INTERNATIONAL STANDARD

ISO 24102-1

First edition
2013-07-01

Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management —

Part 1: Local management

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

Partie 1: Gestion locale

Reference number
ISO 24102-1:2013(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.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2. www.iso.org/directives

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. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received. www.iso.org/patents

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

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

ISO 24102 consists of the following parts, under the general title *Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management*:

— *Part 1: Local management*

— *Part 3: Service access points*

— *Part 4: ITS station-internal management communications*

— *Part 5: Fast service advertisement protocol (FSAP)*

The following parts are under preparation:

— *Part 2: Remote management*

— *Part 6: Path and flow management*

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 part of ISO 24102 is part 1 of a multipart International Standard which determines the intelligent transport systems (ITS) local station management.

The ITS station management entity 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 in line with the general ITS architecture specified in ISO 21217.

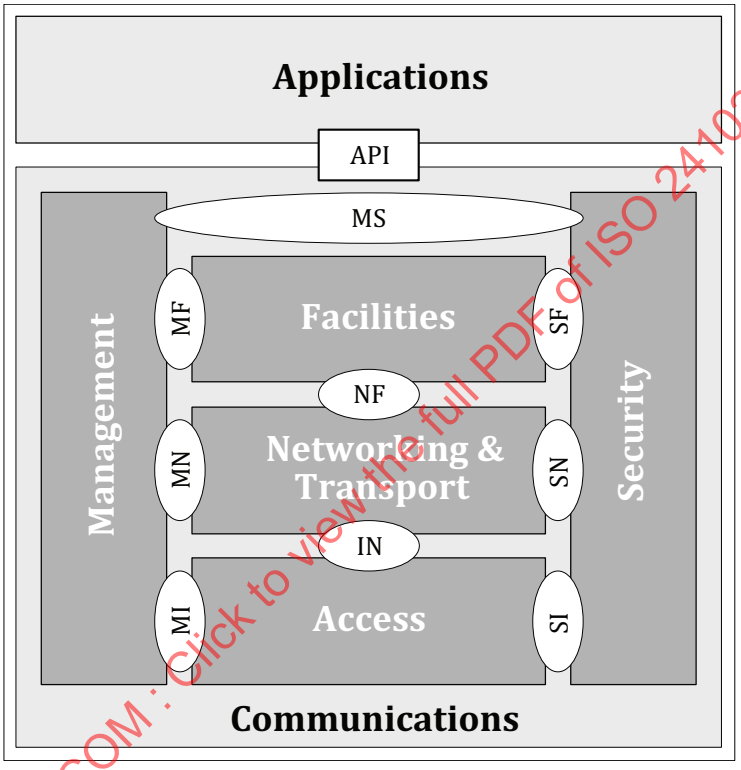

Figure 1 — ITS station reference architecture with named interfaces

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

Intelligent transport systems — Communications access for land mobiles (CALM) — ITS station management —

Part 1: Local management

1 Scope

This part of ISO 24102 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.

Local ITS station management protocols are specified by means of management 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 specified in ISO 21217.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. 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) — Part 2*

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

ISO 21218, *Intelligent transport systems — Communications access for land mobiles (CALM) — Access technology support*

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 102 797-1, *Intelligent Transport Systems (ITS); Road Transport and Traffic Telematics (RTTT); Test specifications for Intelligent Transport Systems, Communications access for land mobiles (CALM), ITS station management (ISO 24102); Part 1: Protocol Implementation Conformance Statement (PICS) proforma*

ETSI TS 102 797-2, *Intelligent Transport Systems (ITS); Road Transport and Traffic Telematics (RTTT); Test specifications for Intelligent Transport Systems, Communications access for land mobiles (CALM), ITS station management (ISO 24102); Part 2: Test Suite Structure and Test Purposes (TSS & TP)*

ETSI TS 102 797-3, *Intelligent Transport Systems (ITS); Road Transport and Traffic Telematics (RTTT); Test specifications for Intelligent Transport Systems, Communications access for land mobiles (CALM), ITS station management (ISO 24102); Part 3: Abstract Test Suite (ATS) and partial PIXIT information*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 21217, ISO 21218, ISO 24102-3, and the following apply.

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

3.3
ITS-S path
part of a communication path between a source node and an anchor node being uniquely identified by a LinkID (identifying a CI in the source node and the next hop node) and by the anchor node

4 Abbreviated terms

For the purposes of this document, the abbreviated terms given in ISO 21217, ISO 21218, ISO 24102-3, and the following apply.

ITS-SCU	ITS station communication unit
ITS-SSI	ITS station state information
LDM	local dynamic map
n.a.	not applicable
PDUs	protocol data units
QoS	quality of service
RI	regulatory information

5 Requirements

The ITS station management entity provides functionality specified in the various parts of this multipart International Standard:

1) The functionality of local ITS station management specified in this part of ISO 24102.

2) The functionality of remote ITS station management will be specified in ISO 24103-2.

3) The functionality of management service access points specified in ISO 24102-3.

4) The functionality of ITS station-internal management communications specified in ISO 24102-4.

5) The functionality of the “Fast Service Advertisement Protocol” (FSAP) specified in ISO 24103-5.

General management functionality shall be as specified in this part of ISO 24102.

Means to secure the access to management functionality need to be specified within the global context of CALM security. Details are outside the scope of this part of ISO 24102.

Detailed mandatory requirements are specified in the following clauses of this part of ISO 24102.

— Clause 6 specifies basic management procedures related to communication interfaces.

— Clause 7 describes congestion control.

— Clause 8 specifies neighbour lists and the link to the "Local Dynamic Map" (LDM) application.

— Clause 9 describes the concept of flow and path management.

— Clause 10 specifies management of "Legacy CIs".

