INTERNATIONAL STANDARD

ISO 21210

First edition
2012-06-15

Intelligent transport systems — Communications access for land mobiles (CALM) — IPv6 Networking

Systèmes intelligents de transport — Accès aux communications des services mobiles terrestres (CALM) — Gestion de réseau IPv6

Reference number
ISO 21210:2012(E)

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Published in Switzerland

Contents

Page

Foreword iv
Introduction v
1 Scope 1
2 Conformance 1
3 Normative references 1
4 Terms and definitions 2
5 Symbols and abbreviated terms 6
6 Requirements 7
Annex A (informative) **Illustration of mobility support** 19
Bibliography 22

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 21210 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Introduction

This International Standard is part of a family of International Standards based on the communications access for land mobiles (CALM) concept. These International Standards specify a common architecture network protocols and communication interface definitions for wired and wireless communications using various access technologies including cellular 2nd generation, cellular 3rd generation, satellite, infra-red, 5 GHz microwave, 60 GHz millimetre-wave and mobile wireless broadband. These and other access technologies that can be incorporated are designed to provide broadcast, unicast and multicast communications between mobile stations, between mobile and fixed stations and between fixed stations in the intelligent transport systems (ITS) sector.

A fundamental advantage of the CALM concept over traditional systems is that applications are abstracted from the access technologies that provide the wireless connectivity and the networks that transport the information from the source to the destination(s). This means that ITS stations are not limited to a single access technology and networking protocol and can implement any of those supported, and the ITS station management can make optimal use of all these resources. To exploit this flexibility, CALM-compliant systems can support handover of different types including

— those involving a change of communication interface without a change of access technology;

— those involving a change of communication interface with a change of access technology;

— those involving reconfiguration or change of the network employed to provide connectivity;

— those involving both a change in communication interface and network reconfiguration.

An introduction to the whole set of International Standards is provided in ISO 21217.

One of the most interesting features of the CALM concept is the ability to use a number of networking protocols designed to meet specific requirements. However, to meet the needs of the majority of anticipated ITS applications and services, IPv6 ('Internet Protocol version 6') is ideally suited. The use of this version of IP scales is to meet the needs of a growing number of vehicles and connected devices, and provides the added functionality necessary in mobile environments [IPv6 mobility support (NEMO), “multiple Care-of Address” (MCoA) support].

This International Standard specifies the IPv6 network protocols and services necessary to support global reachability of ITS stations, continuous Internet connectivity for ITS stations and the handover functionality required to maintain such connectivity. This functionality also allows legacy devices to effectively use an ITS station as an access router to connect to the Internet. Essentially, this specification describes how IPv6 is configured to support ITS stations and provides the necessary management functionality.

Intelligent transport systems — Communications access for land mobiles (CALM) — IPv6 Networking

1 Scope

This International Standard specifies networking protocol functionalities related to IPv6 networking between two or more ITS stations communicating over the global Internet communication network.

The International Standard assumes that the reader is familiar with IETF specifications found in "Request for Comments" (RFCs) of individual IPv6 protocol blocks used within this International Standard. This International Standard does not define a new protocol, a new exchange of messages at the IPv6 layer, or new data structures. It defines how standard IETF protocols are combined so that ITS stations can communicate with one another using the IPv6 family of protocols. Procedures defined to share information between the IPv6 layer and other components of the ITS station architecture are defined in ISO 24102. In addition to the requirements specified within this International Standard, a number of notes and examples are provided to illustrate IPv6 addressing configuration and IPv6 mobility management.

2 Conformance

This International Standard specifies the use of IPv6 networking for ITS stations conforming to the CALM architecture (ISO 21217). A set of protocols specified by the IETF are selected. At minimum, all implementations of IPv6 in the context of ITS stations have to conform with IETF RFC 4294 *IPv6 Node Requirements*.

