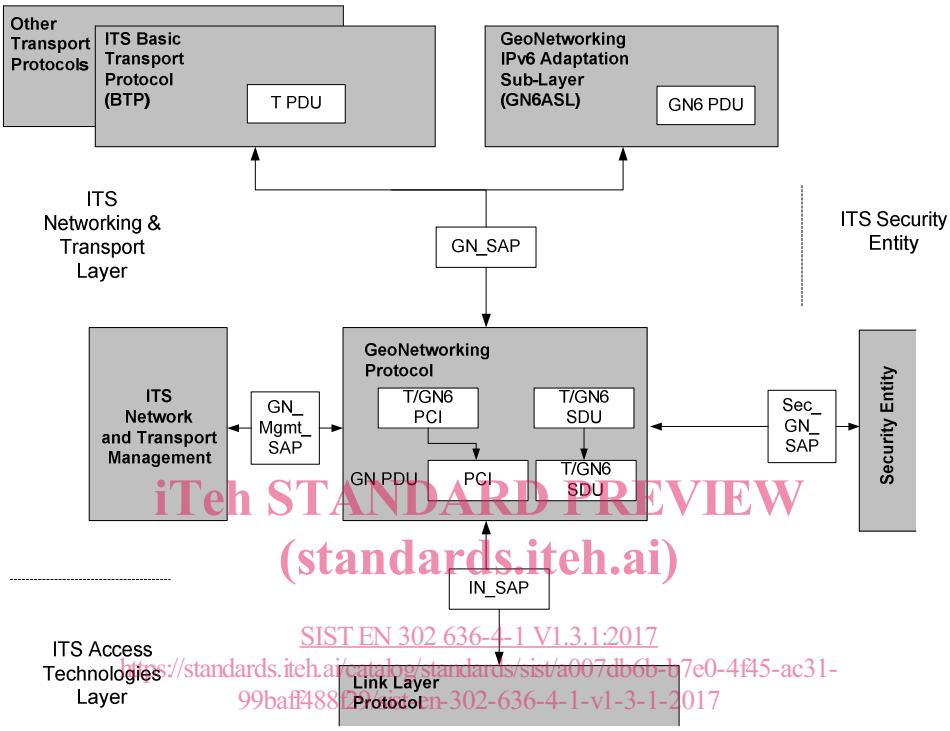

Figure 1: Service primitives, SDUs and PDUs relevant for the GeoNetworking protocol

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.

5 Format convention

The basic convention for the specification of packet formats is illustrated in figure 2. The bits are grouped into octets. The bits of an octet are always shown horizontally and are numbered from 0 to 7. Up to 4 octets are shown horizontally; multiple sets of 4 octets are grouped vertically. Octets are numbered from 0 to N-1.

0								1								2								3							
0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7	0	1	2	3	4	5	6	7
Octet 0								Octet 1								Octet 2								Octet 3							
Octet 4 to Octet 7																															
…																								Octet N-1							

Figure 2: Format convention