INTERNATIONAL STANDARD

ISO 21218

First edition
2008-08-15

Intelligent transport systems — Communications access for land mobiles (CALM) — Medium service access points

Systèmes de transport intelligents — Accès de communication pour services mobiles terrestres (CALM) — Points d'accès au service moyen

Reference number
ISO 21218:2008(E)

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 21218 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

Introduction

This International Standard is part of a family of standards for communications access for land mobiles (CALM) which determine a common architecture, network protocols and air interface definitions for wireless communications using media such as cellular 2nd generation, cellular 3rd generation, microwaves, millimetre waves, and infrared light. Further air interfaces, referred to as communication modules, may be added at a later date. These air interfaces are designed to support point-to-multipoint and point-to-point communications for roadside-to-roadside, vehicle-to-vehicle and vehicle-to-roadside links in the ITS sector.

This International Standard determines the service access points for the OSI (see Clause 4) layers below the network layer, i.e.

— the M-SAP (see Clause 4) offered to the IME for management purposes, and

— the C-SAP (see Clause 4) offered to the CALM network layer for communication purposes.

Intelligent transport systems — Communications access for land mobiles (CALM) — Medium service access points

1 Scope

This International Standard determines the service access points (SAPs) of a communication interface (CI) as provided by the communication adaptation layer (CAL) for communication, and as provided by the CI management adaptation entity (CIMAE) for management of the communication interface.

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*

ISO/IEC 8802-11:2005, *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*

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

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 8802-2, ISO/IEC 8802-11, ISO 21217 and the following apply.

3.1
CI Identifier
unique identifier of a (virtual) **CI**

3.2
CM Protocol Layers
all **OSI** communication protocol layers of a CALM **CI** that are below the CALM network layer except the **CAL**

3.3
COMMAND
command sent to the **CIMAE** using the **M-SAP** service primitive **COMMAND**.request

3.4
Communication Interface
CI
all parts of the **OSI** communication protocol stack below the network layer, including the related management functions, for a specific type of communication protocol

EXAMPLE An example of communication protocol is CALM IR (ISO 21214), others are shown in Figure 1.

3.5
Communication Module
CM
all parts of the **OSI** communication protocol stack below the network layer, including the related management functions comprising the blocks **CMME** and **CMPL**

NOTE CMME and CMPL are shown in Figure 1.

3.6
Interface Management Entity
part of the CALM management which is horizontally connected to the **CIMAE**

3.7
Medium
physical properties of a **CI** used to transmit a modulated signal, e.g. wireless or on a wire

3.8
REQUEST
command sent to the **IME** using the **M-SAP** service primitive **REQUEST**.request

3.9
Virtual Communication Interface
logical entity in a **CI** that is associated with a peer station

3.10
CI Priority Manager
logical entity in a **CI** that is managing priority queues

4 Abbreviated terms

NOTE See also: ISO/IEC 8802-2, ISO/IEC 8802-11, ISO 21210, ISO 21214, ISO 21217.

APN	Access Point Name
BC-VCI	VCI for transmission to the broadcast MAC address
CAL	Communication Adaptation Layer
CEN	European Committee for Standardization
CI	Communication Interface
CIC	Communication interface class
CI-ID	CI Identifier
CIMAE	CI Management Adaptation Entity
CIME	CI Management Entity
CIPL	Interface Protocol Layers
CM	Communication Module

CMME	CM Management Entity
CMPL	CM Protocol Layers
C-SAP	Communication SAP as offered by the CAL to the CALM network layer
DLL	Data Link Layer
DSRC	Dedicated Short Range Communication
ETSI	European Telecommunications Standards Institute
GC-VCI	VCI for transmission to a groupcast MAC address
IME	Interface Management Entity
LSB	Least Significant Bit
MC-VCI	VCI for transmission to a multicast (group) MAC address
ME	Management Entity
MedID	Medium identifier, part of CI-ID
MIB	Management Information Base
M-SAP	Management SAP as offered by the CIMAE towards the IME
MSB	Most Significant Bit
OBU	On-Board Unit
OSI	Open System Interconnection
PIN	Personal Identification Number
RX/TX-CI	CI capable of operating in receive and transmit mode
RX-only-CI	CI capable of operating in receive mode only
RX-VCI	VCI for reception
SerialNumber	Serial Number, part of CI-ID
SIM	Subscriber Identity Module
SNAP	Sub-Network Access Protocol
TDMA	Time Division Multiple Access
TX-only-CI	CI capable of operating in transmit mode only, either broadcast or multicast
TX-VCI	VCI for unicast transmission
UC-VCI	VCI for reception from and transmission to a unicast MAC address (It consists of a TX-VCI and the shared RX-VCI.)
VCI	Virtual Communication Interface
WAVE	Wireless Access in Vehicular Environments (IEEE work item related to CALM M5)

5 Requirements

5.1 Communication Module Adaptation

5.1.1 General

As CALM is open for existing communication modules (CM), i.e. CMs that are not aware of CALM, and CALM-specific CMs, there is a need to adapt the interfaces of such existing CMs to those expected by the CALM network layer and the CALM management. The task is to adapt

— the CM Protocol Layers (CMPL) of the OSI protocol stack of a CM to the common CALM network layer by means of a Communication Adaptation Layer (CAL), and

— the CM Management Entity (CMME) of the CM to the Interface Management Entity (IME) by means of a CI Management Adaptation Entity (CIMAE).

The sum of CMPL and CMME in Figure 1 is entitled Communication Module (CM).

The sum of CM and CAL and CIMAE in Figure 1 is entitled Communication Interface (CI).

CMME and CIMAE constitute the Communication Interface Management Entity (CIME).

CAL and CMPL constitute the Communication Interface Protocol Layers (CIPL).

The CM Protocol Layers shall include at a minimum a physical layer (PHY), a medium access control sub-layer (MAC), and optionally a logical link control sub-layer (LLC). In the communication path, the CAL shall offer an LLC SAP (C-SAP) towards the CALM network layer, and shall serve the underlying protocol layer.

In a specific implementation, the CM may include higher layers of the OSI communication protocol stack including the related management.

The previously stated inclusion of higher protocol layers shall be restricted to those communication technologies already existing and not being aware of CALM, e.g. the cellular media ISO 21212 and ISO 21213.

In the management path, the CIMAE shall provide a Management SAP (M-SAP) towards the IME, and shall serve the CM and the CAL.

The CI adaptation is outlined in Figure 1.

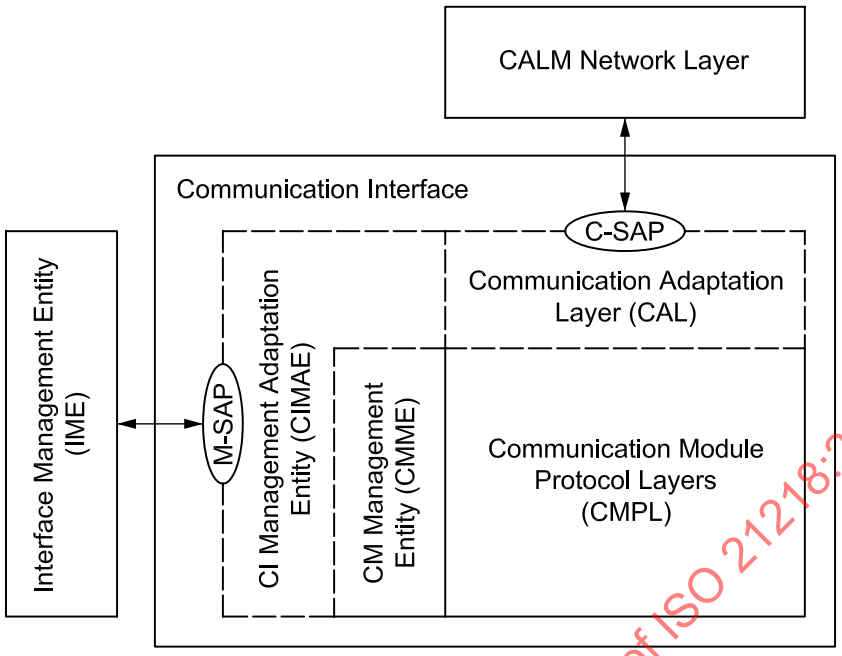

Figure 1 — Architecture

This International Standard provides common basic functional specifications for the Communication Adaptation Layer and for the CI Management Adaptation Entity. It specifies both the Communication SAP (C-SAP) and the Management SAP (M-SAP). Further information may be found in the related standards for the media, e.g. ISO 21212, ISO 21213, ISO 21214.

5.1.2 Communication Adaptation Layer

The CIs built on different media of CALM are using the same CALM network layer. All CIs shall use the same type of C-SAP between the CALM network layer and the CAL.

The medium-specific CAL provides a C-SAP to the CALM network layer following the same principles as outlined in ISO/IEC 8802-2. The supported types of LLC operation and LLC services may depend on the CALM networking protocol selected.

— For CALM FAST communications, Type I. operation is mandatory, with the LLC service XID being prohibited.

— The other types of LLC operation, i.e. Type II. and Type III., are optional.

The CAL can be considered as a medium-specific LLC or as an extension of an existing LLC providing the adaptation of the specific needs of a medium to the common communication C-SAP.

5.1.3 CI Management Adaptation Entity

The CIs built on different media of CALM are using the same IME, i.e. the same CALM management. All CIs shall use the same type of M-SAP between the CALM management and the CIMAE.

The CIMAE provides the M-SAP to the IME following the same principles as outlined in ISO/IEC 8802-11 with respect to the Station Management Entity.

Explicit implementation of the SAP between the CMME and the CIMAE is not required. Thus this SAP is outside the scope of this International Standard.

The CIMAE can be considered as medium-specific management entity providing the adaptation of the specific needs of a medium to the common M-SAP.

5.2 Communication Interface

5.2.1 Classes

Table 1 identifies and distinguishes the classes of CIs.

Table 1 — CI classes

Communication interface class	Definition and explanations
CIC-wl1	Wireless CI that is capable of establishing simultaneous associations with different peer stations for MAC unicast communication, and of receiving from and transmitting to MAC broadcast and multicast (group) addresses. Examples: CALM IR, CALM M5, CALM-MM, …
CIC-wl2	Wireless CI that is capable of establishing a session with a single peer station. Handover between different peer stations may be possible, but not visible to the CALM upper layers and management entities. Examples: CALM-G2, CALM-G3, …
CIC-wl3	Wireless CI that is capable to transmitting only on the basis of MAC broadcast/multicast (group) addresses. Examples: CALM broadcast stations based on CALM-IR, CALM-M5, CALM-MM, …
CIC-wl4	Wireless CI that is capable only of receiving frames from a broadcast station. Examples: Satellite navigation receiver, satellite broadcast receiver, …
CIC-wl5	Wireless CI that is capable only of performing communications between a car and a roadside station based on the master-slave principle with the roadside station being the master. Communication session establishment is done inside the CI. Examples: Japanese DSRC, CEN DSRC, …
CIC-wr1	Wired CI for local area network in a CALM installation. Non-deterministic.
CIC-wr2	Wired CI for local area network in a CALM installation. Deterministic.

5.2.2 Access classes

Access to a remote station may require authentication, for example:

— PIN for a SIM card;

— operator data:

  — provider name;

— APN;

— user name;

— password.

This is identified by means of the CI access class presented in Table 2.

Table 2 — CI access classes

CI access class	Definition and explanations
CIAC-1	No user authentication required. Usage of CI is free of any charge.
CIAC-2	CI requires access credentials, e.g. PIN and operator data. Usage of CI is subject of a service charge, e.g. price per time unit/per data amount unit/flat-rate.
CIAC-3	CI requires access credentials, e.g. PIN and operator data. However, usage of CI is free of any charge.

5.2.3 CI Identifier

CIs shall be referenced/addressed by a unique CI-ID.

The CI-ID shall be constructed according to Figure 2.

<table>
<tr><th colspan="5">CI-ID</th></tr>
<tr><th colspan="2">CtrlCI</th><th colspan="2">SerialNumber</th><th>MedID</th><th>CCK-ID</th></tr>
<tr><td colspan="2">C7 C6 C5 C4 C3 C2 C1 G/U
reserved</td><td colspan="2">Two octet unsigned Integer
MSB... LSB</td><td>One octet unsigned Integer
MSB... LSB</td><td>One octet unsigned Integer
MSB... LSB</td></tr>
<tr><td colspan="2">MS Byte</td><td>Byte 3</td><td>Byte 2</td><td>Byte 1</td><td>LS Byte</td></tr>
</table>

Figure 2 — CI-ID

The **CCK-ID** field identifies a CALM Communication Kernel (CCK) in a CALM installation with several routers and hosts, see ISO 21217. The CCK-ID shall be unique in a CALM installation. The CCK-ID field shall constitute the least significant byte of the CI-ID.

The **MedID** field identifies a CALM CI. The MedID shall be unique within a CCK. The value zero shall be used by the CI during registration at the IME. Assignment of values larger than zero shall be done by the IME. The MedID field shall constitute the second byte of the CI-ID.

NOTE MedID=0 may also indicate "unknown" or "not existent".

The **SerialNumber** field identifies the CI or a VCI of this CI; see clause 5.3.2. The SerialNumber shall constitute the third and fourth byte of the CI-ID. The value zero shall point to the MAC address of the local station and by this to the CI.