"Protocol implementation conformance statements" (PICS) will be provided at a later stage in a later document and will complement the IPv6 conformance tests such as those defined for the IPv6-ready logo program (http://www.ipv6ready.org). The IPv6-ready logo program provides conformance tests for individual IPv6 protocols or sets of IPv6 protocols on an individual protocol basis.

3 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 21217:2010, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

ISO 21218, *Intelligent transport systems — Communications access for land mobiles (CALM) — Medium service access points*

ISO 24102, *Intelligent transport systems — Communications access for land mobiles (CALM) — Management*

IETF Request for Comments (RFC) 2460, *Internet Protocol, Version 6 (IPv6) Specification*

IETF Request for Comments (RFC) 3587, *IPv6 Global Unicast Address Format*

IETF Request for Comments (RFC) 3963, *Network Mobility (NEMO) Basic Support Protocol*

IETF Request for Comments (RFC) 4291, *IP Version 6 Addressing Architecture*

IETF Request for Comments (RFC) 4294, *IPv6 Node Requirements*

IETF Request for Comments (RFC) 4493, *The AES-CMAC Aligorithm*

IETF Request for Comments (RFC) 4861, *Neighbor Discovery for IP Version 6 (IPv6)*

IETF Request for Comments (RFC) 4862, *IPv6 Stateless Address Autoconfiguration*

IETF Request for Comments (RFC) 5648, *Multiple Care-of Addresses Registration*

4 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 21217, ISO 21218 and ISO 24102 and the following apply.

NOTE Wherever terms like "address", "host", "node", "router", "mobile network", "interface", "link" and "subnet", are used in the text without the IPv6 modifier, the IPv6 modifier should be assumed to be present (e.g. IPv6 address, IPv6 interface). Most of the definitions are taken from RFC 2460; RFC 3753 and RFC 4885.

4.1
care-of address
CoA
'IPv6 address' associated with a mobile node while attached on a 'foreign IPv6 link'

4.2
egress IPv6 interface
interface of an MR attached to the 'home IPv6 link' if the 'IPv6 mobile router' is at home, or attached to a 'foreign IPv6 link' if the 'IPv6 mobile router' is in a foreign network

[SOURCE: RFC 3753]

4.3
external IPv6 interface
'IPv6 interface' of an 'ITS-S IPv6 router' in an ITS station used to connect to another ITS station or the Internet

4.4
foreign IPv6 link
'IPv6 link' other than the mobile node's 'home IPv6 link'

4.5
global IPv6 address
'IPv6 address' corresponding to 'Global Unicast Addresses' as specified in RFC 4291

4.6
home address
HoA
'IPv6 address' assigned to a mobile node, used as the permanent address of the mobile node

NOTE The term 'home address' is defined in RFC 3753. This 'IPv6 address' is within the mobile node's 'home IPv6 link'. Standard IP routing mechanisms deliver packets destined for a mobile node's 'home address' to its 'home IPv6 link'.

4.7
home IPv6 link
'IPv6 link' on which a mobile node's 'home IPv6 prefix' is defined

4.8
home IPv6 prefix
'IPv6 prefix' corresponding to a mobile node's 'home address'

4.9
ingress IPv6 interface
interface of an MR attached to an 'IPv6 link' inside the 'IPv6 mobile network'

[SOURCE: RFC 3753]

4.10
home ITS-S IPv6 LAN
'ITS-S IPv6 LAN' providing Internet reachability functions to 'mobile ITS-S IPv6 LANs'

4.11
IPv6 subnet
logical group of connected network nodes

NOTE Nodes in an 'IPv6 subnet' share a common network prefix.

[SOURCE: RFC 3753]

4.12
IPv6 Access Network
AN
'IP network that includes one or more Access Network Routers'

[SOURCE: RFC 3753]

4.13
IPv6 access router
AR
'Access Network Router residing on the edge of an Access Network and connected to one or more Access Points'

NOTE This definition of "access router" is taken from RFC 3753. An 'IPv6 Access Router' offers IP connectivity to Mobile Nodes, acting as a default IPv6 router to the mobile nodes it is currently serving. The 'IPv6 Access Router' may include intelligence beyond a simple forwarding service offered by ordinary IPv6 routers.