— Clause 11 specifies management data elements.

— Clause 12 specifies conformance declaration.

— Clause 13 specifies test methods.

— Annexes provide further mandatory requirements.

6 CI basic management

6.1 General

Basic management procedures related to communication interfaces (CI) shall access a "(Virtual) Communication Interface" (CI/VCI) via the MI-SAP specified in ISO 24102-3.

Any change of status of a CI/VCI shall be reported to all ITS-SCUs with ITS-SCU-Mngmt-Request "VCI-update" specified in ISO 24102-4. Reception of such a notification shall not be acknowledged.

Management communications with CIs/VCIs in other ITS-SCUs shall be with ITS station-internal management communication PDUs "MI-rcmd", "MI-rreq", "MI-rget", and "MI-rset" specified in ISO 24102-4.

Although SAPs and the related service primitives specified in ISO 24102-3 cannot be tested and are not mandatory, in the context of this part of ISO 24102, the elements of the service primitives may be an integral part of PDUs exchanged between physical entities in an ITS station using "ITS station-internal management communications" specified in ISO 24102-4. As PDUs are testable, those elements of service primitives that are part of a PDU become testable.

6.2 CI status

6.2.1 CI state machine

Figure 2 shows the CI state machine specified in ISO 21218.

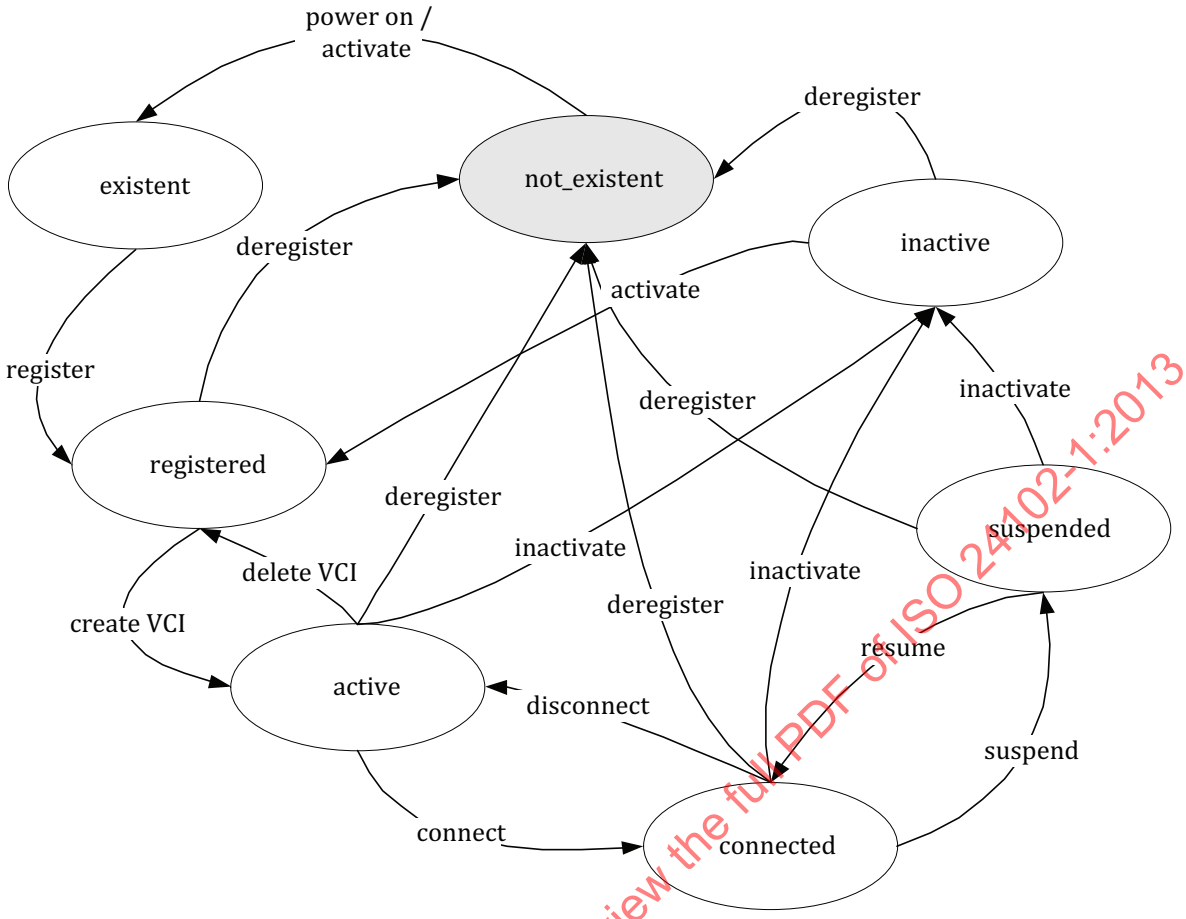

Figure 2 — CI state machine ISO 21218

6.2.2 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 Link-ID (see ISO 21218).

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

The medium identifier MedID, part of the Link-ID specified in ISO 21218, and assigned to a CI during the process of registration 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 1.

Table 1 — Entry in VCI list upon registration of CI

LocalCIID	Medium	CI Status	ConnectMode	RemoteCIID
Identifying the CI as specified in ISO 21218.	I-Parameter "MedType" as specified in ISO 21218.	I-Parameter CIstatus equal to "registered", see ISO 21218.	I-parameter "Connect".	Not applicable. Value identifying the CI as specified in ISO 21218.

6.2.3 VCI creation

Creation of a VCI may be done

— upon request of the ITS station management entity, 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 2, 3, and 4, as applicable, and

— shall create initial entries in the forwarding tables of all supported networking protocols using MN-COMMAND "FWTset" specified in ISO 24102-3, if applicable.

