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Intelligent transport systems — Localized communications — Optical camera communication

Systèmes intelligents de transport — Communications localisées — Communication par caméra optique

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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 of the voluntary nature of standards, 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 www.iso.org/iso/foreword.html.

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

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

Localized communications are an essential component of hybrid communications in Intelligent Transport Systems (ITS). Various access technologies are suited for localized communications. An increasing interest of ITS stakeholders for Cooperative ITS (C-ITS), Urban ITS (U-ITS), and Advanced Driver Assistance Systems (ADAS) is on the access technology in OCC (Optical Camera Communication) specified by IEEE.

OCC is capable of:

a) interoperating with cameras and LEDs devices, and

b) receiving messages from LED sources, and transmitting messages from back light and front light of vehicles to other vehicles.

The purpose of OCC is broadcast dissemination of ITS information from:

— light sources (traffic light, street light, traffic sign), and

— vehicles

to other vehicles (one-to-many); see Figure 1.

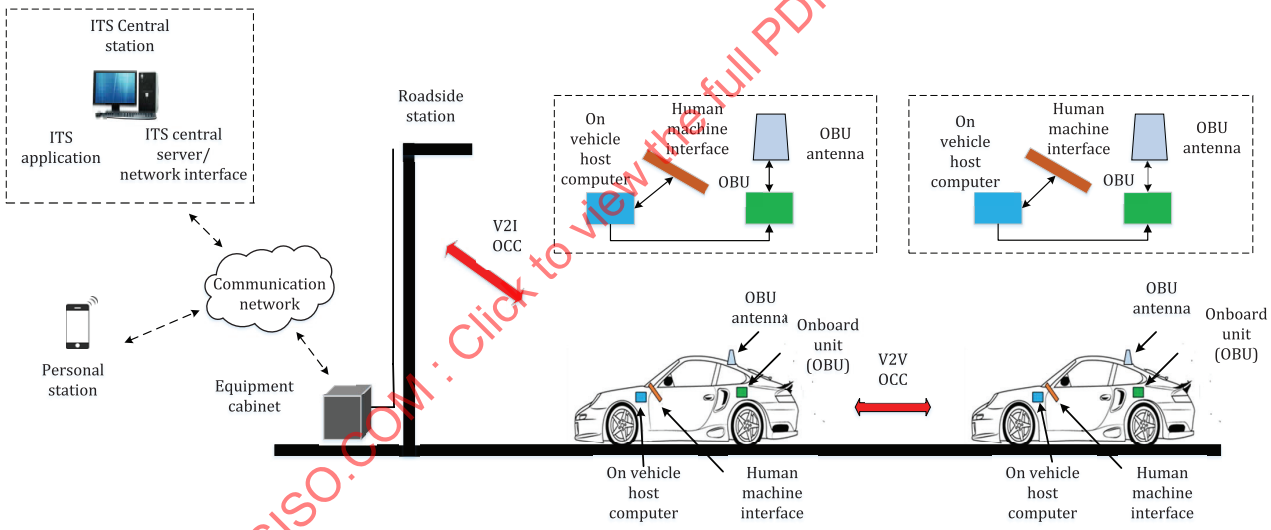

Figure 1 — OCC based ITS Communication

OCC is considered for usage in:

1) roadside ITS station units (ITS-SUs), and

2) vehicle ITS-SUs.

OCC is intended to provide information to vehicles, see Figure 2.

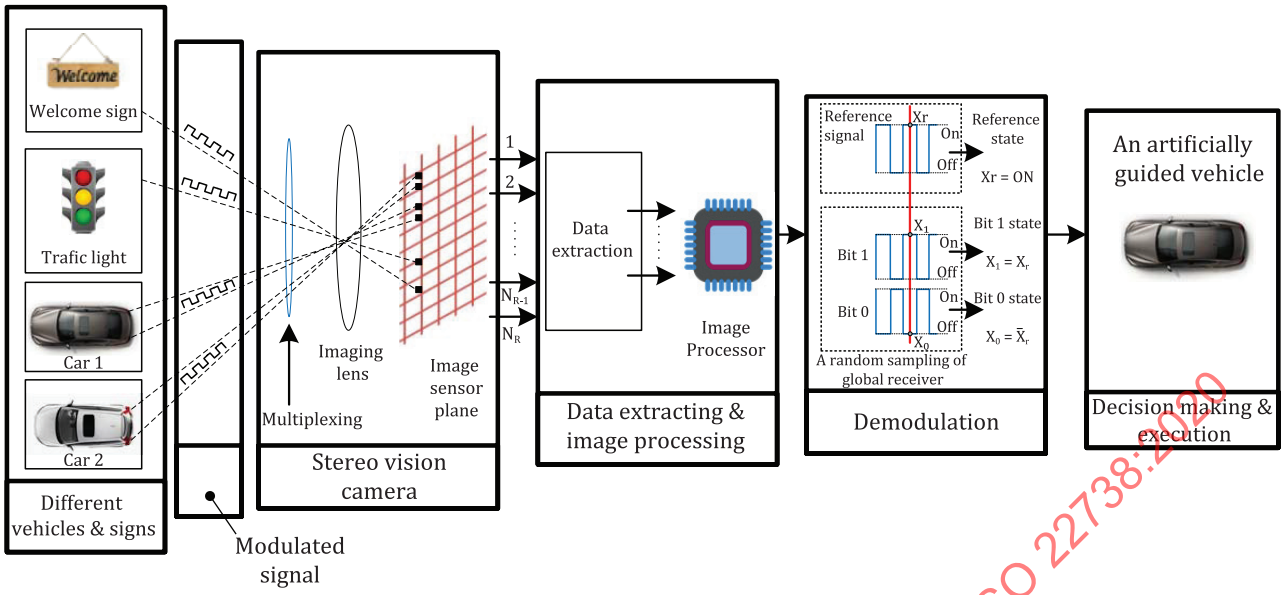

Figure 2 — Vehicle-centric data flow in OCC

OCC uses LEDs as transmitters and cameras as receivers with visible light or near IR (NIR). Characteristics of OCC are:

— visibility (visible light band);

— no regulation in optical frequency;

— harmlessness to human health (infrared and visible light band);

— non-interference with CIs based on radio waves; and

— licence-free operation.