4.14
IPv6 address
IPv6-layer identifier for an interface or a set of interfaces

NOTE IPv6 addresses are assigned to network interfaces, not to nodes.

[SOURCE: RFC 2460]

4.15
IPv6 home agent
HA
'IPv6 router' on a mobile node's 'home IPv6 link' with which the mobile node (MN) has registered its current Care-of Address.

NOTE This definition of 'home agent' is taken from RFC 3753. While the mobile node is away from home, the home agent intercepts packets on the 'home IPv6 link' destined to the mobile node's Home Address (HoA), encapsulates them, and tunnels them to the mobile node's registered Care-of Address (CoA).

4.16
IPv6 host
any 'IPv6 node' that is not a 'IPv6 router'

[SOURCE: RFC 2460]

4.17
IPv6 interface
node's attachment to an 'IPv6 link'

NOTE Each interface is configured with at least one link-local address and possibly other types of IPv6 addresses (global unicast, multicast).

[SOURCE: RFC 2460]

4.18
IPv6 link
communication facility or medium over which nodes can communicate at the link layer, i.e. the layer immediately below IPv6

NOTE A link is the layer immediately below IP. In a layered network stack model, the Link Layer (Layer 2) is normally below the Network (IP) Layer (Layer 3), and above the Physical Layer. Examples are Ethernet (simple or bridged; PPP links; X.25, Frame Relay, or ATM networks; and IP (or higher) layer 'tunnels', such as tunnels over IPv4 or IPv6 itself.

[SOURCE: RFC 2460]

4.19
IPv6 mobile network
entire network, moving as a unit, which dynamically changes its point of attachment to the Internet and thus its reachability in the topology

NOTE This definition of 'mobile network' is taken from RFC 3753.

4.20
IPv6 mobile router
MR
'IPv6 router' capable of changing its point of attachment to the network, moving from one 'IPv6 link' to another 'IPv6 link'

NOTE The mobile IPv6 router is capable of forwarding packets between two or more interfaces, and possibly running a dynamic routing protocol modifying the state by which it does packet forwarding. A mobile IPv6 router acting as a gateway between an entire IPv6 mobile network and the rest of the Internet has one or more egress interface(s) and one or more ingress interface(s). Packets forwarded upstream to the rest of the Internet are transmitted through an egress interface; packets forwarded downstream to the IPv6 mobile network are transmitted through an ingress interface (RFC 3753).

4.21
IPv6 node
device that implements IPv6

[SOURCE: RFC 2460]

4.22
IPv6 prefix
bit string that consists of some number of initial bits of an 'IPv6 address'

NOTE The prefix of length 64 (/64) of an IPv6 'Global Unicast Address' (RFC 3587) identifies a specific IPv6 subnet and its position in the Internet hierarchy

[SOURCE: RFC 3753]

4.23
IPv6 router
'IPv6 node' that forwards IPv6 packets not explicitly IPv6 addressed to itself

[SOURCE: RFC 2460]

4.24
'ITS-S IPv6 access router'
'IPv6 router' implementing communication functions of an ITS station and offering access to 'mobile ITS-S IPv6 LANs'

4.25
'ITS-S IPv6 border router'
IPv6 router implementing communication functions of an ITS station and connecting 'ITS-S IPv6 LANs' to the Internet and other networks

4.26
ITS-S IPv6 home agent
'IPv6 home agent' implementing communication functions of an ITS station and maintaining access to 'mobile ITS-S IPv6 LANs'

4.27
ITS-S IPv6 host
'IPv6 host' implementing non-routing capabilities of an ITS station

4.28
ITS-S IPv6 LAN
IPv6 LAN composed of one or more IPv6 subnets comprising one or more ITS station(s) and 0 or more legacy IPv6 node(s) deployed in an ITS sub-system

NOTE An 'ITS-S IPv6 router' with no 'ITS-S IPv6 LAN interface' is considered as a simple case of an 'ITS-S IPv6 LAN' comprising only one 'IPv6 node'. Considering only 'ITS-S IPv6 LANs' simplifies this International Standard and ensures compatibility among ITS sub-systems equipped to meet different design choices.

