TECHNICAL SPECIFICATION

ISO/TS 17423

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Intelligent transport systems — Cooperative systems — ITS application requirements and objectives for selection of communication profiles

Systèmes intelligents de transport — Systèmes coopératifs — Exigences d'application d'ITS pour sélection d'interfaces de communication

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Contents

Page

Foreword

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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

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For an explanation on the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the WTO principles in the Technical Barriers to Trade (TBT) see the following URL: Foreword - Supplementary information

ISO/TS 17423 was prepared by the European Committee for Standardization (CEN) Technical Committee CEN/TC 278, *Intelligent transport systems*, in collaboration with ISO Technical Committee ISO/TC 204, *Intelligent transport systems*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Introduction

Abstracting applications from communications is a useful basic architectural principle of Intelligent Transport Systems [1)] (ITS) embodied in the ITS station and communication architecture presented in ISO 21217.

Applications and communications are linked together using the concepts of flows and paths and communication profiles described in ISO 21217 with related flow and path management procedures specified in Reference [6]. The ITS station management uses communication requirements and objectives of applications together with the capabilities of the ITS station (status of available communication protocol stacks) and sets of decision rules (regulations and policies) to select suitable parameterized ITS-S communication protocol stacks, also referred to as "ITS-S Communication Profiles" (ITS-SCP), for each source of a potential flow as illustrated in Figure 1. A set of communication requirements is referred to as a Flow Type in Reference [6]. There may be well-known registered Flow Types as specified in ISO/TS 17419.

