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Intelligent transport systems — Localized communications — ITS-M5

Systèmes intelligents de transport — Communications localisées — M5

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

This second edition cancels and replaces the first edition (ISO 21215:2010) which has been technically revised.

The following main changes have been made since the last edition:

— document restructured in support of different regulatory regions;

— requirements applicable for usage in the European Union added;

— LDP/SNAP replaced by EPD;

— ASN.1 aligned with latest developments in ISO/TC 204;

— provisioning for path and flow management added;

— normative annex related to conformance testing, that contains the PICS proforma, added;

— editorial improvements.

Introduction

Localized communications is an essential component of hybrid communications in Intelligent Transport Systems (ITS). Various access technologies are suited for localized communications. A major focus of ITS stakeholders for "Cooperative ITS" and "Urban ITS" is on the access technology originally specified by IEEE in the standard IEEE Std 802.11™-2016. For usage in ITS, IEEE specified the operational mode "Outside the Context of a BSS" (OCB), also known under the acronym of 802.11p.

This document primarily provides complements to IEEE Std 802.11™-2016 OCB needed to operate as an ITS access technology in the various regions of the world, and optionally also supports ordinary WiFi operation, i.e. not applying OCB. An implementation of this document is referred to as an ITS-M5 communication interface (CI).

ITS-M5 CIs are capable of

— interoperating with IEEE WAVE devices, and

— receiving messages from ETSI ITS-G5 devices.

This document supports usage of ITS-M5 in various station contexts. Precise specifications are provided for the context specified in ISO 21217 and ISO 21218. Optional support for "Path and Flow Management" specified in ISO 24102-6[8] is also provided.

Intelligent transport systems — Localized communications — ITS-M5

1 Scope

This document provides specifications of a communication interface (CI) named "ITS-M5". The name "ITS-M5" indicates microwave frequency bands in the range of 5 GHz.

ITS-M5 CIs are based on the wireless LAN technology standardized at IEEE. This document specifies the additions to and deviations from IEEE Std 802.11™-2016 required to make ITS-M5 CIs compatible with the ITS station and communication architecture specified in ISO 21217.

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/IEC 8825-2, *Information technology — ASN.1 encoding rules: Specification of Packed Encoding Rules (PER)*

ISO 21217, *Intelligent Transport Systems — Communications access for land mobiles (CALM) — Architecture*

ISO 21218, *Intelligent Transport Systems — Hybrid communications — Access technology support*

ETSI EN 301 893, *5 GHz RLAN; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU*

ETSI EN 302 571, *Intelligent Transport Systems (ITS); Radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band; Harmonised Standard covering the essential requirements of article 3.2 of Directive 2014/53/EU*

IEEE Std 802™, *IEEE Standard for Local and Metropolitan Area Networks: Overview and Architecture*

IEEE Std 802.11™-2016, *IEEE Standard for Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 11: Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) specifications*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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

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

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

3.1
EtherType
2-octet unsigned Integer number with allowed values ≥1 536 (0x06.00), assigned by the IEEE Registration Authority and used in data link layer frames, which identifies the protocol in the ITS networking & transport layer able to parse and process the ITS-NTPDU contained in the data link layer frame

4 Symbols and abbreviated terms

I-Parameter	Parameter of a CI or virtual CI (VCI) specified in ISO 21218.
M5-parameter	Parameter of an ITS-M5 CI / VCI specified in this document.
,	Commas within numbers are used as decimal points.
e.i.r.p.	Equivalent isotropic radiated power
NPDU	Network PDU
EPD	EtherType protocol discrimination
ITS-SU	ITS station unit (composed of one or several ITS-SCUs)
ITS-SCU	ITS station communication unit
LLC	Logical link control (sub-layer of the data link layer)
LPD	LLC protocol discrimination
LPDU	Link PDU
SNAP	Sub-network access protocol
ITS-NTPDU	ITS networking & transport layer PDU
PDU	Protocol data unit
RLAN	Radio LAN
BRAN	Broadband radio access network
LAN	Local area network
OCB	Outside the context of a BSS
BSS	Basic service set (specified in IEEE Std 802.11™-2016)
PHY	Physical (layer)
MAC	Medium access control (sub-layer of the data link layer)

5 General requirements

5.1 IEEE 802.11

An ITS-M5 implementation shall be compliant with IEEE Std 802.11™-2016, with restrictions and amendments as specified in this document.

