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Intelligent transport systems — Communications access for land mobiles (CALM) — Access technology support

Systèmes intelligents de transport — Accès aux communications des services mobiles terrestres (CALM) — Support à la technologie d'accès

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Foreword

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The committee responsible for this document is ISO/TC 204, *Intelligent transport systems*.

This second edition cancels and replaces the first edition (ISO 21218:2008) which has been technically revised.

Introduction

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

This International Standard determines general technical details related to the access layer of an ITS station specified in ISO 21217 and illustrated in Figure 1 which are applicable to all or several access layer technologies. This includes especially the IN-SAP offered to the ITS-S networking & transport layer for communication purposes.

The MI-SAP presented in Figure 1 is specified by means of a reference to ISO 24102-3. The specification of the SI-SAP is not within the scope of this International Standard.

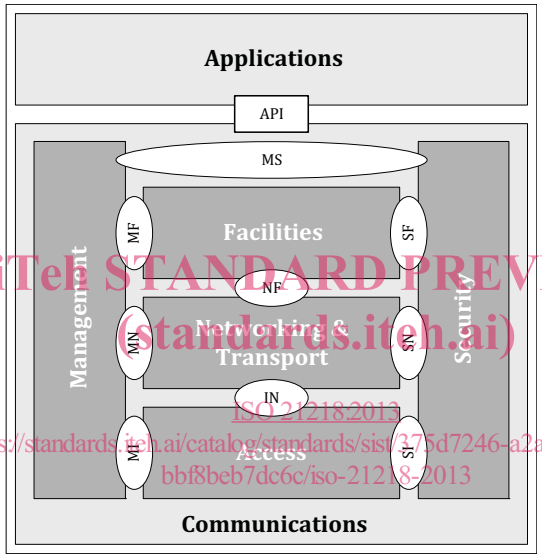

Figure 1 — ITS station reference architecture with named interfaces

Intelligent transport systems — Communications access for land mobiles (CALM) — Access technology support

1 Scope

This International Standard determines general technical details related to the access layer of the ITS station reference architecture specified in ISO 21217 which are applicable to all or several access layer technologies. This includes especially the service access point (SAP) of a communication interface (CI) as provided by the communication adaptation layer (CAL) for communication. The SAP provided by the CI management adaptation entity (MAE) for management of the communication interface is specified by reference to ISO 24102-3.

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

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

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

ISO 24102-1, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 1: Local management*

ISO 24102-3: *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 3: Service access points*

ISO 24102-4, *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management — Part 4: Station-internal management communications*

ETSI TS 102 760-1, *Intelligent transport systems; Road Transport and Traffic Telematics (RTTT); Test specifications for ITS; Communications Access for Land Mobiles (CALM), Medium Service Access Points (ISO 21218); Part 1: Protocol Implementation Conformance Statement (PICS) proforma*

ETSI TS 102 760-2, *Intelligent transport systems; Road Transport and Traffic Telematics (RTTT); Test specifications for ITS; Communications Access for Land Mobiles (CALM), Medium Service Access Points (ISO 21218); Part 2: Test Suite Structure and Test Purposes (TSS & TP)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC 8802-2, ISO 21217, ISO 24102-1, ISO 24102-3, ISO 24102-4 and the following apply.

3.1
(V)CI identifier
unique identifier of a (virtual) CI

3.2
communication interface
CI
instantiation of a specific ITS-S access layer technology and protocol

EXAMPLE An example of communication protocol is IR [5].

3.3
medium
physical properties of a CI used to transmit a modulated signal, e.g. wireless or on a wire, also referred to as access technology

3.4
virtual communication interface
logical entity in a CI that is associated with a peer station

3.5
CI priority manager
logical entity in a CI that is managing priority queues

3.6
Link-ID
identifier of a link given by the address of a VCI

4 Abbreviated terms

NOTE See also: ISO/IEC 8802-2, ISO 21217, ISO 24102-1, ISO 24102-3, ISO 24102-4.

