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

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

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

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ISBN 978 0 580 58545 6

ICS 03.220.01; 35.240.60

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

Amendments issued since publication

Date	Text affected

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INTERNATIONAL STANDARD

ISO 24102

First edition
2010-11-15

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

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

Reference number
ISO 24102:2010(E)

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Foreword

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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 24102 was prepared by Technical Committee ISO/TC 204, *Intelligent transport systems*.

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Introduction

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

This International Standard determines the intelligent transport systems (ITS) station management.

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

1 Scope

This International Standard provides specifications for intelligent transport systems (ITS) station management to be compliant with the ITS station reference architecture and the set of communications access for land mobiles (CALM) related standards.

Management actions are specified via

a) service access points,

b) messages and data that flow between the ITS station management entity and the security entity, the application entity and the various communication protocol layers of the ITS station reference architecture, and

c) protocol data units for management communications between addressable instances of functionality of an ITS station.

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

ISO 15628:2007, *Road transport and traffic telematics — Dedicated short range communication (DSRC) — DSRC application layer*

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

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

ISO 21218:2008, *Intelligent transport systems — Communications access for land mobiles (CALM) — Medium service access points*

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

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3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217, ISO 21210, ISO 29281, ISO 21218, and the following apply.

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

3.1
regulatory information
set of regulatory requirements for radio wave emission

3.2
ITS-S communication unit
addressable instance of the ITS station reference architecture comprising as a minimum the ITS-S router functionality

NOTE ITS-SCU (ITS-S communication unit) previously was named CCK (CALM communication kernel).

4 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO 21217, ISO 21210, ISO 29281, ISO 21218, and the following apply.

CI	Communication Interface
ETSI	European Telecommunications Standards Institute
ITS-SCU	ITS Station Communication Unit
ITSSI	ITS State Information
LDM	Local Dynamic Map
MAC	Medium Access Control
MIB	Management Information Base
MF-COMMAND	command issued by the ITS station management entity and sent to the facilities layer via the MF-SAP
MF-REQUEST	command issued by the facilities layer and sent to the ITS station management entity via the MF-SAP
MI-COMMAND	command issued by the ITS station management entity and sent to the access layer via the MI-SAP
MI-GETPARAM	command issued by the ITS station management entity in order to get the value of one or several CI parameters; it is sent via the MI-SAP to the access layer
MI-REQUEST	command issued by the access layer and sent to the ITS station management entity via the MI-SAP
MI-SETPARAM	command issued by the ITS station management entity in order to set the value of one or several CI parameters. It is sent via the MI-SAP to the access layer
MN-COMMAND	command issued by the ITS station management entity and sent to the networking and transport layer via the MN-SAP

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MN-REQUEST	command issued by the networking and transport layer and sent to the ITS station management entity via the MN-SAP
n.a.	not applicable
PDUs	Protocol Data Units
QoS	Quality of Service
RI	Regulatory Information
SAF	Service Advertisement Frame
SCF	Service Context Frame
SID	Service Identifier
STA	Service Table for Advertisement
VCI	Virtual Communication Interface

NOTE During the process of harmonizing the CALM standards, the SAP names were changed. Subsequently, the names of services and service primitives changed accordingly.

5 Requirements

The ITS station management entity specified in this International Standard provides functionality related to the

— management of communication protocol layers and the security entity presented in the ITS station reference architecture specified in ISO 21217 and presented in Figure 1, and

— station-local management communications (Inter-ITS-SCU communications) enabling a sub-division of an ITS station into several addressable entities, e.g. hosts and routers,

in line with the general ITS architecture specified in ISO 21217.

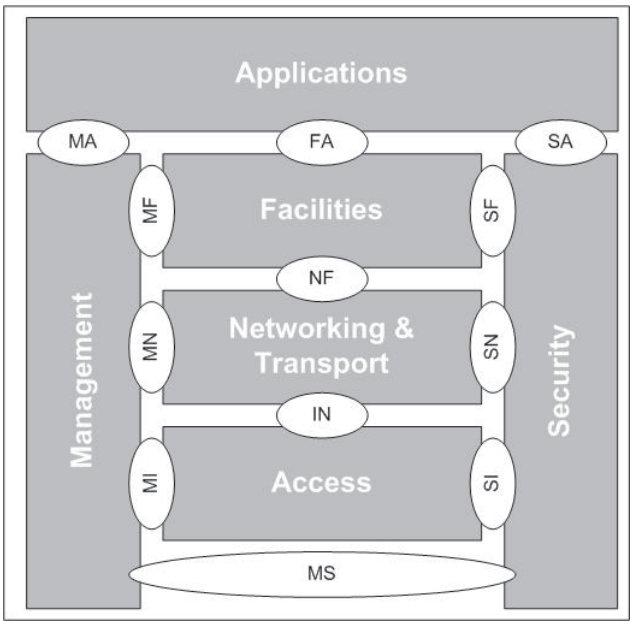

Figure 1 — ITS station reference architecture with named interfaces

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ITS station management is specified as a distributed process, where no supervisory entity is employed.

The ITS station management entity shall provide the service primitives of the

a) MI-SAP, specified in ISO 21218,

b) MN-SAP, specified in this International Standard,

c) MF-SAP, specified in this International Standard.

NOTE 1 SAPs can be non-exposed interfaces. Thus service primitives of SAPs are not subject to conformance tests.

NOTE 2 The MA-interface presented in Figure 1 is not specified in this International Standard, although it is recognized as part of the ITS station reference architecture specified in ISO 21217.

The ITS station management entity shall use the service primitives provided in the NF-SAP, specified in ISO 29281 and in ISO 21210 for the purpose of "Inter-ITS-SCU Communication".

NOTE 3 Figure 18 in ISO 21217 presents details on the ITS-SCU, i.e. an extension on the basic ITS station reference model presenting the NF-SAP connected to the management entity.