5.2 Architecture

The ITS station architecture specified in ISO 21217 is presented in Figure 1. The ITS-M5 CI is allocated in the ITS-S access layer of the ITS station architecture.

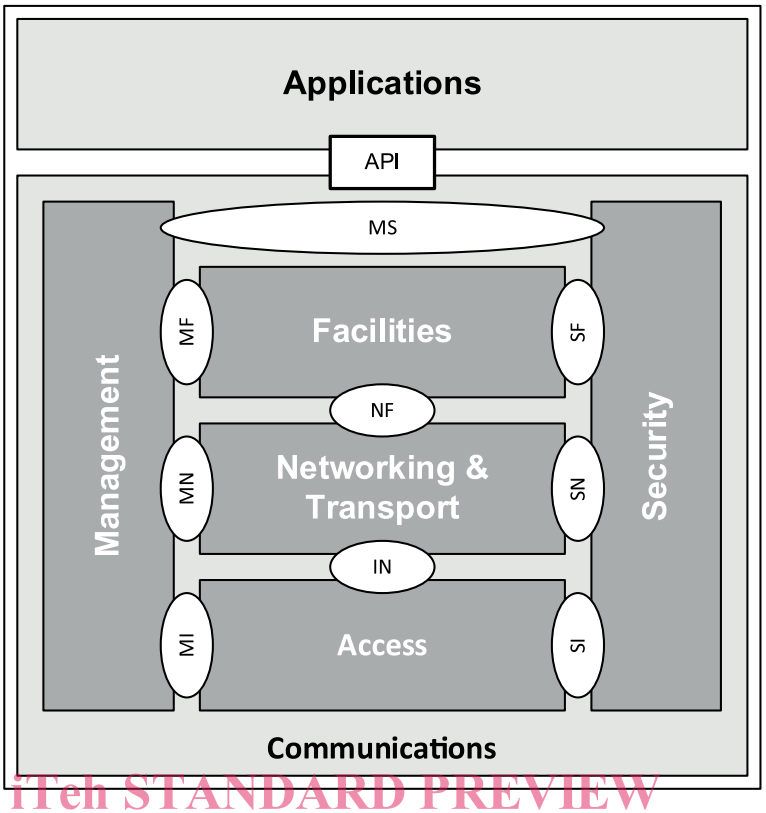

Figure 1 — ITS station architecture

Figure 2 shows the architecture diagram of an ITS-M5 communications interface (CI) embedded in the general ITS station architecture.

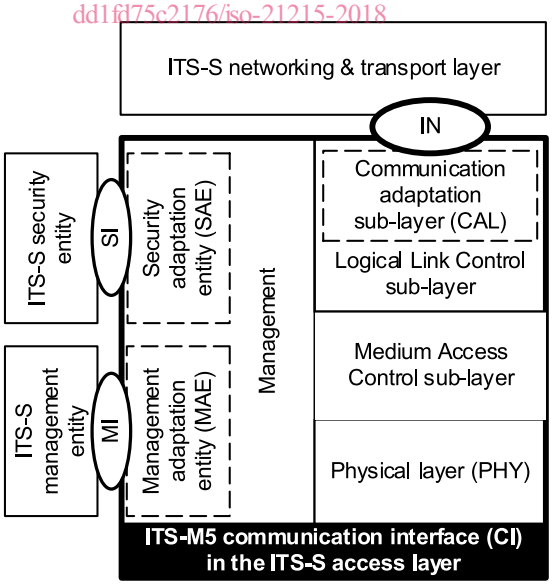

Figure 2 — ITS-M5 CI architecture

The communication protocol layers of the ITS-M5 CI are

a) Physical layer for microwave communications (PHY), and

b) Medium access control sub-layer (MAC).

An ITS-M5 CI as specified in this document is an ITS wireless CI of CI class CIC-I1 for general simultaneous bi-directional communications with multiple peer-stations as specified in ISO 21218. An implementation may also be configured as an ITS wireless CI of CI class CIC-I3 (groupcast transmitter), and CI class CIC-I4 (receiver only).