See also Reference [6].

Figure 3 shows the basic operation of OCC. OCC supports ITS applications for vehicular scenarios such as those already proposed by universities and companies[7], [8], [9].

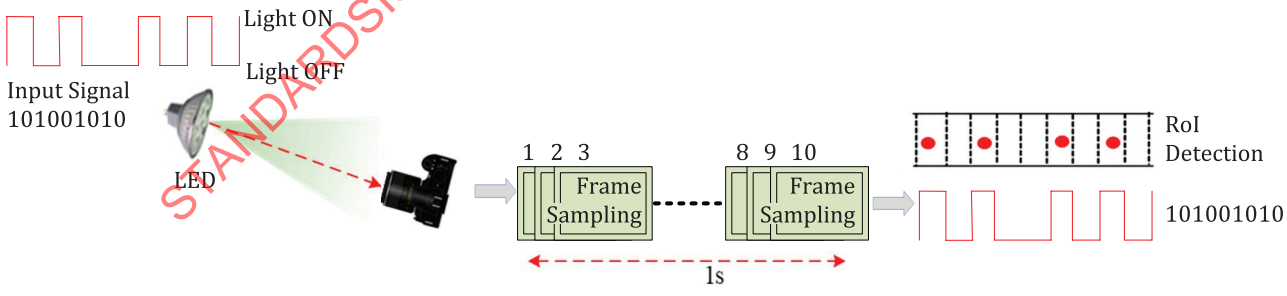

Figure 3 — Basic OCC operation

Intelligent transport systems — Localized communications — Optical camera communication

1 Scope

This document specifies OCC (Optical Camera Communication) as an access technology for localized communications applicable in ITS stations conforming with ISO 21217.

OCC access technology is specified for the implementation context of ISO 21218. This document provides specifications of a communication interface (CI) named "ITS-OCC".

This document specifies the additions to and deviations from IEEE 802.15.7:2018 which are required in order to make ITS-OCC CIs compatible with:

— the ITS station and communication architecture specified in ISO 21217, and

— the hybrid communications support specified in ISO 21218.

This document specifies:

— an OCC profile of IEEE 802.15.7:2018 for usage in C-ITS;

— details of CAL (ISO 21218); and

— details of MAE (ISO 21218, ISO 24102-3).

NOTE Considering safety-related services involving communications between a vehicle and a roadside station being performed on the basis of OCC, it is noted that, due to shadowing, communications can be interrupted or blocked for a significantly long time.

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 17419, *Intelligent transport systems — Cooperative systems — Globally unique identification*

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

ISO 21218, *Intelligent transport systems — Hybrid communications — Access technology support*

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

IEEE 802.15.7:2018, *IEEE standard for Optical Wireless Communication (OWC)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217, ISO 21218, and IEEE 802.15.7:2018 apply.

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

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

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

4 Symbols and abbreviated terms

For the purposes of this document, the symbols and abbreviated terms given in ISO 21217, ISO 21218, and IEEE 802.15.7:2018, and the following apply.

ATS	abstract test suite
DC	direct current
DME	device management entity
DS8-PSK	dimmable spatial 8-phase shift keying
EIRP	equivalent isotropic radiation power
FSK	frequency shift keying
HS-PSK	hybrid spatial phase shift keying
ICS	implementation conformance statement
ITS-OCC	name of the OCC communication interface
LED	light-emitting diode
LLC	logical link control
MAC	medium access control sub-layer
M-FSK	M-ary FSK
NIR	near-infrared radiation
OCC	optical camera communications
OOK	on-off keying
OWC	optical wireless communications
PAN	personal area network
PHY	physical layer
PIB	PAN information base
S2-PSK	spatial 2-phase shift keying
SAP	service access point
SSCS	service-specific convergence layer
SUT	system under test
TSS&TP	test suite structure and test purposes

UFSOOK	undersampled frequency shift OOK
VPPM	variable pulse-position modulation
VPWM	variable pulse-width modulation

5 IEEE 802.15.7

5.1 General requirements

An ITS-OCC CI implementation shall be conformant with the specifications presented in IEEE 802.15.7, with restrictions and amendments as specified in this document.

NOTE IEEE 802.15.7 represents the basis for developing products with guaranteed functionalities. It also provides a minimum benchmark for future developments. IEEE 802.15.7 is intended to support a variety of expected applications, relating to OWC Personal Area Networks. This document only supports a subset of the whole functionality of IEEE 802.15.7.

Information on the frequency band and frequency allocation for rolling shutter OCC are presented in Annex E.

Information on the dimming method is provided in Annex F.

5.2 OCC PHY and MAC architecture

IEEE 802.15.7 defines a PHY and MAC layer for short-range optical wireless communications using visible light in optically transparent media. It considers mobility of the visible link, compatibility with visible-light infrastructures, impairments due to noise and interference from sources like ambient light, and a MAC layer that accommodates visible links. Furthermore, IEEE 802.15.7 adheres to applicable eye safety regulations.

Figure 4 presents the OCC PHY and MAC architecture as specified in IEEE 802.15.7. This architecture maps to the ITSS access layer of the station architecture presented in Figure 5 and Figure 6.

