ETSI EN 302 636-6-1 V1.2.1 (2014-05)

Intelligent Transport Systems (ITS);
Vehicular Communications;
GeoNetworking;
Part 6: Internet Integration;
Sub-part 1: Transmission of IPv6 Packets over GeoNetworking Protocols

Reference

REN/ITS-0030037

Keywords

addressing, Autonomic Networking, IPv6, ITS, network, protocol

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 - NAF 742 C
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

The present document can be downloaded from:
http://www.etsi.org

The present document may be made available in electronic versions and/or in print. The content of any electronic and/or print versions of the present document shall not be modified without the prior written authorization of ETSI. In case of any existing or perceived difference in contents between such versions and/or in print, the only prevailing document is the print of the Portable Document Format (PDF) version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, please send your comment to one of the following services:
http://portal.etsi.org/chaircor/ETSI_support.asp

Copyright Notification

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://ipr.etsi.org).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

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

The present document is part 6, sub-part 1 of a multi-part deliverable. Full details of the entire series can be found in ETSI EN 302 636-1 [3].

National transposition dates	
Date of adoption of this EN:	3 February 2014
Date of latest announcement of this EN (doa):	31 May 2014
Date of latest publication of new National Standard or endorsement of this EN (dop/e):	30 November 2014
Date of withdrawal of any conflicting National Standard (dow):	30 November 2015

Introduction

The ETSI GeoNetworking protocol as defined in ETSI EN 302 636-4-1 [7] and given in ETSI TS 102 636-4-2 [i.23] is a non-IP network-layer protocol that provides geographic addressing and forwarding and belongs to the position-based routing protocols category. Applications and facilities specifically designed for GeoNetworking exploit these functionalities, for example to disseminate warning or generic information messages to geographically scoped areas. The GeoNetworking protocol satisfies the requirements of several ITS services, whose application domain is limited to networks that are disconnected from large existing network infrastructures. However, several ITS applications require the integration of ITS stations with larger networks such as private transport networks or the Internet.

In order to connect networks based on GeoNetworking to networks running the Internet Protocol (IP), which represent the majority of currently deployed large networks, it is necessary to allow GeoNetworking ITS stations to act like Internet hosts or routers. The ETSI Technical Committee ITS recognizes IP version 6 as defined in IETF RFC 2460 [8] as the primary version of IP to be necessarily supported by ITS stations.

The present document introduces a set of mechanisms that allow the GeoNetworking protocol to transport IPv6 packets without introducing modifications to existing IPv6 protocol implementations. By deploying these mechanisms, the following two main advantages are achieved:

1) coverage offered by points-of-attachment to the Internet, such as road-side ITS stations, is extended by means of sub-IP geographic routing; and

2) IPv6 multicast traffic can be geocasted, i.e. addressed and delivered to all ITS stations currently located within a geographic area.

The present document includes a data SAP that enables an IPv6 protocol entity to send and receive packets over the GeoNetworking protocol. This SAP is described in the informative annex C. The present document does not include a management SAP towards the ITS station management entity.

NOTE: In the reminder of the present document, when the sole term "GeoNetworking" is used, it is to be regarded as the ETSI GeoNetworking protocol combining the media-independent part outlined in ETSI EN 302 636-4-1 [7] and at least one of the media-dependent parts (such as ETSI TS 102 636-4-2 [i.23]). It should be noted that the media-dependent extensions do not represent distinct protocol layers.

1 Scope

The present document specifies the transmission of IPv6 packets over the ETSI GeoNetworking protocol as defined in ETSI EN 302 636-4-1 [7] via a protocol adaptation sub-layer referred to as the GN6ASL (GeoNetworking to IPv6 Adaptation Sub-Layer). The scope of the present document is limited to the GN6ASL.

The techniques specified in the present document fulfil the requirements for GeoNetworking and IPv6 integration described in ETSI EN 302 636-1 [3]. In particular, these techniques allow for the transport of IPv6 packets by ETSI GeoNetworking protocol given in ETSI EN 302 636-4-1 [7], enabling sub-IP multi-hop delivery of IPv6 packets, e.g. in a vehicular network. As a result, the connectivity provided by points-of-attachment to IPv6 infrastructure networks is extended by means of mobile relay nodes. In addition to that, the techniques described in the present document allow for geocasting of IPv6 multicast packets.