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
CIID	CI / VCI Identifier presented in a 64-bit EUI field
DLL	Data link layer
DNI	Distinct null identifier
DSRC	Dedicated short range communication
ETSI	"European Telecommunications Standards Institute"
EUI	Extended universal identifier
EUI-64	64-bit EUI
IN-SAP	Communication SAP as offered by the CAL to the ITS-S networking & transport layer
LocalCIID	CIID of a local CI
LSB	Least significant bit
MAC-48	48 bit MAC address

MAE	Management adaptation entity
MC-VCI	VCI for transmission to a multicast (group) MAC address
MI-SAP	Management SAP as offered by the ITS-S management towards the MAE
MSB	Most significant bit
OBU	On-board unit
	NOTE Term used for DSRC [14]
OSI	Open system interconnection
OUI	Organizational universal identifier
PIN	Personal identification number
RemoteCIID	CIID of a VCI enabling MAC groupcast transmissions and MAC unicast communication
RX/TX-CI	CI capable of operating in receive and transmit mode
RX-CI	CI capable of operating in receive mode only
RX-VCI	VCI for reception
SAE	Security adaptation entity
SIM	Subscriber identity module
SNAP	Sub-network access protocol
TDMA	Time division multiple access
TX-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
VCI	virtual communication interface
WAVE	Wireless access in vehicular environments
	NOTE IEEE work item related to [6]

5 Communication module adaptation

5.1 General

As ITS and the concept of an ITS station as a bounded secured managed domain (BSMD) specified in ISO 21217 does not only support access technologies (media) which are especially designed for implementations of ITS, there is a need to adapt the interfaces of these other access technologies to those interfaces expected by the ITS networking & transport layer, the ITS-S management entity, and the ITS-S security entity.

For these other access technologies, the task is to adapt

— the interface on top of the access technology to the IN-SAP by means of a communication adaptation layer (CAL), and

— the management interface to the MI-SAP by means of a management adaptation entity (MAE), and

— the security interface to the SI-SAP by means of a security adaptation entity (SAE).

The implementation of an existing access technology, which was not designed especially for ITS, may include higher layers of the OSI communication protocol stack than just the ITS access layer including the related management. This inclusion of higher protocol layers shall be restricted to those communication technologies already existing and not being aware of ITS and the concept of a BSMD, e.g. the cellular media [3, 4].

The CI adaptation is outlined in Figure 2.

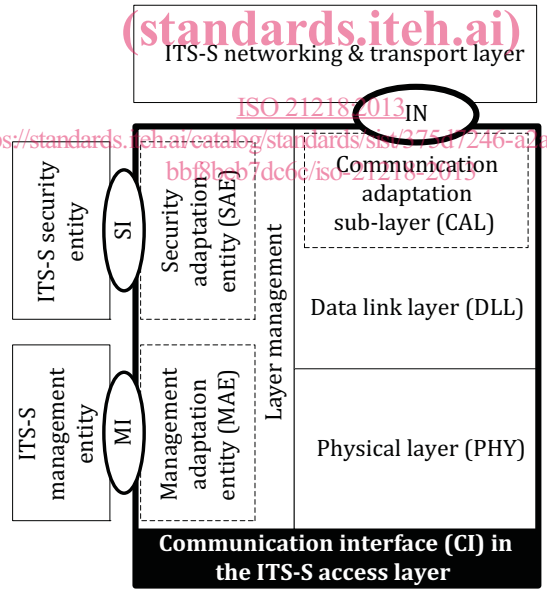

Figure 2 — Architecture

This International Standard provides common basic functional specifications for the communication adaptation Layer, for the management adaptation entity (MAE), and for the security adaptation entity (SAE). It specifies the communication SAP (IN-SAP), the station management SAP (MI-SAP), and the security management SAP (SI-SAP).

5.2 Communication adaptation layer

The CIs built on different media are using the same ITS-S networking & transport layer. All CIs shall use the same type of IN-SAP between the ITS-S networking & transport layer and the CAL.

The medium-specific CAL provides an IN-SAP to the ITS-S networking & transport 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 ITS-S networking & transport layer protocol selected.

— For ad-hoc 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 an access technology (medium)-specific LLC or as an extension of an existing LLC providing the adaptation of the specific needs of an access technology (medium) to the common communication IN-SAP.

5.3 CI management adaptation entity

The CIs built on different media are using the same ITS-S management, applying the functionality specified for the MI-SAP.

The MAE provides the MI-SAP to the ITS-S management following the same principles as outlined in ISO/IEC 8802-11 with respect to the station management entity. The MI-SAP offers the services presented in Clause 9.

