BS ISO 21215:2010

BSI Standards Publication

Intelligent transport systems — Communications access for land mobiles (CALM) — M5

raising standards worldwide™

National foreword

This British Standard is the UK implementation of ISO 21215:2010.

The UK participation in its preparation was entrusted to Technical Committee EPL/278, Road transport informatics.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

ISBN 978 0 580 63349 2

ICS 03.220.01; 35.240.60

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2010.

Amendments issued since publication

Date	Text affected

BS ISO 21215:2010

INTERNATIONAL STANDARD

ISO 21215

First edition
2010-11-15

Intelligent transport systems — Communications access for land mobiles (CALM) — M5

Systèmes intelligents de transport — Accès aux communications des services mobiles terrestres (CALM) — M5

Reference number
ISO 21215:2010(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.org
Web www.iso.org

Published in Switzerland

Contents

Page

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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 21215 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Introduction

This International Standard is part of a family of International Standards for communications access for land mobiles (CALM). An introduction to the whole set of International Standards is provided in ISO 21217.

This International Standard determines the CALM native medium using radio frequencies in the 5 GHz microwave range. This medium is named CALM M5.

CALM M5 was developed with knowledge of the work done at IEEE on WAVE; see IEEE 1609.4 and [14].

CALM M5 is based on the work done in IEEE P802.11p [16], which cannot be referenced at the time of writing this International Standard, as this will become part of IEEE 802.11.

A CALM M5 communication interface can be integrated with a CEN dedicated short-range communication (DSRC) on-board unit (OBU) that is compliant with [11], [12] and [13]. This is to efficiently protect payment transactions based on CEN DSRC systems that are globally in use.

INTERNATIONAL STANDARD **ISO 21215:2010(E)**

Intelligent transport systems — Communications access for land mobiles (CALM) — M5

1 Scope

This International Standard provides specifications of the access layer (OSI layers 1 and 2 and the related management functionality) of a communication interface (CI) named "CALM M5", operating in the 5 GHz microwave frequency range.

CALM M5 CIs include communication modules (CMs) that are based on the wireless LAN technology standardized at IEEE. This International Standard specifies the additions to and deviations from IEEE 802.11, including the amendment [16] developed by IEEE Task Group p (TGp) required to make CALM M5 CIs compatible with the ITS station reference architecture based on the CALM concept specified in ISO 21217.

Frequency allocations in regions other than North America are supported.

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/IEC TR 8802-1, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 1: Overview of Local Area Network Standards*

ISO/IEC 8802-2, *Information technology — Telecommunications and information exchange between systems — Local and metropolitan area networks — Specific requirements — Part 2: Logical link control*

IEEE 802.11, *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*

IEEE 1609.4, *IEEE Trial-Use Standard for Wireless Access in Vehicular Environments (WAVE) — Multi-channel Operation*

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

ISO 21210, *Intelligent transport systems — Communications access for land mobiles (CALM) — IPv6 Networking*

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

ISO 21218, *Intelligent transport systems — Communications access for land mobiles (CALM) — Medium service access points*

ISO 24102, *Intelligent transport systems — Communications access for land mobiles (CALM) — Management*

ISO 29281, *Intelligent transport systems — Communications access for land mobiles (CALM) — Non-IP networking*

ETSI EN 302 571:2007, *Intelligent Transport Systems (ITS); Radiocommunications equipment operating in the 5 855 MHz to 5 925 MHz frequency band; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive*

ETSI EN 301 893:2007, *Broadband Radio Access Networks (BRAN); 5 GHz high performance RLAN; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217, ISO 21210, ISO 24102, ISO 21218, ISO/IEC 8802-2, IEEE 802.11, ETSI EN 301 893:2007, ETSI EN 302 571:2007 and the following apply.

NOTE Terminology in the set of CALM standards was modified during the process of harmonizing International Standards. This might lead to an editorial difference in terms used in this International Standard and in other International Standards from the set of CALM standards. These editorial differences will be resolved during the ongoing process of harmonizing the whole set of CALM standards.

3.1
CALM M5
CALM communication interface that is compliant with one or more modes of operation in the 4 GHz to 5 GHz band as specified in this International Standard (ISO 21215:2010)

3.2
control channel
logical channel associated with a physical communication channel to manage the access of applications to the communication medium which can include assignment of a service channel or an auxiliary channel to an application

3.3
service channel
logical channel associated with a physical communication channel

3.4
auxiliary channel
logical channel associated with a physical communication channel

4 Symbols and abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO 21217, ISO 29281, ISO 21210, ISO 24102, ISO 21218, ISO/IEC 8802-2, IEEE 802.11, ETSI EN 301 893:2007, ETSI EN 302 571:2007 and the following apply.

ACH	Auxiliary Channel
CAL	Communication Adaptation Layer
CCH	Control Channel
CI	Communication Interface
CM	Communication Module

DSRC	Dedicated short-range communication
ITS-S	Intelligent Transport System Station
ITS-SI	Intelligent Transport System Station Information
MAC	Medium Access Control Sub-layer
MI-parameter	Parameter of a CI or virtual CI (VCI) specified in ISO 21218
M5-parameter	Parameter of a CALM M5 CI / VCI specified in this International Standard (ISO 21215:2010)
OBU	On-board unit
PHY	Physical layer for microwave communications
QoS	Quality of Service
SCH	Service Channel
VCI	Virtual Communication Interfaces
,	Commas within numbers are used as decimal points
e.i.r.p.	Equivalent isotropic radiated power
c	speed of light in m/s
d	estimated free space communication distance
f	centre frequency in Hz
G	gain of receiver antenna
L_{impl}	implementation specific losses
L_{path}	path loss
P_{sens}	receiver sensitivity
P_{tx}	transmit power e.i.r.p

5 Requirements

Clauses 6, 7 and 8 provide the principal requirements of this International Standard:

— Clause 6 specifies the global architecture based on the OSI model, together with general requirements by reference to other International Standards;

— Clause 7 specifies the CALM M5 communication interface protocol stack;

— Clause 8 specifies the CALM M5 communication interface management.

Annexes provide further normative and informative details.

6 Architecture

Figure 1 shows the architecture diagram of a CALM M5 communication interface (CI) embedded in the general CALM architecture.

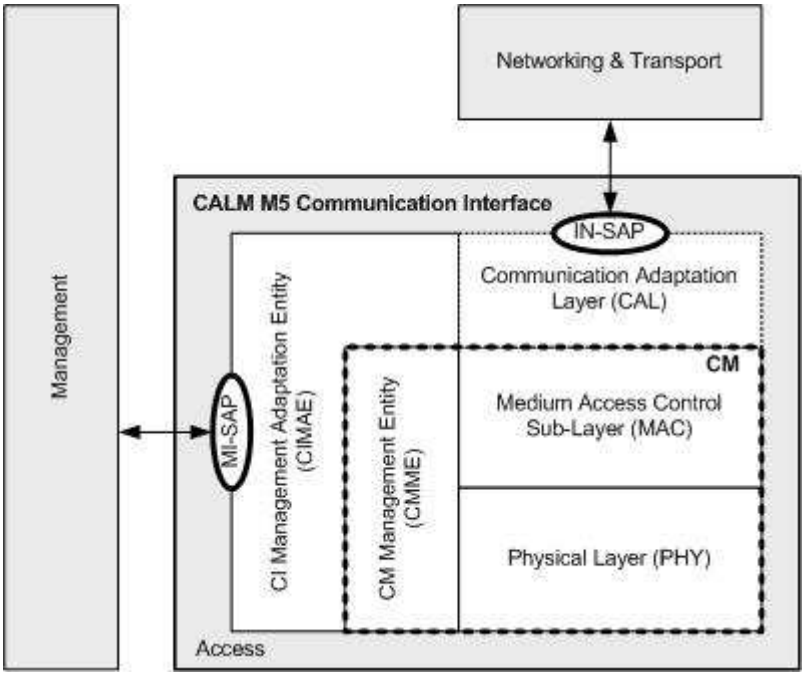

Figure 1 — CALM M5 CI architecture

The M5 communication module (CM) is indicated with a bold dotted line. The CM along with the communication adaptation layer (CAL) and CI management adaptation entity (CIMAE) constitute a CALM CI as specified in ISO 21218.

The communication protocol layers of the CM are

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

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

A CALM M5 CI shall comply with the following CALM International Standards:

— ISO 21218 on access layer service access points;

— ISO 24102 on ITS station management;

— ISO 21217 on global ITS architecture;

— ISO 29281 on non-IP networking; and

— ISO 21210 on IPv6 networking;

with restrictions and amendments as specified in this International Standard.

A CALM M5 CM shall be compliant with IEEE 802.11 with restrictions and amendments as specified in this International Standard.

A CALM M5 CI and virtual CI (VCI) shall support MI-parameters specified in ISO 21218 with amendments and restrictions as specified in this International Standard.

A CALM M5 CI as specified in this International Standard is a CALM wireless CI that shall support CI class CIC-wl1 for general simultaneous bi-directional communications with multiple peer stations, coded in MI-parameter 15 "CIclass" specified in ISO 21218.

NOTE 1 This includes the capability of CI class CIC-wl3 and CIC-wl4.

A CALM M5 CI shall support at least CI access class CIAC-1 coded in MI-parameter 24 "CIaccessClass" specified in ISO 21218.

A CALM M5 CI shall provide an IN-SAP and an MI-SAP as specified in ISO 21218 with restrictions as specified in this International Standard.