NOTE The management of the situation in which a CI may have to maintain more VCIs than addressable with the available SerialNumber address space may be possible and is implementation dependent.

The usage of the **G/U** bit is specified in 5.3.2.

5.2.4 Procedures

5.2.4.1 General

The procedures, as specified here, use management services of the M-SAP, as specified in 5.5.

5.2.4.2 Registration

Registration of a CI at the IME is the process of making the CI known at the IME, and of making it addressable via a unique MedID. See the state machine in Figure 3.

The status of the CI before successful registration shall be CIstatus equal to "not existent".

Upon power-up of the CALM system, or upon physical insertion/activation of a CI, a CI shall request registration of itself at the IME. The following procedure shall apply [steps 1) to 11)].

1) Set SerialNumber (see Figure 2) to a randomly selected number from an equal distribution process, with the seed value derived from the unique MAC address of the CI.

2) Set CCK-ID (see Figure 2) to the value zero.

3) Set MedID (see Figure 2) to the value zero.

4) Set all CtrlCI bits (see Figure 2) to zero.

5) Construct the preliminary CI-ID (see Figure 2).

6) Send **REQUEST** 0 "RegReq" indicating parameter 22 "MedType" and parameter 34 "MAC address" of this CI.

7) Set timer T_register to the value given in parameter 36 "TimeoutRegister".

8) Await **COMMAND** 0 "RegCmd" providing true values of "CCK-ID" and "MedID", and confirming the MAC address as long as T_register has not expired.

9) If the command in the previous step was successfully received, stop T_register and continue with the next step. If T_register had expired, start again with step 1).

10) If MACaddrTemp matches the confirmed MACaddr, registration was successful. Continue with the next step. Otherwise start again with step 1).

11) Upon successful registration, set the SerialNumber to the value zero, which together with the CCK-ID and the MedID as assigned by the IME constitutes the CI-ID of the registered CI. Set parameter 45 "CCK-ID" and parameter 37 "MedID" as received in **COMMAND** 0. Set parameter 42 "CIstatus" to the value "registered", and notify this value to the IME. This setting shall trigger creation of VCIs as specified in 5.3.

In order to register a device with CI class CIC-wl5, set all the CtrlCI bits in step 4) to one.

5.2.4.3 Deregistration

Deregistration of a CI at the IME is the reversal of the registration process of the CI. See the state machine in Figure 3.

Deregistration may be performed by the CIMAE or may be requested by the IME by sending the **COMMAND** 1 "CIstateChng" with the value "deregister".

Deregistration shall result in setting the MedID to the value zero, deletion of all VCIs and setting of parameter 42 "CIstatus" to the value "not existent".

Upon successful deregistration, the CI may be physically removed from the system.

5.2.4.4 Inactivation

Inactivation of a CI is the process to reset the CI and to block all subsequent communications. See the state machine in Figure 3.

Inactivation may be performed by the CIMAE or may be requested by the IME by sending the **COMMAND** 1 "CIstateChng" with the value "inactivate".

Inactivation shall result in resetting the CI. As a consequence, all VCIs shall be deleted and no more pending data packets shall be existent in the CI.

NOTE In a CI of class "CIC-wl2" and access class "CIAC-2" such as specified in ISO 21212 or ISO 21213, inactivation will result in disconnecting from the wireless service, i.e. ringing off.

The CIMEA shall set parameter 42 "CIstatus" to the value "inactive" and shall notify the IME.

5.2.4.5 Activation

Activation of a CI is the process to enable communications in an inactive CI. See the state machine in Figure 3.

Activation may be performed by the CIMAE or may be requested by the IME by sending the **COMMAND** 1 "CIstateChng" with the value "activate".

This command shall trigger creation of VCIs as specified below in this document.

NOTE In a CI of class "CIC-wl2" and access class "CIAC-2" such as specified in ISO 21212 or ISO 21213, the state "active" indicates that the CI is within the communication zone of a base station and thus might connect to the service.

5.2.4.6 Suspension

Suspension of a CI is the process to put all communications of a CI on hold, without deleting any packets or state variables. See the state machine in Figure 3.

Suspension may be performed by the CIMAE or may be requested by the IME by sending the **COMMAND** 1 "CIstateChng" with the value "suspend".

All VCIs shall be maintained. No pending data packets shall be lost. An ongoing frame transmission shall be stopped as quickly as possible.

The CIMEA shall set parameter 42 "CIstatus" to the value "suspended" and shall notify it to the IME.

5.2.4.7 Reactivation

Reactivation of a CI is the process to resume communications in a suspended CI. See the state machine in Figure 3.

Reactivation may be performed by the CIMAE or may be requested by the IME by sending the **COMMAND** 1 "CIstateChng" with the value "reactivate".

The CIMEA shall set parameter 42 "CIstatus" to the value "connected" and shall notify it to the IME. Pending packets shall be processed after activation, if possible, otherwise pending packets may be deleted without notification to the IME.

5.2.4.8 Connection

Connection of a CI is a process that depends on the CI access class.

For CI access class "CIAC-1" connection is established upon first usage of a TX-VCI.

For CI access classes "CIAC-2" and "CIAC-3" connection is achieved upon confirmed establishment of a connection to the communication network. Connection may be requested by the IME by sending the COMMAND 1 "CIstateChng" with the value "connect".

The CIMAE shall set the parameter 42 "CIstatus" to the value "connected" and shall notify it to the IME.

5.2.4.9 Disconnection

Disconnection of a CI is a process that depends on the CI access class.

For CI access class "CIAC-1", disconnection shall be performed upon the situation that no more TX-VCI with a relation to a peer station are known.

For CI access classes "CIAC-2" and "CIAC-3" this is the termination of the connection to the communication network. Disconnection may be requested by the IME by sending COMMAND 1 "CIstateChng" with the value "disconnect". There may be an implicit disconnection caused by deletion of a VCI.

The CIMAE shall set parameter 42 "CIstatus" to the value "active" and shall notify the IME.

5.2.4.10 CI state machine

Figure 3 shows the state machine of a CI as explained in the CI procedures in 5.2.4.2 to 5.2.4.9 and in the VCI procedures in 5.3.3.1 to 5.3.3.3. It covers the start and end state

— not_existent,

the interim states

— existent, and

— registered,

the operational states

— active, and

— connected,

the non-operational states

— suspended, and

— inactive.

See parameter 42 "CIstatus". The transitions between the states are

— power on/activate, see 5.2.4.2,

— register, see 5.2.4.2,

— deregister, see 5.2.4.3,

— create VCI, see 5.3.3.1,

— inactivate, see 5.2.4.4,

— activate, see 5.2.4.5,

— suspend, see 5.2.4.6,

— reactivate, see 5.2.4.7,

— connect, see 5.2.4.8,

— disconnect, see 5.2.4.9, and

— delete VCI, see 5.3.3.3.

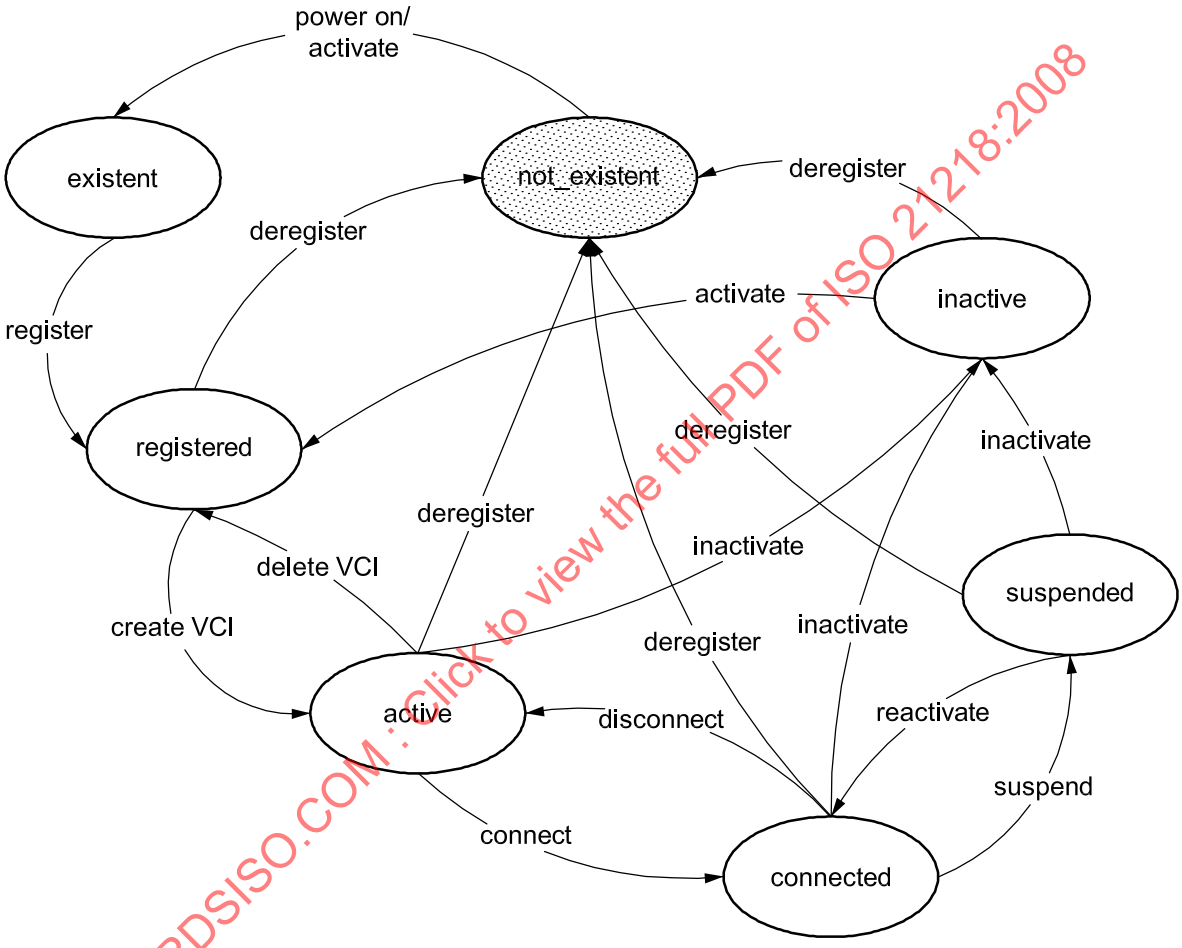

Figure 3 — CI state machine

5.2.4.11 Cross-CI prioritization

5.2.4.11.1 General

Wireless TX-VCIs in a CALM installation might suffer from cross-interference. Subclause 5.2.4.11 considers the case in which at least two local TX-VCIs, e.g. using the same medium, need to be synchronized in order to avoid cross-interference. The procedure to synchronize transmission of multiple CIs based on user priority is called "Cross-CI prioritization".

The design and integration goal shall be to avoid such cross-interference to the greatest possible extent. A possible means of achieving this is proper assignment of allowed wireless communication channels to the CIs.

Priority management across CIs requires involvement of the CALM management for every packet to be prioritized.

This procedure "Cross-CI prioritization" is an optional procedure.

5.2.4.11.2 Registration of CI for prioritization request

A CI may register itself at the IME for the cross-CI prioritization procedure. This registration shall include

— the types of potentially interfering media, see parameter 22 "Medium", and

— the prioritization timeout in milliseconds.

Registration for cross-CI prioritization shall use **REQUEST** 1 "PrioReg".

It is assumed that potentially interfering media are known *a priori* by the CI. Settings shall be made by the manufacturer of the victim device. Settings may be overruled by the IME.

5.2.4.11.3 Prioritization request

A packet to be transmitted with a given high priority may be notified via the IME to other CIs not being in charge of transmitting this packet by means of a dummy transmission request, i.e. by sending **REQUEST** 2 "RTSreq", see Annex C. The minimum required priority is specified in the parameter “MinPrioCrossCI”.

— RTSreq.priority shall be set equal to the user priority of the pending packet,

— RTSreq.seqNo shall be set to a value unique for this CI,

— RTSreq.status shall be set to "request".

NOTE The IME accepts a prioritization request only if RTSreq.priority is at least equal to MinPrioCrossCI.

Upon transmission of the request, the CI may start a timer T_DummyAckReq for this request.

In the case of protection only (see 5.2.4.12) the CI may try immediately to perform the intended transaction without awaiting receipt of an acknowledgement, if it will not cause interference to other CIs in this CALM station.

Otherwise, upon reception of the acknowledge **COMMAND** 4 "RTSackCmd", see Annex B, from the IME with

— RTSackCmd.seqNo equal to the related request, and

— RTSackCmd.status equal to "granted",

the CI shall send the pending packet. The CI shall cancel the timer T_DummyAckReq.

If the acknowledge command shows RTSackCmd.status equal to "ignored", the CI may either send the pending packet or delete it. The CI shall cancel the timer T_DummyAckReq. The CIMAE shall set parameter 44 "MinPrioCrossCI" equal to the value provided in RTSackCmd.priority.

Upon expiration of the timer T_DummyAckReq, if applicable, the CI may either send the pending packet or may delete it.