The scope of the GN6ASL is limited to the fulfilment of the requirements for GeoNetworking and IPv6 integration described in ETSI EN 302 636-1 [3], clause 5.9, by enabling an ITS station including a GeoAdhoc router as given in ETSI EN 302 636-4-1 [7] running the GeoNetworking protocol and an IPv6-compliant protocol layer to:

- exchange IPv6 packets with other ITS stations;
- acquire globally routable IPv6 unicast addresses and communicate with an arbitrary IPv6 host located in the Internet, whenever an ITS station including a GeoAdhoc router and including or connected to an access router [5] providing IPv6 connectivity to the Internet is reachable directly or via other relay ITS stations;
- perform the operations required by IETF RFC 3963 [14] for a Mobile Router whenever:
    a) an ITS mobile router supporting Network Mobility Basic Support (NEMO BS) as defined in IETF RFC 3963 [14] is present in the ITS station and runs on top of the GN6ASL; and
    b) an ITS station including a GeoAdhoc router and including or connected to an access router as defined in ETSI TS 102 636-3 [5] providing IPv6 connectivity to the Internet is reachable directly or via other relay ITS stations.

NOTE: The present document adopts the definition of "IPv6-compliant" and "sub-IP multi-hop delivery" introduced in clause 3.1.

Extending the IPv6 basic standards IETF RFC 2460 [8], IETF RFC 4291 [9], IETF RFC 4007 [10], IETF RFC 4861 [11] and IETF RFC 4862 [13] to support new features is outside the scope of the present document. Extensions to NEMO BS as given in IETF RFC 3963 [14] are outside the scope of the present document. Mechanisms for the dissemination of IPv6 routing information for hosts and routers not directly attaching to the network where GeoNetworking is used are outside the scope of the present document (e.g. discovery of IPv6 in-vehicle prefixes). However, the present document aims at providing the underlying support for the dissemination of such routing information, i.e. IPv6 multicast support for the network where the GeoNetworking protocol is used.

With respect to IPv6 multicast and anycast support, the present document is limited to the support required to enable distribution of IPv6 multicast and anycast traffic on a shared link. Amendments to specific IPv6 multicast forwarding mechanisms are out of the scope of the present document. However, the present document aims at not preventing existing IPv6 multicast forwarding mechanisms from being used in conjunction with the GN6ASL.

In order to facilitate the deployment of ITS systems, the present document aims at maintaining backward compatibility with pre-existent IPv6-compliant protocol implementations and NEMO BS implementations compliant with IETF RFC 3963 [14]. A usage example of NEMO BS with the GN6ASL is presented in the informative annex F.

The mechanisms specified in the present document are distinct from but compatible with the IPv6-related functionalities given in ISO 21210-2010 [i.20], which specifies how IPv6 networking is generally operated in ITS stations. The techniques described in the present document provide a way to transport IPv6 packets that is fully compatible with the IPv6 specifications and pre-existing implementations, and hence is compatible with ISO 21210-2010 [i.20].

2 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 reference document (including any amendments) applies.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbo0x.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.

2.1 Normative references

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

[1] ETSI EN 302 665: "Intelligent Transport Systems (ITS); Communications Architecture".

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

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

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

[5] ETSI TS 102 636-3: "Intelligent Transport Systems (ITS); Vehicular Communications; GeoNetworking; Part 3: Network architecture".

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

[7] ETSI EN 302 636-4-1: "Intelligent Transport System (ITS); Vehicular communications; GeoNetworking; Part 4: Geographical addressing and forwarding for point-to-point and point-to-multipoint communications; Sub-part 1: Media independent functionalities".

[8] IETF RFC 2460: "Internet Protocol, Version 6 (IPv6) Specification".

[9] IETF RFC 4291: "IP Version 6 (IPv6) Addressing Architecture".

[10] IETF RFC 4007: "IPv6 Scoped Address Architecture".

[11] IETF RFC 4861: "Neighbor Discovery for IP version 6 (IPv6)".

[12] IETF RFC 5942: "IPv6 Subnet Model: The Relationship between Links and Subnet Prefixes".