NOTE According to IEEE 802.15.7:2018 Annex B, an LLC sub-layer is part of the "upper layers". Figure 4 does not reflect this fact.

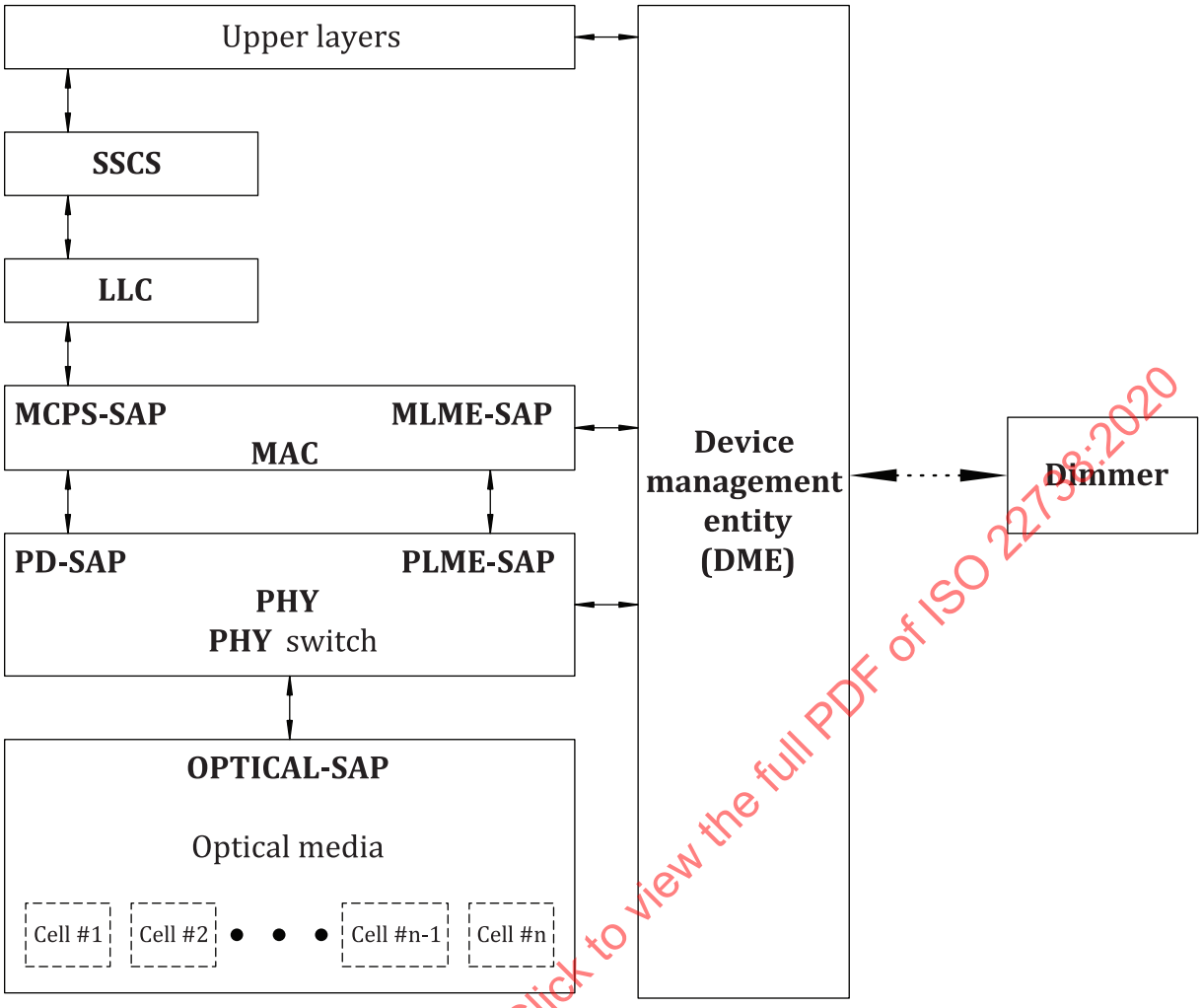

Figure 4 — OCC PHY and MAC architecture in IEEE 802.15.7

5.3 PHY mode

An ITS-OCC CI implementation conformant with this specification shall support PHY mode IV specified in IEEE 802.15.7.

NOTE 1 PHY IV is intended for use with discrete light sources.

NOTE 2 For PHY IV, over-the-air PHY and MAC frame configuration is forbidden.

NOTE 3 PHY IV distinguishes 5 sub-modes by different modulation schemes, i.e. UFSOOK, Twinkle VPPM, S2-PSK, HS-PSK, Offset-VPWM, see also 5.4.

5.4 Modulation schemes

An ITS-OCC implementation shall be conformant with the specification of:

— Spatial 2 Phase Shift Keying (S2-PSK) modulation scheme specified in IEEE 802.15.7;

— Hybrid Spatial Phase Shift Keying (HS-PSK) modulation scheme specified in IEEE 802.15.7.

NOTE The choice between S2-PSK and HS-PSK is given by implementation, i.e. read from the PIB. Thus, there is a potential interoperability problem, as the modulation scheme is not reported in a frame header.

5.5 MAC frame format

This document does not specify normative requirements on the MAC frame format.

NOTE 1 According to IEEE 802.15.7, for PHY IV, the frame control field, the sequence number field, the destination OWPAN identifier field, the MAC source address field, the MAC destination address field, and the auxiliary security header field are not present.

NOTE 2 According to IEEE 802.15.7, in PHY IV, the frame payload field is not used except in the Twinkle VPPM and Offset-VPWM PHY modes. The Twinkle VPPM and Offset-VPWM PHY modes use only the frame payload. The frame payload field has a variable length and contains information specific to individual frame types. If the security is enabled, then the frame payload is protected as defined by the security suite selected for that frame.