5.2.4.11.4 Prioritization release

Upon transmission or deletion of the pending packet, the CI shall release the prioritization request by means of **REQUEST** 2 "RTSreq" (see Annex C) to the IME:

— RTSreq.priority shall be set equal to the request value;

— RTSreq.seqNo shall be set equal to the request value;

— RTSreq.reqStatus shall be set to "release".

The CI priority manager shall continue to serve the priority queues.

5.2.4.11.5 Interferer procedures

The information contained in **REQUEST** 2 "RTSreq" shall be used in the priority queue of the potential inteferer CI. All potential interferers shall be notified by the IME by means of the **COMMAND** 3 "RTScmd", see Annex B:

— RTScmd.reqID shall be set equal to CCK-ID and MedID of the related request;

— RTScmd.priority shall be set equal to the user priority of the related request;

— RTScmd.seqNo shall be set equal to the value of the related request;

— RTScmd.status shall be set to "request".

Once such a dummy entry in the priority queue is subject to transmission,

— the dummy request shall be acknowledged by means of **REQUEST** 3 "RTSackReq", see Annex C, thus

  — RTSackReq.reqID shall be set equal to CCK-ID and MedID of the related request,

  — RTSackReq.seqNo shall be set equal to the value of the related request, and

  — RTSackReq.status shall be set to "granted", then

— the transmitter shall be disabled and a timer T_dummyAckGrant for this request shall be started,

— the CI priority manager shall await either time out of T_dummyAckGrant or shall await release of this dummy transmission request by means of the **COMMAND** 3 "RTScmd", see Annex B, with the parameters set as follows:

  — RTScmd.reqID shall be set equal to CCK-ID and MedID of the related request;

  — RTScmd.priority shall be set equal to the user priority of the related request;

  — RTScmd.seqNo shall be set equal to the value of the related request;

  — RTScmd.status shall be set to "release";

— the CI priority manager shall then delete the dummy transmission request from the queue and shall continue serving the priority queues.

5.2.4.12 Protection of CI

Wireless transmitters and receivers integrated in a CALM station may suffer from cross-interference. Depending on user priorities, the interfering local CI transmitters are disabled for a defined period. This is called "Protection of CI".

NOTE An example of a CI in need of protection is a CEN DSRC OBU as widely used in payment and access control systems.

The design and integration goal is to avoid such cross-interference to the greatest possible extent.

"Protection of CI" shall make use of the "Cross-CI Prioritization" procedure.

Independent of the protection status, the CI may try to perform an intended communication at any time, unless it is requested to disable its transmitter due to a transmission request of a packet with higher priority, announced by means of the Cross-CI prioritization procedure.

The procedure for protection of a CI may be hard-wired in an implementation.

5.2.4.13 Regulatory Information Management

If regulation limits the capabilities of a medium, the CI shall control proper settings of parameters in line with the actually valid regulation. The regulations could depend on, for example,

— the geographical location of the CALM station, or

— the legal type (owner) of the CALM station.

It is possible to get updates of the regulatory information with the following three options:

1) The CI continuously monitors reception of frames with regulatory information, if applicable, in order to have an up-to-date regulatory information list.

2) Alternatively, regulatory information may be derived from a local regulatory database located inside the CI using latitude and longitude of the geographical location of the CALM station. The geographical location of the CALM station shall be provided by a positioning service via the IME, if applicable, otherwise directly from a positioning unit being integrated within the CI. The CI may request to receive updates of the kinematic vector, see parameter 41 "KinematicVector", containing latitude and longitude information by means of **REQUEST** 10 "PosUpdateReq", which defines the update interval and activates/disables updates.

3) Alternatively, regulatory information may be received via other CIs. A CI may request retrieval of regulatory information with **REQUEST** 7 "RIreq", see Annex C. Upon this request the IME shall construct a management packet for transmission via the selected CI in order to retrieve the regulatory information. Upon reception of the regulatory information in a management response packet, the IME shall forward the complete response packet to the requesting CI by means of **COMMAND** 7 "RIcmd", see Annex B.

Attempts of the IME to set parameters of the CI such that regulation would be violated shall be ignored and acknowledged with error code "RI VIOLATION", see Annex D.

The details of regulatory information data content and format are outside the scope of this International Standard.

5.3 Virtual Communication Interface

5.3.1 Concept

The concept of a "Virtual Communication Interface" (VCI) provides a quick and efficient method to set the properties of a CI on a packet-by-packet basis without the continuous involvement of the CALM management entities. It is assumed that different MIB settings may apply for every association with a specific peer station. Access to a VCI may require a minimum user priority.

Each wireless RX/TX-CI shall maintain at least one virtual CI (VCI) for reception and transmission, i.e. a UC-VCI consisting of a TX-VCI plus a receive VCI (RX-VCI). There shall be a single UC-VCI for every active peer station. The RX-VCI shall be shared by all UC-VCIs of the same CI. There shall be one TX-VCI for transmission to the MAC broadcast address (BC-VCI), if applicable. There may be multiple TX-VCIs for transmission to MAC multicast (group) addresses (MC-VCI), if applicable.

NOTE Broadcast address and multicast addresses are referred to as groupcast addresses.

TX-only CIs, i.e. groupcast transmitters, shall contain BC-VCIs and/or MC-VCIs only.

RX-only CIs, e.g. groupcast or satellite positioning receivers, shall contain a single RX-VCI only.

Wired LAN CIs shall contain a single VCI for transmission and reception in both unicast and groupcast/unicast mode.

Figure 4 explains how virtual entities of a CI and user priority are to be handled. After priority checking is performed by the CI priority manager, the CI is set to the MIB values of the TX-VCI valid for the selected packet.

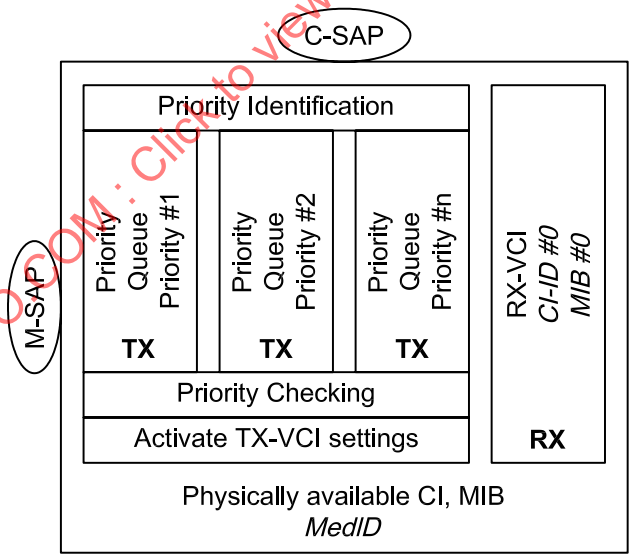

Figure 4 — CI priority queues and virtual communication interfaces

TX-VCIs of a certain CI, e.g. an M5 radio, an MM radio or an IR communication unit, shall share this one CI such that these virtual TX-VCIs behave like full real CIs, running quasi-simultaneously.

Each TX-VCI shall have its own set of parameters (MIB), and state machines/state variables if applicable. The differences between the VCI-MIBs are only in

a) the TX-parameters, and

b) the MAC addresses of the peer stations.

The CI shall use the transmit parameter settings as provided by the MIB of the active VCI. These settings shall apply until another VCI is being used for transmission or is requested by the CALM management.

User priority shall be handled according to the priority parameter provided by the network layer in the service primitive for communication, e.g. **DL-UNITDATA.request**, see 5.4. Priority queues for transmission shall be maintained either in the CAL, the LLC or the MAC of the CI. There shall be only a single set of queues for all TX-VCIs of a CI.

Multiple CIs of the same type, i.e. same medium, are allowed. If these CIs guarantee real simultaneous operation, these CIs may use the same or different priorities without a common priority checking entity. If these CIs operate simultaneously on interfering channels, a cross-CI prioritization mechanism may be applied.

NOTE Further on, it is allowed to provide a medium-specific bridge. This bridge may cover all CIs of the same type. Details are outside the scope of this International Standard.

5.3.2 VCI Identifier

VCIs shall be referenced/addressed by a unique CI-ID. In general, the CI-ID acts as a unique pointer to a MAC address.

The CI-ID shall be constructed according to Figure 2.

The **CCK-ID** field and **MedID** field shall be set as specified for the CI, see clause 5.2.3.

The **SerialNumber** field and the G/U bit identify uniquely a VCI of the CI associated with the MedID. The SerialNumber shall be unique within a CALM CI. For UC-VCIs, the SerialNumber shall be created by either the CIMAE or the IME, dependent upon which entity creates the VCI. The whole number range shall be subdivided according to Table 3 in order to ensure uniqueness of the SerialNumber.

Table 3 — Subdivision of SerialNumber for UC-VCI

Number range	SerialNumber assigned by
0, 1 - 0xFEFF = 0, 1 - 65.279	CIMAE
0xFF00 - 0xFFFF= 65.280 - 65.535	IME

The value of SerialNumber shall be mapped uniquely to the MAC address of the peer station/the local station by the CIMAE in an implementation specific way. The value zero shall point to the MAC address of the local station and by this to the CI. The usage of the value 0xFFFF with the **G/U** bit set to '0' is specified in ISO 29281.

The usage of **CtrlCI** field bits C1 – C7 is specified in ISO 29281.

The **G/U** bit shall be used to distinguish between unicast MAC addresses and groupcast MAC addresses. The value '0' shall indicate a unicast MAC address. The value '1' shall indicate a groupcast MAC address, i.e. either a multicast or a broadcast MAC address.

NOTE For MC-VCI the SerialNumber shall uniquely identify the MAC multicast address, i.e. the two octets shall be two octets of the MAC address as specified in the medium standard.

5.3.3 Procedures

5.3.3.1 Creation of VCI

Upon registration of a CI of CI class "CIC-wl2", the CI shall continuously monitor for a base station providing possible access to the communication network. Once a base station is identified that may provide access to the communication network, a TX-VCI and an RX-VCI shall be created by the CIMAE based upon the default MIB. Parameter 42 "CIstatus" shall be set to "active".

Such a CI shall connect to the service automatically if it is of CI access class "CIAC-1". If it is of CI access class "CIAC-2", initiation of connection depends on parameter 51 "Connect". If "Connect" is set to "manual" it shall await a request from IME to connect. If "Connect" is set to "automatic" it shall connect automatically upon reception of the first data transmission request DL-UNITDATA.request.

Upon registration of an RX/TX-CI of CI class "CIC-wl1", a TX-VCI, a BC-VCI, if applicable, and an RX-VCI shall be created by the CIMAE based on the default MIB. Parameter 42 "CIstatus" shall be set to "active". Upon request to transmit a frame to a peer station, a TX-VCI shall be created, if not already existent. For every peer station from which a packet was received, the relation between the MAC address of the peer station and a CI-ID is maintained for possible reply to this peer station via a TX-VCI.

NOTE A possible implementation is as follows. Upon reception of the first frame from a peer station, the CI-ID of the TX-VCI shall be mapped to the MAC address of this peer station. The value of the MAC address is notified automatically to the IME. Upon reception of a frame from a new peer station, the CIMAE creates a new TX-VCI. The CI-ID of this new TX-VCI is mapped to the MAC address of the new peer station. The value of the MAC address is notified automatically to the IME.

Upon registration of an RX-only CI, an RX-VCI shall be created by the CIMAE based on the default MIB. Parameter 42 "CIstatus" shall be set to "active".

Upon registration of a TX-only CI, a BC-VCI shall be created by the CIMAE based on the default MIB. Parameter 42 "CIstatus" shall be set to "active".

Creation of a VCI shall be notified to the IME by means of **REQUEST** 9 "Events", see Annex C.

Upon request from the IME, the CIMAE shall create a VCI, e.g. UC-VCI or MC-VCI, with SerialNumber as requested by the IME by means of **COMMAND** 9 "VCIcmd", see Annex B. The MIB of this new VCI shall use default values in line with the MIB of the active shared RX-VCI, if applicable. Subsequently the actual MIB of the new VCI may be modified by the IME.

5.3.3.2 Reset of VCI

Upon reset request by means of **COMMAND** 9 "VCIcmd", see Annex B, all state variables and all pending packets and frames shall be deleted. A relation to a peer station, if applicable, shall remain.

Successful reset of a VCI shall be notified to the IME by means of **REQUEST** 9 "Events", see Annex C.

5.3.3.3 Deletion of VCI

The CIMAE may delete a TX-VCI if the related peer station was invisible for a minimum period calculated from the actual time and the time of last reception, see Table 4. If all TX-VCIs associated with the shared RX-VCI are deleted, the CIMAE shall create a new TX-VCI as is to be done upon activation of the CI, see above, and shall use default MIB settings for TX-VCI and RX-VCI.

Deletion of a VCI shall be notified to the IME by means of **REQUEST** 9 "Events", see Annex C.

Upon request from the IME, the CIMAE shall delete a VCI by means of **COMMAND** 9 "VCIcmd", see Annex B. If all TX-VCIs associated with the shared RX-VCI are deleted, the CIMAE shall create a new TX-VCI as is to be done upon activation of the CI, see above, and shall use default MIB settings for TX-VCI and RX-VCI.

5.3.3.4 Association of peer with CI-ID

All packets received from a peer station shall be identified by means of the CI-ID of the related TX-VCI created for this peer station.

Details on assignment of values and relation to MAC addresses are specified in Tables 8 and 9.