Table 2 — Entry in VCI list indicating an active CI

LocalCIID	Medium	CI Status	ConnectMode	RemoteCIID
Identifying the CI as specified in ISO 21218.	Set equal to I-parameter "Medium". See ISO 21218.	Set equal to I-Parameter CIstatus. See ISO 21218.	Set equal to I-parameter "Connect". See ISO 21218.	Not applicable. Value identifying the CI as specified in ISO 21218.

Table 3 — Entry in VCI List upon creation of a broadcast VCI

LocalCIID	Medium	CI Status	ConnectMode	RemoteCIID
As specified in ISO 21218.	Set equal to I-parameter "Medium". See ISO 21218.	Set equal to I-Parameter CIstatus. See ISO 21218.	Set equal to I-parameter "Connect". See ISO 21218.	As specified in ISO 21218.

Table 4 — Entry in VCI List upon creation of a multicast VCI

LocalCIID	Medium	CI Status	ConnectMode	RemoteCIID
As specified in ISO 21218.	Set equal to I-Parameter "Medium". See ISO 21218.	Set equal to I-Parameter CIstatus. See ISO 21218.	Set equal to I-parameter "Connect". See ISO 21218.	As specified in ISO 21218.

Upon request of an ITS-S networking and transport layer 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 I-parameters, the ITS station management entity shall create the VCI and perform all required settings. The state of the CI shall be set to "connected" (see Table 5). The ITS station management entity shall update the VCI list and the forwarding tables.

6.2.4 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 part of ISO 24102.

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, and

— shall delete all entries of this CI and the related VCIs in the forwarding tables using MN-COMMAND "FWTdelete" specified in ISO 24102-3, if applicable.

6.2.5 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 part of ISO 24102.

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, and

— shall 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 "FWTdelete" specified in ISO 24102-3, if applicable.

6.2.6 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 part of ISO 24102.

NOTE Requirements on events upon which a CI shall or may be activated are not specified in this part of ISO 24102.

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".

6.2.7 Suspension

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 part of ISO 24102.

NOTE Requirements when a CI shall or may be suspended are not specified in this part of ISO 24102.

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

— the CI state of this CI and the related VCIs in the forwarding tables to "suspended" using MN-COMMAND "FWTupdate" specified in ISO 24102-3, if applicable.

6.2.8 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 resumed are not specified in this part of ISO 24102.

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

— change the CI state of this CI and the related VCIs in the forwarding tables to “connected” using MN-COMMAND “FWTupdate” specified in ISO 24102-3, if applicable.

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

6.2.9 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 part of ISO 24102.

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 5, and

— change the CI state of this VCI in the forwarding tables to “connected”, using MN-COMMAND “FWTupdate” specified in ISO 24102-3.

Table 5 — Entry in VCI list upon successful connection of a unicast VCI

LocalCIID	Medium	CI Status	ConnectMode	RemoteCIID
As specified in ISO 21218.	Set equal to I-parameter “Medium”. See ISO 21218.	Set equal to I-Parameter CIstatus. See ISO 21218.	Set equal to I-parameter “Connect”. See ISO 21218.	Value identifying the peer station as specified in ISO 21218.

NOTE Access technologies may either be uniquely identified in the OSI MAC layer by means of a 48-bit MAC address, or by other means. As specified in ISO 21218, RemoteCIID contains this information.

6.2.10 Disconnection

Disconnection of a VCI is the process to close relations to a peer station. 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 part of ISO 24102.

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

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

— change the CI state of this VCI in the forwarding tables to “active”, using MN-COMMAND “FWTupdate” specified in ISO 24102-3, if applicable.

6.2.11 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 part of ISO 24102.

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 “FWTdelete” specified in ISO 24102-3, if applicable.

6.3 Cross-CI prioritization

6.3.1 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 [2] and [3] which cannot 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.

6.3.2 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 “PrioReg” specified in ISO 24102-3, the ITS station management entity shall

— create the header of the prioritization table for this CI (see Table 10) containing the Link-ID.LocalCIID 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 LocalCIID of all possible interferers in the ITS station, and

— create an entry in the prioritization table for each identified interferer with the interferer LocalCIID and with “Status Interferer” set to “released”.

6.3.3 Prioritization request

As specified in ISO 21218, a CI may request cross-CI prioritization by means of the MI-REQUEST “RTSreq” specified in ISO 24102-3.

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 “MinPrioCrossCI” specified in ISO 21218. 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”, specified in ISO 24102-3, with priority set equal to parameter “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 table 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 “RTScmd” specified in ISO 24102-3, and shall update the status interferer entries in Table 10 to the value “requested”, and

— 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 10, or

  — the CI requesting prioritization released prioritization by means of MI-REQUEST “RTSreq” specified in ISO 24102-3 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 “RTSackCmd” specified in ISO 24102-3 with “priority” set equal to parameter “MinPrioCrossCI” specified in ISO 21218 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 10 to “prioritization granted”, and

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

The ITS station management entity shall apply “ITS station-internal management communications” specified in ISO 24102-4 in case other ITS-SCUs need to be addressed.

6.3.4 Prioritization release

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

— send the prioritization release MI-COMMAND “RTScmd” specified in ISO 24102-3 with status = “release” to all known potential interferers, and shall update Table 10 for this request, and

— stop the timer T_prioritization, if applicable.

The ITS station management entity shall apply “ITS station-internal management communications” specified in ISO 24102-4 in case other ITS-SCUs need to be addressed.

6.4 VCI I-Parameters

6.4.1 General

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

NOTE The default settings of the access technologies are specified in the media standards.

6.4.2 Setting of parameter values

Setting of I-Parameter values shall be done as specified in ISO 21218.