NOTE 3 According to IEEE 802.15.7, in PHY IV, the FCS field is not used except in the UFSOOK, Offset-VPWM PHY, and Twinkle VPPM PHY modes.

5.6 Dimming

An ITS-OCC CI implementation conformant with this document shall support dimming specified in IEEE 802.15.7. Dimming requests from upper layers to the PHY shall be indicated using the PHY PIB attribute specified in IEEE 802.15.7. The PHY shall support dimming using one of the techniques specified in either dimming during idle time or dimming during data transmission time when the PHY PIB attribute *phyDim* specified in IEEE 802.15.7 is set.

5.7 Mitigation of flickering

An ITS-OCC CI implementation conformant with this document shall support the mitigation of flickering in intra-frames and inter-frames as specified in Table 1.

Table 1 — Flickering mitigation

Operational mode	Data transmission (Intra-frame flicker)	Idle or RX periods (Inter-frame flicker)
S2-PSK	DC-balanced waveforms, ½-rate line code	Out-of-band idle pattern
HS-PSK	VPPM waveforms	

6 ITS station

6.1 ITS station and communication architecture

The ITS station architecture specified in ISO 21217 is presented in Figure 5. The ITS-OCC CI is allocated in the ITS-S access layer of the ITS station architecture.

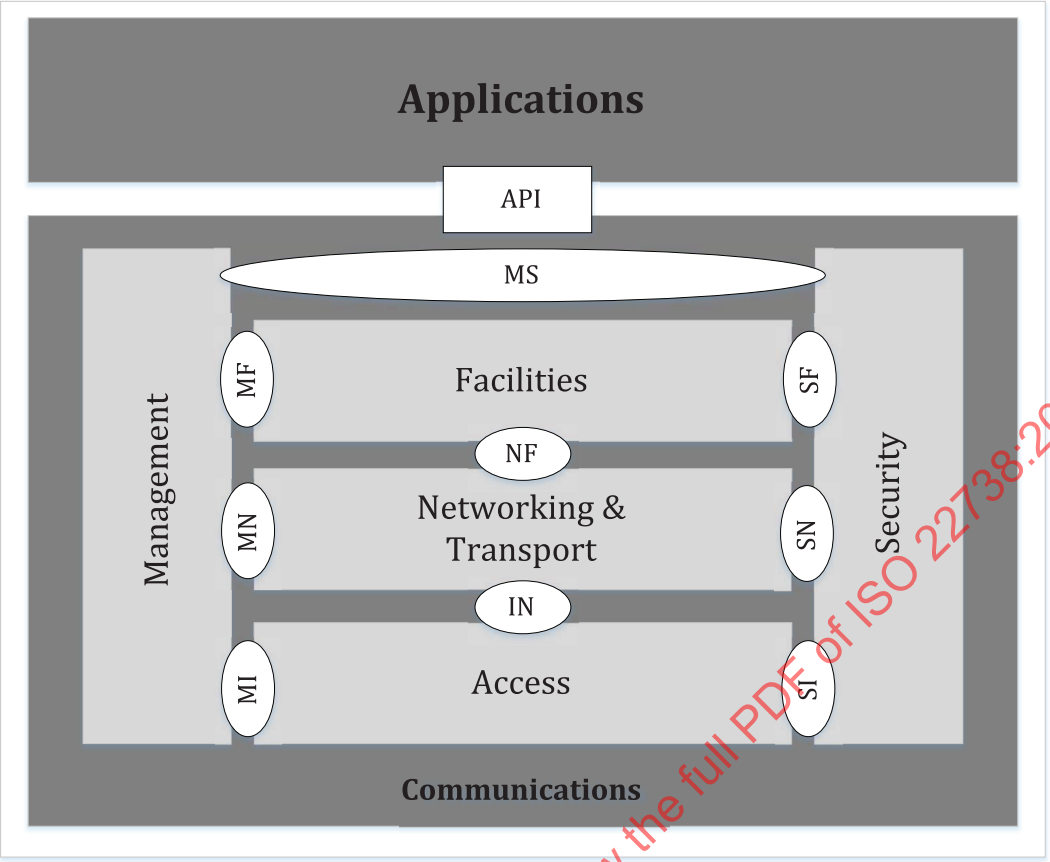

Figure 5 — ITS station architecture (from ISO 21217)

Figure 6 shows the architecture diagram of an ITS-OCC CI embedded in the general ITS station architecture.