NOTE A CI may change its locally administered MAC address for the purpose of privacy. Procedures on how to manage a change of MAC address are medium-specific and outside the scope of this International Standard. A change of MAC address without notification of the peer station will thus result in creation of a new VCI and termination of ongoing communications at the higher OSI layers based on the old MAC address.

The CIMAE shall maintain the following Table 4 with the mappings of peer MAC address and related CI-ID together with time of last reception of a frame.

Table 4 — Peer-List

Peer MAC address	CI-ID	Time of last reception
As received from peer station.	Complete CI-ID according to Figure 2. NOTE For identification of a peer station, bits C1 to C7 are not relevant.	ASN.1 GeneralizedTime with at least one byte for fractional seconds. See parameter 12 in Annex A.

The time of last reception shall be used to estimate whether a peer station has left the communication zone.

5.3.3.5 Change of MIB settings

The CI may automatically change MIB settings according to rules that are specific to the medium.

The IME may request change of MIB settings according to rules specified in ISO 24102.

5.4 Communication SAP

5.4.1 LLC Types of Operation

ISO/IEC 8802-2 defines three types of LLC operation, i.e. Type I., Type II. and Type III.

As a minimum, a CI shall support LLC Type I. operations.

For the C-SAP there is only a single mandatory service defined, i.e. DL-UNITDATA service.

The DL-UNITDATA service provides the unacknowledged connectionless mode data transfer services according to ISO/IEC 8802-2.

Subclauses 5.4.3.1 to 5.4.3.2.5 describe the two mandatory service primitives:

— **DL-UNITDATA.request**;

— **DL-UNITDATA.indication**.

The handling of address parameters and priority for other LLC services shall be the same as specified in this International Standard for the mandatory service.

ISO/IEC 8802-2 defines four classes of LLC, i.e. Class I., Class II., Class III. and Class IV.

Class I. shall be mandatory for CALM CIs with possible restrictions of the LLC services XID and TEST depending on the networking protocol. For CALM FAST according to ISO 29281:2008, XID shall be prohibited.

Further details are outside the scope of this International Standard.

5.4.2 Addressing

5.4.2.1 SAP-Addresses

C-SAP addresses for the Link Service Access Point describe which network protocol is associated with the message to be transferred. Refer to ISO/IEC TR 8802-1. C-SAP addresses for the source, i.e. SSAP address, and C-SAP addresses for the destination, i.e. DSAP address, are distinguished. SSAP and DSAP shall be transmitted via the CI in a medium specific way.

Table 5 — Addresses for the Link Service Access Point (C-SAP) — Informative

C-SAP address	C-SAP address binary LSB .... MSB	Description Network Usage	Comment
	x 0 d d d d d d	DSAP address	ISO/IEC 8802-2
	x 0 s s s s s s	SSAP address	ISO/IEC 8802-2
	x 1 d d d d d d	Reserved DSAP for ISO definition	ISO/IEC 8802-2
	x 1 s s s s s s	Reserved SSAP for ISO definition	ISO/IEC 8802-2
even	0 x d d d d d d	Individual DSAP	ISO/IEC 8802-2, applicable for C-SAP
odd	1 x d d d d d d	Group DSAP	ISO/IEC 8802-2, usage not defined in this International Standard
even	0 x s s s s s s	Command SSAP	ISO/IEC 8802-2, applicable for C-SAP
odd	1 x s s s s s s	Response SSAP	ISO/IEC 8802-2, not applicable for C-SAP, as only UNITDATE service is specified.

The following address mapping applies for CALM:

Table 6 — Addresses for the Link Service Access Point (C-SAP) — Optional

C-SAP address decimal and hexadecimal	C-SAP address binary LSB .... MSB	Description Network Usage	Comment
2 = 0x02	0 1 0 0 0 0 0 0	Individual DSAP for the LLC sub-layer management function at that station	ISO/IEC 15802-2 Remote LAN management, http://iana.org
3 = 0x03	1 1 0 0 0 0 0 0	Group DSAP for the LLC sub-layer management at that station	ISO/IEC 15802-2 Remote LAN management, http://iana.org
166 = 0xA6	0 1 1 0 0 1 0 1	RDE SAP address	RDE = route determination entity To support bridges ISO/IEC 8802-2
170 / 171 = 0xAA / 0xAB	0 1 0 1 0 1 0 1	SNAP	Sub-Network Access Protocol DLL extension See ISO/IEC 8802-2, http://iana.org
182 / 183 = 0xB6 / 0xB7	x 1 1 0 1 1 0 1	CALM IPv6	Network protocol as defined in ISO 21210
186 / 187 = 0xBA / 0xBB	x 1 0 1 1 1 0 1	Fast communication without IPv6 addresses	—
190 / 191 = 0xBE / 0xBF	x 1 1 1 1 1 0 1	Position-based addressing	—
242 / 243 = 0xF2 / 0xF3	x 1 0 0 1 1 1 1	Fast OEM communication without IPv6 addresses	The location of the required application manager for fast OEM communication is defined by the implementation and thus known *a priori*. The protocol/hardware used to transfer frames from the CI to the application and vice versa is implementation specific.
246 / 247 = 0xF6 / 0xF7	x 1 1 0 1 1 1 1	Reserved for future use	—
250/251 = 0xFA / 0xFB	x 1 0 1 1 1 1 1	ITS-MUX	Provides multiplexing/ demultiplexing of PDUs from different networking protocols onto a single frame. See ISO 29281:2008.

Table 7 — Addresses for the Link Service Access Point (C-SAP) – Mandatory

C-SAP address decimal and hexadecimal	C-SAP address binary LSB .... MSB	Description Network Usage	Comment
0 = 0x00	0 0 0 0 0 0 0 0	Null LSAP	Usable as both DSAP and SSAP. Local address.
255 = 0xFF	1 1 1 1 1 1 1 1	Global DSAP	
Plus at least one pair from Table 6 with C-SAP value above 169.			

5.4.2.2 DL-SAP source and destination addresses

The DL-SAP source_address and destination_address as used in the LLC services shall be the concatenation of a CI-ID and a C-SAP address as follows in Figure 5.

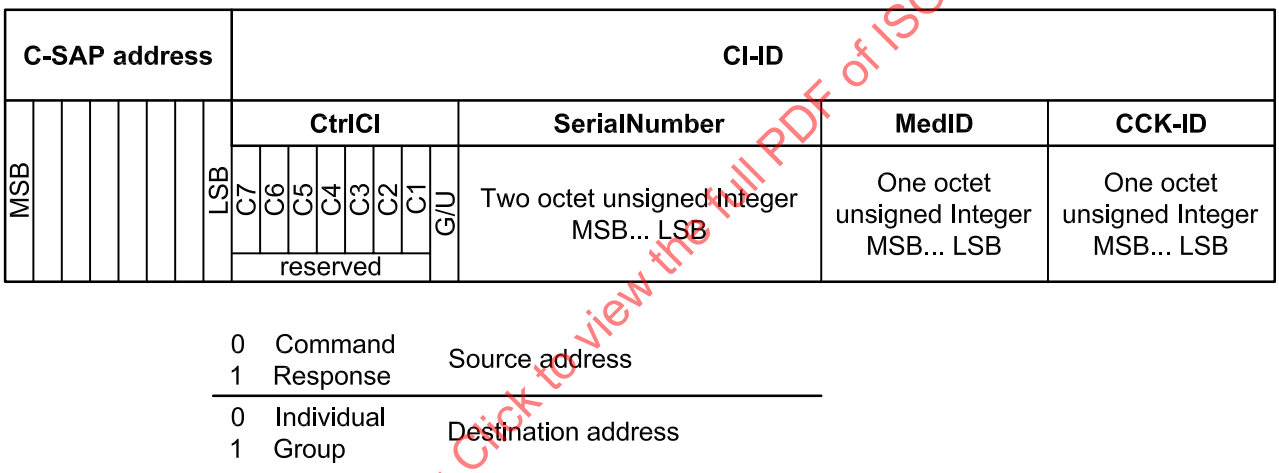

Figure 5 — C-SAP Source and Destination Address Format

The C-SAP address shall constitute the most significant byte of source_address and destination_address.

Tables 8 and 9 specify the mapping of CI-IDs on MAC addresses.

Table 8 — Address parameters in e.g. DL-UNITDATA.request

Source MAC address	Destination MAC address	CI-ID of source_address	CI-ID of destination_address	Comment
Private MAC_{local} of transmitting local station	Broadcast	G/U = '0' SerialNumber = 0	G/U = '1' SerialNumber = 0xFFFF	CCK-ID and MedID of local CI used. C1 – C7: Usage specified in ISO 29281
	Multicast (MAC group) M_{group}		G/U = '1' SerialNumber → M_{group}	
	Private MAC_{peer} of peer CI		G/U = '0' SerialNumber → MAC_{peer}	

Table 9 — Address parameters in e.g. DL-UNITDATA.indication

Source MAC address	Destination MAC address	CI-ID of source_address	CI-ID of destination_address	Comment
Private MAC_{peer} of transmitting peer station	Broadcast	G/U = '0' SerialNumber → MAC_{peer}	G/U = '1' SerialNumber = 0xFFFF	CCK-ID and MedID of local CI used. C1 – C7: Usage specified in ISO 29281
	Multicast (MAC group) M_{group}		G/U = '1' SerialNumber → M_{group}	
	Private MAC_{local} of local CI		G/U = '0' SerialNumber = 0	

Tables 8 and 9 show that the CtrlCI field is irrelevant for the association with a peer station.

5.4.2.3 SNAP

The sub-network access protocol (SNAP) is an optional extension of the LLC, see http://iana.org. SNAP is designed to extend the address space for selecting a network protocol. It applies only to Type I. Unnumbered Information (UI) commands according to ISO/IEC 8802-2.

SNAP is not mandatory, as the C-SAP elements DSAP and SSAP defined are sufficient to select the proper network protocol.

From the information in the SNAP header, the correct C-SAP values shall be derived. Removal of a SNAP header and generation of C-SAP values shall be done at the CAL prior to submission of the packets to the CALM network layer in a **UNITDATA.indication** service primitive via the proper C-SAP as indicated in the SNAP header.

Generation of the SNAP header in a medium supporting SNAP shall be done at the CAL prior to submission of the packet to the MAC sub-layer.

Further details are outside the scope of this International Standard.

5.4.3 Service primitives (informative)

5.4.3.1 DL-UNITDATA.request

5.4.3.1.1 Function

The service primitive **DL-UNITDATA.request** is used for transmission of data.

5.4.3.1.2 Semantics of the service primitive

DL-UNITDATA.request (
source_address,
destination_address,
data,
priority
)

The source_address is defined in 5.4.2.2.

The destination_address is defined in 5.4.2.2.

The data parameter contains the data to be transferred as payload. This parameter is referred to as NPDU.

The priority parameter is defined in 5.4.4.

5.4.3.1.3 When generated

The service primitive **DL-UNITDATA.request** is passed from the CALM network layer to the addressed CAL to request that an LSDU be sent to one or more remote C-SAPs using unacknowledged connectionless-mode data transfer procedures.

5.4.3.1.4 Effect on receipt

Receipt of the service primitive **DL-UNITDATA.request** causes the CAL to attempt to send the LSDU using the unacknowledged connectionless-mode data transfer mode considering the adaptation procedures for the selected VCI and the type of adaptation as indicated by the value of DSAP.

NOTE A packet addressed to a non-existent VCI will be discarded.

5.4.3.1.5 Additional comments

The service primitive **DL-UNITDATA.request** is independent of any connection with the remote C-SAP.

5.4.3.2 DL-UNITDATA.indication

5.4.3.2.1 Function

The service primitive **DL-UNITDATA.indication** is used for reception of data.

5.4.3.2.2 Semantics of the service primitive

DL-UNITDATA.indication (
source_address,
destination_address,
data
priority
)

The source_address is defined in 5.4.2.2.

The destination_address is defined in 5.4.2.2.

The data parameter contains the data that are to be transferred.

The priority parameter is defined in 5.4.4.

5.4.3.2.3 When generated

The service primitive **DL-UNITDATA.indication** is passed from the CAL to the CALM network layer in the case of error-free reception of the physical layer frame to indicate the arrival of an LSDU from the specific remote entity. In the case of fragmentation performed in the CI, this service primitive is passed on only upon complete error-free reception of all fragments of the same block.

5.4.3.2.4 Effect on receipt

The effect on receipt of the service primitive **DL-UNITDATA.indication** by the network layer depends on the network protocol addressed.

5.4.3.2.5 Additional comments

The service primitive **DL-UNITDATA.indication** is independent of any connection to the remote C-SAP. In the absence of errors, the content of the data parameter is logically complete and unchanged relative to the data parameter in the associated **DL-UNITDATA.request** primitive.

5.4.4 Priority

The parameter priority carries the user priority. Priority checking and managing for all TX-VCIs of a CI shall be medium-specific either in the CAL or the CM.

Values for the priority parameter are in the range from 0 to 255, where 0 indicates lowest priority. The choice of priority values depends on applications served by the communication system and is implementation specific, thus it is outside the scope of this International Standard.

Mapping of MAC sub-layer priorities to user priorities and vice versa shall be subject to the CI as specified in the related standard.

