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Intelligent Transport Systems — Communications access for land mobiles (CALM) - CoAP facility

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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.

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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 ITS station reference architecture.

These 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 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 7228 *The Terminologies for Constrained-node network*

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 6690 *The Constrained RESTful Environments (CoRE) Link Format*

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 Technical 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.

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1 Scope

This Technical 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 Technical Specification. This Technical Specification 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 (Management). In addition to the requirements specified within this Technical Specification, a number of notes and examples are provided to illustrate CoAP main facilities.

2 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 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 – Service Access Points*

ISO 19079, *Intelligent transport systems — Communications access for land mobiles (CALM) — 6LoWPAN Networking*

IETF RFC 7228 *The Terminologies for Constrained-node network*

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 6690 *The Constrained RESTful Environments (CoRE) Link Format*

IETF RFC 7252 *The Constrained Application Protocol (CoAP)*

IETF RFC 6347 *Datagram Transport Layer Security (DTLS)*

IETF RFC 6655 *AES-CCM Cipher Suites for Transport Layer Security (TLS)*

3 Terms and definitions

For the purposes of this document, the terms and definitions in ISO 19079, ISO 21210:2012, ISO 21217:2014, ISO 21218:2013 and ISO 24102-3:2013 and the following apply.

NOTE Most of the definitions are taken from IETF RFC 7228 *The Terminologies for Constrained-node network*

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 6690 *The Constrained RESTful Environments (CoRE) Link Format*

IETF RFC 7252, Error! Reference source not found. and Error! Reference source not found..

ITS-S CoAP node

device/node that implements CoAP protocol (IETF RFC 7228 *The Terminologies for Constrained-node network*)

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 6690 *The Constrained RESTful Environments (CoRE) Link Format*

IETF RFC 7252)

ITS-S CoAP Endpoint

entity participating in the CoAP protocol

NOTE 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.

ITS-S CoAP Client

originating endpoint of a request; the destination endpoint of a response

ITS-S Server

destination endpoint of a request; the originating endpoint of a response

Confirmable message

message requiring an acknowledgement.

NOTE These messages are called "Confirmable". When no packets are lost, each Confirmable message prompts exactly one return message of type Acknowledgement or type Reset.

Non-confirmable message

message not requiring an acknowledgement

NOTE This is particularly true for messages that are repeated regularly for application requirements, such as repeated readings from a sensor.

Acknowledgement message

message acknowledging that a specific Confirmable message arrived

NOTE By itself, an Acknowledgement message does not indicate success or failure of any request encapsulated in the Confirmable message.

Reset message

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

NOTE 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").

Subject

a resource in the namespace of an ITS-S CoAP server

NOTE The state of the resource can change over time, ranging from infrequent updates to continuous state transformations.

Observer

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

4 Symbols and abbreviated terms

Symbols and abbreviated terms used in this Technical Specification are listed below. Reference should also be made to ISO 19079, ISO 21210, ISO 21217, ISO 21218, ISO 24102, IETF RFC 4944, IETF RFC 6282, IETF RFC 7228 and IETF RFC 6775.

5 Requirements

5.1 Categories

Clause 6 explains the relationship between the four categories of the requirements.

- The first category (see 6.2) 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 6.3) 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 6.4) 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 6.5) contain requirements defining which of the CoAP functional modules specified in 6.3 and 6.4 are combined for each particular 'ITS-S CoAP node' specified in 6.3;

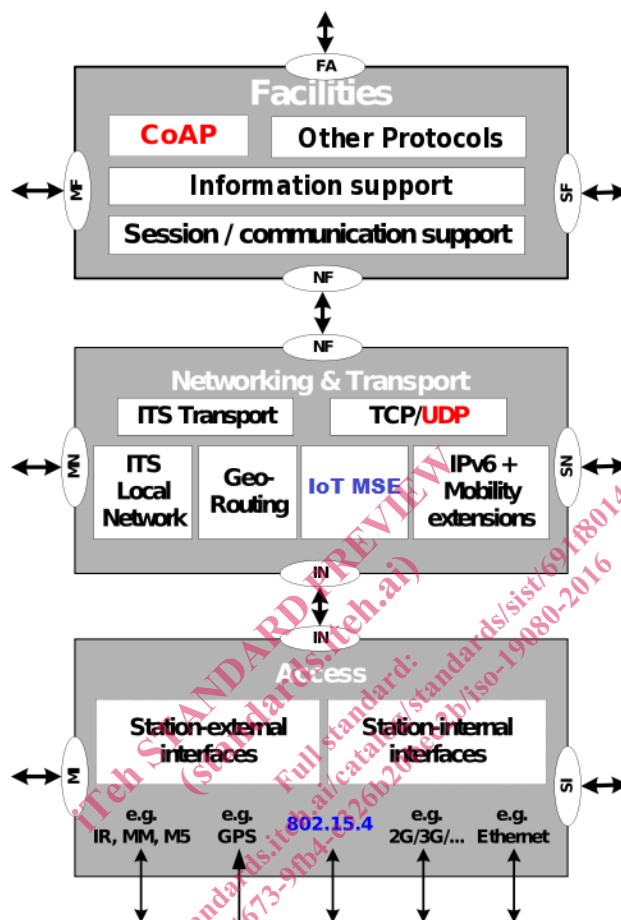


Figure 1: Scope of this TS within the architecture of an ITS-S

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.