A CALM M5 CI shall support Cross-CI prioritization as specified in ISO 21218 with details as specified in this International Standard.

NOTE 2 Multiple CALM M5 CIs per ITS station are possible, regardless of whether the CIs belong to the same ITS-SCU or to different ITS-SCUs; see ISO 24102 for the specification of an ITS-SCU.

A CALM M5 CI shall support all modes of usage of the CtrlCI bits in the CI-ID as specified in ISO 29281 with details as specified in this International Standard.

A CALM M5 CI shall support packets carrying management data being transferred via the MI-SAP as specified in ISO 21218.

A CALM M5 CI shall support one or more of the logical channels "control channel" (CCH), "service channel" (SCH) and "auxiliary channel" (ACH) as specified in ISO 21218.

A CALM M5 CI shall provide quality of service (QoS) functionality based on user priorities as specified in ISO 21218, and based on access categories as specified in IEEE 1609.4.

7 Communication interface protocol stack

7.1 Physical layer

The physical layer of a CALM M5 CI shall be compliant with IEEE 802.11, orthogonal frequency division multiplexing (OFDM) PHY specification for the 5 GHz band, with restrictions and amendments as specified in this International Standard.

Figure 2 shows the PHY frame as transmitted in the microwave medium. It consists of a "PHY Header", a "MAC Frame" and an optional "PHY Trailer".

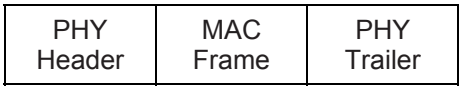

Figure 2 — PHY frame

Table 1 shows how CALM M5 channels are identified by means of "CALM channel number", centre frequency, bandwidth (channel spacing) and channel set identifier. "CALM channel number" is a reference number to the following set of parameters:

— IEEE channel starting frequency;

— IEEE channel number;

— channel bandwidth (channel spacing); and

— channel set identifier (region code, set identifier).

See the ASN.1 element M5channel specified in Annex E. A "CALM channel number" shall be unique inside an ITS station.

Table 1 — Centre frequencies — Informative

CALM channel number	As assigned to CCH, SCH, ACH. The value zero shall not be assigned to the CALM channel number as it has a special meaning; see MI-parameters 0, 1, and 2 specified in ISO 21218.
IEEE channel starting frequency	Used to calculate the centre frequency as specified in IEEE 802.11.
IEEE channel number	As specified in IEEE 802.11.
Bandwidth in MHz	Equals the IEEE channel spacing.
Channel set identifier	Points to a regulation.

NOTE 1 Channel set identifier details are outside the scope of this International Standard.

In Europe, CALM M5 shall comply with the harmonized standards ETSI EN 301 893:2007 and ETSI EN 302 571:2007, respectively, for the frequency bands covered by these ENs. Frequency allocation and some modes of operation in Europe are presented in Annex F.

In case there is only a single common RX-VCI for all TX-VCIs of the same CI, all virtual VCIs of a CI shall use the same centre frequency and bandwidth.

All data rates for a given channel bandwidth as indicated in Table 2 may be supported; the lowest data rate for each supported channel bandwidth shall be mandatory.

Table 2 — Data rates

IEEE Modulation coding scheme (MCS)	0	1	2	3	4	5	6	7
Data rate in Mbit/s 40 MHz channels	12	18	24	36	48	72	96	108
Data rate in Mbit/s 30 MHz channels	9	13,5	18	27	36	54	72	81
Data rate in Mbit/s 20 MHz channels	6	9	12	18	24	36	48	54
Data rate in Mbit/s 10 MHz channels	3	4,5	6	9	12	18	24	27
IEEE RATE coding R1 … R4	'1101'	'1111'	'0101'	'0111'	'1001'	'1011'	'0001'	'0011'
Modulation scheme	BPSK	BPSK	QPSK	QPSK	16-QAM	16-QAM	64-QAM	64-QAM
Coding rate R	1/2	3/4	1/2	3/4	1/2	3/4	2/3	3/4

The transmitter power (e.i.r.p.) shall be adjustable in steps of 0,25 dB.

NOTE 2 The step size indicates resolution; accuracy can be worse than resolution.

7.2 Medium access control layer

7.2.1 General

The medium access control layer of a CALM M5 CI shall be compliant with IEEE 802.11, with restrictions and amendments as specified in this International Standard.

7.2.2 Elements

7.2.2.1 Frame format

Figure 3 shows details of the CALM M5 MAC frame presented in Figure 2.

MAC Header	LLC PDU	FCS

Figure 3 — CALM M5 MAC frame

Details of the "MAC Header" are specified below. The FCS shall be constructed as specified in IEEE 802.11.

7.2.2.2 MAC header

The general format of the "MAC Header" as applicable for data frames of type "DATA" and "QoS DATA", and for management frames of type "BEACON" and "ACTION", see Table 3, is specified in IEEE 802.11 and presented in the informative Figure 4.

NOTE 1 The MAC header of the data frame "DATA" does not contain the element "QoS Control".

Frame Control	Duration / ID	Address 1	Address 2	Address 3	Address 4	Sequence Control	QoS Control
2 octets	2 octets	6 octets	6 octets	6 octets	6 octets	2 octets	2 octets

Figure 4 — MAC header for data frames

"Address 1" and "Address 2" in Figure 4 shall be the MAC addresses of the destination VCI and source VCI, respectively.

The general format of the "Frame Control" field is presented in the informative Figure 5.

Protocol Version	Type	Subtype	To DS	From DS	More Frag	Retry	Pwr Mgt	More Data	WEP	Order
2 bits	2 bits	4 bits	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit	1 bit

Figure 5 — MAC frame control field

The "Protocol Version" field shall be set to the value zero.

"Type" and "Subtype" combinations specified in IEEE 802.11 are as presented in Table 3.

Table 3 — 802.11 frame types

Type	Frame type	Subtype	Name
'00'	Management frame	*'1101'* *'1000'*	ACTION BEACON
'10'	Data frame	*'0000'* *'1000'*	DATA QoS DATA
'01'	Control frame	*'1011'* *'1100'* *'1101'*	RTS CTS ACK

The "Duration / ID" field shall indicate the time in microseconds needed for transmission of the frame.

NOTE 2 Fragmentation at the MAC layer can be avoided by proper restriction of packet size above the MAC layer.

The 12 bit sub-field "Sequence Number" shall be incremented in every new frame. It shall wrap from the value 4095 to zero.

The "QoS Control" field, if present, shall be set as specified in Table 4.

Table 4 — QoS control field elements

Bit numbers	Element	Values	Explanation
3 – 0	TID	0 – 7	Priority of packet, see Tables 9 and 10
		8 – 15	Reserved for future use
4	EOSP	'0' '1'	Defines meaning of bits 8 – 15 '1' shall be used for operation outside the concept of a BSS
6 – 5	Ack Policy	'00' '10'	Acknowledgement No acknowledgement
7	Reserved	'0'	Reserved for future use
15 – 8	EOSP = '0': TXOP Duration Requested	—	—
	EOSP = '1': Queue Size		

7.2.2.3 MAC addresses

7.2.2.3.1 Assignment of MAC addresses

There shall be a MAC address identifying uniquely a CALM M5 CI.

The VCIs of a CALM M5 CI shall be identified by a MAC address, which

a) either is the same MAC address as that of the CI,

b) or is a locally administered MAC address.

A locally administered MAC address may either be unique in the CI or be shared by all or some VCIs.

7.2.2.3.2 Format

The MAC address of a CALM M5 CI / VCI shall be constructed according to the convention as specified in ISO/IEC TR 8802-1. It is a six octet number with bits b0 through b47. Figure 6 illustrates the format of a MAC address.

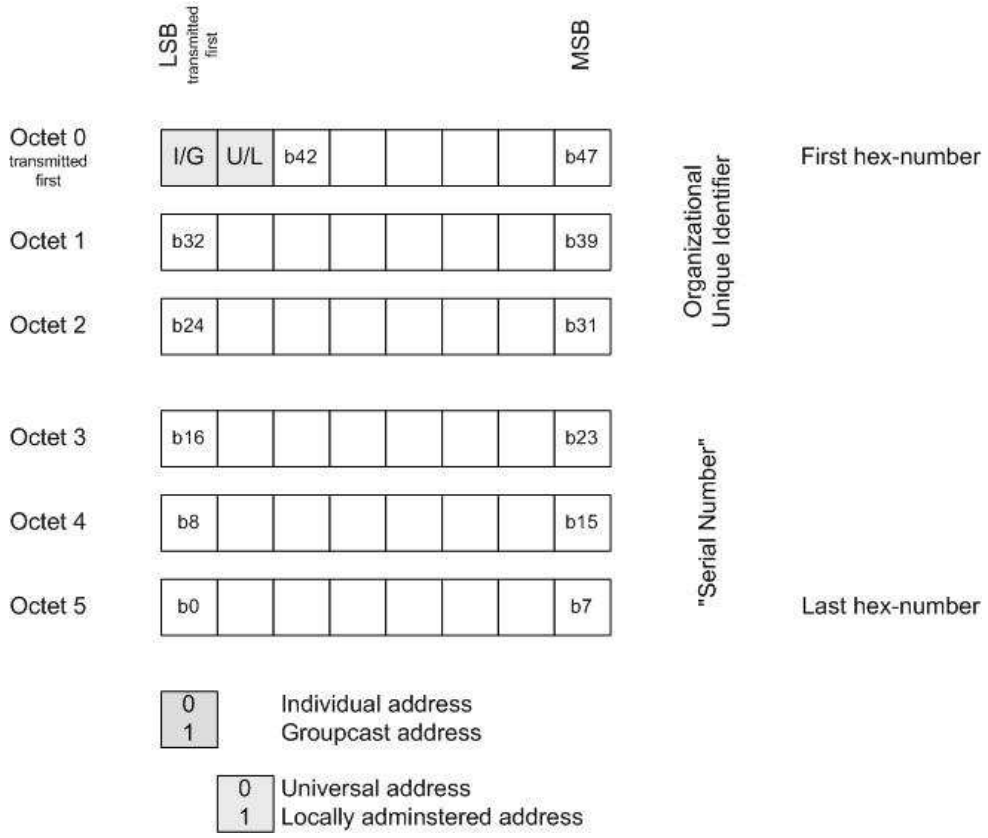

Figure 6 — MAC address format

In a source MAC address, the I/G bit shall be set to zero always.

