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Intelligent Transport Systems — Communications access for land mobiles (CALM) — 6LoWPAN networking

Titre manque

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Foreword

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ISO 19079 was prepared by Technical Committee ISO/TC 204, *Intelligent Transport Systems*, Subcommittee SC , .

This second/third/... edition cancels and replaces the first/second/... edition (), [clause(s) / subclause(s) / table(s) / figure(s) / annex(es)] of which [has / have] been technically revised.

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 (International Standard ISO IS 21217).

These 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 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 Technical Specification 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 Technical Specification 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 — 6LoWPAN networking

1 Scope

This Technical Specification 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 Technical Specification. This Technical Specification does not define a new protocol; neither does it define new abstraction for exchange of messages at the 6LoWPAN layer nor does it defines 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 Technical Specification 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 &Transport layer. The procedures defined to share information between the IoT MSE block of the ITS station networking & transport protocols and other components of the ITS station architecture will be defined in the ISO IS 24102 Standard. The ISO IS 24102 are 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 Technical Specification, a number of notes and examples are provided to illustrate the IoT MSE block and its configuration.

2 Normative reference

The following referenced documents are required for the application of this specification. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendment) 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 21218:2014 Intelligent transport systems — Communications access for land mobiles (CALM) — Medium service access points

ISO 24102 (Part 3):2014Intelligent transport systems — Communications access for land mobiles (CALM) — Management- Part 3: Service access points

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 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 6957Duplicate 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 in ISO IS 21210, ISO IS 21217, ISO IS 21218 and ISO IS 24102 and the following apply.

Further terms and definitions, specific to this document, are included below:

IoT Management Service Entity (MSE)

This defines a collection of modules required for a specific instantiation of 6LoWPAN.

NOTE: The 6LoWPAN network comprises of a set of 6LoWPAN protocols, of which some are already standardized (see IETF RFC s 6282, 6775, etc.).

6LoWPAN address

It includes the network prefix and the host address.

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

6LoWPAN prefix

The '6LoWPAN prefix' corresponds to a node's address.

Link-local address

6LoWPAN address corresponds to a 'link-local 6LoWPAN unicast address' and it is used to communicate with devices in the same PAN.

6LoWPAN Global address

6LoWPAN address are used for communicating with devices globally.

6LoWPAN node

A device that implements 6LoWPAN (IETF RFC 4944, IETF RFC 6282, and IETF RFC 6775).

6LoWPAN host

ITS-S 6LoWPAN node comprising of ITS-SIoT MSEfunctionality other than those of a 6LoWPAN routeror 6LoWPANgateway.

6LoWPAN internal interface

Interface of a 6LoWPAN node in an ITS station used to connect with other 6LoWPAN nodes.

External 6LoWPAN 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.

6LoWPAN ad-hoc router

A device that implements 6LoWPAN (IETF RFC 4944, IETF RFC 6282, and IETF RFC 6775) and a layer-3 ad-hoc routing protocol internally to an ITS-S.

6LoWPAN Access Router (AR)

A 6LoWPAN router residing in an ITS-S at the edge of an Access Network and connected to one or more Access Points.

6LoWPAN-IPv6Border Router (BR)

A 6LoWPAN router residing in an ITS-S at the edge of an Access Network and connected to the Internet

NOTE: This router could perform additional functions related to IPv6 networking as defined in (ISO 21210).

ITS-Station Unit (SU)

The physical instantiation of an ITS-S is called an ITS station unit

NOTE: 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)

ITS-S Communication Unit (CU)

Physical unit in an ITS-SU containing a part or all of the functionality of an ITS-S

NOTE: 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 used in this Technical Specification are listed below. Reference should also be made to ISO IS 21210, ISO IS 21217, ISO IS 21218, ISO IS 24102, IETF RFC 4944, IETF RFC 6282, IETF RFC 6775, IETF RFC 4301, IETF RFC 4302, IETF RFC 4303, and IETF RFC 6347.