Means to secure the access to management functionality need to be specified within the global context of CALM security. This may require, e.g. defining further Inter-ITS-SCU communication PDUs for authentication of ITS-SCUs. Details are outside the scope of this International Standard.

Detailed mandatory requirements are specified in the following clauses of this International Standard.

— Clause 6 specifies "Inter-ITS-SCU communications", i.e. how management commands are exchanged between different addressable entities of an ITS station.

— Clause 7 specifies basic management procedures related to communication interfaces.

— Clause 8 specifies groupcast management.

— Clause 9 specifies FAST service provisions.

— Clause 10 specifies congestion control.

— Clause 11 specifies the concept of "Radar View" and the link to the "Local Dynamic Map" (LDM) application.

— Clause 12 specifies communication interfaces (CI) selection management.

— Clause 13 specifies management of "Legacy CIs".

— Clause 14 specifies management data elements.

— Clause 15 specifies the MN-SAP of the networking and transport layer.

— Clause 16 specifies the MF-SAP of the facilities layer.

— Clause 17 specifies conformance declaration and test methods.

— Annexes provide further mandatory requirements.

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6 Inter-ITS-SCU communication

6.1 Basics

Management communications between ITS-SCUs of the same ITS station, as specified in ISO 21217, shall be based on the ITS station-internal network presented in ISO 21217.

NOTE Installations can provide technically different realizations of the ITS station internal network which can be used to carry inter-ITS-SCU management packets. Details are outside the scope of this International Standard.

The following protocol data units (PDU) shall be used:

— ITS-SCU-Mngmt-Request;

— ITS-SCU-Mngmt-Response.

Details on parameters of these PDUs are shown in Table 1.

Table 1 — Inter-ITS-SCU management PDUs

PDU element	ITS-SCU-Mngmt-Request	ITS-SCU-Mngmt-Response
SourceITS-SCU-ID	ITS-SCU-ID of source ITS-SCU, which produces the request. See parameter 3 "ITS-scuId" specified in Annex A.	ITS-SCU-ID of ITS-SCU, which produces the response.
DestinationITS-SCU-ID	ITS-SCU-ID of destination ITS-SCU, which shall evaluate the request.	Same as SourceITS-SCU-ID of related request if not requested otherwise in this International Standard.
PDU-Counter	Even number generated from a cyclic counter at the ITS-SCU, which produces the request.	PDU-Counter of related request incremented by one.
PDU-ID	Unique identifier of the content of the request.	Same as in ITS-SCU-Mngmt-Request.
Data	Octet string specific to the PDU-ID, carrying the request.	Octet string specific to the PDU-ID, carrying the response.
ErrorStatus	Not existent.	Existent. 0: No error happened >0: Number indicating type of error.

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Figure 2 illustrates Table 1. The element "SourceITS-SCU-ID" shall be transmitted first. In a serial communication link, the most significant byte of an element shall be transmitted first, and the least significant bit of a byte shall be transmitted first.

CCK-Mngmt-Request:

SourceITS-SCU-ID	Destination ITS-SCU-ID	PDU-Counter	PDU-ID	Data

CCK-Mngmt-Response:

SourceITS-SCU-ID	Destination ITS-SCU-ID	PDU-Counter	PDU-ID	Data	Error Status

Figure 2 — Inter-ITS-SCU PDU structure

The ASN.1 specification of the PDUs is provided in Annex B of this International Standard.

NOTE PDU-ID and Data are coded together in an ASN.1 "CHOICE" type. The ASN.1 tag number equals the PDU-ID.

ITS-SCU-ID values used in parameters "SourceITS-SCU-ID" and "DestinationITS-SCU-ID" shall be as specified in Table 2.

Table 2 — ITS-SCU-ID value assignment

SourceITS-SCU-ID	DestinationITS-SCU-ID	Description
0		Reserved. Used to indicate "own/local ITS-SCU".
n.a.	1	ITS-SCU-ID identifying ITS-SCUs of all hosts.
n.a.	2	ITS-SCU-ID identifying ITS-SCUs of all routers.
3 - 7		Reserved for future use.
8 .. 254		ITS-SCU-ID identifying uniquely a specific ITS-SCU in an ITS station.
n.a.	255	ITS-SCU-ID identifying all ITS-SCUs, i.e. those of hosts and routers.

"PDU-ID" values and the related "Data" values shall be set as specified in Annex C of this International Standard.

"ErrorStatus" values shall be set as specified in Table 3.

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Table 3 — ErrorStatus value assignment

ErrorStatus	Description
0	No error
1	PDU-ID unknown or not implemented
2	Duplicate ITS-SCU-ID
3 .. 254	Reserved for future use
255	Unspecified error

6.2 Procedures

6.2.1 PDU-Counter

"PDU-Counter" values shall be set uniquely in an ITS-SCU under the control of the ITS station management entity issuing the request. For every next ITS-SCU-Mngmt-Request PDU, the counter value shall be incremented by two. It shall wrap from 254 to zero.

6.2.2 ITS-SCU-ID assignment

The ITS-SCU shall randomly generate a unique ITS-SCU-ID as specified in Table 2 as its own ITS-SCU-ID and shall put the selected ITS-SCU-ID to its local ITS-SCU-list. ITS-SCU-ID values already being in the local ITS-SCU-list indicate usage by another ITS-SCU in the same station and shall not be selected. Then the ITS-SCU-Mngmt-Request 0 "ITS-SCU-id(new)" shall be sent to all ITS-SCUs, indicating a first choice of ITS-SCU-ID in the "SourceITS-SCU-ID element, or a new choice of ITS-SCU-ID, and the type of ITS-SCU in the "Data" element. In case of a negative acknowledgement, i.e. indication of usage of this ITS-SCU-ID value by another ITS-SCU, see below, the ITS-SCU shall repeat the procedure with a new ITS-SCU-ID value.

Upon activation, an ITS-SCU may listen to receive ITS-SCU-Mngmt-Request 0 "ITS-SCU-id" messages or ITS-SCU-Mngmt-Response 0 "ITS-SCU-id" messages in order to identify already allocated ITS-SCU-IDs.