The broadcast MAC address shall be given by setting all bits to one.

7.2.2.3.3 Multicast address

Multicast MAC addresses shall be constructed as specified in ISO/IEC TR 8802-1.

The multicast group number contained in the multicast MAC address shall be mapped uniquely to the "SerialNumber" in the CI-ID of "destination_address" specified in ISO 21218. The mapping shall be known both in the CI / MC-VCI and in the ITS station management.

The mapping shall be reported for the whole CI in M5-parameter 254.5.6 "MulticastMACs" as specified in ISO 21218.

7.2.2.3.4 Unicast address

For individual MAC addresses a unique mapping of peer MAC address to "SerialNumber" shall be performed as specified in ISO 21218.

7.2.2.3.5 Locally administered address

Locally administered MAC addresses are allowed in addition to global individual MAC addresses. In order to achieve uniqueness within a station

— octet 5 shall be set equal to the ITS-SCU-ID, and

— bits 8 to 39 and 42 to 47 shall be set randomly considering the locally administered MAC addresses of known peer stations, if applicable, in order to minimize the risk of duplicate MAC addresses in the system, and

— Bit 40 "I/G" shall be set to '0', and

— Bit 41 "U/L" shall be set to '1'.

NOTE 1 In case of locally administered MAC addresses, uniqueness of the MAC address can be guaranteed only within a single ITS station.

A CALM M5 CI shall continuously monitor whether a peer station is using the same MAC address. In case of a detected conflict, the CI shall change the MAC address of the related VCI considering the MAC addresses of all known peer stations. The new MAC address shall be notified to the ITS station management as specified in ISO 21218 and in ISO 24102.

Upon notification of change of own MAC address, the ITS station management shall request to send ITS-SI data in a broadcast frame specified in ISO 24102 and in ISO 29281.

NOTE 2 Change of MAC address will break active upper layer sessions. In case unique station identifiers are used, upper layer sessions may be maintained.

7.2.2.4 Channel access

The right to access a physical channel depends on the logical channel CCH, SCH and ACH assigned to a physical channel, and on the user priority assigned to the user application.

The access is defined by the QoS scheme specified in ISO 21218 based on user priorities, and by the mapping of user priorities on logical channels as specified in Table 9.

7.2.2.5 Enhanced distributed channel access

The "Distributed Coordination Function" (DCF) applying "Carrier Sense Multiple Access with Collision Avoidance" (CSMA/CA) shall be mandatory for operation outside the context of a BSS.

For operation outside the context of a BSS, only contention-based channel access shall be applied, thus the "Enhanced Distributed Channel Access" (EDCA) method defined in IEEE 802.11 shall be mandatory and the "HCF Controlled Channel Access" (HCCA) method defined in IEEE 802.11 shall be prohibited. The default set of EDCA parameters shall be as specified in Table 5. The ITS station manager may update these parameters using information from a trusted source.

Table 5 — EDCA parameters

Access category	Contention window CWmin			Contention window CWmax			Arbitration interframe space number AIFSN			Transmit opportunity limit TXOP
	CCH	SCH	ACH	CCH	SCH	ACH	CCH	SCH	ACH	
AC_BK	15	15	15	1023	1023	1023	9	8	7	0
AC_BE	7	11	15	15	511	1023	6	5	4	
AC_VI	3	5	7	7	11	15	3	2	2	
AC_VO	3	3	3	7	7	7	2	2	2	
NOTE Units of parameters presented in this table are as specified in IEEE 802.11.										

7.2.2.6 Data frames

7.2.2.6.1 User priority and access category

The IN-SAP service primitives DL-UNITDATA contain the parameter "priority", which is the CALM user priority. The supported relation between user priority and TID / access category shall be as specified in Tables 9 and 10.

7.2.2.6.2 DATA

A VCI shall use the data frame type "DATA" specified in IEEE 802.11 if M5-parameter 254.5.1 "DataFrameType" is set to 0x08.

7.2.2.6.3 QoS DATA

A VCI shall use the data frame type "QoS DATA" specified in IEEE 802.11 if M5-parameter 254.5.1 "DataFrameType" is set to 0x88.

7.2.2.7 Management frames

Usage of management frames specified in IEEE 802.11 via MI-SAP shall be restricted to data packets of ITS station management applications, i.e. ITS-S applications' transmission requests shall never be performed by management frames.

7.2.3 MAC procedures

7.2.3.1 Fragmentation

The size of the physical layer protocol data unit (PPDU) in the physical layer of CALM M5 is limited to 2 304 bytes. IEEE 802.11 provides for fragmentation of large packets into subsequent frames. Fragmentation of packets at the MAC layer may be avoided by proper restriction of packet size above the MAC layer.

7.2.3.2 Channel access limitation

A CALM M5 CI shall access the wireless channel for no more than a specified percentage of time. The percentage is given by an observation time span and a maximum access time within this observation time span for each logical channel type as specified by the M5-parameter 254.5.4 "AccessLimit". Actual values may depend on regulation. If such an access limitation is not needed, then the observation time span "period" in "LimitChannel" and the maximum access time "limit" shall be set to zero.

NOTE This approach allows specific applications, e.g. road safety-related applications, to always access a specific logical channel without access limitations.

7.3 Logical link control sub-layer

The "Communication Adaptation Layer" (CAL) presented in Figure 1 contains the whole functionality of the LLC sub-layer of CALM M5.

7.4 Communication adaptation layer

7.4.1 General

CALM M5 shall support the minimum LLC-functionality as specified in ISO 21218 with amendments as specified in this International Standard.

"Type 2" operation as specified in ISO/IEC 8802-2 shall be prohibited.

"Type 3" operation as specified in ISO/IEC 8802-2 may be supported optionally, and shall be restricted to auxiliary channels (ACH).

Pending management packets and data packets shall share common priority queues as specified in ISO 21218.

7.4.2 Elements

7.4.2.1 LPDU format

The format of the CALM M5 LPDU shall be as specified in Figure 7.

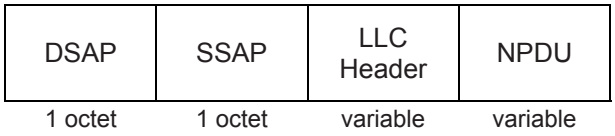

Figure 7 — CALM M5 LPDU

For example, in case the fields DSAP and SSAP contain the value 0xAA, the SNAP protocol is selected and a SNAP header is inserted between LLC header and NPDU. The SNAP header has a size of five octets. The LLC header, in this case, has a limited size of one octet. The CALM M5 LPDU with SNAP is presented in Figure 8.

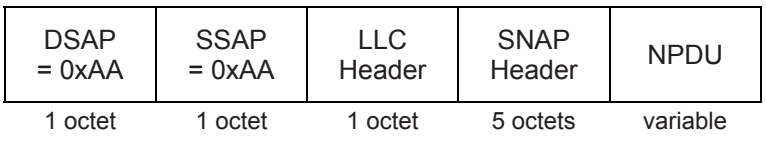

Figure 8 — CALM M5 LPDU with SNAP

An LLC header with size of one octet shall be constructed as specified in Table 6. Further details of the LLC header, including the address elements "DSAP" and "SSAP", are specified in ISO 21218. Details of the payload "NPDU" are specified in the following subclauses.

Table 6 — CALM M5 LLC header

Bit 0 (LSB)	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	Command
1	1	M0	M1	P/F	M2	M3	M4	
1	1	0	0	0	0	0	0	LLC header for UI command as specified in ISO/IEC TR 8802-1.
1	1	CIP0	CIP1	0	CIP2	0	0	UI command, but with "CI Parameter" (CIP) field in NPDU.
1	1	0	0	P	1	1	1	LLC header for TEST command as specified in ISO/IEC TR 8802-1.
1	1	0	0	P	1	0	1	LLC header for XID command as specified in ISO/IEC TR 8802-1 (prohibited for FAST communication).

The LLC header presented in Table 6 is a modification of the header defined in ISO/IEC TR 8802-1 for "Type 1" operation. The original coding of UI command, TEST command and XID command is maintained.

Modifier bits M2, M1 and M0 shall be used to indicate the type of CIP field included in the frame as specified in Tables 6 and 7.

The TX parameters that may be reported in a DL-UNITDATA.request and DL-UNITDATA.indication service primitive are

— MI-parameter 4 "TXpower" as specified in ISO 21218, and

— MI-parameter 5 "DataRate" as specified in ISO 21218.