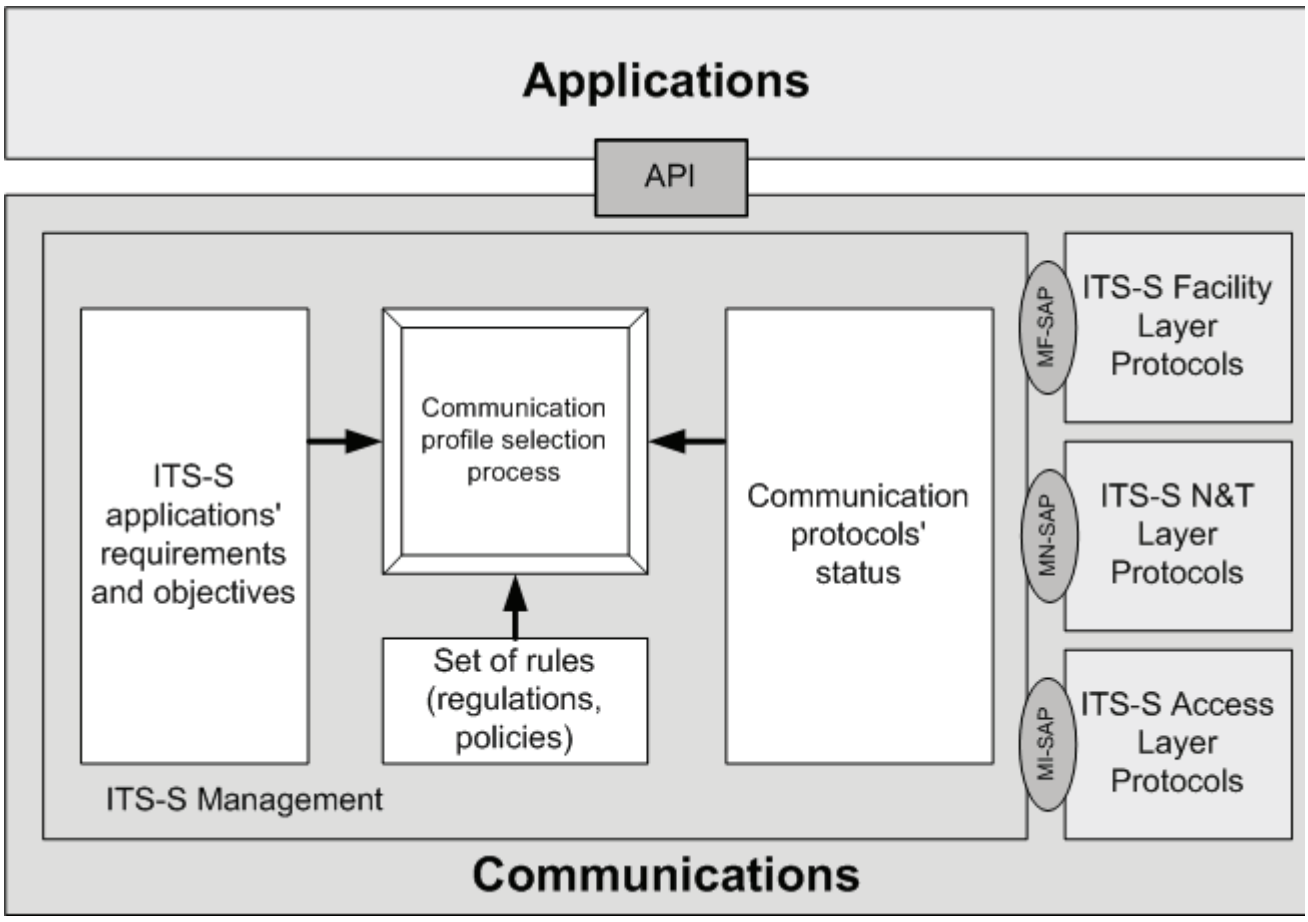

Figure 1 — ITS-S communication profile selection process

An ITS-S communication profile is independent of any destination address. However an instantiation of a communication profile includes the address of the next hop recipient, and a path includes address information of the next hop recipient, the anchor and the destination as specified in Reference [6].

A user of an ITS station unit may be able to influence the selection of ITS-S communication profiles by providing his own policies.

1) The term "Cooperative ITS" (C-ITS) indicates specific features of ITS[1]. For the purpose of this Technical Specification, no distinction between ITS and C-ITS is needed.

Information from a Local Dynamic Map (LDM) on neighbouring stations offering certain communication capabilities may also be useful for the ITS-S communication profile selection process, although not indispensable.

Intelligent transport systems — Cooperative systems — ITS application requirements and objectives for selection of communication profiles

1 Scope

This Technical Specification

— specifies communication service parameters presented by ITS station (ITS-S) application processes to the ITS-S management in support of automatic selection of ITS-S communication profiles in an ITS station unit (ITS-SU),

— specifies related procedures for the static and dynamic ITS-S communication profile selection processes at a high functional level,

— provides an illustration of objectives used to estimate an optimum ITS-S communication profile.

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 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/TS 17419, *Intelligent transport systems — Cooperative systems — Classification and management of ITS applications in a global context*

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

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

ISO 4217:2008, *Codes for the representation of currencies and funds*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/TS 17419, ISO 21217, ISO 21218 and the following apply.

3.1
authorization
prescription that a particular behaviour shall not be prevented

Note 1 to entry: Unlike a permission, an authorization is an empowerment.

3.2
ITS-S application process
element in an ITS station that performs information processing for a particular application, and uses ITS-S services to transmit and receive information

EXAMPLE ITS-S applications, ITS-S facility applications (e.g. for CAM), ITS-S management applications (e.g. FSAP[5]).

3.3
ITS application
instantiation of an ITS service that involves an association of two or more complementary *ITS-S application processes* (3.2)

3.4
ITS service
functionality provided to users of intelligent transport systems designed e.g. to increase safety, sustainability, efficiency, or comfort

3.5
ITS-S application
ITS-S application process (3.2) residing in the *ITS-S application* (3.3) entity

3.6
ITS-S application process provisioner
functionality in an ITS-SU offering *ITS-S application processes* (3.2) for download to other ITS-SUs

3.7
ITS-S communication profile
parameterized ITS-S communication protocol stack

3.8
ITS-S communication protocol stack
set of ITS-S communication protocols, which may be identified by a registered globally unique reference number, enabling communications between an ITS-SCU and other nodes

3.9
ITS-S RX/TX interface
sink or source of an *ITS-S application process* (3.2)

3.10
permission
rule that a particular behaviour is allowed to occur

4 Abbreviated terms

BSME	Bounded Secured Managed Entity, see ISO 21217
CPSP	Communication Profile Selection Process
CRO	Communication Requirements and Objectives
CSP	Communication Service Parameter
CSP_AvgADUrate	Communication service parameter “Average ADU generation rate”
CSP_CommDistance	Communication service parameter “Communication distance”
CSP_DataConfidentiality	Communication service parameter “Need for data confidentiality”
CSP_DataIntegrity	Communication service parameter “Need for data integrity”