An ITS-M5 CI provides the functionality of the IN-SAP specified in ISO 21218, and uses the functionality of the MI-SAP, and the SI-SAP, as specified in ISO 24102-3[6].

NOTE 1 Service primitive functions for the SI-SAP are not identified so far.

NOTE 2 Multiple ITS-M5 CIs per ITS station unit (ITS-SU) are possible, regardless of whether the CIs belong to the same ITS-SCU or to different ITS-SCUs of the same ITS-SU; see ISO 21217 for the specifications of ITS-SU and ITS-SCU.

5.3 Hybrid communications support

An ITS-M5 CI shall support the hybrid communications functionality of ISO 21218, and may implement this functionality in a strict way compliant with ISO 21217, but also in different ways supporting other station architectures.

5.4 Path and flow management support

Support of path and flow management specified in ISO 24102-6[8] is optional.

Details of path and flow management applicable for the ITS-S access layer are specified in ISO 21218.

Path and flow management uses MI-COMMAND and MI-REQUEST service primitive functions presented in Annex B and in Annex C, respectively. Specific behaviour of ITS-M5 upon reception of such MI-COMMANDs, and the procedures to present MI-REQUESTs beyond the requirements set up in ISO 21218 are specified in Annex E.

5.5 MI-SAP support

An ITS-M5 CI shall support the MI-SAP functionality of ISO 24102-3[6] with details specified in ISO 21218, and may implement this functionality in a strict way compliant with ISO 21217, but also in different ways supporting other station architectures.

6 Communication interface protocol stack

6.1 Physical layer

An ITS-M5 implementation shall be compliant with the specification of

— Orthogonal frequency division multiplexing (OFDM) specified in IEEE Std 802.11™-2016, Clause 18.

Other PHY specifications from IEEE Std 802.11™-2016 are not applicable for ITS-M5.

According to regional requirements an ITS-M5 implementation shall

— support applicable congestion control mechanisms, and

— support applicable mitigation techniques enabling coexistence with nearby other services, e.g. mitigation techniques specified in ETSI TS 102 792[21].

EXAMPLE Coexistence with the European "Electronic Toll Collection" (ETC) services based on 5,8 GHz backscatter communications is essential in Europe.

An ITS-G5 implementation shall support self-interference mitigation techniques, e.g. cross-CI prioritization specified in ISO 21218, if self-interference mitigation techniques are applicable for a given implementation.

Radio frequency parameters such as centre frequency, channel spacing, (default) data rates, TX power (density) limits, channel usage are as required by regional regulation.

6.2 Medium access control sub-layer

The "Frame body" field of data frames specified in IEEE Std 802.11™-2016, Figure 9-1 contains the ITS-M5 LPDU (Link Protocol Data Unit) as illustrated in Figure 3.

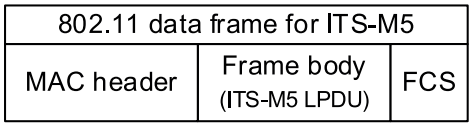

Figure 3 — 802.11 data frame

6.3 Logical link control sub-layer

IEEE Std 802.11™-2016 does not specify a logical link control sub-layer protocol. Related functionality is part of the communication adaptation sub-layer specified in 6.4.

The Length/Type field specified in IEEE 802.3-2015[26] contains a 2-octet unsigned Integer number. Dependent on the value, the field provides either length information or EtherType information. If the value contained in this field is equal to or larger than 1 536 = 0x06.00, the field contains an EtherType address. Ethertype addresses are assigned by the IEEE Registration Authority, and are used to identify the protocol employed directly above the ITS-S access layer. This method of addressing is named "EtherType Protocol Discrimination" (EPD). An ITS-M5 CI shall support EPD specified in IEEE Std 802™.

EXAMPLE ISO FNTP specified in ISO 29281-1[9] is identified by the EtherType 0x89.50. IPv6 is identified by the EtherType 0x86.DD. GeoNetworking specified in the ETSI multi-part standard EN 302 636[20] is identified by the EtherType 0x89.47. The IEEE WSMP specified in IEEE 1609.3[24] is identified by the EtherType 0x88.DC.