The coding of these options shall be as specified in Table 7.

Table 7 — CI transmitter parameters

CIP2	CIP1	CIP0	Type	Parameters contained	Total size in octets
0	0	0	0	nothing contained	0
0	0	1	1	TX power	1
0	1	0	2	TX power, DataRate	5
0	1	1	3	reserved for future use	
1	0	0	4	reserved for future use	
1	0	1	5	reserved for future use	
1	1	0	6	reserved for future use	
1	1	1	7	reserved for future use	

The RX parameters that may be reported in a DL-UNITDATA.indication service primitive can be defined by the ITS station management. Up to seven different settings are possible.

The coding of these options shall be as specified in Table 8. The selection of a type shall be according to M5-parameter 254.5.3 "CIPrxType". Details depend on implementation.

Table 8 — CI receiver parameters

CIP2	CIP1	CIP0	Type	Parameters contained	Total size in octets
0	0	0	0	nothing contained	0
0	0	1	1	Setting number 1	depends on actual setting
0	1	0	2	Setting number 2	depends on actual setting
0	1	1	3	Setting number 3	depends on actual setting
1	0	0	4	Setting number 4	depends on actual setting
1	0	1	5	Setting number 5	depends on actual setting
1	1	0	6	Setting number 6	depends on actual setting
1	1	1	7	Setting number 7	depends on actual setting

The default receiver CIP type shall be CIPrxType = 0.

7.4.2.2 NPDU

In this context, the "Network Protocol Data Unit" (NPDU) is equal to the "data" parameter of the DL-UNITDATA service as specified in ISO 21218. The structure of the NPDU as being present in the frame shall be as specified in Figure 9.

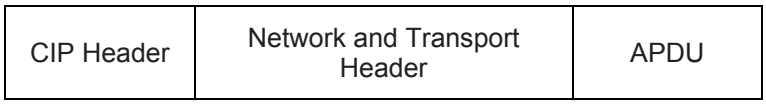

Figure 9 — CALM NPDU

The NPDU consists of

— an optional "CIP Header" element, transmitted first in the frame,

— a "Network and Transport Header" element, and

— an "APDU" element.

The "CIP Header" may include

— TX parameters as received in the frame and as used at the peer station for transmission of the frame,

— RX parameters of the receiving VCI, and

— TX parameters to be used in the transmitting VCI prior to transmission of the frame.

The presence of the "CIP Header" with TX parameters in a frame shall be indicated in the CALM M5 LLC header as specified in Table 6.

The presence of the "CIP Header" with TX parameters in a DL-UNITDATA.request service primitive shall be indicated by means of CtrlCI bit settings as specified in ISO 29281.

The presence of the "CIP Header" with TX parameters in a DL-UNITDATA.indication service primitive shall be indicated by means of CtrlCI bit settings as specified in ISO 29281.

The presence of the "CIP Header" with RX parameters in a DL-UNITDATA.indication service primitive shall be indicated by means of CtrlCI bit settings as specified in ISO 29281.

Details on the "Network Header", "Transport Header", "Data Header" and "Application Data" are outside the scope of this International Standard.

7.4.3 CAL procedures

7.4.3.1 Mapping of CALM user priority on TID values

CALM user priorities as used in parameter "priority" of the DL-UNITDATA.request service primitive specified in ISO 21218 shall be mapped to IEEE access categories (AC) and IEEE TID values as specified in Table 9. See also Table 9-1 in IEEE 802.11.

Table 9 — CALM user priorities and IEEE access categories for TX

Access category (AC)	CALM user priority
AC_VO	224 - 255
	192 - 223
AC_VI	160 - 191
	128 - 159
AC_BK	96 - 127
	64 - 95
AC_BE	32 - 63
	0 - 31

Table 10 — CALM user priorities for RX

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

All 802.11 QoS data frames report a TID value. Non-QoS data frames do not report a TID value, which is interpreted as "unknown".

7.4.3.2 CIP management

7.4.3.2.1 Transmission of a packet

Upon reception of a DL-UNITDATA.request service primitive, CAL shall check the CtrlCI bits in the destination_address. The actions as presented in Table 11 shall be mandatory prior to transmission of the frame.

Table 11 — CIP management for TX

C4	C3	C2	C1	CIP management action
'0'	'0'	'0'	'0'	No further CIP management action needed. Set bits 2, 3 and 5 in the CALM M5 LLC header, see Table 6, to zero.
CIP2	CIP1	CIP0	'0'	Evaluate and apply TX CIP parameters according to the meaning of the values of CIP0, CIP1 and CIP2 specified in Table 7 and remove them from NPDU prior to transmission of frame. Set bits 2, 3 and 5 in the CALM M5 LLC header, see Table 6, to zero.
CIP2	CIP1	CIP0	'1'	Evaluate and apply TX CIP parameters according to the meaning of the values of CIP0, CIP1 and CIP2 specified in Table 7 and keep them in the NPDU for transmission in the frame. Copy CIP0, CIP1 and CIP2 into the CALM M5 LLC header, see Table 6.

7.4.3.2.2 Reception of a frame

Upon reception of a frame, and prior to sending the packet to the CALM networking via IN-SAP, check the CALM M5 LLC header specified in Table 6. The actions as presented in Table 12 and below this table are mandatory.

Table 12 — CIP management for RX

Bit 0 (LSB)	Bit 1	Bit 2	Bit 3	Bit 4	Bit 5	Bit 6	Bit 7	**CIP management action**
1	1	M0	M1	P/F	M2	M3	M4	
1	1	CIP0	CIP1	0	CIP2	1	1	Copy CIP0, CIP1 and CIP2 into CtrlCI bits C2, C3 and C4 of the source_address of the DL-UNITDATA.indication service primitive as specified in ISO 29281.

Check M5-parameter 254.5.3 "CIPrxType" and insert CIP parameters as specified in Table 8 in the NPDU as specified in ISO 29281. Copy bits CIP0, CIP1 and CIP2 as specified in Table 8 for the given value of CIPrxType into the CtrlCI bits C2, C3 and C4 of the destination_address of the DL-UNITDATA.indication service primitive as specified in ISO 29281.

Then process the packet further for transmission via IN-SAP to the CALM networking layer.

8 Communication interface management

8.1 Communication module management entity

The CM management shall be compliant with IEEE 802.11, with restrictions and amendments as specified in this International Standard.

8.2 Communication interface management adaptation entity

8.2.1 Mapping of 802.11 parameters

All IEEE 802.11 parameters that have an equivalent MI-parameter defined in ISO 21218 shall be mapped on MI-parameters. All IEEE 802.11 parameters which are relevant for CALM M5 and do not have an equivalent MI-parameter defined in ISO 21218 can be made visible to the ITS station management by means of medium-specific MI-parameters as specified in this International Standard. MI-parameters which are relevant for CALM M5 but cannot be mapped on an IEEE 802.11 parameters shall be implemented in the CIMAE as specified in ISO 21218.

8.2.2 Mapping of 802.11 commands

All IEEE 802.11 management commands that have an equivalent MI-COMMAND / MI-REQUEST defined in ISO 21218 shall be mapped on these MI-COMMAND / MI-REQUEST. All IEEE 802.11 parameters which are relevant for an implementation of CALM M5 and do not have an equivalent MI-COMMAND / MI-REQUEST defined in ISO 21218 can be made accessible in an implementation-specific way. MI-COMMANDs / MI-REQUESTs which are relevant for CALM M5 but cannot be mapped on an IEEE 802.11 management commands shall be implemented in the CIMAE as specified in ISO 21218.

Annex B provides information on MI-COMMANDs. Annex C provides details on MI-REQUESTs.

8.2.3 Management frames

Transmission of management frames may be requested by the ITS station management with the MI-COMMAND 255 "UnitDataCmd" as specified in ISO 21218. The data packet shall be transmitted in a management frame of type "Action" or "BEACON", see Table 3.

Parameters "sourceAddr" and "destAddr" of "UnitDataCmd" shall be treated the same way as the CI-IDs contained in parameters "sourceAddr" and "destAddr" of the service primitive "DL-UNITDATA.request" specified in ISO 21218.

Parameter "data" of "UnitDataCmd" shall be copied into the CALM information element.

Parameter "priority" of "UnitDataCmd" shall be treated the same way as parameter "priority" of the service primitive "DL-UNITDATA.request".

Parameter "parameter" shall be as specified in Table 13.

Table 13 — Management frame parameter "parameter"

Elements of "parameter"	Range of value	Description
MFcmds	SEQUENCE OF MFcmd	
MFcmd	SEQUENCE	Sequence of defined MAC commands
MFcmd.**ID**	0 - 255	Identifier of specific MAC command MFcmd, unique for CALM M5
MFcmd.**value**	Depends on MFparam.ID	Value of specific MAC command MFcmd

Annex D shows MAC management frame commands MFcmd.

Management frames received from a peer station shall be forwarded to the ITS station management with the MI-REQUEST 255 "UnitDataCmd" as specified in ISO 21218 and in ISO 29281.

Parameters "sourceAddr" and "destAddr" of "UnitDataCmd" shall be set the same way as the CI-IDs contained in parameters "sourceAddr" and "destAddr" of the service primitive "DL-UNITDATA.indication" specified in ISO 21218.

Parameter "data" of "UnitDataCmd" shall be set equal to the contents of the CALM information element.

Parameter "priority" of "UnitDataCmd" shall be treated the same way as parameter "priority" of the service primitive "DL-UNITDATA.indication" specified in ISO 21218.

