INTERNATIONAL STANDARD

ISO 19079

First edition
2016-10-01

Intelligent transport systems — Communications access for land mobiles (CALM) — 6LoWPAN networking

Systèmes intelligents de transport — Accès aux communications des services mobiles terrestres (CALM) — Gestion de réseau 6LoWPAN

Reference number
ISO 19079:2016(E)

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword ... **iv**

Introduction ... **v**

1 Scope ... **1**

2 Normative references ... **1**

3 Terms and definitions ... **2**

4 Symbols and abbreviated terms ... **4**

5 Requirements: ITS-Station 6LoWPAN Nodes ... **4**

5.1 Categories ... 4
5.2 ITS-S nodes implementing 6LoWPAN ... 5
5.2.1 Requirements for all ITS-S 6LoWPAN nodes ... 6
5.2.2 ITS-S 6LoWPAN nodes deployed in roadside ITS sub-systems ... 8
5.2.3 ITS-S 6LoWPAN LAN nodes deployed in vehicle ITS sub-systems ... 9
5.3 The IoT management service entity ... 10
5.3.1 The 6LoWPAN forwarding module ... 10
5.3.2 Internal ITS-S 6LoWPAN interface module ... 11
5.3.3 External 6LoWPAN interface modules ... 11
5.3.4 6LoWPAN/IPv6 Compression module ... 11
5.3.5 6LoWPAN/IPv6 security module ... 12
5.4 Modules implemented in ITS-S 6LoWPAN nodes ... 14
5.4.1 ITS-S 6LoWPAN host modules ... 16
5.4.2 ITS-S 6LoWPAN ad-hoc router modules ... 16
5.4.3 ITS-S 6LoWPAN access router modules ... 16
5.4.4 ITS-S 6LoWPAN-IPv6 border router modules ... 16
5.5 The 6LoWPAN address configuration ... 17
5.5.1 General ... 17
5.5.2 Consideration on address configuration ... 17
5.5.3 Address configuration and Optimized Neighbor Discovery ... 17
5.5.4 Examples: Message Exchange ... 18
5.6 Optional features and functions ... 19
5.6.1 IPv6-IPv4 interoperability ... 19
5.6.2 IPv6 priority ... 19

Annex A (normative) **General usage for MAC-PHY interface: IEEE 802.15.4 Communication and Management Interface Adaptation for IoT MSE** ... **20**

Annex B (normative) **ASN.1 module** ... **24**

Bibliography ... **25**

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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: www.iso.org/iso/foreword.html.

The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

Introduction

The set of International Standards that collectively refer to CALM (Communications Access for Land Mobile) focus on the specification of open interfaces regarding the functionality required by all relevant layers and entities of a standard communication architecture for Intelligent Transport Systems (ITS). This communication is known as the ITS station reference architecture (ISO 21217).

These International Standards are designed to allow interoperable instantiations of ITS stations (ITS-S), which are based on the concept of abstracting applications and services from the underlying communication layers. This abstraction makes the ITS station architecture ideally suited to the development and deployment of Cooperative ITS applications and services.

The set of ITS station International Standards include specifications for security in ITS communications, ITS-S management, distributed ITS-S implementations, legacy communication media interfaces, legacy application interfaces, and new communication interfaces specifically designed for ITS applications such as those targeted to safety of both life and property.

The fundamental advantage of the ITS station with respect to traditional systems is the ability to support vertical handovers between the various access technologies that can be included in an ITS station. Handover mechanisms are defined within the ITS station reference architecture, the ITS station medium service access points International Standard (ISO 21218) and the ITS station management International Standard (ISO 24102).

The ITS station IPv6 networking International Standard (ISO 21210) determines the network protocols to support reachability at a global IP address, continuous Internet connectivity, and the handover policies between session performed by infrastructure mobile routers (MR) using the same media or using different access technologies.

ITS station compliant internal networks (both in-vehicle and off-vehicle) are expected to interact with each other to seamlessly exchange information. This should be true also for information retrieved from Wireless Sensor Networks (WSN) to be dispatched to any ITS station. As WSNs are largely based on low-cost Component of The Shelf (COTS), IETF has promoted the standardization of a set of protocols at the network and facility layers suited for constrained devices (in terms of capability of processing, storage or communication) based on low-rate wireless personal area networks (LR-WPANs) technologies. An important candidate at network layer in this sense is the IETF IPv6 over Low power Wireless Personal Area Networks (6LoWPAN), an adaptation layer for IPv6 that addresses device limitations by means of header compression and protocol optimizations.

This document identifies network protocols that are needed to support global reachability at a global IP address for Wireless Sensor Networks (WSNs) based on the IEEE 802.15.4 access medium; in particular, this document states how to use the set of 6LoWPAN protocols specified by IETF in the context of ITS.