I-Parameter settings of a VCI may be changed

— by the ITS station management entity according to rules specified in this part of ISO 24102, or

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

I-Parameter 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 21218 and in [9]. This shall not affect VCI I-Parameter-settings.

6.4.3 Retrieval of parameter values

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

Retrieval of I-Parameter values may be done by the ITS station management entity according to rules specified in this part of ISO 24102.

6.4.4 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 6;

— those requested by the ITS station management entity by means of the MI-COMMAND “Monitor” specified in ISO 24102-3.

Table 6 shows those I-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).

A specific access technology may not support all parameters listed in Table 6. Consequently, non-supported parameters will never change value, thus a notification will never happen.

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

6.4.5 Access to other ITS-SCUs

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

— read only access;

— manufacturer access.

Access to I-Parameters of another ITS-SCU shall be achieved by means of the ITS station-internal management communication PDUs “MI-rget” and “MI-rset” specified in ISO 24102-4.

Table 6 — List of CI parameters subject to mandatory notification

I-Parameter Name	Behaviour
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.
MACaddrTemp	Upon notification of change of own MAC address, the ITS station management entity shall send “ITS-SSI Data” in a broadcast frame.
CIstatus	
The following parameters are contained in the VCI performance parameter list presented in Table 9.	
ChannelType	Upon notification of change of a performance parameter, the CI selection manager shall recalculate the mapping of ITS-S applications on CIs.
ChannelNo	
DataRateNW	
DataRatesNW	
Directivity	
MinimumUserPriority	
CommRangeRef	
Cost	
Reliability	
All parameters are subject to regulation, e.g. frequencies of operation, maximum transmit power.	

6.5 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.

6.6 Manufacturer access

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

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

7 Congestion control

In some radio communication systems, congestion control is managed only at the MAC sub-layer. For many envisaged ITS applications, this approach is not sufficient. Thus, congestion control needs to be extended to involve other layers of the OSI protocol stack including the ITS-S management, taking into consideration all available information on potential traffic in all communication channels.

Congestion control is a set of functions implemented in one or more ITS stations that is used to address congestion in the various ITS communication links. Congestion control is decentralized in the sense

that ITS stations exchange as little information as possible in the ITS communication links and control decisions are preferably taken locally inside each ITS station.

Figure 3 shows the basic architecture of congestion control.

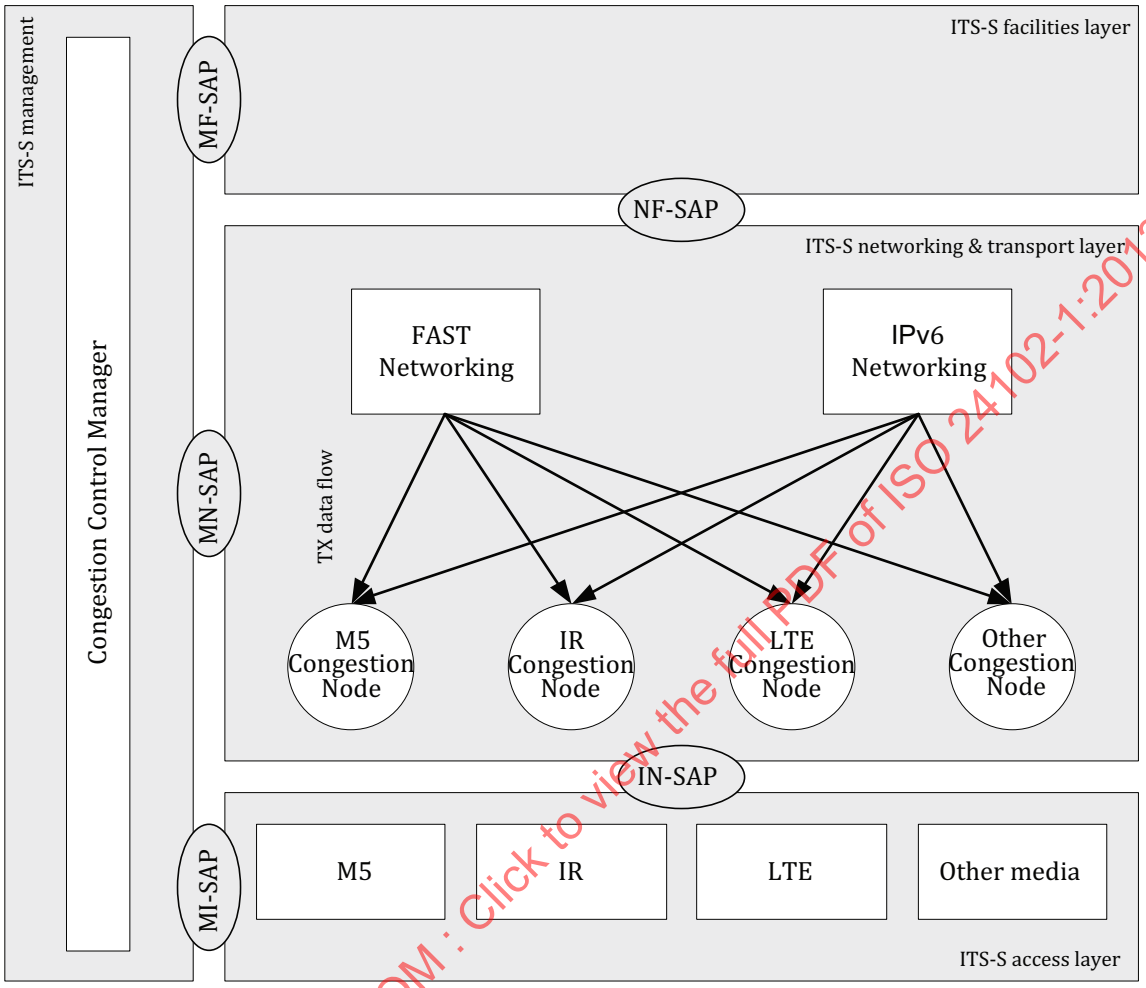

Figure 3 — Congestion control architecture

There are internal congestion nodes in the transmit path of each CI, e.g. M5 and IR ad hoc access technologies, and LTE cellular network technology, and others presented in Figure 3. External congestion nodes are the physically available channels.