NOTE 1 Allocations of EtherType values are published at http://standards.ieee.org/develop/regauth/ethertype/eth.txt.

NOTE 2 EPD replaces LLC Protocol Discrimination (LPD). ETSI ITS-G5 is the only known ITS access technology still using LPD.

Different to the information in IEEE Std 802.11™-2016, 5.1.4, EPD is applicable in all frequency bands as long as dot11OCBActivated is set to true, i.e. activating the operation mode "outside the context of a BSS" (OCB).

The ITS-M5 LPDU illustrated in Figure 4 contains the ITS-NTPDU introduced in ISO 21217, preceded by the EtherType field.

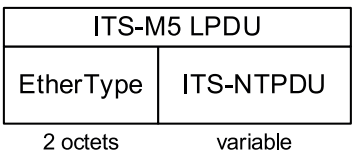

Figure 4 — ITS-M5 LPDU

NOTE 3 Values in the range 0 through 1 535 (0x05.FF) are not allowed to occur in the EtherType field, as these numbers provide length information.

On the basis of "best effort" an ITS-M5 CI may also support reception of 802.11 data frames with a frame body field supporting SNAP (SubNetwork Access Protocol) addressing rather than EtherType addressing. SNAP addressing is illustrated in Figure 5. Discrimination between SNAP and EPD is possible as long as the value 0xAA.AA is not used as an EtherType address.

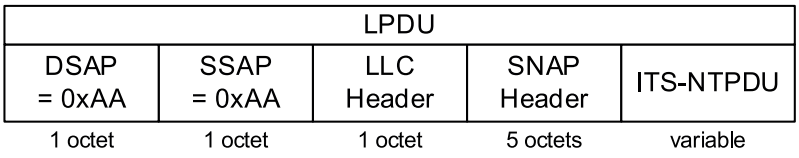

Figure 5 — SNAP addressing

NOTE 4 SNAP is an extension of the deprecated IEEE 802.2 Logical Link Control (LLC) standard, still available as ISO/IEC 8802-1:2001[25]. Currently the only know implementation of SNAP in ITS is standardized in ETSI EN 302 663[19] for ETSI ITS-G5.

NOTE 5 The normative support of EPD enables interoperability with IEEE WAVE devices (e.g. for road safety messages from the BSM message set). The SNAP support in receive mode allows reception of messages from ITS station units conformant with ETSI EN 302 663 (e.g. broadcast road safety messages such as CAM and DENM).

6.4 Communication adaptation sub-layer

The communication adaptation sub-layer (CAL) is introduced in ISO 21218. The major task of CAL is to provide the IN-SAP. ASN.1 details of the IN-SAP IN-UNITDATA service primitives are specified in ISO 21218.

ITS-M5 CIs being compliant with ISO 21218 shall use an EtherType value in the IN-UNITDATA service primitives to identify the applicable ITS-S networking & transport layer protocol.

In other implementation contexts, the EtherType value shall be used in the applicable service access point primitives that exchange service data units between ITS-M5 and the network layer entity; details are outside the scope of this document.

The IN-SAP service primitives of DL-UNITDATA contain the parameter "priority", which is the user priority specified in ISO 21218. In implementations being compliant with ISO 21218 the relation between user priority and IEEE 802.11 access category shall be as specified in Tables 1 and 2.

Table 1 — User priorities and IEEE access categories for TX

User priority	Access category (AC)	Data traffic type	UP in IEEE 802.1D	Data traffic type in IEEE 802.1D
224 – 255	AC_VO	Voice	7	Network control (NC)
192 – 223			6	Voice (VO)
160 – 191	AC_VI	Video	5	Video (VI)
128 – 159			4	Controlled load
96 – 127	AC_BE	Best effort	3	Excellent effort (EE)
64 – 95			0	Best effort (BE)
32 – 63	AC_BK	Background	2	Spare (-)
0 – 31			1	Background (BK)

Table 2 — User priorities for RX

TID	unknown	1	2	0	3	4	5	6	7
User priority	0	31	63	95	127	159	191	223	255