Intelligent transport systems — Communications access for land mobiles (CALM) — 6LoWPAN networking

1 Scope

This document describes the networking protocol functionality related to 6LoWPAN networking between two or more ITS stations communicating over the global Internet communication network.

It is assumed that the reader is familiar with IETF specifications found in "Request for Comments" (RFCs) 4944, 6282 and 2460 for 6LoWPAN and IPv6 protocols respective blocks used within this document. This document does not define a new protocol, neither does it define new abstraction for exchange of messages at the 6LoWPAN layer nor does it define new data structures. It, however, illustrates how the IETF protocols are combined to allow seamless communication among both heterogeneous and homogeneous ITS stations using 6LoWPAN. The 6LoWPAN family of protocols defined in this document as the Internet of Things Management Service Entity (IoT MSE) is integrated within the ITS station reference architecture as a new protocol block of the ITS station Networking and Transport layer. The procedures defined to share information between the IoT MSE block of the ITS station networking and transport protocols and other components of the ITS station architecture will be defined in the ISO 24102 series. ISO 24102 series includes the specifications for ITS station management, which are standardized to be compliant with the ITS station reference architecture and related standards.

In addition to the requirements described within this document, a number of notes and examples are provided to illustrate the IoT MSE block and its configuration.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 21210:2012, *Intelligent transport systems — Communications access for land mobiles (CALM) — IPv6 Networking*

ISO 21217:2014, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

ISO 21218:2013, *Intelligent transport systems — Communications access for land mobiles (CALM) — Access technology support*

ISO 24102-3:2013, *Intelligent transport systems — Communications access for land mobiles (CALM) — Management- Part 3: Service access points*

ISO 24102-6, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 6: Path and flow management*

ETSI/TS 102 760-1 V1.1.1 (2009-11), *Intelligent Transport Systems (ITS); Test specifications for Intelligent Transport Systems; Communications Access for Land Mobiles (CALM); Medium Service Access Points (ISO 21218); Part 1: Implementation Conformance Statement (ICS) proforma*

IETF RFC 2460 *Internet Protocol Version 6*

IETF RFC 4861 *Neighbor Discovery for IP version 6 (IPv6)*

IETF RFC 4301 *Security Architecture for the Internet Protocol*

IETF RFC 4302 *IP Authentication Header*

IETF RFC 4303 *IP Encapsulating Security Payload (ESP)*

IETF RFC 4835 *Cryptographic Algorithm Implementation Requirements for Encapsulating Security Payload (ESP) and Authentication Header (AH)*

IETF RFC 3566 *The AES-XCBC-MAC-96 Algorithm and Its Use With IPsec*

IETF RFC 7228 *Terminology for Constrained-Node Networks*

IETF RFC 4919 *IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs): Overview, Assumptions, Problem Statement, and Goals*

IETF RFC 4944 *Transmission of IPv6 Packets over IEEE 802.15.4 Networks*

IETF RFC 6282 *Compression Format for IPv6 Datagrams over IEEE 802.15.4-Based Networks*

IETF RFC 6347 *Datagram Transport Layer Security Version 1.2*

IETF RFC 6775:2012 *Neighbor Discovery Optimization for IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs)*

IETF RFC 6550 IPv6 *Routing Protocol for Low-Power and Lossy Networks (RPL)*

IETF RFC 6568 *Design and Application Spaces for IPv6 over Low-Power Wireless Personal Area Networks (6LoWPANs)*

IETF RFC 6957 *Duplicate Address Detection Proxy*

IEEE 802.15.4-2006*Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (WPANs)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21210, ISO 21217, ISO 21218 and ISO 24102-3 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp/

3.1
IoT management service entity
IoT MSE
collection of modules required for a specific instantiation of 6LoWPAN

Note 1 to entry: The 6LoWPAN network comprises of a set of 6LoWPAN protocols, of which some are already standardized (see IETF RFC 6282and IETF RFC 6775, etc.).

3.2
6LoWPAN address
address including the network prefix and the host address

Note 1 to entry: The network-prefix set-up determines if the device can be addressed globally whereas the host address should be unique within the 6LoWPAN.

3.3
6LoWPAN prefix
prefix corresponding to a node's address

3.4
link-local address
6LoWPAN address corresponding to a “link-local 6LoWPAN unicast address” and being used to communicate with devices in the same PAN

3.5
6LoWPAN global address
6LoWPAN address for communicating with devices globally

3.6
6LoWPAN node
device that implements 6LoWPAN

Note 1 to entry: See IETF RFC 4944, IETF RFC 6282 and IETF RFC 6775.