A VCI may require a minimum user priority as an access prerequisite. Packets offered to a VCI for transmission with a user priority below the minimum user priority according to parameter 11 "MinimumUserPriority", see Annex A, shall be deleted. The IME shall be notified by means of **REQUEST** 9 "Events". The default priority value shall indicate lowest priority.

Packets pending for transmission with a priority at least equal to the MinimumSuspendPriority, see parameter 21 in Annex A, shall be served immediately so that a packet with lower priority currently being transmitted at the MAC/physical layer is suspended immediately and retransmitted at a later time, if supported by the CI.

Pending packets of same priority shall be stored in a first-in first-out queue. As soon as a queue is filled up above an alert threshold defined in parameter 32 "QueueAlarmThreshold", see Annex A, the IME shall be notified by means of **REQUEST** 9 "Events".

If the queues for pending packets can store no further packets, the IME shall immediately be notified by means of **REQUEST** 9 "Events". The packets of the new request may be deleted.

Packets pending in a VCI shall not be sent once the lifetime of these packets has expired, if applicable.

NOTE Lifetime management requires knowledge of the lifetime of a packet in the VCI. This can be achieved by means of a lifetime entry in the CIP header.

Priority management across CIs may be a somewhat slow process which requires involvement of the CALM management for every packet to be prioritized. A packet to be transmitted may be recognized in CIs that are not in charge of transmitting it by means of a dummy transmission request. Details are specified in 5.2.4.11.

For protection, see 5.2.4.12.

5.5 Management SAP

5.5.1 General

Basically, there are the following different types of services:

a) a service that allows IME to set parameter values in the (virtual) CI;

b) a service that allows IME to read parameter values from the (virtual) CI;

c) a service that allows CIMAE to notify events to the IME, including changes in (virtual) CI parameter values;

d) a service that allows IME to send a command "**COMMAND**" to the CIMAE;

e) a service that allows the CIMAE to send a command "**REQUEST**" to the IME;

f) transmission request of a management data packet;

g) reception notification of a management data packet.

Setting of parameter values shall be built on the service **CIMAE-SETPARM**.

Reading of parameter values shall be built on the service **CIMAE-GETPARAM**.

Issuing of commands by the IME shall be built on the service **CIMAE-COMMAND**.

Issuing of commands by the CI shall be built on the service **CIMAE-REQUEST**.

Transmission request and reception notification of management data packets are built on the services **CIMAE-COMMAND** and **CIMAE-REQUEST**.

Event notifications are built on the service **CIMAE-REQUEST**.

Annex E presents ASN.1 definitions of the management parameters and service primitives.

Every request and confirm service primitive is identified by a CommandRef parameter. A value unique within the available number space is assigned to the request service primitive. The related confirm service primitive uses the same number as provided in the related request service primitive.

5.5.2 CIMAE-SETPARAM

5.5.2.1 CIMAE-SETPARAM.request

5.5.2.1.1 Function

The management service primitive **CIMAE-SETPARAM.request** allows setting of CI parameters by the IME.

5.5.2.1.2 Semantics

The parameters of the management service primitive **CIMAE-SETPARAM.request** are as follows:

CIMAE-SETPARAM.request (
CI-ID,
CommandRef,
Sequence of M-Param
)

Table 10 — CIMAE-SETPARAM.request Parameter description

Name	Type	Valid Range	Description
CI-ID	Structure	-	Unique identifier of a VCI/CI. The setting of the control bits C1 – C7 of the CtrlCI field is ignored if not specified differently in other CALM standards.
CommandRef	Integer	0 to 255	Unique cyclic reference number of command.
-	One octet Integer	0 to 255	Number of subsequent elements M-Param.
M-Param.No	One octet Integer	1 to 255	See Annex A.
M-Param.Value	-	Dependent on Parameter	See Annex A.

See ASN.1 definitions in Annex E.

5.5.2.1.3 When generated

The management service primitive **CIMAE-SETPARAM.request** is generated by the IME when CI parameters are set.

5.5.2.1.4 Effect on receipt

On receipt of the management service primitive **CIMAE-SETPARAM.request** the selected parameters are set if applicable.

5.5.2.2 CIMAE-SETPARAM.confirm

5.5.2.2.1 Function

The management service primitive **CIMAE-SETPARAM.confirm** reports the result of a previous **CIMAE-SETPARAM.request**.

5.5.2.2.2 Semantics

The parameters of the management service primitive **CIMAE-SETPARAM.confirm** are as follows:

CIMAE-SETPARAM.confirm (
CI-ID,
CommandRef,
Sequence of Errors OPTIONAL
)

The optional element "Sequence of Errors" is available if at least one of the requested settings was in error. It may be available in order to acknowledge settings explicitly.

Table 11 — CIMAE-SETPARAM.confirm Parameter description

Name	Type	Valid Range	Description
CI-ID	Structure		Unique identifier of a VCI/CI. The setting of the control bits C1 – C7 of the CtrlCI field is ignored if not specified differently in other CALM standards.
CommandRef	Integer	Same as in related request	Unique cyclic reference number of command.
-	One octet Integer	0, 1 to 255	Number of subsequent error messages.
Errors.M-paramNo	One octet Integer	0 to 254	Parameter reference number for which Result.Code applies.
Errors.errStatus	One octet integer	See Table D.1	Return/error code

A request to set a defined "read only" parameter is acknowledged with ErrStatus 7 "ACCESS VIOLATION". A request to set an undefined parameter is acknowledged with ErrStatus 2 "INVALID PARAMETER NUMBER". A request to set a defined parameter with an illegal value is acknowledged with ErrStatus 3 "INVALID PARAMETER VALUE". A request to set a defined parameter with an illegal type of value is acknowledged with ErrStatus 1 "UNSPECIFIED FAILURE".

See ASN.1 definitions in Annex E.

5.5.2.2.3 When generated

The management service primitive **CIMAE-SETPARAM.confirm** is generated by the CIMAE upon reception of a previous **CIMAE-SETPARAM.request**.

5.5.2.2.4 Effect on receipt

On receipt of this primitive, the IME shall evaluate Errors, if applicable, and act accordingly. Details are outside the scope of this International Standard.

5.5.3 CIMAE-GETPARAM

5.5.3.1 CIMAE-GETPARAM.request

5.5.3.1.1 Function

The management service primitive **CIMAE-GETPARAM.request** requests reporting of CI parameter values to the IME.

5.5.3.1.2 Semantics

The parameters of the management service primitive **CIMAE-GETPARAM.request** are as follows:

CIMAE-GETPARAM.request (
CI-ID,
CommandRef
Sequence of M-Param.No
)

Table 12 — CIMAE-GETPARAM.request Parameter description

Name	Type	Valid Range	Description
CI-ID	Structure		Unique identifier of a VCI/CI. The setting of the control bits C1 – C7 of the CtrlCI field is ignored if not specified differently in other CALM standards.
CommandRef	Integer	0 to 255	Unique cyclic reference number of command.
-	One octet Integer	0 to 255	Number of subsequent elements M-Param.No.
M-Param.No	Once octet Integer	0 to 255	See Annex A.

See ASN.1 definitions in Annex E.

5.5.3.1.3 When generated

This primitive is generated by the IME when CI parameters are retrieved.

5.5.3.1.4 Effect on receipt

On receipt of the management service primitive **CIMAE-GETPARAM.request** CI parameters are reported to the IME.

5.5.3.2 CIMAE-GETPARAM.confirm

5.5.3.2.1 Function

The management service primitive **CIMAE-GETPARAM.confirm** reports CI parameter values to the IME.

5.5.3.2.2 Semantics

The parameters of the management service primitive **CIMAE-GETPARAM.confirm** are as follows:

CIMAE-GETPARAM.confirm (
CI-ID,
CommandRef,
Sequence of M-Param
)

Table 13 — CIMAE-GETPARAM.confirm parameter description

Name	Type	Valid Range	Description
CI-ID	Structure		Unique identifier of a VCI/CI. The setting of the control bits C1 – C7 of the CtrlCI field is ignored if not specified differently in other CALM standards.
CommandRef	Integer	Same as in related request	Unique cyclic reference number of command.
-	One octet Integer	0 to 255	Number of subsequent elements M-Param.
M-Param.No	One octet Integer	1 to 255	See Annex A.
M-Param.Value	-	Dependent on parameter	See Annex A.

A request to get the value of a defined "write only" parameter is acknowledged with ErrStatus 7 "ACCESS VIOLATION". A request to get the value of an undefined parameter is acknowledged with ErrStatus 2 "INVALID PARAMETER NUMBER".

See ASN.1 definitions in Annex E.

5.5.3.2.3 When generated

The management service primitive **CIMAE-GETPARAM.confirm** is generated by the CIMAE upon reception of a previous **CIMAE-GETPARAM.request**.

5.5.3.2.4 Effect on receipt

The IME shall evaluate the parameter values and act accordingly. If any errors occurred in the processing of the related **CIMAE-GETPARAM.request**, the **CIMAE-GETPARAM.confirm** shall contain at least the entry Param.No = 255, where M-Param.Value shall explain the details of the error, see Table D.1.

Further details are outside the scope of this International Standard.

5.5.4 CIMAE-COMMAND

5.5.4.1 CIMAE-COMMAND.request

5.5.4.1.1 Function

The management service primitive **CIMAE-COMMAND.request** allows the IME to trigger an action at a CI.

5.5.4.1.2 Semantics

The parameters of the management service primitive **CIMAE-COMMAND.request** are as follows:

CIMAE-COMMAND.request (
CI-ID,
CommandRef,
M-Command
)

Table 14 — CIMAE-COMMAND.request Parameter description

Name	Type	Valid Range	Description
CI-ID	Structure	-	Unique identifier of a VCI/CI. The setting of the control bits C1 – C7 of the CtrlCI field is ignored if not specified differently in other CALM standards.
CommandRef	Integer	0 to 255	Unique cyclic reference number of command.
M-Command.No	One octet Integer	1 to 255	See Annex B.
M-Command.Value	-	Dependent on Command.No	See Annex B.

See ASN.1 definitions in Annex E.

5.5.4.1.3 When generated

The management service primitive **CIMAE-COMMAND.request** is generated by the IME when the CI shall perform an action.

5.5.4.1.4 Effect on receipt

On receipt of the management service primitive **CIMAE-COMMAND.request** by the CIMAE, the requested action is performed.

5.5.4.2 CIMAE-COMMAND.confirm

5.5.4.2.1 Function

The management service primitive **CIMAE-COMMAND.confirm** reports the result of a previous **CIMAE-COMMAND.request**.

5.5.4.2.2 Semantics

The parameters of the management service primitive **CIMAE-COMMAND.confirm** are as follows:

CIMAE-COMMAND.confirm (
CI-ID,
CommandRef
ErrStatus
)

Table 15 — CIMAE-COMMAND.confirm Parameter description

Name	Type	Valid Range	Description
CI-ID	Structure		Unique identifier of a VCI/CI. The setting of the control bits C1 – C7 of the CtrlCI field is ignored if not specified differently in other CALM standards.
CommandRef	Integer	Same as in related request	Unique cyclic reference number of command.
ErrStatus	One octet integer	See Table D.1	Return/error code.

An undefined COMMAND is acknowledged with ErrStatus 5 "INVALID COMMAND/REQUEST NUMBER".

See ASN.1 definitions in Annex E.

5.5.4.2.3 When generated

The management service primitive **CIMAE-COMMAND.confirm** is generated by the CIMAE upon performance of a previous **CIMAE-COMMAND.request**.

5.5.4.2.4 Effect on receipt

On receipt of this primitive, the IME shall evaluate ErrStatus and act accordingly. Details are outside the scope of this International Standard.

5.5.4.3 COMMANDs to the CIMAE

5.5.4.3.1 Overview

A command to the CIMAE is referred to as **COMMAND** in this International Standard.

Annex B provides an overview and details on **COMMAND**s that may be sent by the IME to the CIMAE.

5.5.4.3.2 RegCmd

COMMAND 0 "RegCmd" shall be used by the IME to acknowledge a registration request from a CI. See 5.2.4.2.

5.5.4.3.3 CIstateChng

COMMAND 1 "CIstateChng" shall be used by the IME to request a change of CI state. See 5.2.4.4, 5.2.4.5, 5.2.4.7 and 5.2.4.8.

5.5.4.3.4 WakeUp

COMMAND 2 "WakeUp" shall be used by the IME to enable and disable transmission of wake-up signals in a CI. Details depend on the medium.

5.5.4.3.5 RTScmd

COMMAND 3 "RTScmd" shall be used by the IME to request prioritization over interfering CIs. See 5.2.4.11.

5.5.4.3.6 RTSackcmd

COMMAND 4 "RTSackcmd" shall be used by the IME to acknowledge a prioritization request from a CI. See 5.2.4.11.

5.5.4.3.7 RegInfo

COMMAND 7 "RegInfo" shall be used by the IME to forward a management data packet to a CI containing regulatory information as received via another CI. See 5.2.4.13.

5.5.4.3.8 Manufacturer

COMMAND 8 "ManuCmd" shall be used by the IME to allow a manufacturer to have private access to their CI.

5.5.4.3.9 VCIcmd

COMMAND 9 "VCIcmd" shall be used by the IME to request creation, deletion or reset of a VCI. See 5.3.

5.5.4.3.10 Monitor

COMMAND 10 "Monitor" shall be used by the IME to request automatic notification of change of parameter values. See 5.5.6.