Upon reception of an ITS-SCU-Mngmt-Request 0 "ITS-SCU-id(new)", an ITS-SCU shall check the SourceITS-SCU-ID.

— If the SourceITS-SCU-ID is equal to the own ITS-SCU-ID, the receiving ITS-SCU shall send an ITS-SCU-Mngmt-Response 0 "ITS-SCU-id" to all ITS-SCUs, reporting the own ITS-SCU-ID and type of ITS-SCU to all ITS-SCUs, indicating ErrorStatus=2.

— If the SourceITS-SCU-ID is different to the own ITS-SCU-ID, the ITS-SCU shall take this information to its local ITS-SCU-list, if not already present there. An existing entry shall not be updated with this new information. The ITS-SCU shall acknowledge the ITS-SCU-Mngmt-Request with the ITS-SCU-Mngmt-Response 0 "ITS-SCU-id", reporting the own ITS-SCU-ID and type of ITS-SCU, indicating ErrorStatus=0.

Upon reception of an ITS-SCU-Mngmt-Request 0 "ITS-SCU-id(alive)", an ITS-SCU shall check the SourceITS-SCU-ID.

— If the SourceITS-SCU-ID is equal to the own ITS-SCU-ID, the receiving ITS-SCU shall send an ITS-SCU-Mngmt-Response 0 "-id" to all ITS-SCUs, reporting the own ITS-SCU-ID and type of ITS-SCU to all ITS-SCUs, indicating ErrorStatus=2. All ITS-SCUs with this ITS-SCU-ID shall invalidate this ITS-SCU-ID and shall start the procedure to select a new ITS-SCU-ID.

— If the SourceITS-SCU-ID is different to the own ITS-SCU-ID, the ITS-SCU shall take this information to its local ITS-SCU-list, if not already present there. The ITS-SCU-Mngmt-Request shall not be acknowledged with an ITS-SCU-Mngmt-Response.

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Upon reception of an ITS-SCU-Mngmt-Response 0 "ITS-SCU-id", an ITS-SCU shall check the ErrorStatus.

— In case of ErrorStatus=0, the ITS-SCU shall take this information to its local ITS-SCU-list, if not already present there.

— In case of ErrorStatus=2, an address conflict was detected. The procedure to be selected upon this event depends on the value of "Message" and SourceITS-SCU-ID contained in the ITS-SCU-Mngmt-Response as presented in Table 4.

Table 4 — Error handling procedure for ITS-SCU-Mngmt-Response 0

ITS-SCU-Mngmt-Response 0 "ITS-SCU-id (ErrorStatus = 2)"	SourceITS-SCU-ID = own ITS-SCU-ID	SourceITS-SCU-ID ≠ own ITS-SCU-ID
Message = new	Map ITS-SCU-ID to ITS-SCUtype reported in the response. Restart ITS-SCU-ID assignment process.	Nothing shall be done.
Message = alive	**IMPORTANT — This should never happen.** Reset ITS-SCU and restart ITS-SCU-ID assignment process.	**IMPORTANT — This should never happen.** Delete SourceITS-SCU-ID from local ITS-SCU-list. Request deletion of related entries in forwarding tables.
Message = delete	**IMPORTANT — This should never happen.** Nothing shall be done.	

AN ITS-SCU shall be considered to be fully alive only upon first successful reception of ITS-SCU-Mngmt-Request 0 "ITS-SCU-id(alive)".

6.2.3 Maintenance of ITS-SCU-ID

Every ITS-SCU shall periodically transmit the "alive-signal" Mngmt-Request 0 "ITS-SCU-id(alive)" in order to indicate its presence in the ITS station. The period of transmission shall be as set in parameter 11 "Talive" specified in Annex A. The value of "Talive" shall be defined by implementation and shall be unique in an ITS station.

The ITS-SCU periodically shall check the local ITS-SCU-list. If for a period of at least three times "Talive" no "alive-signal" Mngmt-Request 0 "ITS-SCU-id(alive)" was received, the ITS-SCU shall assume that this ITS-SCU is no longer alive. The ITS-SCU-ID shall be deleted from the local ITS-SCU-list.

6.2.4 Deletion of ITS-SCU-ID

Deletion of an ITS-SCU-ID from the local ITS-SCU-list shall result in deleting all related entries in forwarding tables.

6.2.5 Shut-down of ITS-SCU

Prior to performing a shut-down of ITS-SCU, the Mngmt-Request 0 "ITS-SCU-id(delete)" message shall be sent to all ITS-SCUs.

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7 CI basic management

7.1 General

Basic management procedures related to communication interfaces (CI) shall access a CI/VCI via the MI-SAP specified in ISO 21218.

Any change of status of a CI/VCI shall be reported to all ITS-SCUs with ITS-SCU-Mngmt-Request 10 "VCI-update". Reception of such a notification shall not be acknowledged.

Management communications with CIs/VCIs in other ITS-SCUs shall be with Inter-ITS-SCU communication PDUs 5 "MI-rcmd", 6 "MI-rreq", 7 "MI-rget" and 8 "MI-rset" as specified in this International Standard.

SAPs and the related service primitives can not be tested and are not mandatory. However in the context of this International Standard, the elements of the service primitives may be an integral part of PDUs exchanged between physical entities in an ITS station using "Inter-ITS-SCU Communications". As PDUs are testable, those elements of service primitives that are part of a PDU become testable.

7.2 CI status

7.2.1 CI state machine

Figure 3 shows the CI state machine specified in ISO 21218.