NOTE Congestion in the receive path of a CI is not considered in this part of ISO 24102.

A wireless medium shared by all neighbouring ITS stations constitutes the essential congestion node. Thus, congestion control shall take care of the actual communication channel load observed at the external congestion node and at the internal congestion node.

Whereas the external congestion load cannot be influenced directly, the internal congestion load can be adjusted. This adjustment also has impact on the external congestion load.

Congestion control management may be based on

a) QoS management based on user priority as specified in ISO 21218,

b) I-Parameters accessible via MI-SAP as specified in ISO 24102-3,

c) CIP management via IN-SAP on a packet per packet basis as specified in [9],

d) networking information accessible via MN-SAP, e.g. contained in the neighbour list,

e) application information accessible via MF-SAP, e.g. provided at time of registration at the ITS station management entity for the purpose of CI selection, as specified in [5].

The part of the congestion control algorithm running autonomously in a station is a pure performance matter and may be subject to continuous improvements.

ETSI TC ITS is working on standards for congestion control algorithms with a focus on the M5 ad hoc access technology. A congestion control algorithm allocated in the access layer is specified in [8].

8 Neighbour list

The ITS station management entity may maintain a neighbour list, i.e. a list of all known neighbouring stations. This list shall contain

— "ITS-SSI Data" information specified in this part of ISO 24102, received via MN-SAP with MN-REQUEST Its-ssiPeerNot specified in ISO 24102-3, and

— forwarding table information of networking protocols received via MN-SAP with MN-REQUESTS "FWTsetNot", "FWTupdateNot", and FWTdeleteNot specified in ISO 24102-3.

The neighbour list information shall be made available to the LDM application via the MF-SAP using MF-COMMAND "LDMnotify" specified in ISO 24102-3, if applicable.

NOTE 1 The LDM application is considered to be a facilities layer service made available to the ITS station and the ITS-S applications. ETSI TC ITS, ISO TC204 WG18, and CEN TC278 WG16 are developing standards on LDM.

NOTE 2 An early LDM implementation was already developed and validated in the CVIS project[1] of the European Union.

The neighbour list process shall not send updates to the LDM application prior to registration of the LDM application at the neighbour list. Registration of the LDM application is made by means of the MF-SAP request MF-REQUEST "LDMregister" specified in ISO 24102-3. This request shall be acknowledged.

NOTE 3 ITS-SSI data are exchanged between ITS stations using e.g. the "Cooperative Awareness Message" (CAM) specified in [7].

9 Paths and flows

The general concept of paths and flows in ITS communications is based on similar concepts in IPv6 networking. This concept of paths and flows is essential in describing the abstraction of ITS-S applications from the communications services available in an ITS station (see ISO 21217). This clause provides definitions for path and flow in the context of the ITS station reference architecture specified in ISO 21217. Identification of paths and flows is unique within an ITS station.

A communication path is defined as a sequence of nodes connected by links, starting at a source node and ending at one or more destination nodes. All communication paths have at least one fixed node between the source and the destination node that is referred to as an anchor node. The anchor node divides the communication path into two parts, one part from the source node to the anchor node and the second from the anchor node to the destination node. The anchor node and the destination node may be one and the same node. The part of the communication path between the source node and the anchor node is referred to as an "ITS-S Path". An "ITS-S Path" is uniquely identified by a LinkID (identifying a CI in the source node and the next hop node) and by the anchor node. The next hop node and the anchor node may be one and the same node.

A flow type is a set of communication requirements/characteristics associated with a specific flow.

NOTE Categories of communication requirements/characteristics include QoS, security, priority, and communication type (unicast, broadcast, multicast, bicast, anycast, geocast).

A flow is an identifiable sequence of packets of a given flow type to be transmitted to one or more entities. Each flow is identified by a FlowID which is unique in an ITS station and is mapped to a given path or a set of available paths.

Procedures for ascertaining available ITS-S paths and for mapping flows to those paths are divided into distinct functions within the ITS-S management.

— Path management is a process for obtaining information about the anchor nodes, next hop nodes, and available CIs. This process results in a local list of currently available paths and potentially available paths to be used in the future. The ITS-S management entity exchanges path management information with various communication protocol layers using well-defined service primitives, e.g. MN-Request.STAGeoNot, MN-Request.STATopoNot, MN-Request.STAServNot, MN-Request.PathNot, MN-Request.PathMetricNot, MN-Commmand.PathMNGT, and MN-Commmand.STAServDiscov.

— Flow management is a process of keeping track of the requirements of all flows and collecting flow statistics. The ITS-S management entity exchanges flow management information with various communication protocol layers using well-defined service primitives, e.g. MF-Request.ITS-S-Appl-RegMN-Request.FlowStat, MN-Command.FlowFeedback.

— Path selection is a process of determining the most appropriate path(s) from available paths for a given flow or set of flows of the same characteristics. The ITS-S management entity commands the decisions using well-defined service primitives, e.g. MN-Command.FlowClassificationRule and MN-Command.FlowPolicy.

Figure 4 illustrates the building blocks and data flows in the ITS station management entity involved in the path selection process.