CSP_DestinationDomain	Communication service parameter “Destination domain”
CSP_DestinationType	Communication service parameter “Destination type”
CSP_Directivity	Communication service parameter “Directivity”
CSP_ExpFlowLifetime	Communication service parameter “Expected flow lifetime”
CSP_FlowType	Communication service parameter “Flow type”
CSP_LogicalChannelType	Communication service parameter “Logical channel”
CSP_MaxADU	Communication service parameter “Maximum ADU size”
CSP_MaxLat	Communication service parameter “Maximum allowed latency”
CSP_MaxPrio	Communication service parameter “Maximum priority”
CSP_MinThP	Communication service parameter “Minimum throughput”
CSP_NonRepudiation	Communication service parameter “Need for non-repudiation”
CSP_NxRepeat	Communication service parameter “N-times ADU repetition”
CSP_PortNo	Communication service parameter “Port Number”
CSP_Protocol	Communication service parameter “Protocol requirements”
CSP_Resilience	Communication service parameter “Resilience”
CSP_SessionCont	Communication service parameter “Session continuity”
CSP_SourceAuthentication	Communication service parameter “Source authentication”
FlowID	Flow Identifier[6]
IICP	ITS station-internal management communications protocol[4]
ITS-S	ITS station, see ISO 21217
ITS-SCP	ITS station communication profile
ITS-SCPS	ITS station communication protocol stack
ITS-SCU	ITS station communication unit, see ISO 21217
ITS-SU	ITS station unit, see ISO 21217
R_ConnectRate	“Maximum rate per connection” rule
R_ConnectTimeRate	“Maximum rate per connection time” rule
R_DataUnitRate	“Maximum rate per data unit” rule
R_FlatRate	“Flat Rate” rule
R_StationAnonymity	“Need for station anonymity” rule
R_StationAuthentication	“Support of station authentication” rule
R_StationLocationPrivacy	“Need for station location privacy” rule

5 Communication service parameters

5.1 Abstraction of application processes from communications

The ITS station (ITS-S) reference architecture presented in Figure 2 and specified in ISO 21217 distinguishes two main blocks, i.e. “Applications” and “Communications”. ITS-S application processes in “Applications” access communication services in “Communications” through an API. Portability of ITS-S application processes, which leads to the creation of ITS application process repositories as described in ISO/TS 17419, is enabled by

— abstraction of ITS-S application processes (in “Applications”) from communication protocols (in “Facilities”, “Networking & Transport”, “Access”) and supporting management and security functionality (in “Management”, “Security”) introduced as an essential basics of an ITS station in ISO 21217, and

— procedures by which instances of ITS-S application processes running in an ITS station unit (ITS-SU) specified in ISO 21217 can present requirements for communication services in an abstract and standardized way to the ITS station management as specified in this Technical Specification, and

— procedures for automatic selection of optimum communication profiles by the ITS station management for each set of required communication services.

Communication service requirements are presented by means of communication service parameters as identified in this Technical Specification. These parameters are used to identify sets of possible choices of ITS-S communication profiles as well as selecting the “optimal” ITS-S communication profile out of each set. The selection of the “optimal” ITS-S communication profile is implementation dependent and generally involves the formulation of a cost function based on objectives that needs to be extremized (maximized or minimized) as discussed in Annex C.

