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Intelligent transport systems — Communications access for land mobiles (CALM) — CoAP facility

Systèmes intelligents de transport — Accès aux communications des services mobiles terrestres (CALM) — Équipements CoAP

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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

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Foreword

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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).

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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 communications access for land mobile (CALM) focus on the specification of open interfaces regarding the functionality required by all relevant layers and entities of a Standard ITS station reference architecture.

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

The set of CALM 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 designed for safety of both life and property.

The fundamental advantage of the CALM concept with respect to traditional systems is the ability to support vertical handovers between the various media that can be included in a CALM system. Handover mechanisms are defined within the CALM architecture International Standard (ISO 21217), the CALM medium service access points International Standard (ISO 21218) and the CALM communication and station management International Standard (ISO 24102).

At network layer, CALM IPv6 networking ISO 21210 and CALM 6LoWPAN networking ISO 19079 determine the network protocols to support reachability at a global IPv6 address for Wireless Sensor Networks (WSNs) based on the IEEE 802.15.4 access medium.

CALM compliant 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 WSN to be dispatched to any ITS-Station. As WSNs are largely based on low-cost Component of The Shelf (COTS), IETF has started the standardization of a set of protocols at network and facility layer 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 application layer in this sense is the IETF Constrained Application Protocol (CoAP) (IETF RFC 7252), an optimized Representational State Transfer (REST) protocol built on top of the UDP transport protocol, and implementing a subset of HTTP specifications. This document specifies some facility protocols by leveraging the reachability of the WSN nodes guaranteed by the adoption of 6LoWPAN at the Network Layer, and describes how to use CoAP protocol specified by IETF in the context of C-ITS.

For a general introduction to CALM architecture, IPv6 networking and 6LoWPAN networking, the reader is referred to ISO 21217, ISO 21210 and ISO 19079, respectively.

Intelligent transport systems — Communications access for land mobiles (CALM) — CoAP facility

1 Scope

This document describes the CoAP facilities 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) of individual CoAP and 6LoWPAN protocol blocks used within this document. This document does not define a new protocol, a new exchange of messages at the CoAP layer, or new data structures. It defines how protocols standardized by IETF are combined so that ITS stations can communicate with one another using CoAP. Procedures defined to share information between the CoAP layer and other components of the ITS station architecture are defined in ISO 24102 series (Management). In addition to the requirements specified within this document, a number of notes and examples are provided to illustrate CoAP main facilities.

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

ISO 24102-6[1)], *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 6: Path and flow management*

IETF RFC 6690, *The Constrained RESTful Environments (CoRE) Link Format*

IETF RFC 7252:2014, *The Constrained Application Protocol (CoAP)*

IETF RFC 7641, *Observing Resources in the Constrained Application Protocol (CoAP)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 19079, ISO 21210, ISO 21217, ISO 21218, 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 http://www.iso.org/obp

NOTE Most of the definitions are taken from IETF RFC 7252, IETF RFC 7228 and IETF RFC 6690.

3.1
ITS-S CoAP node
device/node that implements CoAP protocol

[SOURCE: IETF RFC 7252]

1) To be published.

3.2
ITS-S CoAP Endpoint
entity participating in the CoAP protocol

Note 1 to entry: Colloquially, an endpoint lives on a "node", although "host" would be more consistent with Internet standards usage, and is further identified by transport-layer multiplexing information that can include a UDP port number and a security association.

[SOURCE: IETF RFC 7252]

3.3
ITS-S CoAP Client
originating endpoint of a request; the destination endpoint of a response

[SOURCE: IETF RFC 7252]

3.4
ITS-S Server
destination endpoint of a request; the originating endpoint of a response

[SOURCE: IETF RFC 7252]

3.5
confirmable message
message requiring an acknowledgement

Note 1 to entry: These messages are called "confirmable". When no packets are lost, each confirmable message prompts exactly one return message of type acknowledgement or type reset.

[SOURCE: IETF RFC 7252]

3.6
non-confirmable message
message not requiring an acknowledgement

Note 1 to entry: This is particularly true for messages that are repeated regularly for application requirements, such as repeated readings from a sensor.

[SOURCE: IETF RFC 7252]

3.7
acknowledgement message
message acknowledging that a specific confirmable message arrived

Note 1 to entry: By itself, an acknowledgement message does not indicate success or failure of any request encapsulated in the confirmable message.

[SOURCE: IETF RFC 7252]

3.8
reset message
message indicating that a specific message (confirmable or non-confirmable) was received, but some context is missing to properly process it

Note 1 to entry: This condition is usually caused when the receiving node has rebooted and has forgotten some state that would be required to interpret the message. Provoking a reset message (e.g. by sending an empty confirmable message) is also useful as an inexpensive check of the aliveness of an endpoint ("CoAP ping").

[SOURCE: IETF RFC 7252]

3.9
subject
resource in the namespace of an ITS-S CoAP server

Note 1 to entry: The state of the resource can change over time, ranging from infrequent updates to continuous state transformations.