3.7
6LoWPAN host
ITS-S 6LoWPAN node comprising of ITS-S IoT MSE functionality other than those of a 6LoWPAN router or 6LoWPAN gateway

3.8
6LoWPAN internal interface
interface of a 6LoWPAN node in an ITS station used to connect with other 6LoWPAN nodes

3.9
6LoWPAN external interface
6LoWPAN interface of an ITS-S 6LoWPAN router node in an ITS station used to connect to the Internet or to other ITS-Stations

3.10
6LoWPAN ad-hoc router
device that implements 6LoWPAN and a layer-3 ad-hoc routing protocol internally to an ITS-S

Note 1 to entry: IETF RFC 4944, IETF RFC 6282, and IETF RFC 6775.

3.11
6LoWPAN access router
6LoWPAN AR
6LoWPAN router residing in an ITS-S at the edge of an Access Network and connected to one or more access points

3.12
6LoWPAN-IPv6 border router
6LoWPAN-IPv6 BR
6LoWPAN router residing in an ITS-S at the edge of an Access Network and connected to the Internet

Note 1 to entry: This router could perform additional functions related to IPv6 networking as defined in ISO 21210.

3.13
ITS-station unit
ITS-SU
physical instantiation of an ITS-S

Note 1 to entry: This could be a distributed instantiation in a 6LoWPAN/IPv6 Border router and 6LoWPAN Hosts. An ITS-SU contains one or more ITS-SCUs, and hence one or more communication interfaces (CIs). See Annex A for guidelines on CI.

3.14
ITS-S communication unit
ITS-S CU
physical unit in an ITS-SU containing a part or all of the functionality of an ITS-S

Note 1 to entry: In case an ITS-SU consists of a single physical unit, the ITS-SU and the ITS-SCU are identical. In case an ITS-SU consists of more than one ITS-SCU, then these ITS-SCUs are interconnected via the ITS station-internal network of the ITS-SU.

4 Symbols and abbreviated terms

Symbols and abbreviated terms specified in ISO 21210, ISO 21217, ISO 21218, ISO 24102-3, IETF RFC 4944, IETF RFC 6282, IETF RFC 6775, IETF RFC 4301, IETF RFC 4302, IETF RFC 4303, IETF RFC 6347 apply.

5 Requirements: ITS-Station 6LoWPAN Nodes

5.1 Categories

This subclause describes the relationship between the five categories of requirements.

— The first category (see 5.2) contains requirements applying to a specific instantiation of an ITS-S 6LoWPAN node and the requirements applying to different types of 6LoWPAN nodes in each ITS sub-system.

— The second category (see 5.3) contains requirements that define the IoT MSE (6LoWPAN networking) modules, which are specific to the "ITS-S 6LoWPAN nodes". The five different modules are detailed under this category and they may be combined in different ways according to the functions of the 6LoWPAN nodes that is defined in 5.2.

— The third category (see 5.4) contains requirements defining which of the IoT MSE modules specified in 5.3 are combined for each particular "ITS-S 6LoWPAN node" specified in 5.2 and it further provides an example instantiation for an ITS-SU distributed in one or more ITS-SCUs.

— The fourth category (see 5.5) contains 6LoWPAN addressing requirements that are applicable to "ITS-S 6LoWPAN nodes" according to the functions listed in 5.2.

— The fifth category (see 5.6) contains optional features and functions. Their actual specification is currently out of the scope of this document.

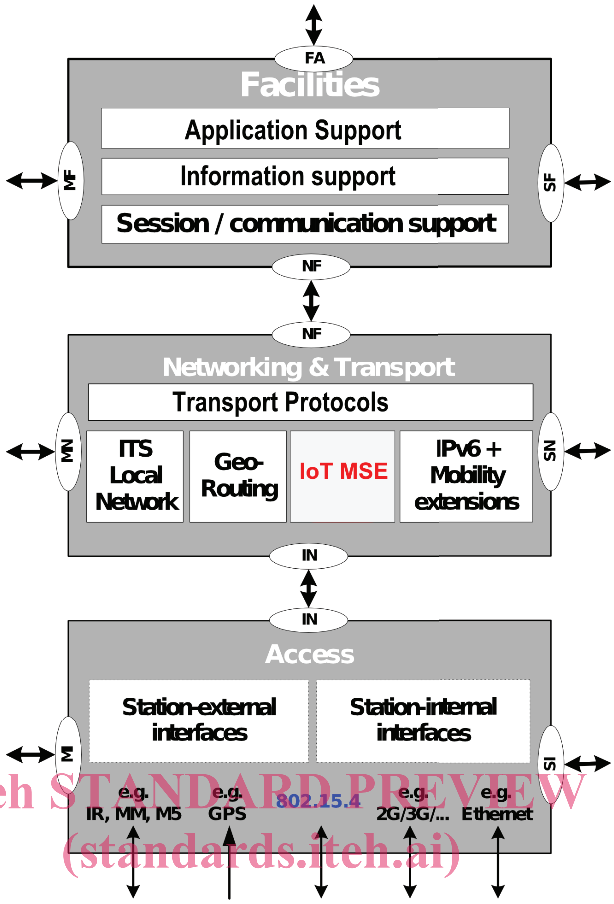

Figure 1 — Scope of IoT MSE (6LoWPAN Networking) within the ITS station reference architecture

In Annex A, the general usage for MAC-PHY interface is provided.