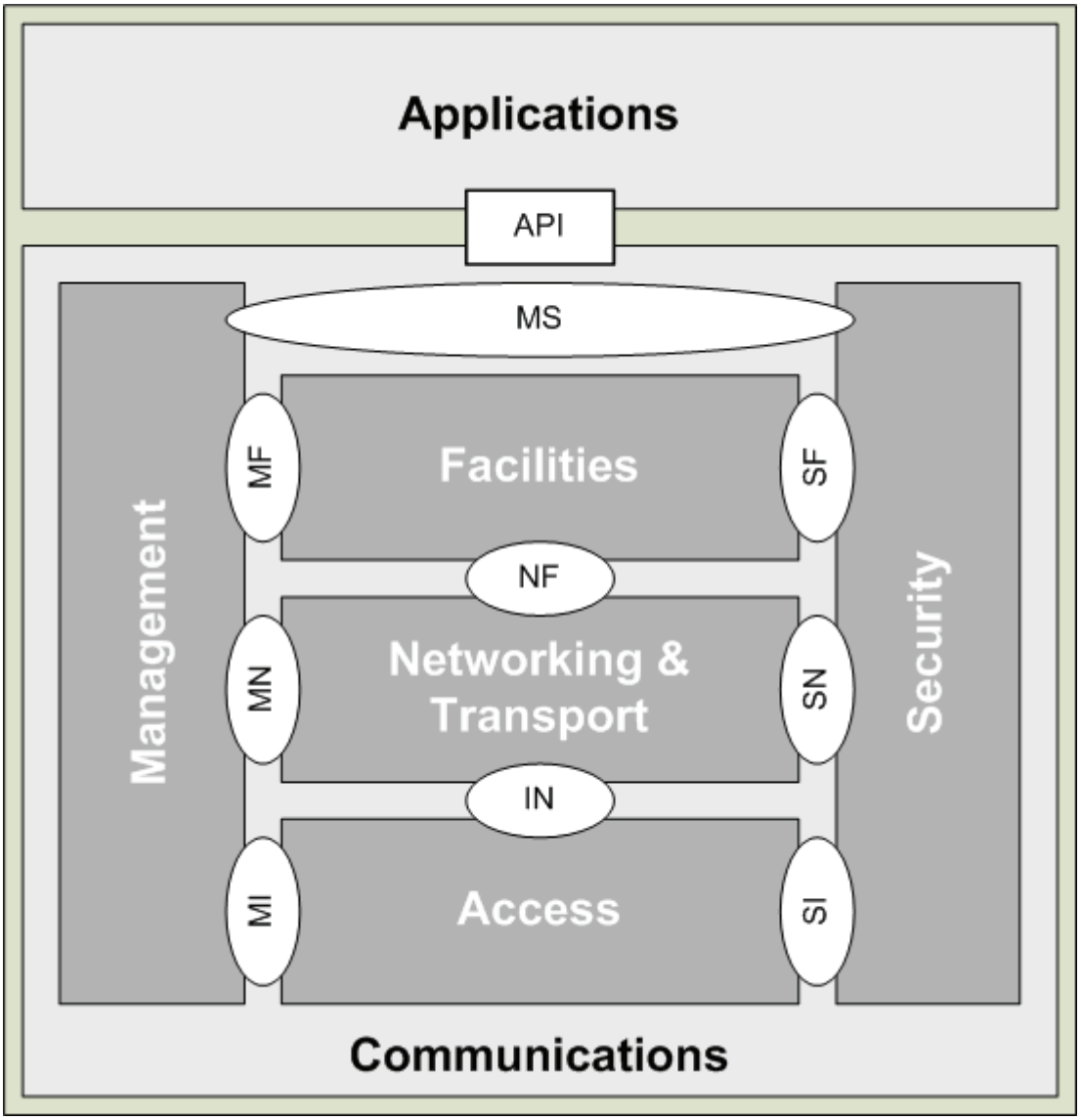

Figure 2 — ITS station architecture [from **ISO 21217**]

The same approach to present communication requirements and objectives also applies to:

— ITS-S application processes located in the ITS-S facilities layer (e.g. CAM source),

— ITS-S application processes located in the ITS-S management entity (e.g. SAM and CTX sources [5]),

— ITS-S application processes located in the ITS-S security entity, and

— ITS-S application processes located somewhere else in an ITS station.

There are also other application processes that can get access to the communication tools of an ITS-SU. Such other application processes are not certified to be installed in an ITS-SU implemented as a BSME as described in ISO 21217 and ISO/TS 17419, but may use selected functionality from it, especially communication functionality.

Figure 3 illustrates a simplified version of Figure 2 to be applied to the process illustrated in Figure 1 considering ITS-S application processes in general.