[SOURCE: IETF RFC 7641]

3.10
observer
ITS-S CoAP client that is interested in having a current representation of the resource at any given time

[SOURCE: IETF RFC 7641]

4 Symbols and abbreviated terms

For the purposes of this document, symbols and abbreviated terms in ISO 21210, ISO 21217, IETF RFC 4944, IETF RFC 6282 apply.

5 Requirements

5.1 Categories

Clause 5 explains the relationship between the four categories of the requirements.

— The first category (see 5.2) contains requirements applying to all ITS-S CoAP nodes and it specifies requirements that are applicable to the different types of CoAP nodes in each ITS sub-system.

— The second category (see 5.3) contains the requirements that define the CoAP functional modules that are mandatory for the implementation of "ITS-S CoAP nodes". Two different modules are detailed.

— The third category (see 5.4) contains optional features and functions specified as one of the functional modules of the CoAP protocol block. These optional features could be combined to realize a set of ITS-S architecture depending on the specific application.

— The fourth category (see 5.5) contain requirements defining which of the CoAP functional modules specified in 5.3 and 5.4 are combined for each particular "ITS-S CoAP node" specified in 5.3.

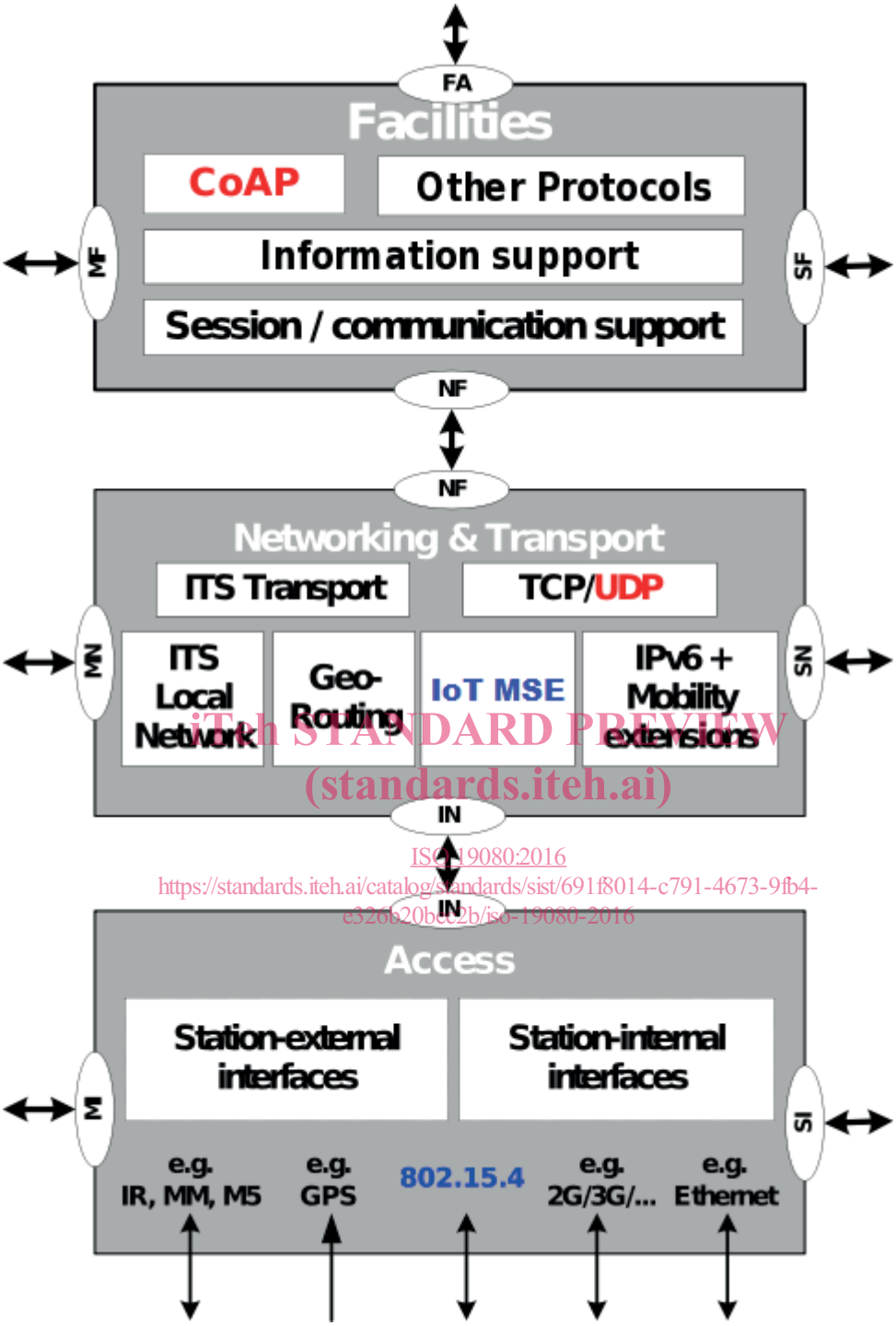

Figure 1 — Scope of this document within the architecture of an ITS-S

5.2 ITS-S nodes implementing CoAP

5.2.1 General

As CoAP was designed according to the REST architecture, it thus exhibits functionality similar to that of the HTTP protocol, it will support web style transactions originated or directed to 6LoWPAN nodes in ITS stations (ISO 19079).