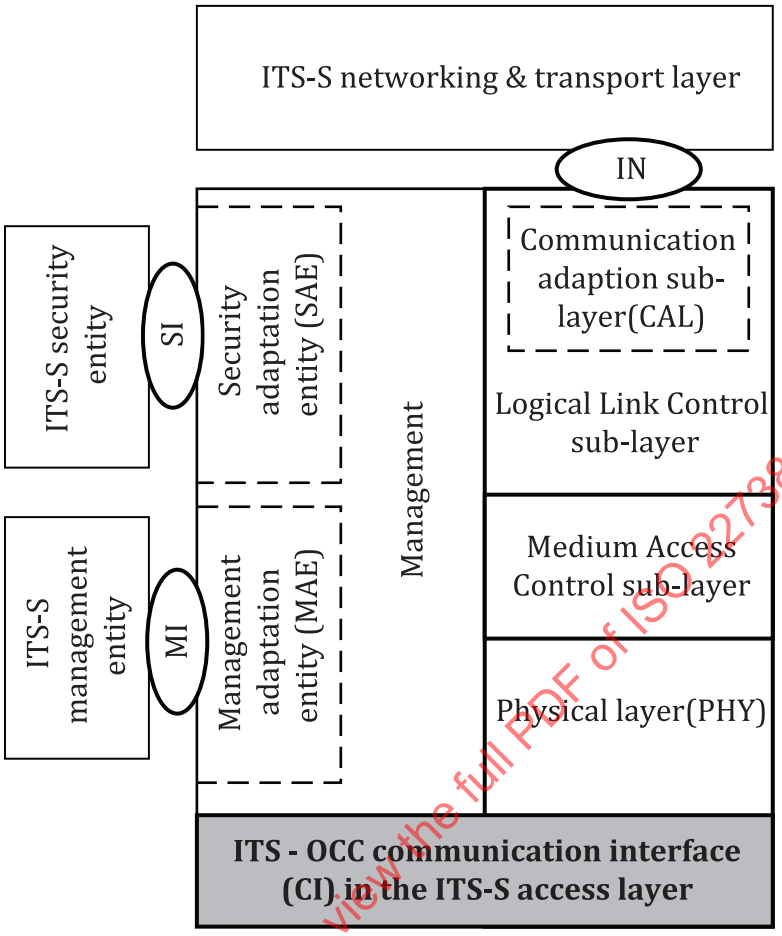

Figure 6 — ITS-OCC CI architecture

The OSI communication protocol layers of the ITS-OCC CI are:

a) Physical layer (PHY); and

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

An ITS-OCC CI as specified in this document is an ITS wireless CI

— of MedType 12; The ASN.1 type of MedType shall be `ITSatt`, specified in ISO 17419 for ITS-ATT — see also the NOTE below;

— of CI class CIC-il3, specified in ISO 21218;

— of CI access class CIAC-1, specified in ISO 21218.

NOTE The parameter MedType was originally specified in the first edition of ISO 21218 and then continued in ISO 17419 with the new name ITS-ATT. Values 0 through 11, 128, 254, and 255 are already assigned values presented in ISO 17419. The next available value 12 is thus used for ITS-OCC CIs.

An ITS-OCC CI shall provide the functionality of the IN-SAP specified in ISO 21218, and uses the functionality of an MI-SAP, and an SI-SAP, as specified in ISO 21218 and ISO 24102-3.

ASN.1 definitions applicable for ITS-OCC shall be as specified in Annex D.

6.2 ITS-S service access points

6.2.1 General

As service access points (SAPs) by definition describe functional behaviour only, SAPs may be implemented in different ways. Requirements set up in this document to support SAPs and the related service primitives thus mean to support the functionality. This support may be implemented either in a strict meaning or in an implementation-specific way.

6.2.2 Communications SAPs

An ITS-OCC CI shall support the IN-SAP functionality specified in ISO 21218.

6.2.3 Management SAPs

An ITS-OCC CI shall support the MI-SAP functionality of ISO 24102-3, taking into account details specified in ISO 21218, and may implement this functionality in a strict way conformant with ISO 21217 and ISO 21218, but also in different ways supporting other station architectures.

The general specification of MI-COMMANDs is provided in ISO 24102-3. The applicability for ITS-OCC shall be as specified in Annex B.

The general specification of MI-REQUESTs is provided in ISO 24102-3. The applicability for ITS-OCC shall be as specified in Annex B.

6.2.4 Security SAPs

An ITS-OCC CI shall support the SI-SAP functionality of ISO 24102-3, taking into account details specified in ISO 21218.

NOTE At the time of publishing this document, ISO 21218 did not yet specify any security details.

6.3 Hybrid communications support

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

7 Communication interface protocol stack

7.1 Communication interface parameters

Communication interface parameters for the general case are specified in ISO 21218. Additional details that are specific to ITS-OCC shall be as specified in Annex A.

7.2 Physical layer

The configuration of the OCC PHY layer shall be implemented via the configuration of PHY PIB attributes as specified in IEEE 802.15.7 (see Table 2).

Table 2 — PHY PIB attributes

Attribute	Type	Range	Description	ISO 21188 I-parameter
phyOccMcsID	Integer	0–15	This attribute identifies the OCC modulation when *phyOccEnable* = 1: 0: UFSOOK 1: Twinkle VPPM **2: S2-PSK (5 bps)** **3: HS-PSK (22 kbps)** 4: Offset-VPWM 5–15: Reserved	Part of medium-specific parameter OperationalMode, see A.2
phyDim	Integer	0–1 000	This attribute specifies the dimming level in steps of 0,1 %.	Part of medium-specific parameter OperationalMode, see A.2

Dependent on the value of *phyOccMcsID*, the configuration of individual PHY modes shall be implemented as presented in Table 3 for S2-PSK, and in Table 4 for HS-PSK.

Table 3 — PHY PIB attribute configuration of S2-PSK

OCC Attribute	Type	Range	Description
phyS2pskNoLightSources	Integer	0–3	The number of light sources used to modulate the S2-PSK signal. 0: two light sources 1–3: Reserved
phyS2pskModulationRate	Integer	0–7	This attribute specifies the modulation frequency used for S2-PSK. 0: 200 Hz 2–7: Reserved

Table 4 — PHY PIB attribute configuration of HS-PSK

OCC Attribute	Type	Range	Description
phyHSpskHighStreamMode	Integer	0–7	The modulation of high data stream. 0: DS8-PSK mode 1: DS10-PSK mode 2–7: Reserved
phyHSpskModulationRate	Integer	0–7	This attribute specifies the modulation frequency used for S2-PSK and DSM-PSK of HS-PSK. 0: 200 Hz for S2-PSK and 80 kHz for DS8-PSK 1: 200 Hz for S2-PSK and 400 kHz for DS8-PSK 2–7: Reserved
phyHSpskLowDim	Integer	0-500	This attribute specifies the low dimming level of DSM-PSK
phyHSpskHighDim	Integer	500–1 000	This attribute specifies the high dimming level of DSM-PSK

Table 4 *(continued)*

OCC Attribute	Type	Range	Description
phyHSpskPsduLength	Integer	—	This is to specify the length of the high-speed link of HS-PSK.