[13] IETF RFC 4862: "IPv6 Stateless Address Autoconfiguration".

[14] IETF RFC 3963: "Network Mobility (NEMO) Basic Support Protocol".

[15] IETF RFC 6724: "Default Address Selection for Internet Protocol version 6 (IPv6)".

[16] IETF RFC 2464: "Transmission of IPv6 Packets over Ethernet Networks".

[17] IETF RFC 5072: "IP Version 6 over PPP".

[18] IETF RFC 3810: "Multicast Listener Discovery Version 2 (MLDv2) for IPv6".

[19] IETF RFC 4601: "Protocol Independent Multicast - Sparse Mode (PIM-SM): Protocol Specification (Revised)".

[20] IETF RFC 4605: "Internet Group Management Protocol (IGMP) / Multicast Listener Discovery (MLD)-Based Multicast Forwarding ("IGMP/MLD Proxying")".

[21] IETF RFC 3306: "Unicast-Prefix-based IPv6 Multicast Addresses".

[22] IETF RFC 2022: "Support for Multicast over UNI 3.0/3.1 based ATM Networks".

[23] IETF RFC 1042: "Standard for the Transmission of IP Datagrams over IEEE 802 Networks".

[24] IETF RFC 3971: "SEcure Neighbor Discovery (SEND)".

[25] IETF RFC 4293: "Management Information Base for the Internet Protocol (IP)".

[26] IETF RFC 2526: "Reserved IPv6 Subnet Anycast Addresses".

[27] 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".

[28] ISO/IEC 15802-3: "Information Technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Common specifications - Part 3: Media Access Control (MAC) Bridges" (previously known as IEEE Std 802.1D-1998).

[29] IEEE 802.11:2012: "IEEE Standard for Information Technology - Telecommunications and Information Exchange Between Systems-Local and Metropolitan Area Networks - Specific Requirements - Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications".

[30] IEEE 802.1Q:1998: "IEEE Standards for Local and Metropolitan Area Networks: Virtual Bridged Local Area Networks".

[31] 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".

[32] IEEE "Guidelines For 64-bit Global Identifier (EUI-64)".

NOTE: Available at http://standards.ieee.org/regauth/oui/tutorials/EUI64.html.

2.2 Informative references

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] IETF RFC 3753: "Mobility Related Terminology".

[i.2] IETF RFC 4885: "Network Mobility Support Terminology".

[i.3] IETF RFC 6434: "IPv6 Node Requirements".

[i.4] IETF RFC 4903: "Multi-Link Subnet Issues".

[i.5] IETF RFC 4840: "Multiple Encapsulation Methods Considered Harmful".

[i.6] IETF RFC 3316: "Internet Protocol Version 6 (IPv6) for Some Second and Third Generation Cellular Hosts".

[i.7] IETF RFC 5154: "IP over IEEE 802.16 Problem Statement and Goals".

[i.8] IETF RFC 3549: "Linux Netlink as an IP Services Protocol".

[i.9] IETF RFC 3314: "Recommendations for IPv6 in Third Generation Partnership Project (3GPP) Standards".

[i.10] IETF RFC 1661: "The Point-to-Point Protocol (PPP)".

[i.11] IETF RFC 2578: "Structure of Management Information Version 2 (SMIv2)".

[i.12] IETF RFC 2579: "Textual Conventions for SMIv2".

[i.13] IETF RFC 2491: "IPv6 over Non-Broadcast Multiple Access (NBMA) networks".

[i.14] IETF RFC 6775: "Neighbor Discovery Optimization for IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs)".

[i.15] ETSI TR 102 893: "Intelligent Transport Systems (ITS); Security; Threat, Vulnerability and Risk Analysis (TVRA)".

[i.16] ETSI TS 102 731: "Intelligent Transport Systems (ITS); Security; Security Services and Architecture".

[i.17] ETSI TS 103 097:"Intelligent Transport Systems (ITS); Security; Security header and certificate formats for ITS G5".

[i.18] ETSI TS 102 637-2: "Intelligent Transport Systems (ITS); Vehicular Communications; Basic Set of Applications; Part 2: Specification of Cooperative Awareness Basic Service".