For a better understanding of CoAP, the terminologies are specified in IETF RFC 7252 and the "Terminologies behind constrained-node networks" in IETF RFC 7228. These documents shall serve as the normative references for how to apply "CoAP" to ITS CALM.

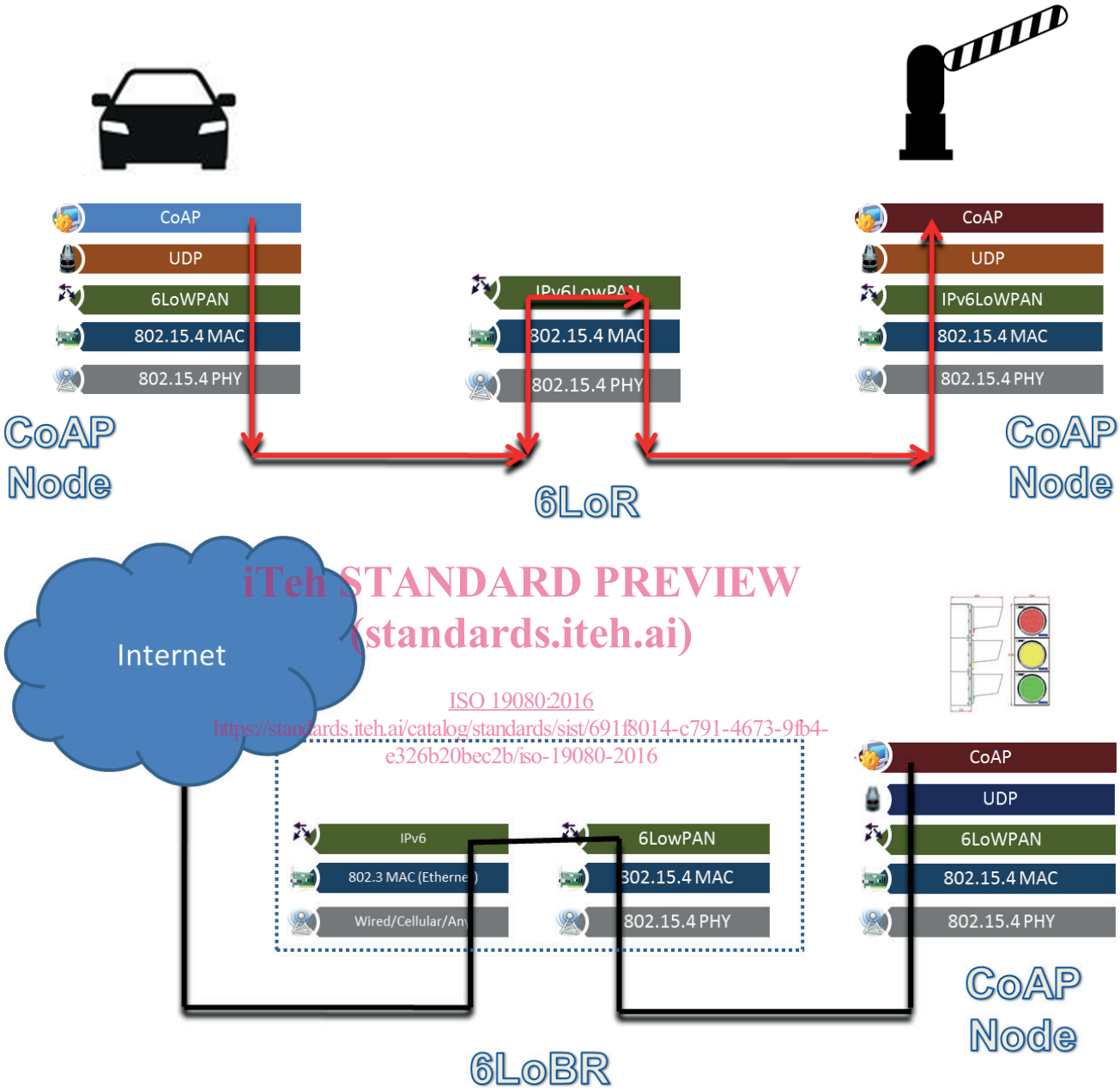

Figure 2 — CoAP based subsystem

A station implementing CoAP (in a PAN) is pictorially represented in Figure 2 together with its connections with other CoAP nodes in the same 6LoWPAN (IETF RFC 4919, IETF RFC 4944, IETF RFC 6282), eventually exploiting the multi-hop forwarding module featured by ad-hoc routers. The forwarding service established with peers of the Internet is also shown leveraging the functionality provided by a "6LoWPAN Border Router" equipped with at least two MAC interfaces.

The CoAP-based ITS stations can notably take part in the "road-side" and "vehicular" subsystems as pictorially shown in ISO 21217:2014, Figure 16, although this protocol instantiated at the facility layer does not depend on the actual network topology. The other scenarios will not be discussed in this document due to the reduced impact they provide on the C-ITS general architecture.