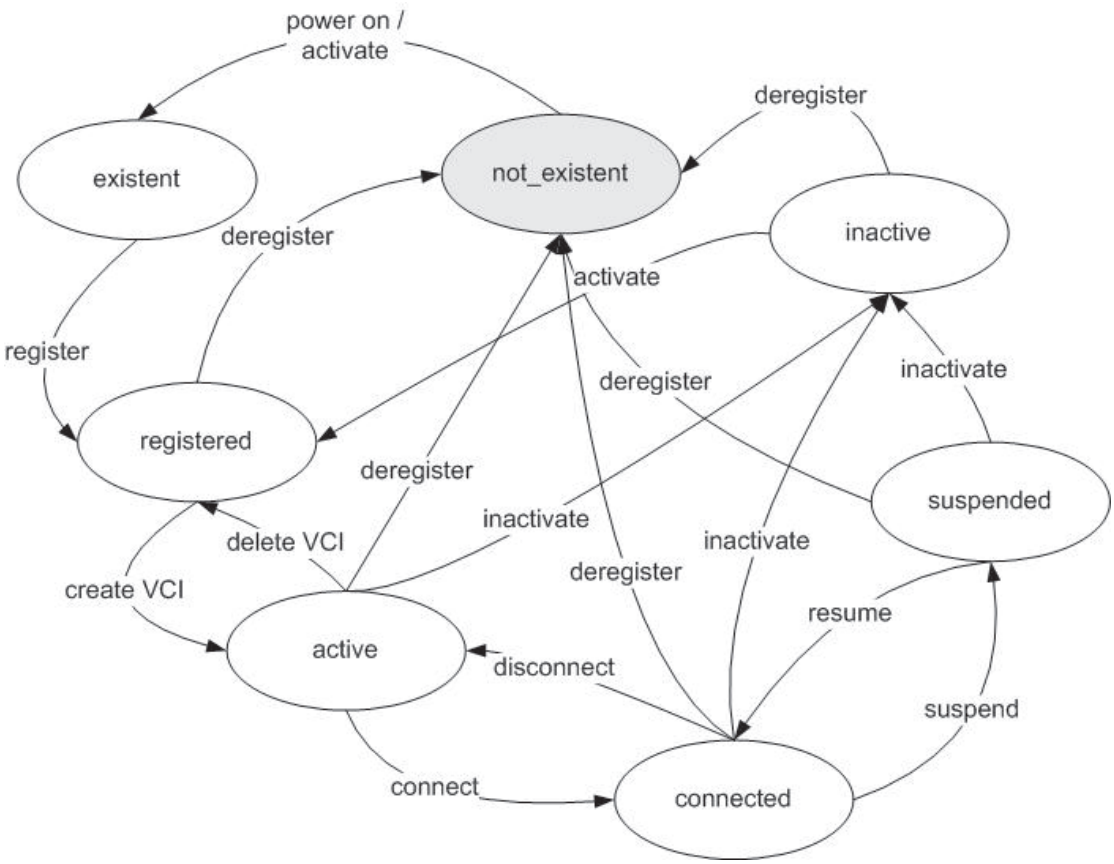

Figure 3 — CI state machine ISO 21218

NOTE ISO 21218:2008 uses the term "reactivate" instead of "resume".

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7.2.2 Registration

Registration of a CI at the ITS station management entity is the process to make the CI known to the ITS station management entity, and to make it addressable via a unique MedID, see ISO 21218.

Registration of a CI shall be done as specified in ISO 21218.

The medium identifier MedID, part of the CI-ID as specified in ISO 21218, and assigned to a CI during the process of registration shall be generated randomly. The MedID shall be unique within an ITS-SCU.

Upon successful registration of a CI, the ITS station management entity shall create an entry in the VCI list with the values specified in Table 5.

Table 5 — Entry in VCI list upon registration of CI

CI-ID	Medium	CI/VCI Status	ConnectMode	NWsupport	Peer MAC address
ITS-SCU-ID and MedID set. SerialNumber set to zero. CtrlCI bits set to zero.	Set equal to MI-parameter 22 "Medium". See ISO 21218.	"registered", see ISO 21218.	Set equal to MI-parameter 51 "Connect".	Set equal to MI-parameter 23 "NWsupport".	Set to zero.

7.2.3 VCI creation

Creation of a VCI may be done

— upon request of the ITS station management entity, or

— upon request of a networking protocol, or

— by the CI on its own.

Creation of a VCI shall be done as specified in ISO 21218.

Upon successful creation of a VCI the ITS station management entity

— shall create an entry in the VCI list with the values specified in Tables 6, 7 and 8, as applicable,

— shall create initial entries in the forwarding tables of all supported networking protocols using MN-COMMAND 1, if applicable.

Table 6 — Entry in VCI list indicating an active CI

CI-ID	Medium	CI/VCI Status	ConnectMode	NWsupport	Peer MAC address
ITS-SCU-ID and MedID set. SerialNumber set to zero. CtrlCI bits set to zero.	Set equal to MI-parameter 22 "Medium". See ISO 21218.	"active", see ISO 21218.	Set equal to MI-parameter 51 "Connect".	Set equal to MI-parameter 23 "NWsupport".	Unknown, set to zero.

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Table 7 — Entry in VCI List upon creation of a broadcast VCI

CI-ID	Medium	CI/VCI Status	ConnectMode	NWsupport	Peer MAC address
ITS-SCU-ID and MedID set. SerialNumber set to 65535. G/U bit set to 1. Other CtrlCI bits set to zero.	Set equal to MI-parameter 22 "Medium". See ISO 21218.	"active", see ISO 21218.	Not used. Set equal to MI-parameter 51 "Connect".	Set equal to MI-parameter 23 "NWsupport".	Not used. Set to zero.

Table 8 — Entry in VCI List upon creation of a multicast VCI

CI-ID	Medium	CI/VCI Status	ConnectMode	NWsupport	Peer MAC address
ITS-SCU-ID and MedID set. SerialNumber set to multicast group number. G/U bit set to 1. Other CtrlCI bits set to zero.	Set equal to MI-parameter 22 "Medium". See ISO 21218.	"active", see ISO 21218.	Not used. Set equal to MI-parameter 51 "Connect".	Set equal to MI-parameter 23 "NWsupport".	Not used. Set to zero.