Parameter "parameter" of "UnitDataCmd" shall be as specified in Table 13.

8.2.4 Cross-CI prioritization procedure

The basic "Cross-CI prioritization procedure" is specified in ISO 21218 and ISO 24102. For CALM M5 the option "CI protection" shall be mandatory for all implementations with a CEN DSRC OBU being part of the ITS station.

NOTE Typically, a DSRC OBU compliant with [11] has a wide-band receiver. The protection gap around the centre frequency of DSRC is approximately F_prot_dsrc = ±200 MHz, i.e. covering the 5,9 GHz ITS band and the upper part of the RLAN band below the DSRC bands, see Figure F.1. For further information see [15].

The following behaviour shall apply.

a) The DSRC CM shall register for protection with the following parameters:

   1) "interferers" = 5 (CALM M5), optionally other interfering CALM CI present in an ITS station;

   2) "priority" = priority of payment systems; and

   3) "timeout" defined by implementation.

b) Upon reception of a DSRC frame as defined by the manufacturer, see [11] and [13], the protection request shall be processed within a maximum time of T_react_dsrc = 1 ms.

c) Upon reception of the DSRC frame "Release", see [13], protection shall be released. Protection may be released already at an earlier time dependent on implementation.

8.2.5 CI registration

The registration procedure of a CALM CI is specified in ISO 21218.

NOTE It is intended to amend ISO 21218 to include the following mandatory procedure:

The random value of SerialNumber shall be generated with an m-sequence generator with a shift-register length of 16. The polynomial shall be

$$x^{16} + x^{14} + x^{13} + x^{11} + 1$$

This results in a pseudo-random sequence with period of 65.535. The start value in the shift register shall be set equal to octets 3 and 4 of the globally unique MAC address, see Figure 6 and MI-parameter 34.

In case of failure to register, the next SerialNumber value shall be taken from the shift register after clocking it as often as given by the integer representation of bits b0 through b4 of the globally unique MAC address plus 1.

MI-parameter 36 TimeoutRegister shall be set to 50 ms plus the integer equivalent of octet 5 of the globally unique MAC address, interpreted in milliseconds.

Alternatively to the procedure specified in the note above, a random generator procedure providing a better source of randomness may be used.

8.2.6 VCI deletion

Deletion of CALM VCIs is specified in ISO 21218.

A CALM M5 UC-VCI with a relation to a peer station shall be deleted as soon as no clearly identified frames from the related peer station were received for a minimum time span given by MI-parameter 13 InactivityTimeLimit. The initial value shall be as specified in Annex A. The value of InactivityTimeLimit may be changed according to the operational needs.

Deletion of a VCI shall be notified to the ITS station management.

8.2.7 Regulatory information management

Regulatory information management

— involves regulatory information contained in a database installed in the CALM M5 CI at time of installation and subsequently modified by regulatory information updates as specified in ISO 21218,

— involves regulatory domain in which the ITS station is located, and

— shall ensure that a CALM M5 CI always operates according to the locally valid regulatory requirements given by the applicable regulatory information.

Regulatory information for CALM M5 shall be the set of parameters given in Table 14. Further "static" regulatory requirements may apply.

Table 14 — Regulatory information parameters

MI-parameter No.	Parameter Name	Description	Source
254.5.2	M5RegScheme		
	M5RegScheme.channelSetID	Channel set identifier	This International Standard
	M5RegScheme.creationDate	Date and time of creation of this regulatory information	Regulation of region
	M5RegScheme.channelType	Specifies type of logical channel for which the regulatory scheme applies	Regulation of region
	M5RegScheme.minUserPriority	Minimum value of user priority needed to use this regulatory scheme	Regulation. May be further restricted by CALM
	M5RegScheme.txPowMax	Maximum allowed transmit power (e.i.r.p.)	Regulation of a region
—	Security	Means to authenticate source of regulatory information	Regulation of a region

8.2.8 MI-parameters

8.2.8.1 General

ISO 21218 specifies MI-parameters as general parameters of a CALM CI / VCI.

The set of MI-parameters defining the properties of a CI is presented in A.2.

Some of these MI-parameters get assigned a default value as specified in A.3.

Some of these MI-parameters are not mandatory or are not applicable for CALM M5; see A.4.

Some MI-parameters need a treatment and interpretation which is specific to CALM M5; see A.1. The special treatment shall be as specified in the following subclauses.

8.2.8.2 CCH, SCH, ACH

The CALM channel number as given in Table 1 shall be used in MI-parameters 0 "ACH", 1 "CCH" and 2 "SCH".

8.2.8.3 Transmit power

MI-parameter 4 "TXpower" shall indicate the actual attenuation *A*/dB relative to the maximum e.i.r.p. allowed for the selected regulatory class according to the following formula:

$$A / dB = -0{,}25 \cdot TXpower$$

Changes of "TXpower" shall change the transmit power monotonically.

8.2.8.4 Maximum e.i.r.p.

The maximum e.i.r.p. of a CI shall be provided in MI-parameter 49 "TXpowMax" in steps of 0,25 dBm.

8.2.8.5 Data rate

Data rates, see Table 2, shall be coded in MI-parameter 5 "DataRate".

8.2.8.6 Average data rate

The average data rate available to the CALM network layer at the IN-SAP shall be coded in MI-parameter 6 "DataRateNW".

The procedure on how to calculate an estimate is outside the scope of this International Standard. The value depends on

— the ratio of NPDU size and CALM M5 protocol overhead,

— application of a TDMA scheme, see CCH and SCH arrangements, and

— availability of the wireless medium, i.e. radio channel congestion.

Minimum and maximum possible values shall be coded in MI-parameter 7 "DataRatesNW".

8.2.8.7 Communication range reference

MI-parameter 16 "CommRangeRef" in ISO 21218 shall be calculated assuming a symmetric link and free space propagation. The parameters needed to perform the calculation are

— receiver sensitivity in dBm, MI-parameter 3 "RXsensitivity" specified in ISO 21218, P_{sens},

— transmit power e.i.r.p. in dBm, calculated from MI-parameter 4 "TXpower" and MI-parameter 49 "TXpowMax" specified in ISO 21218, P_{tx},

— gain of receiver antenna in dB, G,

— implementation specific losses in dB, L_{impl}.

From these parameters, the path loss, L_{path}, in dB shall be calculated from

$$L_{path} = P_{tx} - P_{sens} + G - L_{impl}$$

The estimated free space communication distance, d, in metres shall be calculated as

$$d = \frac{c}{4 \cdot \pi \cdot f} \cdot 10^{\frac{L_{path}}{20}}$$

where

c is speed of light in m/s, and

f is the centre frequency in Hz. This value shall be rounded to 10 cm and stored in MI-parameter 16 "CommRangeRef" of ISO 21218. A new value shall be calculated as soon as one of the related parameters is changed.

8.2.8.8 Directivity

Antenna characteristics depend on implementation.

8.2.8.9 MediumUsage

Every CI shall continuously estimate the average time span used in transmit mode and in receive mode for all VCIs.

Receive mode shall be detected by means of properly received MAC frames disregarding the receiver address.

The observation interval shall be as specified in MI-parameter 30 "MedUseObservationTime". The calculation of MI-parameter 29 "MediumUsage" shall be a gliding procedure. The calculation procedure may be triggered e.g. upon transmission of a frame, successful reception of a frame, time-out given by MI-parameter 30.

9 Conformance

The template for Protocol Implementation Conformance Statements is intended to be developed by ETSI TC ITS.

10 Test methods

Conformance tests are intended to be developed by ETSI TC ITS.

11 Marking, labelling and packaging

CALM M5 equipment shall be clearly and permanently marked with the

— ISO standard number of this International Standard, and

— ETSI standard numbers of the related test standards.

CALM M5 equipment shall be clearly and permanently marked stating with which national regulations it complies or may comply by proper tuning.

CALM M5 equipment shall be provided with clear tuning instructions on how to meet the regulations of the country or countries in which it is intended to be used.

CALM M5 equipment shall be clearly and permanently marked to instruct that it shall only be used when properly tuned to meet national radio regulations pertaining for the frequencies at which it operates.

Annex A
(normative)

Parameters

A.1 M5 specific parameters

A.1.1 Overview

Table A.1 specifies details of MI-parameters that are specific to a CALM M5 CI, and M5-parameters.

NOTE 1 Param. No equal to 254.5.x identifies M5-parameter number x.

NOTE 2 Terminology in the set of CALM standards was modified during the process of harmonizing International Standards. This might lead to an editorial difference in the term "MI-parameter" versus "M-parameter" used in this International Standard and in other International Standards from the set of CALM standards. These editorial differences will be resolved during the ongoing process of harmonizing the whole set of CALM standards.