5.5.4.3.11 UnitDataCmd

COMMAND 255 "UnitDataCmd" shall be used by the IME to request transmission of a management data packet. See 5.5.7.

5.5.5 CIMAE-REQUEST

5.5.5.1 CIMAE-REQUEST.request

5.5.5.1.1 Function

The management service primitive **CIMAE-REQUEST.request** allows the CIMAE to trigger an action at the IME.

5.5.5.1.2 Semantics

The parameters of the management service primitive **CIMAE-REQUEST.request** are as follows:

CIMAE-REQUEST.request (
CI-ID,
CommandRef,
M-Request
)

Table 16 — CIMAE-REQUEST.request Parameter description

Name	Type	Valid Range	Description
CI-ID	Structure	-	Unique identifier of a VCI/CI. The setting of the control bits C1 – C7 of the CtrlCI field is ignored if not specified differently in other CALM standards.
CommandRef	Integer	0 to 255	Unique cyclic reference number of command.
M-Request.No	One octet Integer	1 to 255	See Annex C.
M-Request.Value	-	Dependent on Request.No	See Annex C.

See ASN.1 definitions in Annex E.

5.5.5.1.3 When generated

The management service primitive **CIMAE-REQUEST.request** is generated by a CIMAE when the IME shall perform an action.

5.5.5.1.4 Effect on receipt

On receipt of the management service primitive **CIMAE-REQUEST.request** the required action is performed.

5.5.5.2 CIMAE-REQUEST.confirm

5.5.5.2.1 Function

The management service primitive **CIMAE-REQUEST.confirm** reports the result of a previous **CIMAE-REQUEST.request**.

5.5.5.2.2 Semantics

The parameters of the management service primitive **CIMAE-REQUEST.confirm** are as follows:

CIMAE-REQUEST.confirm (
CI-ID,
CommandRef,
ErrStatus
)

Table 17 — CIMAE-REQUEST.confirm Parameter description

Name	Type	Valid Range	Description
CI-ID	Structure		Unique identifier of a VCI/CI. The setting of the control bits C1 – C7 of the CtrlCI field is ignored if not specified differently in other CALM standards.
CommandRef	Integer	Same as in related request	Unique cyclic reference number of command.
ErrStatus	One octet integer	See Table D.1	Return/error code.

An undefined REQUEST is acknowledged with ErrStatus 5 "INVALID COMMAND/REQUEST NUMBER".

See ASN.1 definitions in Annex E.

5.5.5.2.3 When generated

The management service primitive **CIMAE-REQUEST.confirm** is generated by the IME upon performance of a previous **CIMAE-REQUEST.request**.

5.5.5.2.4 Effect on receipt

On receipt of this primitive, the CIMAE shall evaluate ErrStatus and act accordingly. Details are outside the scope of this International Standard.

5.5.5.3 Requests to the IME

5.5.5.3.1 Overview

A command to the IME is referred to as M-REQUEST in this International Standard.

Annex C provides an overview and details on requests that may be sent by the CIMAE to the IME.

5.5.5.3.2 RegReq

M-REQUEST 0 "RegReq" shall be used by the CIMAE to register a CI. See 5.2.4.2.

5.5.5.3.3 PrioReg

M-REQUEST 1 "PrioritizationRequest" shall be used by the CIMAE to register at the IME for the cross-CI prioritization procedure. See 5.2.4.11.

5.5.5.3.4 RTSreq

M-REQUEST 2 "RTSreq" shall be used by the CIMAE to request and release cross-CI prioritization. See 5.2.4.11.

5.5.5.3.5 RTSackreq

M-REQUEST 3 "RTSackReq" shall be used by the CIMAE to acknowledge a cross-CI prioritization request. See 5.2.4.11.

5.5.5.3.6 RegInfo

M-REQUEST 7 "RegInfo" shall be used by the CIMAE to request retrieval of regulatory information via another CI. See 5.2.4.13.

5.5.5.3.7 ManuReq

M-REQUEST 8 "ManuReq" shall be used by the CIMAE to reply to a manufacturer-specific access to the CI.

5.5.5.3.8 Events

M-REQUEST 9 "Events" shall be used by the CIMAE to notify events. Table 18 shows events that are defined.

Table 18 — Events

Event Number	Event description	Request.Value
0	A transmission request was rejected due to a user priority that was below the minimum required priority as defined by parameter 11 "MinimumUserPriority".	Parameter 11 "MinimumUserPriority" CI-ID of VCI
1	A transmission queue is filled above the threshold defined by parameter 32 "QueueAlarmThreshold".	Priority of the queue
2	A transmission queue is full.	Priority of the queue
3	A VCI was created.	CI-ID of VCI
4	A VCI was deleted.	CI-ID of VCI
5	A parameter subject to notification has changed its value.	M-Param
6	A transmission queue is emptied below the threshold defined by parameter 47 "QueueLowThreshold".	Priority of the queue
7	A VCI was reset.	CI-ID of VCI

5.5.5.3.9 PosUpdateReq

REQUEST 10 "PosUpdateReq" shall be used by the CIMAE to manage reception of updates of the actual position of the station.

A value zero provided in the command shall stop delivery of updates by the IME.

A value larger than zero in the command shall start delivery of updates by the IME, with an update interval in milliseconds as indicated by the value provided.

The updates shall be written in parameter 41 "KinematicVector" by means of the SETPARAM service.

5.5.5.3.10 UnitDataReq

REQUEST 255 "UnitDataReq" shall be used by the CIMAE to notify reception of management data packets. See 5.5.7.

5.5.6 CIMAE-NOTIFY

5.5.6.1 Pseudo-service

The **CIMAE-NOTIFY** service is a pseudo-service.

The **CIMAE-COMMAND** service shall be used to start and stop monitoring of a specific parameter. **CIMAE-COMMAND.request** (CI-ID, M-Command.No = 10, M-Command.Value = {Param.No, Monitor = TRUE}) shall be used to start monitoring of a parameter. **CIMAE-COMMAND.request** (CI-ID, M-Command.No = 10, Command.Value = {M-Param.No, Monitor = FALSE}) shall be used to stop monitoring of a parameter.

Notification of a parameter value shall be done with **CIMAE-REQUEST.request** (CI-ID, M-Request.No = 9, Request.Value={M-Param.No, M-M-Param.Value}).

5.5.6.2 Retrieve monitor status

The actual status of monitoring of parameters can be retrieved by means of the **CIMAE-GETPARAM.request** service primitive with Param.No 43 "Notify".

The related **CIMAE-GETPARAM.response** shall show all parameter numbers that are currently activated for monitoring.

5.5.7 MAC management frame

COMMAND 255 "UnitDataCmd" is used by the IME to request transmission of a management data packet. The CIMAE shall treat this packet the same way as packets received from the C-SAP, except for indication of a management packet in the MAC header of the transmitted frame. Usage of the CtrlCI bits in CI-ID are optional.

REQUEST 255 "UnitDataReq" is used by the CIMAE to notify reception of a management data packet to the IME. Usage of the CtrlCI bits in CI-ID is optional.

6 Conformance

Protocol Implementation Conformance Statements will be specified in a future document [1)].

7 Test methods

Conformance tests will be specified in a future document [2)].

1) ETSI DTS/ERM-TG37-266-1.

2) ETSI DTS/ERM-TG37-266-2.

Annex A
(normative)

CI parameters

A.1 Overview

Table A.1 presents the relation between parameter number "M-Param.No" and parameter name as used in the services **CIMAE-SETPARAM** and **CIMAE-GETPARAM**, and provides a short description of the parameters. A more detailed description is provided in A.2.

"M-Param.No" is equal to the ASN.1 CHOICE tag of M-Param, see Annex E.

"CommProfile" shows which parameters may be part of the Communication profile, see parameter 20.

"Access" specifies the possible access to the parameter:

— R: Read by IME only, includes notify by CI/VCI;

— W: Write by IME only;

— RW: Read and Write;

— N: Notify by CI only;

— NW: Notify by CI and Write by IME;

— x: to be defined by medium standard.

"Owner" specifies the owner of the parameter:

— VCI: a VCI;

— CI: a CI, i.e. the SerialNumber in CI-ID is equal to zero;

— x: to be defined by medium standard.

NOTE A parameter may apply only for a limited number of media.

Table A.1 — CI Parameters

M-Param. No	Parameter name	Comm-Profile	Access	Description	Owner
0	AuxiliaryChannel	Yes	RW	Information on auxiliary channels in addition to control channel and service channel.	VCI
1	ControlChannel	Yes	RW	Reference number for control channel.	VCI
2	ServiceChannel	Yes	RW	Reference number for service channel.	VCI
3	RXsensitivity	Yes	RW	Medium-specific reference number of RX sensitivity. NOTE In ISO 21214 this is RX-CLASS (1-11).	VCI
4	TXpower	Yes	RW	Medium-specific reference number of TX power. NOTE In ISO 21214 this is TX-CLASS (1-16).	VCI
5	DataRate	Yes	RW	Data rate in the link in units of 100 bit/s.	VCI
6	DataRateNW	Yes	R	Estimate of average data rate available at the C-SAP in 100 bit/s. NOTE 1 The value of this parameter is based on the assumption of a reliable, error-free communications link. NOTE 2 The value of this parameter may depend on the actual operational load of the CI, e.g. in the case of a TDMA scheme and multiple simultaneous users. NOTE 3 In a TDMA scheme this value depends on the number of timeslots (= peer devices) served in a single TDMA frame.	VCI
7	DataRatesNW	Yes	R	Minimum and maximum possible value of DataRateNW.	VCI
8	DataRateNWreq	No	RW	Minimum required value of DataRateNW. This value defines the possible number of time slots (= peer stations) served in a TDMA scheme.	CI
9	Directivity	Yes	R, RW	Characteristics of beam. NOTE CI parameter: Read only VCI parameter: Read/Write	CI, VCI
10	BlockLength	Yes	RW	Maximum length of LPDU	VCI
11	MinimumUserPriority	Yes	RW	Minimum value of user priority needed to use the VCI. NOTE Default value defined.	VCI

Table A.1 (*continued*)

M-Param. No	Parameter name	Comm-Profile	Access	Description	Owner
12	TimeOfLastReception	No	R	Time when last frame was successfully received.	VCI
13	InactivityTimeLimit	No	RW	Maximum allowed idle time for an RX-VCI.	VCI
14	DistancePeer	No	R	Distance in 1/10 m to peer station measured by the CI	VCI
15	CIclass	Yes	R	Communications interface class.	CI
16	CommRangeRef	Yes	R	Estimate of size of communication zone in 1/10 m. NOTE Value is derived from TXpower, RXsensitivity and the properties of the reference station. To be calculated by the CIMAE.	VCI
17	Cost	No	R	Price information. Cost of communication in terms of money: • per byte/per second/flat-rate/free of charge; • amount per unit (optional).	VCI
18	Reliability	No	R	Real-time measure of reliability of CI.	VCI
19	Properties	No	R	Properties of a CI. List of all communication profile parameters defined for the CI showing the complete range of values.	CI
20	CommProfile	No	R	Communication profile. Contains the set of parameter values that define the actual communication properties of a VCI. A default profile shall be defined for each medium. The column CommProfile of this table indicates which parameters may be part of the Communication profile.	VCI
21	MinimumSuspendPriority	No	RW	Minimum user priority needed to suspend a current frame with lower priority from transmission. Default value: 255 (highest priority).	CI
22	Medium	Yes	R	Enumerator indicating type of medium.	CI
23	NWsupport	Yes	R	Indication of supported network communication protocols, e.g. CALM FAST, IPv6, …	VCI
24	CIaccessClass	Yes	R	CI access class.	CI

Table A.1 (*continued*)

M-Param. No	Parameter name	Comm-Profile	Access	Description	Owner
25	RegulatoryInformation	No	RW	RI data structure containing either the actually valid regulatory information, or a statement that no regulation is known or applicable.	CI
26	FreeAirTime	Yes	RW	Gap between subsequent TDMA frames in milliseconds.	VCI
27	SIMpin	No	W	PIN needed to access a SIM card.	CI
28	ProviderInfo	No	W	Access information for a provider.	CI
29	MediumUsage	No	R	Percentage of active usage of medium.	CI
30	MedUseObservationTime	No	RW	Observation time used to calculate MediumUsage.	CI
31	SuspendSupportFlag	Yes	R	Flag indicating whether the CI supports the suspend procedure based on parameter 21.	CI
32	QueueAlarmThreshold	No	RW	Threshold indicating the minimum level of usage of a transmit queue in a CI above which the IME shall be notified.	CI
33	QueueLevel	No	N	Actual level in a transmit queue for a specific priority.	CI
34	MACaddress	Yes	R	Globally assigned MAC address of CI.	CI
35	MACaddrTemp	Yes	RW	Actually used MAC address of CI/VCI.	VCI
36	TimeoutRegister	No	RW	Time out to be used during registration of a CI. Shall be set to a random value at time of integration of the CI. May be set by the IME to a value as appropriate in the CALM system.	CI
37	MedID	No	RW	MedID as to be used in CI-ID.	CI
38	VirtualCI	No	R	SerialNumber and CtrlCI bits of all VCIs of the selected CI being alive.	CI
39	FrameLengthMax	Yes	RW	Maximum length of a TDMA frame in milliseconds.	VCI
40	KinematicVectorIn	No	W	Kinematic vector of CALM station as provided to CI.	CI
41	KinematicVectorOut	No	R	Kinematic vector of CALM station as estimated by CI.	CI
42	CIstatus	No	R	Status of CI.	CI
43	Notify	No	R	List of parameters for automatic notification.	VCI
44	MinPrioCrossCI	No	RW	Minimum required user priority in order to be able to request cross-CI prioritization.	CI
45	CckId	No	RW	Valid CCK-ID.	CI

Table A.1 (*continued*)

M-Param. No	Parameter name	Comm-Profile	Access	Description	Owner
46	PeerMAC	No	RW	MAC address of peer station related to the VCI.	VCI
47	QueueLowThreshold	No	RW	Threshold indicating the maximum level of usage of a transmit queue in a CI below which the IME shall be notified.	CI
48	PeerRXpower	No	R	RX power as estimated at the peer station.	VCI
49	TXpowMax	Yes	R	Maximum allowed transmit power EIRP in dBm.	VCI
50	ManufacturerDeviceID	No	R	Text string to be defined by manufacturer, clearly identifying the CI.	CI
51	Connect	Yes	R	Flag indicating whether CI will connect automatically or manually upon request.	CI
52 to 253				Reserved for future use.	
254	MediumParam	No	x	Medium-specific parameter as specified in a CALM medium standard.	x
255	Errors	No	N	Virtual parameter indicating errors in **CIMAE-GETPARAM.confirm**. Not to be used in **CIMAE-SETPARAM** and in **CIMAE-GETPARAM.request**.	