Upon request of a networking protocol to create a VCI with a specific relation to a peer station, of which the MAC address is known a priori, and with specific settings of the MI-parameters, the ITS station management entity shall create the VCI and perform all required settings. The state of the VCI shall be set to "connected", see Table 9. The ITS station management entity shall update the VCI list and the forwarding tables.

7.2.4 Deregistration

Deregistration of a CI at the ITS station management entity is the process reversal to the registration process. Successful deregistration is a prerequisite to remove a CI from the system during operation.

Deregistration of a CI may be done

— by the CI on its own,

— upon request of the ITS station management entity as specified in this International Standard.

Deregistration of a CI shall be done as specified in ISO 21218.

Upon successful deregistration, the ITS station management entity

— shall delete all entries of this CI and the related VCIs in the VCI list,

— may re-use the value of MedID of this CI, but only in case there are no more so far unused MedID values available for registration of a new CI, and

— shall delete all entries of this CI and the related VCIs in the forwarding tables using MN-COMMAND 3.

NOTE Not to reuse a MedID value immediately allows the upper OSI layers to "time-out", i.e. to avoid addressing conflicts.

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7.2.5 Inactivation

Inactivation of a CI is the process to reset the CI and to block all subsequent communications.

Inactivation of a CI may be done upon request of the ITS station management entity.

NOTE Conditions when a CI shall or may be inactivated are not specified in this International Standard.

Inactivation of a CI shall be done as specified in ISO 21218.

Upon successful inactivation, the ITS station management entity

— shall change the status element of this CI in the VCI list to "inactive", and shall delete the entries of all related VCIs in the VCI list,

— change the CI state of this CI in the forwarding tables to "inactive", and shall delete the entries of all related VCIs in the forwarding tables using MN-COMMAND 3.

7.2.6 Activation

Activation of a CI is the process to enable communications in an inactive CI. Upon successful activation the ITS station management entity shall change the status element of this CI to the value "registered".

Activation of a CI may be done upon request of the ITS station management entity as specified in this International Standard.

NOTE Requirements on events upon which a CI shall or may be activated are not specified in this International Standard.

Activation of a CI shall be done as specified in ISO 21218.

Upon successful activation, the ITS station management entity shall change the status element of this CI in the VCI list to the value "registered".

7.2.7 Suspension of a CI

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

Suspension of a CI may be done upon request of the ITS station management entity as specified in this International Standard.

NOTE Requirements when a CI shall or may be suspended are not specified in this International Standard.

Suspension of a CI shall be done as specified in ISO 21218.

Upon successful suspension, the ITS station management entity

— shall change the status element of this CI and the related VCIs in the VCI list to "suspended", and

— shall change the CI state of this CI and the related VCIs in the forwarding tables to "suspended" using MN-COMMAND 2.

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7.2.8 Resuming

Resuming of a CI is the process to enable communications in a suspended CI.

Resuming of a CI may be done upon request of the ITS station management entity.

NOTE 1 Conditions when a CI shall or may be reactivated are not specified in this International Standard.

Resuming of a CI shall be done as specified in ISO 21218.

Upon successful resuming, the ITS station management entity shall change

— the status element of this CI in the VCI list to "active", and the status of the related VCIs in the VCI list to "connected", and

— the CI state of this CI and the related VCIs in the forwarding tables to "connected" using MN-COMMAND 2.

NOTE 2 This VCI state might be wrong. However this will be resolved automatically.

NOTE 3 ISO 21218:2008 uses the term "reactivation" instead of "resuming".

7.2.9 Connection

Connection establishment of a CI is the process to initiate and maintain a relation to a specific peer station. Distinction is made according to the CI access class.

Connection of a VCI may be done

— by the CI on its own,

— upon request of the ITS station management entity as specified in this International Standard.

Connection of a VCI shall be done as specified in ISO 21218.

Upon successful connection to a peer station, the ITS station management entity

— shall create an entry in the VCI list with the values specified in Table 9, and

— change the CI state of this VCI in the forwarding tables to "connected", using MN-COMMAND 2.

Table 9 — Entry in VCI list upon creation of a unicast VCI

CI-ID	Medium	CI/VCI Status	ConnectMode	NWsupport	Peer MAC address
ITS-SCU-ID and MedID set. SerialNumber set to value, pointing to peer MAC address. CtrlCI bits set to zero.	Set equal to MI-parameter22 "Medium". See ISO 21218.	"connected", see ISO 21218.	Set equal to MI-parameter 51 "Connect".	Set equal to MI-parameter 23 "NWsupport".	Set equal to MAC address of peer station.

There are media which do not provide information on the peer MAC address. For such media all bits of the "Peer MAC address" field in the VCI list shall be set to one.

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7.2.10 Disconnection

Disconnection of a VCI is the process to close relations to peer stations. Distinction is made according to the CI access class as specified in ISO 21218.

Disconnection of a VCI may be done

— by the CI on its own,

— upon request of the ITS station management entity as specified in this International Standard.

Disconnection of a VCI shall be done as specified in ISO 21218. Upon successful disconnection of a VCI by the ITS station management entity or by the CI, the ITS station management entity shall delete

— the entry of the VCI in the VCI list, and

— the entries of this VCI in the forwarding tables using MN-COMMAND 3.

7.2.11 Deletion of a VCI

Deletion of a VCI may be done

— by the CI on its own,

— upon request of the ITS station management entity as specified in this International Standard.

Deletion of a VCI shall be done as specified in ISO 21218.

Upon successful deletion of a VCI the ITS station management entity shall delete

— the entry in the VCI list, and

— the entries of this VCI in the forwarding tables using MN-COMMAND 3.

7.3 Cross-CI prioritization

7.3.1 General

Wireless TX-VCIs in an ITS station might suffer from cross-interference. This clause considers the case that 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 as far as possible. A possible means to achieve this is proper assignment of orthogonal wireless communication channels to the CIs.