Table A.1 — M5 specific MI-parameters

Param. No	Parameter Name	Range / values	Description	Owner
0	AuxiliaryChannel	same as ISO 21218	Values different to zero point to a specific physical channel	See ISO 21218
1	ControlChannel	same as ISO 21218	Values different to zero point to a specific physical channel	See ISO 21218
2	ServiceChannel	same as ISO 21218	Values different to zero point to a specific physical channel	See ISO 21218
4	TXpower	0 - 255	Actual attenuation *A*/dB relative to the maximum e.i.r.p.	See ISO 21218
22	Medium	5	Indicating CALM M5	See ISO 21218
25	RegulatoryInformation	Structure	See Table 14	See ISO 21218
29	MediumUsage	same as ISO 21218	See 8.2.8.9 on the calculation procedure	See ISO 21218
30	MedUseObservationTime			
34	MACaddress	48 bit pattern	Globally unique 48 bit MAC address as specified in ISO/IEC TR 8802-1	See ISO 21218

Table A.1 (*continued*)

Param. No	Parameter Name	Range / values	Description	Owner
35	MACaddrTemp	48 bit pattern	Locally administered 48 bit MAC address as specified in ISO/IEC TR 8802-1	See ISO 21218
46	PeerMAC	48 bit pattern	Locally or globally administered 48 bit MAC address as specified in ISO/IEC TR 8802-1	See ISO 21218
49	TXpowMax	0 - 255	Maximum allowed transmit power e.i.r.p. TXpowMax = 0 shall equal –20 dBm. Step size shall be 0,25 dB	See ISO 21218
50	ManufacturerDeviceID	same as ISO 21218	Printable string of variable length as defined by manufacturer	See ISO 21218
254.5.0	SSID	Octet string of variable length 0 – 32	StationID, e.g. to be contained in information element SSID specified in IEEE 802.11	CI
254.5.1	DataFrameType	0x08, 0x88	Selects data frame type applicable in a VCI	VCI
254.5.2	M5RegSchemes	SEQUENCE	Pointer to all known valid regulatory schemes	CI / VCI
254.5.3	CIPrxType	0 - 7	Selects set of RX CIP parameters	VCI
254.5.4	AccessLimit	SEQUENCE	Defines the access limit in percentage of time for ACH, SCH and CCH	VCI
254.5.5	CIPrxSetting	SEQUENCE	Defines RX CIP sets If there is only an empty entry for a set number, then this set number shall not be used to report RX parameters	VCI
254.5.6	MulticastMACs	SEQUENCE	Relation between multicast MAC addresses and CI-ID of a MC-VCIs	CI
254.5.7 – 254.5.255			Reserved for future use	

A.1.2 Description

A.1.2.1 SSID (Parameter 254.5.0)

Table A.2 — Parameter SSID

ASN.1 Type	Valid Range	Description
Param21215.**sSID**	Octet string of variable length 0 – 32	StationID, to be contained e.g. in information element SSID specified in IEEE 802.11.

A.1.2.2 DataFrameType (Parameter 254.5.1)

Table A.3 — Parameter DataFrameType

ASN.1 Type	Valid Range	Description
Param21215.**dataFrameType**	0x08, 0x88	Selects data frame type applicable in a UC-VCI. Set equal to bits B0 … B7 of frame control field as specified in IEEE 802.11, see also Figure 5.

A.1.2.3 M5RegScheme (Parameter 254.5.2)

Table A.4 — Parameter M5RegScheme

ASN.1 Type	Valid Range	Description
Param21215.**m5RegScheme**	SEQUENCE	Pointer to all known valid regulatory schemes
M5RegScheme.**channelSetID**		Channel set identifier
ChannelSetID.**regionCode**		
.RegionCode.**selector**	BIT STRING (SIZE(2))	Defines meaning of .Region.code '00': CountryCode as specified in ISO 3166, ISO 14816 '01': RegionCode '10', '11': reserved for future use
.RegionCode.**code**	BIT STRING (SIZE(10))	Identifies country or region
ChannelSetID.**setID**	INTEGER(0..4095)	Reference number unique for a country code
M5RegScheme.**creationDate**	Generalized Time	Start time of validity of this scheme
M5RegScheme.**channelType**	ACH, CCH, SCH, any	Type of logical channel
M5RegScheme.**minUserPriority**	See ISO 21218	Minimum required user priority
M5RegScheme.txPowMax	See MI-parameter 49 "TXpowMax" in ISO 21218	Maximum allowed TX power e.i.r.p.

A.1.2.4 ClPrxType (Parameter 254.5.3)

Table A.5 — Parameter ClPrxType

ASN.1 Type	Valid Range	Description
Param21215.**clPrxType**	0 - 7	Selects predefined type of RX CIPs 0: No RX CIPs

A.1.2.5 AccessLimit (Parameter 254.5.0)

Table A.6 — Parameter AccessLimit

ASN.1 Type	Valid Range	Description
Param21215.**accessLimit**	SEQUENCE	Defines the access limit in percentage of time for ACH, SCH and CCH
AccessLimit.**limitCCH**	Sequence	Limit for CCH
.LimitCCH.**limit**	0 - 255	0: no access to CCH allowed 1 - 200: limit in 0,5 % > 200: no limit
.LimitCCH.**period**	0 - 65535	Observation time for limit in multiples of 10 milliseconds
AccessLimit.**limitSCH**	Sequence	Limit for SCH
.LimitSCH.**limit**	0 - 255	0: no access to SCH allowed 1 - 200: limit in 0,5 % > 200: no limit
.LimitSCH.**period**	0 - 65535	Observation time for limit in multiples of 10 milliseconds
AccessLimit.**limitACH**	Sequence	Limit for ACH
.LimitACH.**limit**	0 - 255	0: no access to ACH allowed 1 - 200: limit in 0,5 % > 200: no limit
.LimitACH.**period**	0 - 65535	Observation time for limit in multiples of 10 milliseconds

A.1.2.6 CIPrxSetting (Parameter 254.5.5)

Table A.7 — Parameter CIPrxSetting

ASN.1 Type	Valid Range	Description
Param21215.**cIPrxSetting**	SEQUENCE	Defines CIP sets
CIPrxSetting.**set1**	SEQUENCE OF	Defines setting number 1
.Set1.**param**	Any parameter known in the M5 VCI	First parameter
...		Further parameters
CIPrxSetting.**set2**	SEQUENCE OF	Defines setting number 2
.Set2.**param**	Any parameter known in the M5 VCI	First parameter
...		Further parameters
CIPrxSetting.set3	SEQUENCE OF	Defines setting number 3
.Set3.**param**	Any parameter known in the M5 VCI	First parameter
...		Further parameters
CIPrxSetting.set4	SEQUENCE OF	Defines setting number 4
.Set4.**param**	Any parameter known in the M5 VCI	First parameter
...		Further parameters
CIPrxSetting.set5	SEQUENCE OF	Defines setting number 5
.Set5.**param**	Any parameter known in the M5 VCI	First parameter
...		Further parameters
CIPrxSetting.set6	SEQUENCE OF	Defines setting number 6
.Set6.**param**	Any parameter known in the M5 VCI	First parameter
...		Further parameters
CIPrxSetting.set7	SEQUENCE OF	Defines setting number 7
.Set7.**param**	Any parameter known in the M5 VCI	First parameter
...		Further parameters

A.1.2.7 MulticastMACs (Parameter 254.5.6)

Table A.8 — Parameter MulticastMACs

ASN.1 Type	Valid Range	Description
Param21215.**multicastMACs**	SEQUENCE OF	Defines relations between MAC multicast addresses and CI-IDs of MC-VCIs for a CI
MulticastMACs.**mcMACciid**	SEQUENCE	One of such relations
.McMACciid.**mcMAC**	MACaddress	Multicast MAC address of MC-VCI
.McMACciid.**ciid**	CI-ID	CI-ID of MC-VCI

A.2 Properties

Table A.9 specifies some properties of a CALM M5 CI / VCI, see MI-parameter 19 "Properties" in ISO 21218.

Table A.9 — Properties

Param. No	Parameter Name	Range / values	Comments
15	CIclass	CIC-wl1	
22	Medium	5	
24	CIaccessClass	CIAC-1	
51	Connect	0	
254.5.1	DataFrameType	0x08, 0x88	Frame types "DATA" and "QoS DATA"

A.3 Default values

Table A.10 specifies some default values of parameters.

Table A.10 — Default parameter values

Param. No	MI-parameter name	Range / values	Comments
0	AuxiliaryChannel		Preferably is present in an ITS station
1	ControlChannel		Shall always be present in an ITS station
2	ServiceChannel		Should always be present in an ITS station
5	DataRate	minimum possible value of properties	
6	DataRateNW	equal to the average of DataRatesNW.minimum and DataRatesNW.maximum	
9	Directivity	fixed, 0, 0, 0, 360, 40	Omnidirectional
10	BlockLength	2300	Maximum length of LPDU Valid for both data frames and management frames

Table A.10 (*continued*)

Param. No	MI-parameter name	Range / values	Comments
11	MinimumUserPriority	0	
13	InactivityTimeLimit	0	
15	CIclass	CIC-wl1	
16	CommRangeRef		Depends on implementation
21	MinimumSuspendPriority	255	
22	Medium	5	
23	CommunicationMode	CALM FAST	Minimum required
24	CIaccessClass	CIAC-1	
29	MediumUsage	Start value: {0,0}	Dynamically assigned
30	MedUseObservationTime	50	
31	SuspendSupportFlag	255	
32	QueueAlarmThreshold	170	
34	MACaddress	globally administered	
35	MACaddrTemp	equal to MACaddress	
36	TimeoutRegister	128	
44	MinPrioCrossCI	0	
47	QueueLowThreshold	85	
49	TXpowMax	Fixed by regulation	Depends on regulatory class
-	T_DummyAckReq		
-	T_dummyAckGrant		
254.5.0	SSID	""	Zero length octet string
254.5.1	DataFrameType	0x08	Frame type "DATA"

A.4 Non-mandatory parameters

Table A.11 lists MI-parameters that either are unsupported or may be optionally supported.