A.2 Description

A.2.1 Basics

This clause defines the detailed structure of the CI parameters. The ASN.1 coding of the parameters is presented in Annex E.

Some Parameters just contain medium-specific reference numbers. The meaning of these reference numbers and the management of these parameters is detailed in the related standards of the media.

Some parameters are applicable only for selected media.

A.2.2 AuxiliaryChannel (M-Param.No=0)

ASN.1 Type	Valid Range	Description
M-Param.**auxChannel**	0, 1 to 255	Reference number of the RF channel corresponding to the Auxiliary Channel. 0: This VCI is not an auxiliary channel.

A.2.3 ControlChannel (M-Param.No=1)

ASN.1 Type	Valid Range	Description
M-Param.**ctrlChanNo**	0, 1 to 255	Reference number of the RF channel corresponding to the Control Channel. 0: This VCI is not a control channel.

A.2.4 ServiceChannel (M-Param.No=2)

ASN.1 Type	Valid Range	Description
M-Param.**servChanNo**	0, 1 to 255	Reference number of the RF channel corresponding to a Service Channel. 0: This VCI is not a service channel.

A.2.5 RXSensitivity (M-Param.No=3)

ASN.1 Type	Valid Range	Description
M-Param.**rxSens**	0 to 255	Medium-specific reference number of RX sensitivity.

A.2.6 TXPower (M-Param.No=4)

ASN.1 Type	Valid Range	Description
M-Param.**txPower**	0 to 255	Medium-specific reference number of TX power.

A.2.7 DataRate (M-Param.No=5)

ASN.1 Type	Valid Range	Description
M-Param.**dataRate**	0 to $2^{32}-1$	Data rate in the air in 100 bit/s.

A.2.8 DataRateNW (M-Param.No=6)

ASN.1 Type	Valid Range	Description
M-Param.**dataRateNW**	0 to $2^{32}-1$	Estimate of average data rate available at the C-SAP in 100 bit/s.

A.2.9 DataRatesNW (M-Param.No=7)

ASN.1 Type	Valid Range	Description
M-Param.**dataRatesNW**		Minimum and maximum possible value of DataRateNW.
DataRatesNW.**minimum**	0 to 2^{32}–1	Minimum possible value of DataRateNW.
DataRatesNW.**maximum**	0 to 2^{32}–1	Maximum possible value of DataRateNW.

A.2.10 DataRateNWreq (M-Param.No=8)

ASN.1 Type	Valid Range	Description
M-Param.**dataRateNWreq**	0 to 2^{32}–1	Minimum required value of the data rate in 100 bit/s available to the application. This value defines the possible number of time slots (= peer stations) served in a TDMA scheme. The actual value is provided in parameter 6 "DataRateNW".

A.2.11 Directivity (M-Param.No=9)

ASN.1 Type	Valid Range	Description
M-Param.**directivity**	—	Characteristics of beam.
Directivity.**mode**	fixed, tracking	Fixed: Exactly this direction. Tracking: Start with this direction and then track the peer station.
Directivity.**dirPredef**	0 1 to 255	1 to 255 Selects predefined directions (direction set). 0: Directions as specified by the following four parameters.
Directivity.**bsAzimuth**	–180° to –180°	Specifies the horizontal angle of the bore sight in relation to the x-axis of the vehicle (y-direction).
Directivity. **bsElevation**	–90° to +90°	Specifies the vertical angle of the bore sight in relation to the x-axis of the vehicle (z-direction).
Directivity. **openHorizontal**	0° to 180°	Specifies the one-sided horizontal opening (y-direction) of the beam symmetric to the bore sight, see ISO 21214.
Directivity. **openVertical**	0° to 180°	Specifies the one-sided vertical opening (z-direction) of the beam symmetric to the bore sight, see ISO 21214.

A.2.12 BlockLength (M-Param.No=10)

ASN.1 Type	Valid Range	Description
M-Param.**blockLength**	0 to 2^{16}–1	Maximum length of LPDU in octets.

A.2.13 MinimumUserPriority (M-Param.No=11)

ASN.1 Type	Valid Range	Description
M-Param.**minUserPriority**	0 to 255	Minimum value of user priority needed to use the VCI.

A.2.14 TimeOfLastReception (M-Param.No=12)

ASN.1 Type	Valid Range	Description
M-Param.**timeOfLastRecep**		Time when last frame was successfully received. GeneralizedTime. Minimum requested resolution shall be one microsecond. Shall be initialized with time of creation of the VCI.

A.2.15 InactivityTimeLimit (M-Param.No=13)

ASN.1 Type	Valid Range	Description
M-Param.**inactTimeLimit**	0, 1 to 2^{16}–1	Maximum allowed idle time of an RX-VCI, i.e. maximum allowed time without proper reception of a frame. 0: No limit. >0: Limit in milliseconds. The time limit counter shall start on reception of every frame received.

A.2.16 DistancePeer (M-Param.No=14)

ASN.1 Type	Valid Range	Description
M-Param.**distancePeer**	0 to 32 767, extendable	Distance in 1/10 m to peer station measured by the CI.

A.2.17 CIclass (M-Param.No=15)

ASN.1 Type	Valid Range	Description
M-Param.**ciClass**	See Table 1	Communications interface class.

A.2.18 CommRangeRef (M-Param.No=16)

ASN.1 Type	Valid Range	Description
M-Param.**commRangeRef**	0 to 65535	Communication distance to a reference peer station in 1/10 m. The communication range shall be calculated based on the link parameters of the reference peer station, and the station's own link parameter.

A.2.19 Cost (M-Param.No=17)

ASN.1 Type	Valid Range	Description
M-Param.cost		Cost information.
Cost.**class**	0 to 255	Classes of costs. 0: Cost information is temporarily unavailable. 1: Free of any charge. 2: Fixed flat rate. 3: Price per time unit. 4: Price per amount of data. 5 to 254: Reserved for future use. 255: General variable cost according to contract.
Cost.**currency**	tbd	Reserved for a later version of this International Standard.
Cost.**timeUnit**	tbd	Reserved for a later version of this International Standard.
Cost.**amountUnit**	tbd	Reserved for a later version of this International Standard.

A.2.20 Reliability (M-Param.No=18)

ASN.1 Type	Valid Range	Description
M-Param.**reliability**	0 to 100, 101 to 255	0 to 100: Percentage. Value zero indicates unreliable medium. Value 100 indicates best reliability. 101 to 255: Reserved for future use.

A.2.21 Properties (M-Param.No=19)

ASN.1 Type	Valid Range	Description
M-Param.**properties**		List of all communication profile parameters defined for the CI showing the complete range of values. Note 1 The same value of M-Param.No may appear several times if the related parameter may take on different values. Note 2 The SEQUENCE shall be ordered firstly according to M-Param.No and secondly according to the value of Param.Value, both in ascending order.

A.2.22 CommProfil (M-Param.No=20)

ASN.1 Type	Valid Range	Description
M-Param.**commProfile**		A profile is constituted by a list of communications parameters.

A.2.23 MinimumSuspendPriority (M-Param.No=21)

ASN.1 Type	Valid Range	Description
M-Param.**minSuspPriority**	0 ... 255	Minimum user priority needed to suspend a current frame with lower priority from transmission. Default value: 255 (highest priority).

A.2.24 Medium (M-Param.No=22)

ASN.1 Type	Valid Range	Description
M-Param.**medType**	0, 1, 2, 3, 4, 5, 6, 128, 254, 255	0: unknown 1: any – used in a selector 2: CALM 21212 "2G cellular" 3: CALM 21213 "3G cellular" 4: CALM 21214 "IR" 5: CALM 21215 "M5" 6: CALM 21216 "MM" 7: CALM 25112 "802.16e" 8: CALM 25113 "HC-SDMA" 9: CALM 29283 "802.20" 128 : ISO 15628254: LAN fast, predicted 254: LAN non-IP 255: LAN IP

A.2.25 NWsupport (M-Param.No=23)

ASN.1 Type	Valid Range	Description
M-Param.**nwSupport**	'0000 0000' to '1111 1111'	One octet bit string indicating supported networking options, e.g. CALM FAST, IPv6, … A bit set to '1'B indicates support of the mode. CM0 = LSB: CALM FAST CM1: CALM IPv6 CM2: Geo-routing CM3: WAVE CM4: Local port protocol CM5 – CM7: reserved for future use

A.2.26 ClaccessClass (M-Param.No=24)

ASN.1 Type	Valid Range	Description
M-Param.**ciaClass**	1, 255	1: ciac-1 2: ciac-3 255: ciac-2 See Table 2.

A.2.27 RegulatoryInformation (M-Param.No=25)

ASN.1 Type	Valid Range	Description
M-Param.**regInfo**		
RegInfo.**status**	0, 1, 255	0: not applicable 1: not known or invalid 254: new 255: valid
RegInfo.**limits**	any octet string	Details of octet string depend on medium.

A.2.28 FreeAirTime (M-Param.No=26)

ASN.1 Type	Valid Range	Description
M-Param.**freeAirTime**	0 to 255	Gap between subsequent TDMA frames in milliseconds.

A.2.29 SIMpin (M-Param.No=27)

ASN.1 Type	Valid Range	Description
M-Param.**simPin**	any string of printable characters	PIN needed to access a SIM card.

A.2.30 ProviderInfo (M-Param.No=28)

ASN.1 Type	Valid Range	Description
M-Param.**providerInfo**		Access information for a provider.
ProviderInfo.**provName**	any string of printable characters	Name of provider.
ProviderInfo.**apn**	any string of printable characters	Name of access point.
ProviderInfo.**username**	any string of printable characters	Log-in name of user.
ProviderInfo.**password**	any string of printable characters	Password for log-in.

A.2.31 MediumUsage (M-Param.No=29)

ASN.1 Type	Valid Range	Description
M-Param.**mediumUsage**		Percentage of active usage of medium. Distinguishes between receive and transmit. Sliding window averaging. Observation time defined by MedUseObservationTime. Details are medium-specific.
MediumUsage.**receive**	0 to 255	Receive channel occupancy. The value of 255 equals 100 %
MediumUsage.**transmit**	0 to 255	Transmit channel occupancy. The value of 255 equals 100 %

A.2.32 MedUseObservationTime (M-Param.No=30)

ASN.1 Type	Valid Range	Description
M-Param.**medUseObsTime**		Observation time in selected unit used to calculate MediumUsage.
MedUseObsTime.**value**	0, 1 to 65,535	0: No observation. 1 to 65,535: Size of gliding window for measurement of parameter 29 "MediumUsage". Note: A medium can use the nearest available value and can change this parameter accordingly.
MedUseObsTime.**unit**	0, 1, 255	0: microseconds 1: milliseconds 255: seconds

A.2.33 SuspendSupportFlag (M-Param.No=31)

ASN.1 Type	Valid Range	Description
M-Param.**suspendSup**	0 to 255	Flag indicating whether the CI supports the suspend procedure based on parameter 21. '0': Procedure not supported. >'0': Procedure supported.

A.2.34 QueueAlarmThreshold (M-Param.No=32)

ASN.1 Type	Valid Range	Description
M-Param.**queueAlarmTh**	0 to 255	Threshold indicating the minimum level of usage of a transmit queue in a CI above which the IME shall be notified. 0: Transmit queue is empty. 255: Transmit queue is full (100 %).

A.2.35 QueueLevel (M-Param.No=33)

ASN.1 Type	Valid Range	Description
M-Param.**queueLevel**	—	Actual level in a transmit queue for a specific priority. Shall be notified once the threshold defined by parameter QueueAlarmThreshold is exceeded.
QueueLevel.**priority**	0 to 255	User priority value of selected transmit queue.
QueueLevel.**level**	0 to 255	Actual level in the selected transmit queue.