4.29
ITS-S IPv6 LAN interface
'IPv6 interface' of an 'IPv6 node' in an ITS station used to connect to the 'ITS-S IPv6 LAN'

NOTE All 'IPv6 interfaces' are either 'external IPv6 interfaces' or 'ITS-S IPv6 LAN interfaces'.

4.30
ITS-S IPv6 LAN node
node on an 'ITS-S IPv6 LANITS-S IPv6 LAN'

NOTE Any 'ITS-S IPv6 node' or 'legacy IPv6 node'.

4.31
'ITS-S IPv6 mobile router'
'IPv6 router' implementing communication functions of an ITS station and deployed in a 'mobile ITS-S IPv6 LAN'

4.32
ITS-S IPv6 node
'IPv6 node' ('IPv6 host' or 'IPv6 router') implementing functions of an ITS station

NOTE The ITS station comprises a communication function and application functions. These functions may be split into physically separated nodes communicating over an LAN.

4.33
ITS-S IPv6 router
'IPv6 router' implementing routing capabilities of an ITS station

4.34
ITS-S IPv6 router serving an ITS-S IPv6 LAN
'ITS-S IPv6 router' that is connecting an 'ITS IPv6 LAN' to other 'ITS IPv6 LANs' or the global Internet

4.35
legacy IPv6 node
'IPv6 node' in accordance with RFC 4294 (IPv6 node requirements) and functions without additional IPv6 networking capabilities

4.36
link-local IPv6 address
'IPv6 address' corresponding to a 'link-local IPv6 unicast address' as specified in RFC 4291

4.37
mobile edge multihoming
possibility for a mobile node ('IPv6 host' or 'IPv6 router' serving an 'IPv6 mobile network') to connect simultaneously to the Internet through multiple points of attachment, either using multiple communication media or using multiple interfaces of the same communication medium, or through multiple 'IPv6 mobile routers' serving the same 'IPv6 mobile network'

NOTE Mobile edge multihoming mechanisms are known as MonAmi6 support within the IETF as a reference to the former MonAmi6 Working Group where these mechanisms were first defined before being taken over by the MeXT Working Group. For a comprehensive understanding of the mobile edge multihoming issues, it is recommended that the user read RFC 4980.

4.38
mobile ITS-S IPv6 LAN
'ITS-S IPv6 LAN' having the capability of changing its point of attachment to the ITS domain or the Internet

4.39
mobile ITS-S IPv6 LAN node
'IPv6 node' on a 'mobile ITS-S IPv6 LAN'

4.40
network mobility support
network function allowing an entire mobile IPv6 subnet' or 'IPv6 mobile network' to change its point of attachment to the Internet and, thus, its reachability in the topology, without interrupting IP packet delivery to or from this 'IPv6 mobile network'

NOTE This terminology associated with this support function is defined in RFC 3753 and RFC 4885.

4.41
tunnel
forwarding path between two nodes on which the payload consists of encapsulated packets

5 Symbols and abbreviated terms

Symbols and abbreviated terms used in this International Standard are listed below. Reference should also be made to ISO 21217, ISO 21218, ISO 24102, IETF RFC 3753 and IETF RFC 4885.

AR IPv6 access router

BR IPv6 border router

CoA IPv6 'Care-of Address'

DHCP Dynamic Host Configuration Protocol

DNS Dynamic Name Server

HA IPv6 home agent