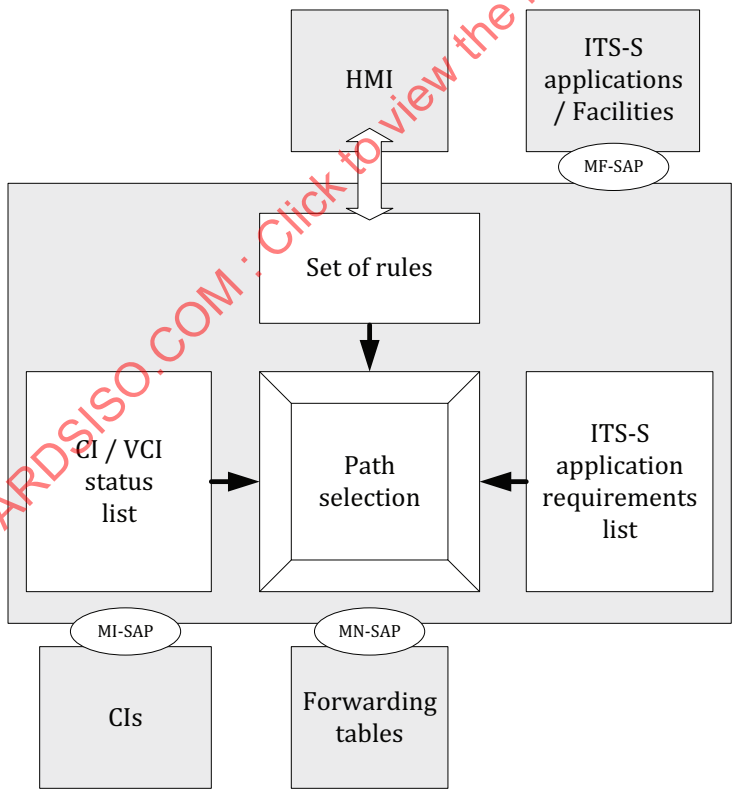

Figure 4 — Path selection

The CI/VCI status list, i.e. as a minimum the VCI list presented in Table 8, extended by the VCI property list presented in Table 9, contains properties, statuses, and performance parameters of all CIs and virtual communication interfaces (VCI) in an ITS station. The CI/VCI status list is frequently updated

via MI-SAP. An ITS-S router may advertise its properties to all ITS-S hosts, or an ITS-S host may perform a scan of all CIs attached to the local network.

Requirements obtained via MF-SAP using MF-REQUEST "ITS-S-Appl-Reg" specified in ISO 24102-3 is stored in an ITS-S application requirements list.

For the purpose of the preceding list of management procedures, other tables not illustrated in Figure 4 are maintained:

— Local ITS station information table

  Records the status of the local ITS station.

— Neighbour ITS station information table

  Maintains the status of the other ITS stations that are involved in the path determination. This table will thus not record information about all ITS stations in the neighbourhood of the ITS station.

— Path information table

  Records various information about all existing or possible paths.

— Flow requirement table

  Records performance requirements to be applied to each application flow.

— Flow information table

  Contains networking parameters used to identify each flow.

— Flow statistics table

  Contains various statistics about each flow and how flows are classified and routed.

— Flow policy table

  Contains policies generated by the ITS station management entity. Allows to link flows to paths.

Further details will be specified in a new work item at ISO. The proper reference will be provided in a future version of this part of ISO 24102.

10 Legacy CI

10.1 Registration

Upon successful activation of a "Legacy CI" at the ITS station management entity as specified in ISO 21218, the CI management shall retrieve the I-parameter "LegacyOption" specified in ISO 21218. The CI management shall notify presence of a "Legacy CI" to the "Legacy CI Port Manager" with MF-COMMAND "LegacyCI" specified in ISO 24102-3 indicating the Link-ID of the CI, the CI class, and the type within this CI class as given in "LegacyOption".

— Upon successful confirmation of the MF-COMMAND "LegacyCI", which shall provide the ServicePort information of the "FAST networking and transport layer protocol" (FNTP) pointing to the "Legacy CI Port Manager", the CI management shall set the I-parameter "NWrefPM" in the "Legacy CI" to the value received in the MF-COMMAND.confirmation service primitive. The ITS station management entity shall create the required entries in the FNTP networking tables with "Link Port" of the remote application set to PORT_NON illustrated in [9] in order to enable communications between the "Legacy CI" and the "Legacy CI Port Manager" using MN-COMMAND "FWTset" specified in ISO 24102-3.

— Upon unsuccessful confirmation of the MF-COMMAND "LegacyCI", indicated by "ErrStatus" = 1 and "Service Port" = {PORT_NON, PORT_NON} in the MF-COMMAND.confirmation service primitive, the CI management shall set the I-parameter "NWrefPM" in the "Legacy CI" to the value PORT_NON,

indicating failure of registration. Subsequently, the "Legacy CI" shall enter the CI state "registered" specified in ISO 21218. Dependent on the implementation, the "Legacy CI" then may try again to get a NWrefPM number by creating a new VCI and entering again the CI state "active".

NOTE The specification above so far assumes that the legacy service entity registers at the Legacy CI Port Manager before the Legacy CI becomes active. However, the procedure has to be successful also in case the Legacy CI becomes active before the legacy service entity registers. Formally, this can be achieved by a procedure triggered by the legacy service entity.

The procedure may require "ITS station-internal management communication" as specified in ISO 24102-4.

10.2 CI states

Possible states of a CI are specified in ISO 21218.

All state changes shall be notified to the "Legacy CI Port Manager" with MF-COMMAND "StateCInotify" specified in ISO 24102-3.

11 Management data elements

11.1 ITS-SCU list

The ITS station management entity shall maintain information on all ITS-SCUs of its station with details as shown in Table 7. The ITS-SCU list shall be represented in parameter "ITS-scuList" specified in Annex B.