7.3 Data link layer

7.3.1 General

The basic behaviour of the ITS-OCC CI data link layer shall be as specified in IEEE 802.15.7.

7.3.2 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.

8 Communication interface management

8.1 General management

The basic management of an ITS-OCC CI shall be as specified in IEEE 802.15.7.

8.2 Management adaptation entity

8.2.1 OCC parameters and I-Parameters

In implementations conformant with ISO 21218, the following rules apply:

— OCC parameters (PHY PIB) that have an equivalent I-Parameter defined in ISO 21218 shall be mapped on I-Parameters as specified in Annex A.

— OCC parameters (PHY PIB) which are relevant for ITS-OCC and do not have an equivalent I-Parameter defined in ISO 21218 shall be made visible to the ITS station management by means of medium-specific I-Parameters as specified in Annex A.

— I-Parameters which are relevant for ITS-OCC but cannot be mapped on an OCC parameter shall be implemented in the MAE as specified in ISO 21218, taking into account details specified in Annex A.

8.2.2 OCC management commands and MI-SAP commands and requests

In implementations conformant with ISO 21218 and ISO 24102-3, the following rules apply:

— OCC management commands that have an equivalent MI-COMMAND / MI-REQUEST defined in ISO 24102-3 shall be mapped on these MI-COMMAND / MI-REQUEST as specified in Annex B and Annex C.

— OCC management commands that are relevant for an implementation of ITS-OCC and do not have an equivalent MI-COMMAND / MI-REQUEST defined in ISO 24102-3 shall be made accessible in an implementation specific way.

— MI-COMMANDs / MI-REQUESTs which are relevant for ITS-OCC but cannot be mapped on OCC management commands are implemented in the MAE as specified in ISO 24102-3 taking into account details specified in Annex B and Annex C.

9 Procedures

9.1 Transmit procedure

Upon reception of a transmission request service primitive (e.g. an IN-UNITDATA.request service primitive specified in ISO 21218), CAL shall perform settings of 802.15.7 transmit parameters (e.g. type of modulation scheme (S2-PSK or HS-PSK), data rate, frequency, dimming value), as requested in a previous set-up by the ITS station management, and then forward the transmission request to the MCPS-SAP presented in Figure 4 and specified in IEEE 802.15.7.

9.2 Receive procedures

Upon reception of a frame via the MCPS-SAP presented in Figure 4 and specified in IEEE 802.15.7, CAL shall present the received packet to the ITS-S networking & transport layer, e.g. using the IN-UNITDATA. indication service primitive specified in ISO 21218.

9.3 Management procedures

No management procedures are specified in this document. For general applicable management procedures see IEEE 802.15.7, ISO 21218 and ISO 24102-1.

10 Conformance

Conformance testing of ITS-OCC is fully specified only in combination with applicable requirements for a specific station architecture, e.g. specified in ISO 21218.

Implementation conformance statements (ICS) complementing those ISO 21218 are not specified in this document.

11 Test methods

The test suite structure and test purposes (TSS&TP) and an abstract test suite (ATS) for conformance tests are not specified in this document.

Conformance testing may use upper tester access in the system under test (SUT) applying ITS station-internal management communications specified in ISO/TS 20026, ISO 24102-4, and ISO 24102-3.

Annex A
(normative)

Communication interface parameters

A.1 General

Communication interface parameters (I-Parameters) are generally specified in ISO 21218 for all access technologies. This normative annex provides details specific to ITS-OCC, and additional parameters dedicated to ITS-OCC.

A.2 I-Parameters specific to ITS-OCC

I-Parameters are specified in ISO 21218. Table A.1 specifies details of I-Parameters that are specific to ITS-OCC.

Table A.1 — I-Parameters specific to OCC

I-Param. No.	I-Parameter name / ASN.1 Type	Description/ range /values
8	LLaddress / `LLaddress`	These addresses are 64bit MAC addresses. This type is identified by the reference value `c-ITSatt-iso22738`. As IEEE 802.15.7 does not specify DLL addresses, neither globally unique nor dynamically assigned, an LLaddress of the ITS-OCC CI shall be generated as a LegacyCIID as specified in ISO 21218; see ASN.1 type `OCC-Layer2Address`.
9	LLaddressTemp / `LLaddressTemp`	
29	LLaddressPeer / `LLaddressPeer`	
15	RegulatoryInformation / `RegulatoryScheme`	RI data structure identified by the reference value `c-RegScheme-iso22738` set to `NULL`. No regulation known; see ASN.1 type `OCC-RegulatoryScheme`. Not applicable for OCC.
32	RXsensitivity / `RxSens`	The receiver sensitivity is presented in the format identified by the reference value `c-ITSatt-iso22738` set to `NULL`; see ASN.1 type `OCC-RXsensitivity` Not applicable for OCC.
33	TXpower / `TxPower`	The transmit power EIRP is presented in the format identified by the reference value `c-ITSatt-iso22738` set to `NULL`; see ASN.1 type `OCC-TXpower` Not applicable for OCC.
34	TXpowMax / `TxPowerMax`	
35	PeerTXpower / `PeerTXpower`	
36	LinkDataRate / `DataRateLink`	The OCC link data rate is presented in the format identified by the reference value `c-ITSattiso22738`. Not applicable for OCC.
NOTE I-Parameters of which the ASN.1 format is not specified so far, either are not used, or the format might be specified in a later version of this document.		