Priority management across CIs is a somewhat slow process which requires involvement of the ITS station management entity for every packet to be prioritized.

The procedure of cross-CI prioritization is an optional procedure. The part of it related to the CI is specified in ISO 21218.

NOTE An implicit option of cross-CI prioritization is CI protection. A CI to be protected is a device for radio communications such as passive transponder systems based on [4] and ISO 15628:2007 which can not harm other CIs.

In CI protection mode, the CI to be protected does not need to await the positive acknowledgement of a prioritization request, but may try to perform communication at any time.

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7.3.2 Registration of CI for prioritization request

Upon request of a CI to register for the cross-CI prioritization procedure by means of the MI-REQUEST 1 "PrioReg", see ISO 21218, the ITS station management entity shall

— create the header of the prioritization table for this CI, see Table 21, containing the MedID of the CI and the timeout information. The list entries "Request number", "Priority" and "Status", if already created, shall be set to zero,

— evaluate the list of MedType information contained in "PrioReg" in order to identify the MedID and ITS-SCU-ID of all possible interferers in the ITS station, and

— create an entry in the prioritization table for each identified interferer with the interferer ITS-SCU-ID and MedID, and with "Status Interferer" set to "released".

7.3.3 Prioritization request

As specified in ISO 21218, a CI may request cross-CI prioritization by means of the MI-REQUEST 2 "RTSreq".

Upon reception of such a request, the ITS station management entity shall compare the presented priority with the minimum priority required for cross-CI prioritization given in parameter 1 "MinPrioCrossCI" specified in Annex A. If the presented priority is less than the minimum priority required, then the ITS station management entity shall notify unsuccessful prioritization to the requesting CI by means of MI-COMMAND "RTSackCmd", see ISO 21218, with priority set equal to parameter 1 "MinPrioCrossCI" and with status set to "ignored". Otherwise continue with the following steps.

The ITS station management entity shall

— either create or update the cross-CI prioritization list entries "Status", "Priority" and "Request number" as given in RTSreq,

— start a prioritization timer T_prioritization for this request,

— forward the prioritization request to all known potential interferers by means of the MI-COMMAND 3 "RTScmd", and shall update the status interferer entries in Table 21 to the value "requested",

— await acknowledgement messages from all interferers until end of the prioritization period, i.e. either

  — the timer T_prioritization expired according to the timeout value given in Table 21, or

  — the CI requesting prioritization released prioritization by means of MI-REQUEST 2 "RTSreq" with "status" set to "release".

Upon expiration of the timer T_prioritization, the ITS station management entity shall notify unsuccessful prioritization to the requesting CI by means of MI-COMMAND 4 "RTSackCmd" with "priority" set equal to parameter 1 "MinPrioCrossCI" and with "status" set to "ignored".

Upon reception of an acknowledgement message from an interferer, the ITS station management entity shall

— set the status of the interferer in Table 21 to "prioritization granted", and

— notify successful prioritization to the requesting CI by means of MI-COMMAND 4 "RTSackCmd" with "priority" set equal to parameter 1 "MinPrioCrossCI" and with status set to "granted" once all interferers disabled their transmitter.

The ITS station management entity shall apply "Inter-ITS-SCU communications" in case other ITS-SCUs need to be addressed.

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7.3.4 Prioritization release

Upon the end of the prioritization period, the ITS station management entity shall

— send the prioritization release MI-COMMAND 3 "RTScmd" with status = "release" to all known potential interferers, and shall update Table 21 for this request, and

— stop the timer T_prioritization, if applicable.

The ITS station management entity shall apply "Inter-ITS-SCU communications" in case other ITS-SCUs need to be addressed.

7.4 VCI MIB

7.4.1 Basics

Upon registration of a CI, its RX-VCI and TX-VCI, if applicable, shall operate on the default MIB settings.

NOTE The default MIB settings are specified in the media standards.

7.4.2 Setting of parameter values

Setting of MIB values shall be done as specified in ISO 21218.

MIB settings of a VCI may be changed

— by the ITS station management entity according to rules specified in this International Standard,

— by the VCI on its own according to rules specified in the related medium standard.

MIB values shall be set in accordance with regulatory requirements, if applicable.

Transmit parameters of a VCI may be changed temporarily on a packet by packet basis applying CIP-management as specified in ISO 29281. This shall not affect VCI MIB-settings.

7.4.3 Retrieval of parameter values

Retrieval of MIB values - either of a single parameter, or of multiple parameters, or of the complete MIB - of a VCI shall be done as specified in ISO 21218.

Retrieval of MIB values may be done by the ITS station management entity according to rules specified in this International Standard.

7.4.4 Monitoring of parameters

CIs/VCIs shall notify the ITS station management entity of changes of the following parameters:

— those that are required to be reported, i.e. mandatory change notification according to Table 10,

— those requested by the ITS station management entity by means of the MI-COMMAND 10 "Monitor", see ISO 21218.

Table 10 shows those MI-parameters for which mandatory monitoring shall apply, and the related mandatory behaviour of the ITS station management entity upon notification of a new value. The ITS station management entity shall request automatic monitoring to be performed by all CIMAEs, see ISO 21218.

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A specific access technology may not support all parameters listed in Table 10. Consequently, non-supported parameters never will change value, thus a notification never will happen.

Further parameters may be subject to automatic notification of value-changes as defined by implementation or according to other specifications.

7.4.5 Access to other ITS-SCUs

Direct access of the ITS station management entity in an ITS-SCU to the MIB of other ITS-SCUs shall be prohibited, except for the following cases:

— read only access;

— manufacturer access.

Access to an MIB of another ITS-SCU shall be achieved by means of the Inter-ITS-SCU PDUs "MI-rget" 7 and "MI-rset" 8, see Annex C.