Table 7 — Local ITS-SCU-list

ITS-SCU-ID	ITS-SCU type	Time of last update of this information	Unique-ID
Unique identifier of an ITS-SCU of the same ITS station.	"ITS-S Host", "ITS-S Router", or "ITS-S Host and ITS-S Router".	Usage may depend on implementation.	Text string to be defined by manufacturer of ITS-SCU, indicating type and serial number of hardware, and version of firmware/software.

11.2 VCI list

The ITS station management entity shall maintain information on the status of media with a minimum of details as shown in Table 8. The VCI list shall be represented in parameter "VciList" specified in Annex B.

Table 8 — VCI List (medium status list)

LocalCIID	Medium	CI Status	Connect Mode	RemoteCIID
Unique reference number of the CI/VCI. See ISO 21218.	Set equal to I-Parameter "Medium". See ISO 21218.	Set equal to I-Parameter CIstatus. See ISO 21218.	Equal to I-Parameter "Connect". See ISO 21218.	Pointing to the peer station identified by I-Parameter "Peer-MAC". See ISO 21218.

There shall be one entry in the VCI list for every CI/VCI being existent in the whole ITS station, i.e. having a CI state different to "not_existent" (see ISO 21218).

11.3 VCI performance parameter list

The ITS station management entity shall maintain information on the actual values of performance parameters of VCIs. There shall be a list as presented in Table 9 for every active VCI and every active CI, identified by the LINK-ID. The lists shall contain the actual values of at least the following I-Parameters

specified in ISO 21218. The VCI performance parameter list shall be represented in parameter "VCIperformList" specified in Annex B.

Table 9 — VCI performance parameter list

I-Parameter	Comment
Link-ID	Link-ID of VCI.
ChannelType	Indicates whether a VCI acts as a CCH, SCH, or ACH.
DataRateNW	Estimate of average data rate available at the IF-SAP in 100 bit/s. Alternatively, this value could be estimated in the network layer.
DataRatesNW	Minimum and maximum possible values of DataRateNW.
Directivity	Indicates the direction of communication possible due to the given antenna pattern. Preferably, only pre-defined directivities are used.
MinimumUserPriority	Minimum value of user priority needed to use the VCI.
CommRangeRef	Estimate of the communication distance to a reference peer station in 1/10 m.
Cost	Information on cost of the link-usage in terms of money.
Reliability	Percentage value indicating estimate of reliability.

NOTE 1 Further parameters to allow the ITS station management to decide on an optimum path may be as specified in [10]. Values of these parameters may be estimated and provided by the ITS-S networking and transport layer via the MN-SAP.

NOTE 2 In a real implementation, vendor-specific parameters can be added to this list.

11.4 Cross-CI prioritization list

If cross-CI prioritization is supported by the ITS station management entity, the ITS station management entity in an ITS-SCU shall maintain information on a cross-CI prioritization list for every requesting CI of the same ITS-SCU and for every related request with details as specified in Table 10. The cross-CI prioritization list shall be presented in parameter "CrossCiPrioList", specified in Annex B.

Table 10 — Cross-CI prioritization table

LINK-ID.LocalCIID	Timeout		
LocalCIID specified in ISO 21218 of CI requesting cross-CI prioritization.	Maximum prioritization time in milliseconds. Used in interferer to set T_Dummy-AckGrant. The value is given by PrioReg.timeout of the related CI (see ISO 21218).		
Request number	**Priority**	**Status**	**Timer**
Reference number of this request. MI-REQUEST RTSreq. seqNo	User priority of packet to be prioritized. Provided in MI-REQUEST RTSreq. priority. See ISO 21218	TX status of CI requesting cross-CI prioritization. 0: release. Provided in MI-REQUEST RTSreq.status. 16: request. Provided in MI-REQUEST RTSreq.status. 64: ignored. Provided in MI-REQUEST RTSackReq. 128: granted. Provided in MI-REQUEST RTSackReq. See ISO 21218.	T_prioritization
Interferer ID	**Status interferer**		
Unique reference number of interferer #1 (Local-CIID). Derived from MedTyp as provided in PrioReg.interferers, see ISO 21218 by checking the VCI list.	0: released. Set upon transmission of MI-COMMAND RTSemd with status="release" to this interferer. 16: prioritization request sent. Set upon transmission of MI-COMMAND RTSreq with status="request" to this interferer. 64: request ignored. Set upon reception of acknowledgement from this interferer with MI-REQUEST RTSackReq.status = "ignored". 128: prioritization granted. Set upon reception of acknowledgement from this interferer with MI-REQUEST RTSackReq.status = "granted".		
Unique reference number of interferer #2.			
…			
Request number	**Priority**	**Status**	**Timer**
… further request			
Interferer LocalCIID	**Status Interferer**		
…			

11.5 Application requirements list

The ITS station management entity shall maintain information as shown in Table 11 for every application being registered at the CI selection manager. The application requirements list shall be represented in parameter "ApplReqList" specified in Annex B.

Table 11 — ITS-S application requirements list

Application ID	Unique identifier of an ITS-S application/service in an ITS station. See ASN.1 parameter ApplicationID.
Data rate	Minimum average data rate requested at the IF-SAP in 100 bit/s. Corresponds with I-Parameter DataRateNW in Table 9.
Cost	Maximum acceptable cost of the link-usage in terms of money. Corresponds with I-Parameter Cost in Table 9.
Network support	Network protocols needed. Corresponds with I-Parameter NWsupport specified in ISO 21218.
Medium support	Types of CIs. Corresponds with I-Parameter MedType specified in ISO 21218.

Further ITS-S application requirements parameters are specified as optional parameters, e.g. in [10], in order to allow the CI selection manager to decide on an optimum CI.

NOTE In a real implementation, further parameters can be added to this list.