Table A.1 *(continued)*

I-Param. No.	I-Parameter name / ASN.1 Type	Description/ range /values
53	PhysicalChannelIdentifier / `PhysicalChannelIdentifier`	The ITS-OCC physical channel identifier is presented in the format identified by the reference value `c-ITSatt-iso22738`. Not specified so far.
54	OperationalMode / `OperationalMode`	The operational mode is presented in the format identified by the reference value `c-ITSatt-iso22738` and specified in Annex D. It points to PHY IV and the related selected modulation scheme phyOccMcsID, and to the dimming level phyDim; see ASN.1 type `Occ-OperationalMode`.
56	QoSrequirement / `QoSrequirement`	QoS requirements are presented in the format identified by the reference value `c-ITSattiso22738`. Not specified so far.
NOTE I-Parameters of which the ASN.1 format is not specified so far, either are not used, or the format might be specified in a later version of this document.		

A.3 Default of I-Parameters

Table A.2 — Default values of I-Parameters of OCC

I-Param. No.	I-Parameter name / ASN.1 Type	Default values / comments
4	ITS-SCU-ID / `ITS-scuId`	Allowed is the range 5 through 65534,
6	LocalCIID / `LocalCIID`	Calculated from MAC address.
7	TimeoutRegister / `TimeoutRegistration`	100 ms
8	LLaddress / `LLAddress`	Static MAC address as set by manufacturer.
9	LLaddressTemp / `LLAddressTemp`	Same as LLaddress.
10	CIclass / `CIclass`	CIC-il3.
11	CIaccessClass / `CIaClass`	CIAC-1.
12	CIstatus / `CIstatus`	0: not-existent
13	Notify / `Notify`	CIstatus
14	MedType / `MedType`	`c-ITSatt-iso22738` = 12: ISO 22738
15	RegulatoryInformation / `RegInfo`	Not applicable
16	Connect / `Connect`	Not applicable

Table A.2 *(continued)*

I-Param. No.	I-Parameter name / ASN.1 Type	Default values / comments
19	MinimumUserPriority / `MinimumUserPriority`	0: no restriction — smallest possible value (default in ISO 21218).
20	QueueLevel / `QueueLevelActual`	{priority, 0}
21	QueueLevelThreshold / `QueueLowThreshold`	{priority, 85}
22	QueueAlarmThreshold / `QueueAlarmThreshold`	{priority, 170}
24	CommRangeRef / `CommuniationRangeReference`	Calculation based on default values.
25	TimeOfLastReception / `TimeOfLastReception`	IAT set to 0.
26	InactivityTimeLimit / `InactTimeLimit`	0: no limit.
27	MediumUsage / `MediumUsage`	{receive:0, transmit: 0}.
28	MedUseObservationTime / `MedUseObsTime`	1 second.
31	MinPrioCrossCI / `MinimumCrossCiPriority`	0: smallest possible value.
32	RXsensitivity / `RxSens`	0: reference sensitivity. Not applicable.
33	TXpower / `TxPower`	0: reference power. Not applicable.
34	TXpowMax / `TxPowerMax`	As required by regulation, otherwise 0: reference power. Not applicable.
36	LinkDataRate / `DataRateLink`	Default as required by regulation, or minimum possible value.
37	DataRateNW / `DataRateNetwork`	Equal to average of DataRatesNW.minimum and DataRatesNW.maximum.
38	DataRatesNW / `DataRatesNetwork`	{minimum: minimum possible value if known, otherwise 0, maximum: maximum possible value if known, otherwise 0}.
39	DataRateNWreq / `DataRateNetworkRequired`	Same as DataRateNW.
40	Directivity / `Directivity`	{fixed, 0, 0, 0, 360, 40} — omnidirectional, or not supported.
41	BlockLength / `BlockLength`	Not yet defined.
46	Cost / `MediumCost`	CostClass 0: "tempUnavailable".

Table A.2 *(continued)*

I-Param. No.	I-Parameter name / ASN.1 Type	Default values / comments
47	Reliability / `Reliability`	255: unknown.
48	LogicalChannels / `LogicalChannels`	Mappings for all supported physical channels and logical channels. Default as required by regional regulation.
52	LimitChannelAccess / `LimitChannelAccess`	{default channel, 200, 0}: no limitation.
53	PhysicalChannelIdentifier / `PhysicalChannelIdentifier`	Default as required by regional regulation, if applicable, or factory setting.
54	OperationalMode / `OperationalMode`	PHY mode 4, HS-PSK, Dimming level 0 {4; 3; 0}

Annex B
(normative)

MI-COMMANDs

B.1 General

The management service primitives MI-COMMAND.request and MI-COMMAND.confirm and some of the functions of MI-COMMAND.request are specified in ISO 24102-3. Further functions are specified e.g. in ISO 21218 and in ISO 24102-6.

B.2 Required functionality

The functionality of MI-COMMANDs shall be supported as specified in Table B.1.

Table B.1 — MI-COMMANDs

COMMAND	Description	Requirement
SimIUTcmd	See in ISO/TS 20026 and ISO 24102-3.	Mandatory if ISO/TS 20026 is supported, otherwise optional.
EchoTest	See ISO 24102-3.	
CIstateChange	Change of CI status.	Mandatory if path and flow management specified in ISO 24102-6 is supported, or mandatory if ISO 21218 is supported, otherwise optional.
MonitorIparameters	Command to request monitoring of parameters.	
ManufacturerCommand	Allows for manufacturer-specific access to the CI. Used e.g. for test and maintenance purposes.	Optional.
VCImanagement	Command to request creation, reset or deletion of a VCI. Setting of parameters different to the default values for a newly created VCI has to be done in subsequent MI-SET commands.	Mandatory if ISO 21218 is supported, otherwise optional.