Table A.11 — Non-mandatory MI-parameters

Param. No	Parameter Name	Comment
3	RXsensitivity	n.a.
8	DataRateNWreq	n.a.
14	DistancePeer	May be optionally supported. Distance to peer could be estimated from field strength measurement or calculated from position of peer station.
17	Cost	n.a.
18	Reliability	n.a.
26	FreeAirTime	Parameter needed for e.g. CALM IR
27	SIMpin	Parameter needed for CI access category CIAC-2
28	ProviderInfo	Parameter needed for CI access category CIAC-2
39	FrameLengthMax	Parameter needed for e.g. CALM IR
41	KinematicVectorOut	May be optionally supported
48	PeerRCpower	Parameter used in WAVE

Annex B
(normative)

MI-COMMAND

B.1 General

This annex deals with commands **MI-COMMAND.request** sent to the CI, and with acknowledgements **MI-COMMAND.confirm** as specified in ISO 21218.

NOTE Terminology in the set of CALM standards was modified during the process of harmonizing International Standards. This might lead to an editorial difference in the term "MI-COMMAND" versus "CIMAE-COMMAND" used in this International Standard and in other International Standards from the set of CALM standards. These editorial differences will be resolved during the ongoing process of harmonizing the whole set of CALM standards.

B.2 Not supported

COMMAND 2 "WakeUp" shall not be supported. The ErrStatus in the acknowledgement shall be set to 5 "INVALID COMMAND/REQUEST NUMBER".

B.3 Special treatment

B.3.1 RegInfo

COMMAND 7 "RegInfo" will be supported in a future edition of ISO 21215.

B.3.2 UnitDataCmd

See 8.2.3.

Annex C
(normative)

MI-REQUEST

C.1 General

This annex deals with commands **MI-REQUEST.request** sent to the ITS station management, and with acknowledgements **MI-REQUEST.confirm** as specified in ISO 21218.

NOTE Terminology in the set of CALM standards was modified during the process of harmonizing International Standards. This might lead to an editorial difference in the term "MI-REQUEST" versus "CIMAE-REQUEST" used in this International Standard and in other International Standards from the set of CALM standards. These editorial differences will be resolved during the ongoing process of harmonizing the whole set of CALM standards.

C.2 Not supported

None.

C.3 Special treatment

C.3.1 RegInfo

REQUEST 7 "RegInfo" will be supported in a future edition of ISO 21215.

C.3.2 UnitDataReq

See 8.2.3.

Annex D
(normative)

Management frame MAC commands

Transmission and reception of management frames are specified in 8.2.3. Table D.1 shows MAC commands to be used in the parameter "parameter", see Table 13.

The MAC command with MFcmd.ID = 0 shall be mandatory. It shall be the first element in parameter "parameter".

Table D.1 — Management frame MAC command

MFcmd.ID	Name	Type	Value / range	Description
0	MFframeType	INTEGER(0..255)	0x80, 0xD0	Indicates type of management frame. Equal to bits B0 … B7 of frame control field as specified in IEEE 802.11, see also Figure 5.
1-255				Reserved for future use.

Annex E
(normative)

ASN.1 definitions

E.1 Use of modules

The ASN.1 modules specified in the following subclause shall be used. ASN.1 BASIC-PER, UNALIGNED as specified in ISO/IEC 8825-2 shall apply. The definitions are made such that every ASN.1 element has a length of an integer multiple of a byte.

E.2 ASN.1 modules

```
CALMm5 {iso(1) standard(0) calm-m5(21215)} DEFINITIONS::=BEGIN

    IMPORTS
    CI-ID, Errors, MACaddress, MI-Param, TxPowMax, UserPriority
    FROM CALMllsap {iso(1) standard(0) calm-ll-sap(21218)};

    -- End of IMPORTS

    AccessLimit::=SEQUENCE{
        limitCCH        LimitChannel,
        limitSCH        LimitChannel,
        limitACH        LimitChannel
        }

    ChannelSetID::=SEQUENCE{
        regionCode      RegionCode,          -- selects applicable region
        setID           INTEGER(0..4095)     -- number unique in region
        }

    RegionCode::=SEQUENCE{
        selector        BIT STRING(SIZE(2)),
        code            BIT STRING(SIZE(10))
        }

    ChannelType::=ENUMERATED{
        aCH             (1), -- only ACH
        cCH             (2), -- only CCH
        sCH             (4), -- only SCH
        na              (255) -- not used. Fixes size of element to 1 octet.
        }

    CIPset::=SEQUENCE OF SEQUENCE{
        param21218      SEQUENCE OF MI-Param,       -- can be empty sequence
        param21215      SEQUENCE OF Param21215      -- can be empty sequence
        }
```

```
CIPrxSetting::=SEQUENCE{
    set1            CIPset,
    set2            CIPset,
    set3            CIPset,
    set4            CIPset,
    set5            CIPset,
    set6            CIPset,
    set7            CIPset
    }

DataFrameType::=INTEGER(0..255)                 -- 0x08, 0x88

LimitChannel::=SEQUENCE{
    limit           INTEGER(0..255),      -- steps of 0,5 %
                                          -- 0: no access
                                          -- >200: no limit
    period          INTEGER(0..65535)     -- observation interval in 10 ms
                                          -- 0: no limit
    }

MFcmds::=SEQUENCE OF MFcmd

MFcmd::= CHOICE{
    mFframeType     [0] MFframeType,
    --              [1-255]
    ...
    }

MFframeType::=INTEGER(0..255)                   -- 0x80, 0xD0

McMACciid::=SEQUENCE {                          -- CI parameter
    mcMAC           MACaddress,
    ciid            CI-ID                       -- of MC-VCI for TX
    }

MulticastMACs::=SEQUENCE OF McMACciid           -- CI parameter

M5channel::=SEQUENCE{
    calmChannelNo   INTEGER(0..255),    -- CALM channel number
                                        -- as assigned to CCH, SCH and ACH
    ieeeStartFreq   INTEGER(0..65535),  -- 802.11 channel starting frequency
                                        -- in steps of 500 kHz
    ieeeChannelNo   INTEGER(0..65535),  -- 802.11 channel number
    channelBandwidth INTEGER(0..65535), -- Channel bandwidth
                                        -- in steps of10 kHz
    channelSetID    ChannelSetID        -- Channel set identifier
    }


M5RegSchemes::=SEQUENCE OF M5RegScheme

M5RegScheme::=SEQUENCE{
    channelSetID    ChannelSetID,               -- globally unique region ID
    creationDate    GeneralizedTime,            -- start time of validity
    channelType     ChannelType,                -- type of channel
    minUserPriority UserPriority,               -- minimum user priority need
    txPowMax        TxPowMax                    -- maximum allowed TX power
    }
```

```
Param21215::=CHOICE{
   ssid             [0] Ssid,
   dataFrameType    [1] DataFrameType,
   m5RegSchemes     [2] M5RegSchemes,
   cIPrxType        [3] INTEGER(0..255),        -- default = 1
   accessLimit      [4] AccessLimit,
   cIPrxSetting     [5] CIPrxSetting,
   multicastMACs    [6] MulticastMACs,
   --               [4-254]
   errors           [255] Errors,
   ...
   }

RegInfoM5::=SEQUENCE{
   m5RegScheme      M5RegScheme,
   security         OCTET STRING                -- for authentication
   }

RegulatoryScheme::=OCTET STRING (CONTAINING
   RegInfoM5)       -- redefinition of 21218


Ssid::=OCTET STRING (SIZE(0..32))
```

END

Annex F
(informative)

Operation in Europe

Figure F.1 shows frequency allocation in Europe for the RLAN band [4], [6], [7], the DSRC band [3], [5] and the ITS band in 5 GHz [8], [9], [10] together with the spectral power limits for CALM M5 operated in either the RLAN band or the ITS bands.

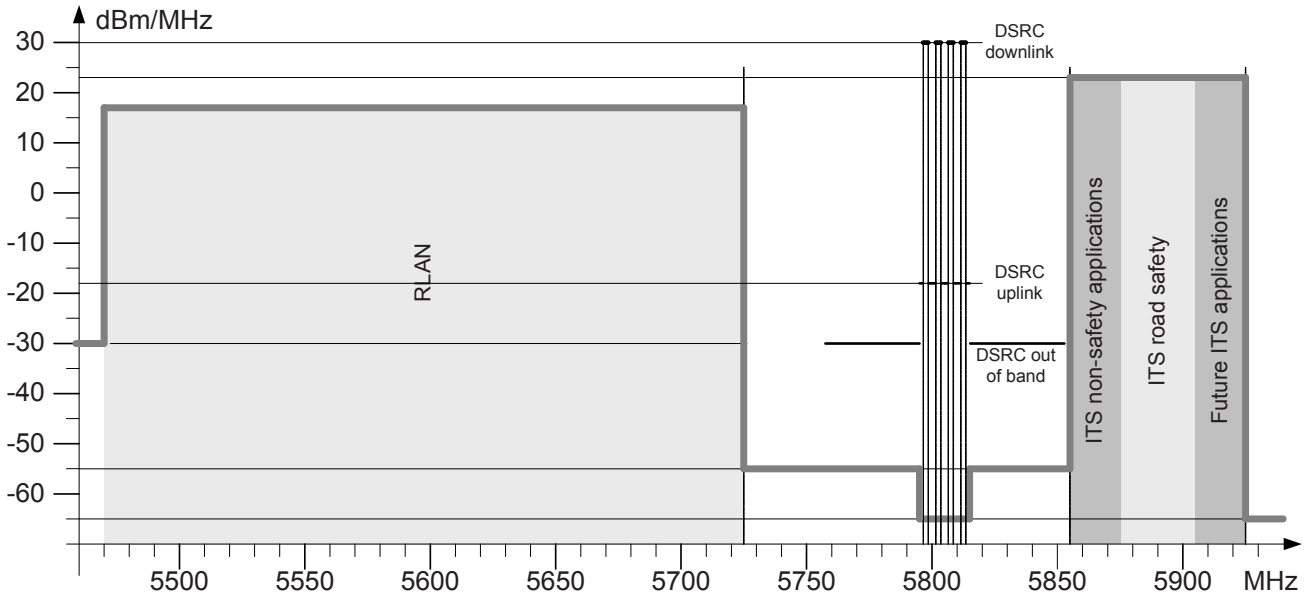

Figure F.1 — Power spectrum density for Europe

Technical characteristics for pan-European harmonized communications equipment operating in the 5 GHz frequency range and intended for road-safety applications and for non-safety-related ITS applications are specified in the system reference documents [1] and [2].