[i.19] Universal TUN/TAP driver for Linux, Solaris and FreeBSD.

NOTE: Available at http://vtun.sourceforge.net/tun/index.html.

[i.20] ISO 21210-2010: "Intelligent Transport Systems - Communications access for land mobiles (CALM) - IPv6 networking".

[i.21] ETSI TS 123 060: "Digital cellular telecommunications system (Phase 2+); Universal Mobile Telecommunications System (UMTS); General Packet Radio Service (GPRS); Service description; Stage 2 (3GPP TS 23.060 Release 9)".

[i.22] ISO/IEC Technical Report 11802-5:1997(E): "Information technology-Telecommunications and information exchange between systems-Local and metropolitan area networks-Technical reports and guidelines-Part 5: Medium Access Control (MAC) Bridging of Ethernet V2.0 in Local Area Networks" (previously known as IEEE Std 802.1H-1997).

[i.23] 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-G5A media".

[i.24] ETSI TS 102 723-10: "Intelligent Transport Systems; OSI cross-layer topics; Part 10: Interface between access layer and network and transport layers".

[i.25] GeoNet D1.2: FP7 STREP N 216269 European Project GeoNet - Geographic addressing and routing for vehicular communications - Deliverable D1.2 v1.1: "Final GeoNet Architecture Design".

[i.26] GeoNet D2.2: FP7 STREP N 216269 European Project GeoNet - Geographic addressing and routing for vehicular communications - Deliverable D2.2 v1.1: "Specification - Final Release".

[i.27] GeoNet D7.1: FP7 STREP N 216269 European Project GeoNet - Geographic addressing and routing for vehicular communications - Deliverable D7.1 v1.0: "GeoNet Experimentation Results".

[i.28] NemoROReqDraft: IETF draft-ietf-mext-nemo-ro-automotive-req-02 (July 2009): "Automotive Industry Requirements for NEMO Route Optimization".

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 TS 102 636-3 [5], IETF RFC 4861 [11], IETF RFC 6434 [i.3], IETF RFC 4885 [i.2] and the following apply:

geographical virtual link: link-local multicast-capable virtual link spanning multiple physical links with geographically scoped boundaries

GN6 adaptation sub-layer: protocol adaptation sub-layer supporting the transmission of IPv6 packets over the GeoNetworking protocol

GVL area: geographical area associated with a GVL

IPv6-compliant: compliant with IETF RFC 2460 [8], IETF RFC 4291 [9], IETF RFC 4007 [10], IETF RFC 4861 [11] and IETF RFC 4862 [13]

IPv6 next hop: IPv6 node resulting from the next-hop determination described in IETF RFC 4861 [11], section 5.2

sub-IP multi-hop delivery: IP packet delivery traversing several ITS stations where the Hop Limit field of the IPv6 header given in IETF RFC 2460 [8] is not decreased

topological virtual link: link-local multicast-capable virtual link spanning multiple physical links with topologically scoped boundaries

3.2 Symbols

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

GEO_{MAX}	Size of the largest GeoNetworking header
GN_SAP	GeoNetworking Service Access Point
MTU_{AL}	Maximum transmission unit offered by the protocol layer below GeoNetworking
MTU_{GN6}	Maximum transmission unit offered by GN6ASL to IPv6
MTU_{VI}	Typical maximum transmission unit associated to the type of a virtual interface
STALE	Stale state of an IPv6 Neighbor Cache entry
VL_ID	Virtual Link IDentifier

3.3 Abbreviations

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

ASL	Adaptation Sub-Layer
ASN.1	Abstract Syntax Notation One
CGA	Cryptographically Generated Addresses
DGVL	Dynamic Geographical Virtual Link
EDCA	Enhanced Distributed Channel Access
EIID	Extended Interface Identifier
EUI	Extended Unique Identifier
GN6	GeoNetworking-IPv6
GN6ASL	GeoNetworking-IPv6 Adaptation Sub-Layer
GN6SDU	GN6 Service Data Unit
GPRS	General Packet Radio Service
GVL	Geographical Virtual Link
IANA	Internet Assigned Numbers Authority
ID	Identifier
IID	Interface Identifier
IP	Internet Protocol
ITS	Intelligent Transport System