The MAE can be considered as medium-specific management providing the adaptation of the specific needs of an access technology (medium) to the common MI-SAP.

5.4 CI security adaptation entity

The current version of this International Standard does not provide the specification of the SAE.

6 Communication interface

6.1 Architecture

This International Standard uses the concept of

— Communication interface (CI) with

— virtual communication interfaces (VCIs).

A CI is a real communication equipment containing functionality of the ITS-S access layer. On top of a CI, one or several VCIs for transmission (TX-VCIs) to specific peer ITS-Ss, groups of ITS-Ss, or all ITS-Ss, and one or several receive VCIs (RX-VCIs), may be created.

NOTE The number of RX-VCIs is equal to the number of receive channels which can be operated simultaneously by the CI.

Further details on VCIs are specified in Clause 7.

6.2 Classification of CIs

6.2.1.1 CI 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: Access technologies specified in [5, 6, 7, …]
CIC-wl2	Wireless CI that is capable of establishing a session with a single base station. Handover between different base stations may be possible, but not visible to the ITS upper layers and the ITS-S management. Examples: Access technologies specified in [3, 4, …]
CIC-wl3	Wireless CI that is capable to transmitting only on the basis of MAC broadcast/multicast (group) addresses. Examples: Access technologies specified in [5, 6, 7, …]
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-lan1	CI for station-internal network of an ITS station. Non-deterministic.
CIC-lan2	CI for station-internal network of an ITS station. Deterministic.

6.2.1.2 CI 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 CI access classes. A CI shall support exactly one of the CI access classes presented in Table 2 in line with requirements presented in Table 3.

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.

6.2.1.3 Mapping

The possible relations between CI classes and CI access classes shall be as presented in Table 3.

Table 3 — CI classes and access classes

CI classes	CI access classes		
	CIAC-1	CIAC-2	CIAC-3
CIC-wl1	mandatory	prohibited	prohibited
CIC-wl2	Exactly one out of the three CI access classes is mandatory		
CIC-wl3	Exactly one out of the three CI access classes is mandatory		
CIC-wl4	prohibited	prohibited	prohibited
CIC-wl5	mandatory	prohibited	prohibited
CIC-lan1	mandatory	not applicable	not applicable
CIC-lan2	mandatory	not applicable	not applicable

6.3 Link Identifier

CIs and VCIs shall be referenced/addressed by a unique Link-ID. The Link-ID shall be constructed according to Figure 3.

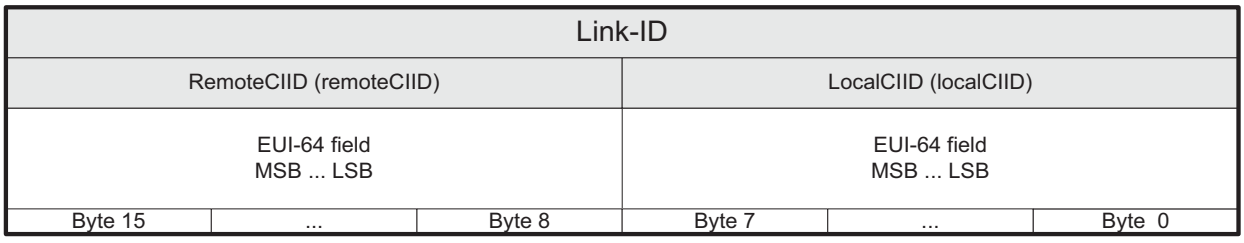

Figure 3 — Link-ID

The **LocalCIID** field identifies uniquely a specific CI in a specific ITS-S communication unit (ITS-SCU) in an instance of an ITS station.

NOTE A two octet ITS-SCU-ID specified in ISO 24102-4, identifying uniquely an ITS-SCU of an ITS-S, can be derived from LocalCIID be means of a look-up table.

The **RemoteCIID** field identifies a VCI of the CI identified by LocalCIID which connects to a remote ITS-S unit (e.g. MAC unicast communication), or to a group of them (e.g. MAC broadcast or multicast communication). One reserved number of RemoteCIID shall identify the CI which is addressed by the value of LocalCIID. This reserved number shall be

— the distinct null identifier (DNI) presented in Annex C.2 for CIs supporting 48-bit MAC addresses,

— the VCISerialNumber zero presented in Annex C.3 for CIs which do not support 48-bit MAC addresses.