More specifically, for transmitter out-of-band emissions the limits presented in Table F.1 apply in Europe.

Table F.1 — Out-of-band maximum power (European regulation)

Out-of-band frequency range	Out-of-band maximum power
< 5,4 GHz	As specified in ETSI EN 301 893:2007
5,4 GHz - 5,725 GHz	–55 dBm e.i.r.p. within 1 MHz reference bandwidth
5,725 GHz - 5,795 GHz	–55 dBm e.i.r.p. within 1 MHz reference bandwidth
5,795 GHz - 5,815 GHz	–65 dBm e.i.r.p. within 1 MHz reference bandwidth
5,815 GHz - 5,855 GHz	–55 dBm e.i.r.p. within 1 MHz reference bandwidth
5,855 GHz - 5,925 GHz	–55 dBm e.i.r.p. within 1 MHz reference bandwidth
> 5,925 GHz	As specified in ETSI EN 302 571:2007

Further details on in-band transmission power are specified in ETSI EN 301 893:2007 and ETSI EN 302 571:2007.

Receiver performance requirements for 10 MHz channel spacing are presented in Table F.2.

Table F.2 — Receiver performance requirements for 10 MHz channel spacing

MCS (see Table 2)	Adjacent channel rejection			Non-adjacent channel rejection		
	Minimum required	Enhanced 1	Enhanced 2	Minimum required	Enhanced 1	Enhanced 2
0	16 dB	28 dB	34 dB	32 dB	42 dB	44 dB
1	15 dB	27 dB	33 dB	31 dB	41 dB	43 dB
2	13 dB	25 dB	31 dB	29 dB	39 dB	41 dB
3	11 dB	23 dB	29 dB	27 dB	37 dB	39 dB
4	8 dB	20 dB	26 dB	24 dB	34 dB	36 dB
5	4 dB	16 dB	22 dB	20 dB	30 dB	32 dB
6	0 dB	12 dB	18 dB	16 dB	26 dB	28 dB
7	−1 dB	11 dB	17 dB	15 dB	25 dB	27 dB

NOTE Values for "Minimum required" and "Enhanced 1" are taken from IEEE 802.11 and [16].

In Europe CALM M5 operates outside the context of a BSS. Consequently the MAC services SCAN, JOIN, ASSOCIATE and AUTHENTICATE specified in IEEE 802.11 are not applicable.

Bibliography

[1] ETSI TR 102 492-1 V1.1.1 (2005-06), *Technical Report; Electromagnetic compatibility and Radio spectrum Matters (ERM); Intelligent Transport Systems (ITS); Part 1: Technical characteristics for pan-European harmonized communications equipment operating in the 5 GHz frequency range and intended for critical road-safety applications; System Reference Document*

[2] ETSI TR 102 492-2 V1.1.1 (2006-07), *Technical Report; Electromagnetic compatibility and Radio spectrum Matters (ERM); Intelligent Transport Systems (ITS); Part 2: Technical characteristics for pan European harmonized communications equipment operating in the 5 GHz frequency range intended for road safety and traffic management, and for non-safety related ITS applications; System Reference Document*

[3] ERC Recommendation 70-03 relating to the use of Short Range Devices (SRD)

[4] ERC/DEC/(99)23, *ERC Decision of 29 November 1999 on the harmonised frequency bands to be designated for the introduction of High Performance Radio Local Area Networks (HIPERLANs)*

[5] ECC/DEC(02)01, *ECC Decision of 15 March 2002 on the frequency bands to be designated for the co-ordinated introduction of Road Transport and Traffic Telematic Systems*

[6] 2005/513/EC, *Commission Decision of 11 July 2005 on the harmonised use of radio spectrum in the 5 GHz frequency band for the implementation of wireless access systems including radio local area networks (WAS/RLANs)*

[7] 2007/90/EC, *Commission Decision of 12 February 2007 amending Decision 2005/513/EC on the harmonised use of radio spectrum in the 5 GHz frequency band for the implementation of Wireless Access Systems including Radio Local Area Networks (WAS/RLANs)*

[8] ECC/DEC/(08)01, *ECC Decision of 14 March 2008 on the harmonised use of the 5875-5925 MHz frequency band for Intelligent Transport Systems (ITS)*

[9] ECC/REC/(08)01, *ECC Recommendation (08)01 on the use of the band 5855-5875 MHz for Intelligent Transport Systems (ITS)*

[10] 2008/671/EC, *Commission Decision of 5 August 2008 on the harmonised use of radio spectrum in the 5 875-5 905 MHz frequency band for safety-related applications of Intelligent Transport Systems (ITS)*

[11] CEN EN 12253:2003, *Road transport and traffic telematics — Dedicated Short Range Communication (DSRC) — Physical layer using microwave at 5,8 GHz*

[12] CEN EN 12795:2003, *Road transport and traffic telematics — Dedicated Short Range Communication (DSRC) — DSRC data link layer: medium access and logical link control*

[13] CEN EN 12834:2003, *Road transport and traffic telematics — Dedicated Short Range Communication (DSRC) — DSRC application layer*

[14] IEEE 1609.3:2007, *IEEE Trial-use Standard for Wireless Access in Vehicular Environments (WAVE) — Networking Services*

[15] ETSI TR 102 654 V1.1.1 (2008), *Technical Report; Electromagnetic compatibility and Radio spectrum Matters (ERM); Road Transport and Traffic Telematics (RTTT); Co-location and Co-existence considerations regarding Dedicated Short Range Communication (DSRC) transmission equipment and Intelligent Transport Systems (ITS) operating in the 5 GHz frequency range and other potential sources of interference*

[16] IEEE P802.11pTM/D9.0:2009, *Draft 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; Amendment 7: Wireless Access in Vehicular Environments*

[17] ISO 3166-1, *Codes for the representation of names of countries and their subdivisions — Part 1: Country codes*

[18] ISO 14816, *Road transport and traffic telematics — Automatic vehicle and equipment identification — Numbering and data structure*

ICS 03.220.01; 35.240.60

Price based on 40 pages

This page deliberately left blank

British Standards Institution (BSI)

BSI is the independent national body responsible for preparing British Standards and other standards-related publications, information and services.
It presents the UK view on standards in Europe and at the international level.

It is incorporated by Royal Charter.

Revisions

British Standards are updated by amendment or revision. Users of British Standards should make sure that they possess the latest amendments or editions.

It is the constant aim of BSI to improve the quality of our products and services. We would be grateful if anyone finding an inaccuracy or ambiguity while using this British Standard would inform the Secretary of the technical committee responsible, the identity of which can be found on the inside front cover.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001

BSI offers Members an individual updating service called PLUS which ensures that subscribers automatically receive the latest editions of standards.

Tel: +44 (0)20 8996 7669 Fax: +44 (0)20 8996 7001
Email: plus@bsigroup.com

Buying standards

You may buy PDF and hard copy versions of standards directly using a credit card from the BSI Shop on the website **www.bsigroup.com/shop.** In addition all orders for BSI, international and foreign standards publications can be addressed to BSI Customer Services.

Tel: +44 (0)20 8996 9001 Fax: +44 (0)20 8996 7001
Email: orders@bsigroup.com

In response to orders for international standards, it is BSI policy to supply the BSI implementation of those that have been published as British Standards, unless otherwise requested.

Information on standards

BSI provides a wide range of information on national, European and international standards through its Knowledge Centre.

Tel: +44 (0)20 8996 7004 Fax: +44 (0)20 8996 7005
Email: knowledgecentre@bsigroup.com

Various BSI electronic information services are also available which give details on all its products and services.

Tel: +44 (0)20 8996 7111 Fax: +44 (0)20 8996 7048
Email: info@bsigroup.com

BSI Subscribing Members are kept up to date with standards developments and receive substantial discounts on the purchase price of standards. For details of these and other benefits contact Membership Administration.

Tel: +44 (0)20 8996 7002 Fax: +44 (0)20 8996 7001
Email: membership@bsigroup.com

Information regarding online access to British Standards via British Standards Online can be found at **www.bsigroup.com/BSOL**

Further information about BSI is available on the BSI website at **www.bsigroup.com/standards**

Copyright

Tel: +44 (0)20 8996 7070
Email: copyright@bsigroup.com

BSI Group Headquarters

389 Chiswick High Road London W4 4AL UK

Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/standards

raising standards worldwide™