Table 10 — List of CI parameters subject to mandatory notification

M-Param.No	Parameter Name	Behaviour
25	RI	Upon notification of change of regulatory information, the ITS station management shall accept the new limits for subsequent operations until a new update of RI will be available.
35	MACaddrTemp	Upon notification of change of own MAC address, the ITS station management entity shall send "ITSSI Data", see ISO 29281, in a broadcast frame.
42	CIstatus	See 7.2.
The following parameters are contained in the VCI performance parameter list presented in Table 20.		Upon notification of change of a performance parameter, the CI selection manager shall recalculate the mapping of ITS-S applications on CIs.
n.a.	ChannelType	
n.a.	ChannelNo	
6	DataRateNW	
7	DataRatesNW	
9	Directivity	
11	MinimumUserPriority	
16	CommRangeRef	
17	Cost	
18	Reliability	
All parameters subject to regulation, e.g. frequencies of operation, maximum transmit power.		

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7.5 Regulatory information management

All ITS stations shall comply with regional regulations. Management of regulatory information (RI) uses mechanisms specified in ISO 21218. A request from the ITS station management entity to set one or more parameters in a CI/VCI that would violate the associated regulatory information contained in the CI/VCI shall result in a confirm from the CI/VCI containing the error code "RI VIOLATION" as specified in ISO 21218. Upon such an error indication, the ITS station management entity may

— retrieve from the CI/VCI the RI parameter values,

— retrieve RI from a trusted source,

— request new settings of RI in the CI.

7.6 Manufacturer access

A manufacturer of a CI may access its CI via the MI-SAP as specified in ISO 21218.

Access to the MI-SAP shall be performed applying "Inter-ITS-SCU Communications".

Access security is outside the scope of the set of CALM International Standards, i.e. the manufacturer shall implement its own security scheme.

8 Groupcast management

8.1 Architecture

Groupcasting is specified in ISO 29281.

Groupcast management handles data transmissions based on MAC groupcast frames, i.e. broadcast frames and multicast frames. The groupcast manager shall manage

— periodic groupcasting, especially FAST service advertisement,

— MAC management groupcast frames.

This International Standard specifies the elements and procedures of the groupcast manager.

8.2 Groupcast manager

The groupcast manager of an ITS-SCU shall perform the following tasks:

1) check whether a groupcast registration/update/de-registration request received via MF-SAP with MF-REQUESTs 1, 2, 3, 4, 5 and 6 specified in Annex E, either broadcast pool data or service advertisement information, can be satisfied at this ITS-SCU, and which CIs in this ITS-SCU shall groupcast which data and service advertisements using which network protocol;

2) if a groupcast registration/update/de-registration request can not be satisfied at this ITS-SCU, then this request shall be forwarded to the proper ITS-SCU using "Inter-ITS-SCU Communications" with PDU-ID 2, see Table C.1;

3) if a groupcast registration/update/de-registration request can be satisfied at this ITS-SCU, it shall be forwarded to the proper groupcast scheduler via the MN-SAP using MN-COMMAND 4 specified in Annex F;

4) check whether groupcast data received from a groupcast scheduler via MN-SAP with MN-REQUESTs 6 and 7 specified in Annex G can be processed in the local ITS-SCU, or at which ITS-SCU the final recipient resides;

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5) if received groupcast data can not be finally processed at this ITS-SCU, then these groupcast data shall be forwarded to the proper ITS-SCU using "Inter-ITS-SCU Communications" with PDU-ID 1;

6) if received groupcast data can be finally processed at this ITS-SCU, then these groupcast data shall be processed. The processing shall result in either sending service table contexts (STCs) via the MN-SAP using MN-COMMAND 5 or optionally forwarding the received groupcast data to the proper destination using MF-COMMANDs 1, 2 and 3 specified in Annex D;

7) manage FAST service session initialization as specified in ISO 29281 which includes maintenance of FAST forwarding tables using MN-COMMANDs 1, 2, 3 specified in Annex G;

8) handle MI-COMMANDs 9 "VCIcmd", 10 "Monitor" and 255 "UnitDataCmd" specified in ISO 21218;

9) handle MI-REQUESTs 9 "Events" and 255 "UnitDataReq" specified in ISO 21218;

10) handle MI-SETPARAM and MI-GETPARAM commands specified in ISO 21218 in order to manage parameters of VCIs.

9 FAST service provision

9.1 FAST services

FAST services are services provided to ITS-S applications that make use of the FAST networking protocol as defined in ISO 29281. These services are categorized as follows:

— registered service;

— non-registered service;

— forwarding of information in a standardized way to a registered actor, e.g. Man-Machine Interface (display, beeper, ...) or an actor in the vehicle.

All possibilities are treated equally, i.e. by means of a standardized service identifier (SID); see Table 15. SID is reported e.g. in the ASN.1 element serviceID; see Tables 11 and 13.

Syntax and semantics of the packets are known a-priori, partly to the communication system, and partly to the service.

Each service consists of a provider part, i.e. the service provider application, and a user part, i.e. the client (service user) application. Service user application and service provider application generally are referred to as ITS-S applications as specified in ISO 21217.

NOTE 1 ISO 29281 uses terms such as "client entity", "client groupcast manager", "client application". Within this International Standard, "client" and "service user", used in ISO 29281, are treated as synonyms. Terminology will be editorially aligned during the next revision of ISO 29281.

NOTE 2 Access of ITS-S applications, including those designed for the FAST protocol, to the communication protocol stack is controlled in order to ensure preferred operation of important ITS-S applications. Quality of service (QoS) means are specified in ISO 21218.

9.2 Frame flow

9.2.1 Overview

Communication is structured in a service initialization phase and a service operation phase as illustrated in Figures 4 and 5. During the service initialization phase, service advertisement frames (SAF) and service context frames (SCF) are exchanged.

NOTE Figures 4 and 5 show examples of the service operation phase. It is also possible to have requests without responses.