LocalCIID and RemoteCIID are presented in 64-bit global identifier (EUI-64) fields, see annex C.1, which may contain a 48-bit MAC address as illustrated in Annex C.2.

For access technologies using 48-bit MAC addresses, LocalCIID may contain the globally unique MAC address of the CI, and RemoteCIID may contain either the individual MAC address reported in a received frame, or broadcast MAC address or a multicast MAC address.

Other access technologies shall use the numbering scheme specified in Annex C.3.

NOTE LocalCIID andRemoteCIID may appear in an access layer frame in the communication link between peer ITS station units as part of an NPDU dependent on the networking & transport layer protocol being used. Thus LocalCIID and RemoteCIID may become subject for considerations on privacy.

6.4 Procedures

6.4.1 General

The procedures as specified here use management services of the MI-SAP, as specified in 8.5.

6.4.2 Registration

Registration of a CI at the ITS-S management is the process of making the CI known at the ITS-S management, and of making it addressable via a unique Link-ID. See the state machine in Figure 4.

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

Upon power-up, or upon physical insertion/activation of a CI, a CI supporting 48-bit MAC addresses shall request registration of itself at the ITS-S management. The following procedure shall apply.

1) Create a Link-ID illustrated in Figure 3 with LocalCIID representing the globally valid unique MAC address of the CI as stored in I-Parameter 9 "MAC address", with RemoteCIID equal to the "Distinct Null Indicator" (DNI) value presented in Annex C.

2) Send MI-REQUEST "RegReq" indicating I-Parameter 17 "MedType" using the Link-ID constructed in step 1).

3) Set timer T_register to the value given in I-Parameter 8 "TimeoutRegister".

4) Await MI-COMMAND "RegCmd" providing the "ITS-SCU-ID" and "MedID" as long as T_register has not expired.

5) 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 2).

6) Upon successful registration, set I-Parameter 5 "ITS-SCU-ID" as received in MI-COMMAND "RegCmd". Set I-Parameter 13 "CIstatus" to the value "registered", and notify this value to the ITS-S management. This setting shall trigger creation of VCIs as specified in Clause 7.

Upon power-up, or upon physical insertion/activation of a CI, a CI not supporting 48-bit MAC addresses shall request registration of itself at the ITS-S management. The following procedure shall apply.

1) Create a preliminary Link-ID illustrated in Figure 3 with LocalCIID and RemoteCIID constructed as illustrated in Figure with

   i) LocalCIID:

      I) Set VCISerialNumber to the value zero, indicating the local CI.

      II) Set ITS-SCU-ID to the value zero, see ISO 24102-4.

      III) Set MedID to a value.

      IV) Set all bits in the UC/GC field to zero.

NOTE The selected value for MedID might already be in use by another CI. Thus this value needs to be confirmed by the ITS-S management entity in order to become valid.

   ii) RemoteCIID:

      I) Set VCISerialNumber to the value zero, indicating the address of the CI.

      II) Set ITS-SCU-ID to the value zero.

      III) Set MedID to the same value as used in LocalCIID.

      IV) Set all bits in the UC/GC field to zero.

2) Send REQUEST "RegReq" indicating I-Parameter 17 "MedType".

3) Set timer T_register to the value given in I-Parameter 8 "TimeoutRegister".

4) Await COMMAND "RegCmd" providing true values of "ITS-SCU-ID" and "MedID" as long as T_register has not expired.

5) 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), using a different value for MedID.

6) Create the valid Link-ID of the CI using the values of ITS-SCU-ID, MedID as given by the ITS-S management in step 4).

7) Upon successful registration, set I-Parameter 5 "ITS-SCU-ID" and I-Parameter 6 "MedID" as received in COMMAND "RegCmd". Set I-Parameter 13 "CIstatus" to the value "registered", and notify this value to the ITS management. This setting shall trigger creation of VCIs as specified in 7.

6.4.3 Deregistration

Deregistration of a CI at the ITS-S management is the reversal of the registration process of the CI. See the state machine in Figure 4.

Deregistration may be performed by the MAE or may be requested by the ITS-S management by sending the MI-COMMAND "CIstateChng" with the value "deregister".