12 Conformance

The "Protocol Implementation Conformance Statements" (PICS) proforma specified in ETSI TS 102 797-1 shall be used to declare elements of an implementation conforming to this part of ISO 24102.

13 Test methods

The "Test Suite Structure & Test Purposes" (TSS&TP) for conformance testing are specified in ETSI TS 102 797-2.

The "Abstract Test Suite" (ATS) for conformance testing is specified in ETSI TS 102 797-3.

Annex A
(normative)

ASN.1 modules

A.1 Overview

The following ASN.1 module is specified in this annex:

— CALMmanagement { ISO (1) standard (0) calm-management (24102) local (1) version1 (1)}.

A.2 Module CALMmanagement

This module specifies ASN.1 type definitions together with useful ASN.1 value definitions.

Unaligned packed encoding rules (PER) as specified in ISO/IEC 8825-2 shall be applied for this ASN.1 module.

```
CALMmanagement { iso (1) standard (0) calm-management (24102) local (1) version1 (1)}

DEFINITIONS AUTOMATIC TAGS::=BEGIN

IMPORTS

CIstatus, Connect, DataRate, DataRatesNW, Directivity, KineVectOut, Link-ID, MACaddress,
MedType, UserPriority FROM CALMllsap {iso(1) standard(0) calm-ll-sap(21218) version1(1)}

ITS-SCUtype FROM CALMiitsscu {iso (1) standard (0) calm-management (24102) iitsscu (4)
version1 (1)}

MediumCost FROM CITSapplReq {iso(1) standard(0) cits-applReq (17423) version1 (1)}

LogicalChannelType FROM CITSapplMgmtComm {iso(1) standard(0) cits-applMgmt (17419) comm
(3) version1 (1)}
;

-- End of IMPORTS

-- Types

ApplReqList::=SEQUENCE{
     applicationID ApplicationID,
     requirements  ApplRequirements
     }

ApplicationID::=SEQUENCE{
     hostITS-scuId   ITS-scuId,
     seqNumber       INTEGER(0..65535) -- unique in the ITS-SCU (host)
     }

ApplRequirements::=SEQUENCE{
     dataRate      DataRate,
     cost          MediumCost,
     medSupport    SEQUENCE OF MedType, -- zero: any wireless
     ...
     }

CrCiPrioList::=SEQUENCE (SIZE(0..255)) OF CrCiPrioReq

CrCiPrioReq::=SEQUENCE{
     linkId        Link-ID,   -- requesting CI
     timeout       INTEGER(0..255),
     request       CCPrequest,
```

```
     interferer    SEQUENCE OF CCPpotInt -- potential interferers
     }

CCPrequest::=SEQUENCE (SIZE(0..255)) OF SEQUENCE
     {
     reqNo         INTEGER(0..255),
     priority      UserPriority,
     status        CCPstatus
     }

CCPpotInt::=SEQUENCE{
     linkId        Link-ID,   -- interferer
     status        CCPstatus
     }

CCPstatus::=INTEGER{
     released (0),
     requestd (16),
     ignored (64),
     granted (128)
     }

ITS-scuId::=INTEGER(0..65535)

ITS-scuList::=SEQUENCE{
     iTS-scuId     ITS-scuId,
     its-scuType   ITS-SCUtype,
     time          GeneralizedTime,
     uniqueID      PrintableString
     }

ITS-SSI::=SEQUENCE{
     stationType        StationType,
     stationID          StationID,
     stationPosition    KineVectOut
     }

Param24102::=SEQUENCE{
     fill           BIT STRING (SIZE(4)),
     params         CHOICE{
          stationID          [0] StationID,
          minPrioCrossCI     [1] UserPriority,
          stationPosition    [2] KineVectOut,
          iTS-scuId          [3] ITS-scuId,
          vciList            [4]VciList,
          crCiPrioList       [5] CrCiPrioList,
          timerITS-SSI       [6] INTEGER(0..65535),
          its-ssi            [7] ITS-SSI,
          applReqList        [8] ApplReqList,
          vCIperformList     [9] VCIperformList,
          talive             [10] Talive,
          iTS-scuList        [11] ITS-scuList
          }
     }

Param24102No::=INTEGER{
     stationID          (0),
     minPrioCrossCI     (1),
     stationPosition    (2),
     iTS-scuId          (3),
     vciList            (4),
     crCiPrioList       (5),
     timerITS-SSI       (6),
     its-ssi            (7),
     applReqList        (8),
     vCIperformList     (9),
     talive             (10),
     iTS-scuList        (11)
     } (0..255)

Talive::=INTEGER(0..65535) -- time in ms
```

```
VciList::=SEQUENCE (SIZE(0..255)) OF VciListEntry

VciListEntry::=SEQUENCE{
     linkId         Link-ID,
     medType        MedType,
     status         CIstatus,
     connect        Connect,
     macAddress     MACaddress
     }

VCIperformList::=SEQUENCE (SIZE(0..255)) OF VCIperformance

VCIperformance::=SEQUENCE{
     linkId         Link-ID
     channelType    LogicalChannelType,
     channelNo      INTEGER(0..255),
     minUserPrio    UserPriority,
     dataRateNW     DataRate,
     dataRatesNW    DataRatesNW,
     directivity    Directivity,
     commRangeRef   INTEGER(0..65535),    -- in 1/10 m
     cost           MediumCost,
     reliability    INTEGER(0..255)
     }

StationID::=OCTET STRING (SIZE(4))

StationType::= INTEGER{
     mobile         (0),
     fixed          (1),
     infrastructure(254),
     unknown        (255)
     } (0..255)


/*
   The ASN.1 specification has been checked for conformance to the ASN.1
   standards by OSS ASN.1 Syntax Checker, and by OSS ASN-1STEP
*/
END
```