Annex C
(normative)

MI-REQUESTs

C.1 General

The management service primitives MI-REQUEST.request and MI-REQUEST.confirm and some of the functions of MI-REQUEST.request are specified in ISO 24102-3. Further functions are specified e.g. in ISO 21218 and in ISO 24102-6.

C.2 Required functionality

The functionality of MI-REQUESTs shall be supported as specified in Table C.1C.

Table C.1C — MI-REQUESTs

REQUEST	Description	Requirement
SimIUTreq	See in ISO/TS 20026 and ISO 24102-3.	Mandatory if ISO/TS 20026 is supported, otherwise optional.
TestMIEcho	See ISO 24102-3.	
EventNotification	Notification of an event.	Mandatory if ISO 21218 is supported, otherwise optional.
PositionUpdate	Requests to receive position updates with update interval as indicated in milliseconds / cancels the request.	Optional.
RegistrationCI	Request to register the CI.	Mandatory if dynamic registration specified in ISO 21218 and ISO 24102-1 are supported, otherwise not applicable.

Annex D
(normative)

ASN.1 definitions

D.1 Overview

The ASN.1 basic notation is specified in ISO/IEC 8824-1. The following ASN.1 module is specified in D.2:

— ITSocc {iso (1) standard (0) occ (22738) opt (1) version0 (0)}

Further on, this document also provides ASN.1 type and value specifications in D.3 to be registered in the registry of ISO 21218.

In case the ASN.1 specifications given in this annex are not conformant with illustrations or specifications provided elsewhere in this document, the specifications given in this annex shall prevail.

Updates of these ASN.1 specifications will be published on http://standards.iso.org/iso/22738/.

Applicable encodings of the types and values defined in this document depend on the usage. ASN.1 BASIC-PER, UNALIGNED, as specified in ISO/IEC 8825-2, shall apply if no other explicit requirement on encoding is given.

D.2 Module ITSocc

```
ITSocc {iso (1) standard (0) occ (22738) opt (1) version0 (0)}
DEFINITIONS AUTOMATIC TAGS::= BEGIN
IMPORTS
-- ISO 21218
MedID, VCIserialNumber FROM ITSllsap {iso(1) standard(0) calm-ll-sap(21218) asnm-1 (1)
version2 (2)}

-- C-ITS Data Dictionary (still in ISO 17419)
Logic, UserPriority FROM CITSdataDictionary1 {iso (1) standard (0) cits-applMgmt (17419)
dataDictionary (1) version1 (1)}
; -- End of IMPORTS

-- Medium-specific I-Parameter
-- Link Layer Address
OCC-Layer2Address ::= LegacyCIID

/*
The definition of LegacyCIID should be an extension of
{iso(1) standard(0) cits-applMgmt (17419) dataDictionary (1) version1 (1)}
The format is specified in ISO 21218:2018 Annex C.3
*/

LegacyCIID ::= SEQUENCE{
   ucgc  UcGc, -- set to 63 indicating broadcast
   ulBit BOOLEAN, -- set to TRUE
   igBit BOOLEAN, -- set to TRUE
   selector FFFEvalue, -- set to 0xfffe
   medID MedID, -- see ISO 21218
   vciSerialNo VCIserialNumber -- see ISO 21218
   }

UcGc ::= INTEGER(0..63)

FFFEvalue ::= INTEGER{
   fffe (65534)
```

```
   } (0..65535) -- only the value 65534 is valid

Occ-OperationalMode::=SEQUENCE{
   phyMode  OccPhyMode,
   modSchemeOccModulationScheme,
   dimming  OccDimming
   }

OccPhyMode ::= INTEGER{
   modeI      (1),
   modeII     (2),
   modeIII    (3),
   modeIV     (4), -- this is the only value supported by this document
   modeV      (5),
   modeVI     (6)
   } (0..7)

OccModulationScheme ::= INTEGER{
-- for phyOccEnable = 1
   ufsook   (0), -- phyOccMcsID = 0
   twinkleVppm (1), -- phyOccMcsID = 1
   s2Psk (2), -- phyOccMcsID = 2
   hsPsk (3), -- phyOccMcsID = 3
   offsetVpwm  (4) -- phyOccMcsID = 4
   } (0..7)

OccDimming ::= INTEGER(0..1000) -- 10 bit

-- RegulatoryScheme
OCC-RegulatoryScheme::=NULL

-- RXsensitivity
OCC-RXsensitivity::=NULL

-- TXpower
OCC-TXpower::=NULL

-- LinkDataRate
OCC-DataRateLink::=INTEGER{
   s2Psk (5),
   hsPsk (22000)
   } (0..65535) -- bit per second


/* Formats of I-Parameters to be specified later, if applicable

-- PhysicalChannelIdentifier
OCC-PhysicalChannelIdentifier::=
-- QoSrequirement
OCC-QoSrequirement::=
*/
--
END
```


D.3 Definitions to be added in ISO 21218

The following definitions are dynamic extensions of types defined in ISO 21218 with CLASS. An up-to-date version of the ASN.1 module ITSocc {iso (1) standard (0) occ (22738) opt (1) version0 (0)} including all dynamic updates is published at http://standards.iso.org/iso/21218.

IMPORT statement to be added, if not yet existent:

```
-- From ISO 22738
OCC-DataRateLink, OCC-Layer2Address, Occ-OperationalMode, OCC-RegulatoryScheme, OCC-
RXsensitivity, OCC-TXpower FROM ITSocc {iso (1) standard (0) occ (22738) opt (1) version0
(0)}
-- From EN ISO 17419-2
c-ITSatt-iso22738 FROM CITSapplMgmtComm {iso (1) standard (0) cits-applMgmt (17419)
```