5 Requirements: ITS-Station 6LoWPAN Nodes

5.1 Categories

This Section 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 defines 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 provide 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 scope of this Technical Specification.

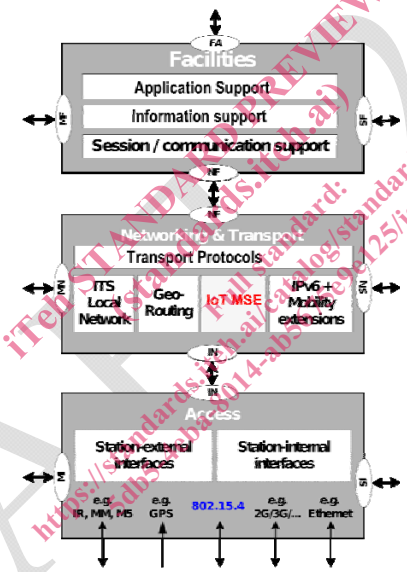

Figure 1 — Scope of IoT MSE (6LoWPAN Networking) within the ITS station reference architecture.

In Annex A (“IEEE 802.15.4 Communication and Management Interface Adaptation for the IoT MSE block”) the general usage for MAC-PHY interface will be provided.

5.2 ITS-S nodes implementing 6LoWPAN

Figure 1 illustrates the scope of 6LoWPAN 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.

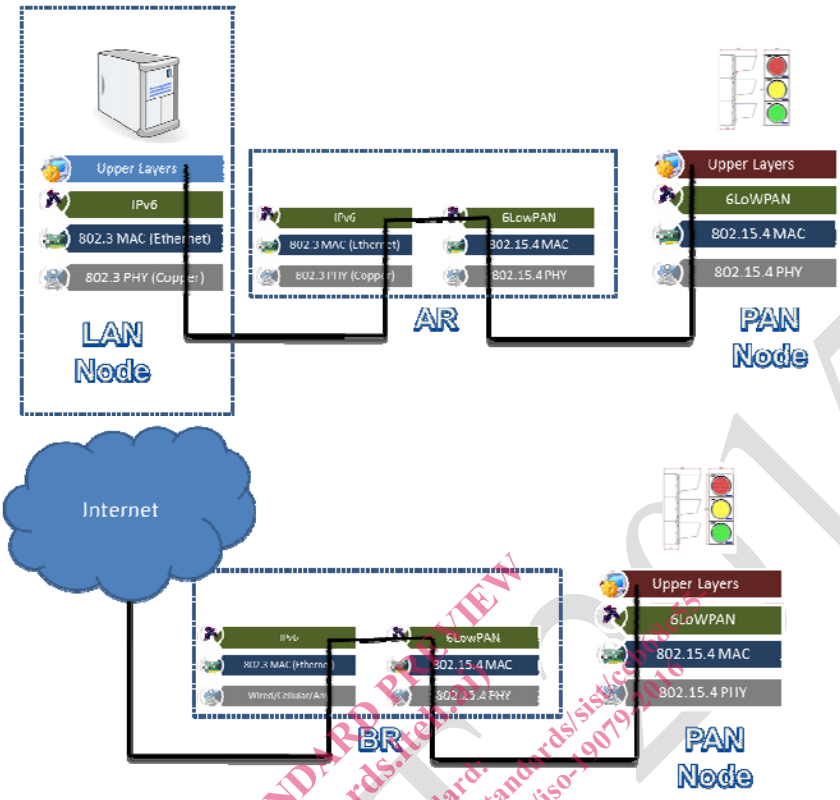

Figure 2 — A 6LoWPAN subsystem.

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 21217:2012 Figure 16. The other scenarios will not be discussed in this Technical Specification due to the reduced impact they provide on the C-ITS general architecture.

5.2.1 Requirements for all ITS-S 6LoWPAN nodes

This sub-clause 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'.

Note 1: 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 asthe “Road-side” and “Vehicular” subsystems, etc. as pictorially shown in Figure 3.