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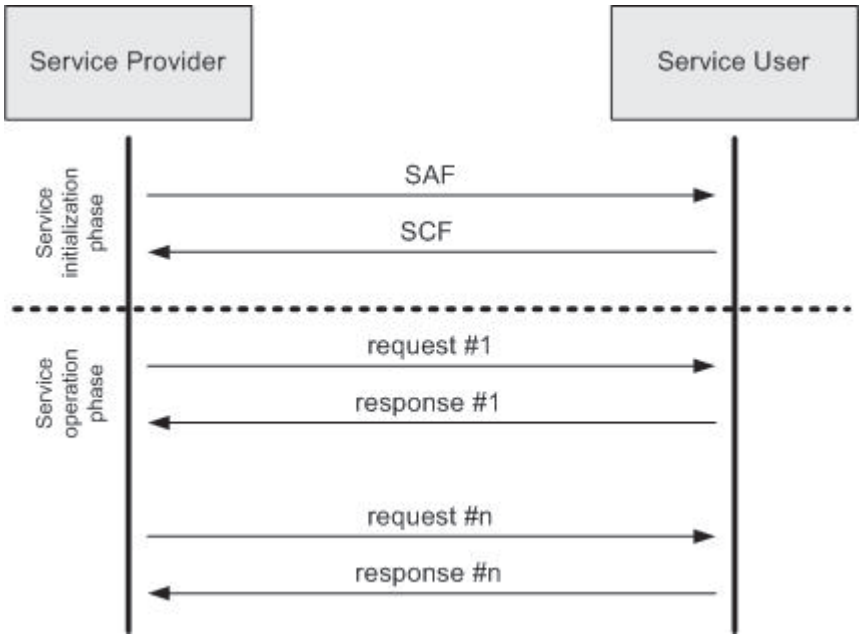

Figure 4 — Service provision with SCF

NOTE In case SCF is not present, request #1 will not be present. See the following Figure 5.

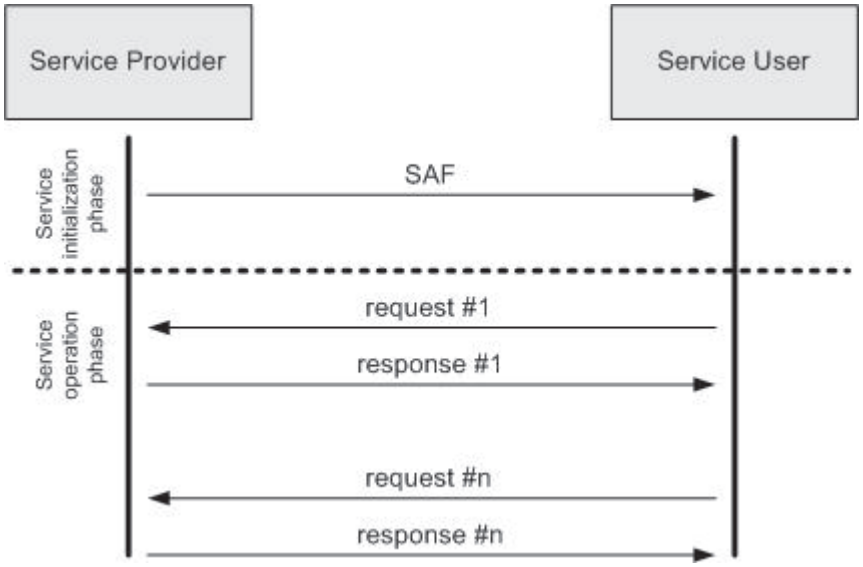

Figure 5 —Service provision without SCF

The frames presented in Figures 4 and 5 shall consist of a header and a body as presented in Figure 6. Such a header and body constitute the TPDU of the FAST networking protocol specified in ISO 29281. Details of the header and the body shall be as specified in Tables 11, 12, 13, 14, 16 and 17.

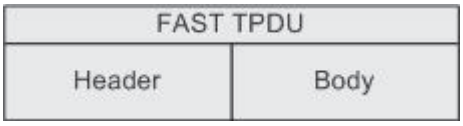

Figure 6 — FAST service TPDU

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9.2.2 Service advertisement frame

A "Service Advertisement Frame" (SAF) shall be sent on request of the groupcast manager in the router. The "Service Table for Advertisement" (STA) represents the body contained in the SAF and shall be as specified in Table 11.

Either the serviceList or the ipServList shall be present.

The channelList shall be present only if the element serviceChannel is present in either serviceList or ipServList.

The iPprefixInfo shall be present only if the element ipServList is present.

Table 11 — Service Table for Advertisement

Element	Type	Description
serviceList	SEQUENCE (SIZE (0..255)) OF SEQUENCE { serviceID INTEGER(0..127,...), serviceData OCTET STRING optional, serverNWref INTEGER(0..255) optional, serviceChannel INTEGER(0..255) optional } optional	serviceID: (registered) Unique SID serviceData: Syntax and semantics depends on service. serverNWref: NW header information for subsequent communication (pointer to location of local service for this service). serviceChannel: Optional medium specific information on the logical channel to be used for subsequent communication. Present only if a channel different to the advertisement channel is to be used. Points to entry in channelList. Value only unique at this ITS station.
channelList	SEQUENCE (SIZE (0..255)) OF SEQUENCE { serviceChannel INTEGER(0..255), medium MedType schParams OCTET STRING } optional	serviceChannel: Those used in serviceList. medium: Indicates type of CI. schParams: Medium specific parameters of the referenced serviceChannel including MAC address.
ipServList	SEQUENCE (SIZE (0..255)) OF SEQUENCE { serviceID INTEGER(0..127,...), serviceData OCTET STRING optional, ipInfo SEQUENCE OF IpAddressInfo, serviceChannel INTEGER(0..255) optional } optional	serviceID: (registered) Unique SID serviceData: Syntax and semantics depends on service. ipInfo: Parameters of the IPv6 protocol of the service provider to be used during the service operation phase. serviceChannel: Optional medium specific information on the logical channel to be used for subsequent communication.
ipPrefixInfo	SEQUENCE (SIZE (0..255)) OF IpPrefix optional	IpPrefix: Information on available IPv6 prefixes.

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