A.2.36 MACaddress (M-Param.No=34)

ASN.1 Type	Valid Range	Description
M-Param.**macAddress**	See ISO/IEC 8802-2.	Globally assigned six-byte unique MAC address of CI.

A.2.37 MACaddrTemp (M-Param.No=35)

ASN.1 Type	Valid Range	Description
M-Param.**macAddrTemp**	See ISO/IEC 8802-2.	Six-byte MAC address of CI actually used, either temporarily assigned locally administered, or globally assigned.

A.2.38 TimeoutRegister (M-Param.No=36)

ASN.1 Type	Valid Range	Description
M-Param.**timeoutReg**	1 to 255	Timeout in milliseconds used in registration procedure for timer T_Register. Shall be set to a random value at time of integration of the CI. May be set by the IME to a value as appropriate in the CALM system.

A.2.39 MedID (M-Param.No=37)

ASN.1 Type	Valid Range	Description
M-Param.**medID**	1 to 255	MedID as to be used in CI-ID.

A.2.40 VirtualCI (M-Param.No=38)

ASN.1 Type	Valid Range	Description
M-Param.**virtualCI**		SerialNumber and CtrlCI bits of all VCIs of the selected CI being alive.
VirtualCI.**vciRef**		CI-ID without MedID.

A.2.41 FrameLengthMax (M-Param.No=39)

ASN.1 Type	Valid Range	Description
M-Param.**frameLengthMax**	0 to 255	Maximum length of a TDMA frame in milliseconds.

A.2.42 KinematicVectorIn (M-Param.No=40)

ASN.1 Type	Valid Range	Description
M-Param.**kineVectIn**	—	Kinematic vector of CALM station as calculated by a positioning service.
KineVectIn.**dut**		Date and universal time.
KineVectIn.**lat**	± π/2	Latitude in rad. Resolution 10^{-8} rad.
KineVectIn.**lon**	± π	Longitude in rad. Resolution 10^{-8} rad.
KineVectIn.**alt**	0 to 6 553,5 m	Altitude. Resolution 0,1 m.
KineVectIn.**gs**	0 to 655,35 m/s	Ground speed. Resolution 0,01 m/s.
KineVectIn.**tta**	0 to 360,0°	True track angle. Resolution 0,1°.

A.2.43 KinematicVectorOut (M-Param.No=41)

ASN.1 Type	Valid Range	Description
M-Param.**kineVectOut**	—	Kinematic vector of CALM station as estimated by the CI.
KineVectOut.**dut**		Date and universal time, optional.
KineVectOut.**lat**	± π/2	Latitude in rad. Resolution 10^{-8} rad, optional.
KineVectOut.**lon**	± π	Longitude in rad. Resolution 10^{-8} rad, optional.
KineVectOut.**alt**	0 to 6 553,5 m	Altitude. Resolution 0,1 m, optional.
KineVectOut.**gs**	0 to 655,35 m/s	Ground speed. Resolution 0,01 m/s, optional.
KineVectOut.**tta**	0 to 360,0°	True track angle. Resolution 0,1°, optional.

A.2.44 CIstatus (M-Param.No=42)

ASN.1 Type	Valid Range	Description
M-Param.**ciStatus**	0, 1, 4, 8, 64, 128	0: not existent 1: existent 4: registered 8: active 16: connected 64: suspended 128: inactive

A.2.45 Notify (M-Param.No=43)

ASN.1 Type	Valid Range	Description
M-Param.**notify**	—	List of parameters for automatic notification.
Notify.M-paramNo	0 to 254	Reference number of parameter to be monitored.

A.2.46 MinPrioCrossCI (M-Param.No=44)

ASN.1 Type	Valid Range	Description
M-Param.**minPrioCrossCI**	0 to 255	Minimum required user priority in order to be able to request cross-CI prioritization.

A.2.47 CckId (M-Param.No=45)

ASN.1 Type	Valid Range	Description
M-Param.**cckId**	0 to 255	CCK-ID

A.2.48 PeerMAC (M-Param.No=46)

ASN.1 Type	Valid Range	Description
M-Param.**peerMAC**	See ISO/IEC 8802-2	MAC address of peer station related to a TX-VCI. Set to zero if no relation to a peer station exists. Only applicable for UC-VCIs.

A.2.49 QueueLowThreshold (M-Param.No=47)

ASN.1 Type	Valid Range	Description
M-Param.**queueLowTh**	0 to 255	Threshold indicating the maximum level of usage of a transmit queue in a CI below which the IME shall be notified. 0: Transmit queue is empty. 255: Transmit queue is full (100 %)

A.2.50 PeerRXpower (M-Param.No=48)

ASN.1 Type	Valid Range	Description
M-Param.**peerRXpower**	0 to 255	Power in dBm starting at –100 dBm in steps of 0,5 dB.

A.2.51 TXpowMax (M-Param.No=49)

ASN.1 Type	Valid Range	Description
M-Param.**txPowMax**	INTEGER(0..255)	Unit, minimum value and step size defined by medium.

A.2.52 ManufacturerDeviceID (M-Param.No=50)

ASN.1 Type	Valid Range	Description
M-Param.**manuDeviceID**	PrintableString	Text string to be defined by manufacturer, clearly identifying the CI.

A.2.53 Connect (M-Param.No=51)

ASN.1 Type	Valid Range	Description
M-Param.**connect**	"automatic" "manual"	Flag indicating mode of connection of a CI.

A.2.54 MediumParam (M-Param.No=254)

ASN.1 Type	Valid Range	Description
M-Param.**mediumParam**		
MediumParam.**Medium**	0 to 255	Medium identifier, see parameter 22.
MediumM-Param.**No**	0 to 255	Medium-specific reference number of parameter.
MediumParam.**Detail**		Detail of parameter as specified in medium standard.

A.2.55 Errors (M-Param.No=255)

ASN.1 Type	Valid Range	Description
M-Param.**errors**		
Errors.M-paramNo	0 to 254	Reference number of parameter in error.
Errors.Med.Type	0 to 255	Present only if Errors.M-paramNo equals 254. Medium identifier, see parameter 22.
Errors.Med.ParamNo	0 to 255	Present only if Errors.M-paramNo equals 254. Medium-specific reference number of parameter.
Errors.**errStatus**	See Table D.1	Error/return code

Annex B
(normative)

COMMANDs

B.1 Overview

Table B.1 presents the relation between **COMMAND** reference number "Command.No" and **COMMAND** name as used in the service **CIMAE-COMMAND**, and provides a short description of the **COMMAND**s. A more detailed description is provided in B.2.

"Command.No" is equal to the ASN.1 CHOICE tag of M-Command, see Annex E.

Table B.1 — COMMANDs

Command.No	**COMMAND** name	Description
0	RegCmd	Command acknowledging the request to register the CI.
1	CIstateChng	Change of CI status.
2	WakeUp	0: Stops transmission of wake-up signal. 1 to 255: Starts repetitive transmission of wake-up signal with maximum interval in milliseconds.
3	RTScmd	Information on a Request To Send (RTS). Used for cross-CI prioritization.
4	RTSackCmd	Acknowledgement of an RTSreq request.
5	Reserved for future use	
6	Reserved for future use	
7	RIcmd	Acknowledgement of **REQUEST** 7 "RIreq".
8	ManuCmd	Allows for manufacturer-specific access to the CI. Used e.g. for test and maintenance purposes. NOTE Details are outside the scope of this International Standard.
9	VCIcmd	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 **CIMAE-SETPARAM** commands.
10	Monitor	Command to request monitoring of parameters, see 5.5.6.
11 – 254	Reserved for future use	
255	UnitDataCmd	Command to request transmission of a management data packet.

B.2 Description

B.2.1 Basics

This clause defines the detailed structure of the CI **COMMAND**s. The ASN.1 coding of the **COMMAND**s is presented in Annex E.

Some COMMANDs are applicable only for selected media.

B.2.2 RegCmd (M-Command.No=0)

ASN.1 Type	Valid Range	Description
M-Command.**regCmd**		Request to register the CI.
RegCmd.**cckId**	0 to 255	Value of CCK-ID assigned by IME.
RegCmd.**medID**	1 to 255	Value of MedID assigned by IME.
RegCmd.**macAddress**	See ISO/IEC TR 8802-1	Confirmation of unique MAC of the CI.

B.2.3 ClstateChng (M-Command.No=1)

ASN.1 Type	Valid Range	Description
M-Command.**clstate**	0, 4, 8, 64, 128	0: deregister 4: activate 8: reactivate 16: connect 32: disconnect 64: suspend 128: inactivate

B.2.4 WakeUp (M-Command.No=2)

ASN.1 Type	Valid Range	Description
M-Command.**wakeUp**	0, 1 to 255	0: Stops transmission of wake-up signal. 1 to 255: Starts repetitive transmission of wake-up signal with maximum interval in milliseconds.

B.2.5 RTScmd (M-Command.No=3)

ASN.1 Type	Valid Range	Description
M-Command.**rTScmd**	—	Information on a Request To Send (RTS) of another CI. Used for cross-CI prioritization. Shall be acknowledged by **REQUEST** "RTSackReq".
RTScmd.**reqID**	1 to 255	CCK-ID and MedID of CI announcing the dummy request.
RTScmd.**priority**	0 to 255	User priority of dummy request.
RTScmd.**seqNo**	0 to 255	Sequential number to identify dummy request. Cyclic counter.
RTScmd.**status**	0, 16	0: release 16: request

B.2.6 RTSackCmd (M-Command.No=4)

ASN.1 Type	Valid Range	Description
M-Command.**rTSackCmd**	—	Acknowledgement of a **REQUEST** "RTSreq".
RTSackCmd.**priority**	0 to 255	Equal to MinPrioCrossCI, see ISO/IEC TR 8802-1.
RTSackCmd.**seqNo**	0 to 255	Sequential number to identify dummy request. Cyclic counter.
RTSackCmd.**status**	64, 128	64: ignored 128: granted

B.2.7 RIcmd (CommandLLSP.No=7)

ASN.1 Type	Valid Range	Description
M-Command.**rIcmd**		
RIcmd.**medID**	1 to 255	MedID of CI requesting regulatory information.
RIcmd.**ri**	OCTET STRING	RI in medium-specific format.

B.2.8 Manufacturer (M-Command.No=8)

ASN.1 Type	Valid Range	Description
M-Command.**manuCmd**	any octet string	Manufacturer-specific octet string.

B.2.9 VCIcmd (M-Command.No=9)

ASN.1 Type	Valid Range	Description
M-Command.**VCIcmd**		
VCIcmd.**vciRef**		CI-ID without MedID.
VCIcmd.peerMAC		MAC address of peer station. This optional parameter is restricted for creation of a VCI with a requested relation of the CI-ID to the peer station with this given MAC address.
VCIcmd.**alive**	0, 1	FALSE: Delete VCI, if alive. TRUE: Create VCI, if not existent, or reset it. For creation use vciRef and MedID.

B.2.10 Monitor (M-Command.No=10)

ASN.1 Type	Valid Range	Description
M-CommandLLSAP.**monitor**		Sequence of parameters of which change of value shall be notified.
Monitor.M-paramNo	0 to 254	Reference number of parameter to be monitored.
Monitor.**active**	0, 255	0: stop monitoring 255: start monitoring

B.2.11 UnitDataCmd (M-Param.No=255)

ASN.1 Type	Valid Range	Description
M-Command.**unitDataCmd**		Transmission request of a management data packet.
UnitDataCmd.**sourceAddr**		Same as source_address in DL_UNITDATA.request.
UnitDataCmd.**destAddr**		Same as destination_address in DL_UNITDATA.request.
UnitDataCmd.**data**		Same as data in DL_UNITDATA.request.
UnitDataCmd.**priority**		Same as priority in DL_UNITDATA.request.
UnitDataCmd.**parameter**		Parameters to be set prior to transmission/ status information of received packet. Details depend on the medium.

Annex C
(normative)

REQUESTs

C.1 Overview

Table C.1 presents the relation between **REQUEST** reference number "Request.No" and **REQUEST** name as used in the service **CIMAE-REQUEST**, and provides a short description of the **REQUEST**s. A more detailed description is provided in C.2.

"Request.No" is equal to the ASN.1 CHOICE tag of M-Request, see Annex E.

Table C.1 — REQUESTs

Command.No	**REQUEST** name	Description
0	RegReq	Request to register the CI.
1	PrioReg	Cross-CI Prioritization Registration.
2	RTSreq	Dummy Request To Send (RTS). Used for cross-CI prioritization.
3	RTSackReq	Acknowledgement of **COMMAND** "RTScmd". Used for cross-CI prioritization.
4	Reserved for future use	
5	Reserved for future use	
6	Reserved for future use	
7	RIreq	Request to get regulatory information via another CI.
8	ManuReq	Optional reply to a **COMMAND** 8 "ManuCmd", see 5.5.6.
9	Events	Notification of an event.
10	PosUpdateReq	Requests to receive position updates with update interval as indicated in milliseconds/cancels the request.
255	UnitDataReq	Reception notification of a management data packet.

C.2 Description

C.2.1 Basics

This clause defines the detailed structure of the CI **REQUESTs**. The ASN.1 coding of the **REQUESTs** is presented in Annex E.

Some REQUESTs are applicable only for selected media.