5.2 ITS-S nodes implementing 6LoWPAN

Figure 1 illustrates the scope of IoT MSE within the ITS station reference at the Network and Transport (NT) layer. A station implementing 6LoWPAN(in a PAN) is pictorially represented in Figure 2 together with its (eventual) connectivity to ordinary Internet peers (in a LAN) making use of a special node (i.e. an “Access Router”) equipped with at least two MAC interfaces.

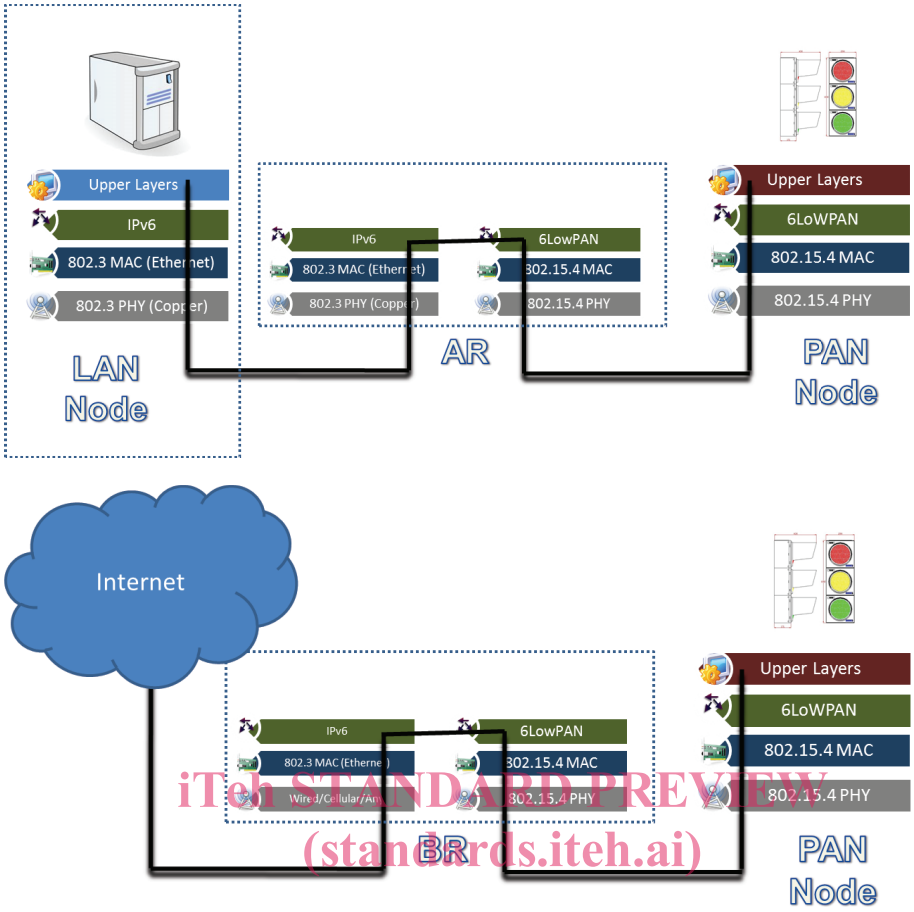

Figure 2 — 6LoWPAN subsystem

If the router device connects the PAN to the Internet, the device is called “Border Router”.

The 6LoWPAN-based ITS stations can notably take part in the “Road-side” and “Vehicular” subsystems as pictorially shown in ISO 21217:2014, Figure 16. The other scenarios will not be discussed in this document due to the reduced impact they provide on the C-ITS general architecture.

5.2.1 Requirements for all ITS-S 6LoWPAN nodes

5.2.1.1 General

This subclause specifies the functional requirements of all ITS stations implementing 6LoWPAN networking. A Personal Area Network in an ITS station implemented according to these specifications is referred to as an “ITS-S 6LoWPAN”.

5.2.1.2 Specific Instantiation of 6LoWPAN nodes

Additional features may be required according to the role played by the ITS-S 6LoWPAN node, which in this instance could be an ITS-S 6LoWPAN host, an ITS-S 6LoWPAN (ad-hoc) router as well as a multi-MAC device such as ITS-S IPv6 mobile router, ITS-S IPv6 access router, ITS-S IPv6 border router (see ISO 21210) regardless of the deployment scenarios such as the “Road-side” and “Vehicular” subsystems, etc. as pictorially shown in Figure 3.