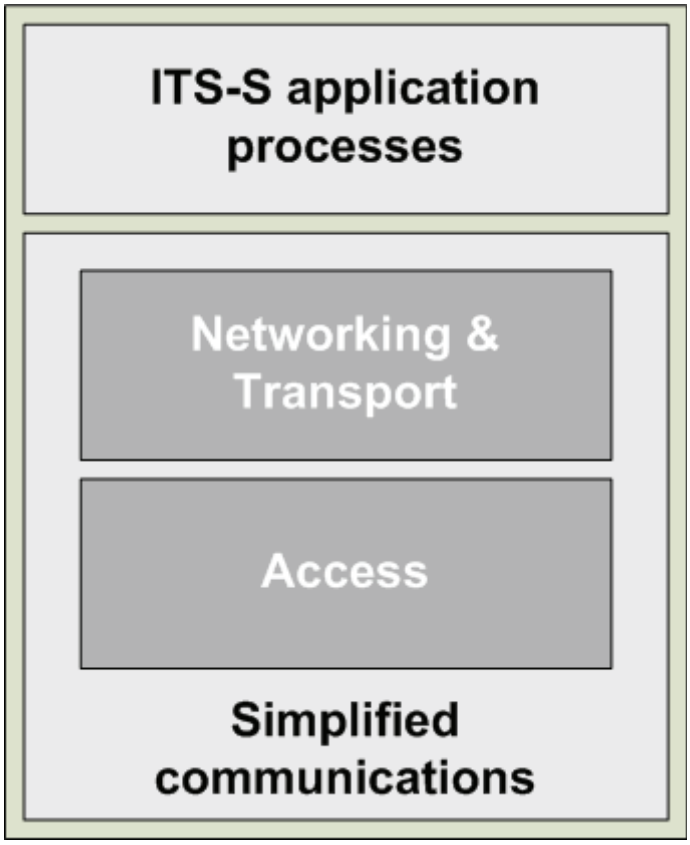

Figure 3 — Simplified architecture

Application processes are classified in ISO/TS 17419 as:

— ITS-S application processes certified for a BSME and identified by an ITS-AID (ITS-S facilities applications, ITS-S management applications, ITS-S security applications and ITS-S applications):

  — authorized ITS-S applications

  — permitted ITS-S applications

— application processes not certified for a BSME and without ITS-AID:

The definitions of "authorized" and "permitted" are given in Reference [12].

Communication service parameters are specified in 5.3, 5.4, 5.5, 5.6 and 5.7. An overview is presented in 5.8. An ITS-S application process shall present the mandatory communication service parameters, and may present those optional communication service parameters which are relevant for it.

Users of ITS-SUs may present rules, see Figure 1, by means of user policies, e.g. for cases where the ITS-S application process did not specify a specific value (example: financial requirements). Requirements may also be given by authorities in terms of regulations and policies, or by other entities in terms of policies, see Figure 1.

NOTE Regulations are enforceable rules. Policies are rules or guidelines which cannot be enforced.

An ITS-S application process may have more than one communication source[2)], and these communication sources may have different communication requirements. Each communication source (and sink) of an ITS-S application process is identified by a reference number of ASN.1 type InterfaceNo specified in ISO/TS 17419 which is unique in the scope of that ITS-S application process. For each communication

2) An ITS-S application process might need to maintain flows for different communication sources, e.g. audio, video and messages (e.g. SPaT, IVI, CAM, DENM, ...).

source an ITS-S application process presents a set of communication requirements to the ITS-S management as specified in this Technical Specification. Such a set of communication requirements is linked to an ITS flow type identifier (ITS-FlowTypeID). ITS-FlowTypeIDs may be well-known registered identifiers pointing to pre-defined well-known sets of requirements as specified in ISO/TS 17419, or may be dynamically assigned in an ITS-SU.

Communication service parameters presented by ITS-S application processes for each communication source are used by the ITS station management to select the best suited ITS-S communication profile per communication source. It might be that an ITS-S management is not able to provide a communication protocol stack which fully complies with the requirements, i.e. fails to identify and select an appropriate ITS-S communication profile. In this failure situation either a best effort approach to enable communications or a refuse to support this particular communication source applies. In any case the ITS-S management reports the status of the ITS-S communication profile selection procedure to the ITS-S application process.

Once a FlowID has been assigned to an ITS-S application process, the ITS-S application process cannot update communication service parameters associated with the flow.[6]

The interface between “Applications” and “Communications” illustrated in Figure 1 is an “Application Programming Interface” (API). An API provides the functionality described in the service access points MA-SAP, SA-SAP and FA-SAP specified in ISO 24102-3. Details of APIs depend on the operating system used to implement them.

ITS-S application processes may reside in the ITS-S application entity, in the ITS-S facilities layer, in the ITS-S security entity, and in the ITS-S management entity. The interaction between ITS-S application processes and the ITS-S management entity is specified in terms of functions in the service primitives of the MA-SAP, the MF-SAP, and the MS-SAP illustrated in Figure 2.

The specification of APIs for ITS is outside the scope of this Technical Specification.

Management procedures and service primitives related to these communication service parameters are specified in Clause 7.

The normative Annex A provides an ASN.1 module with specifications of types and values used to present the communication requirements and objectives.

5.2 Communication service parameter classes

Communication service parameters are grouped into classes. The following communication service parameter classes are identified in this Technical Specification:

— The class of operational parameters is specified in 5.3.

— The class of destination parameters is specified in 5.4.

— The class of performance parameters is specified in 5.5.

— The class of security parameters is specified in 5.6.

— The class of protocol parameters is specified in 5.7.

— An overview of all parameters identified in this Technical Specification is presented in 5.8.

Some communication service parameters are mandatory, i.e. shall be presented by all ITS-S application processes as specified in 7.2.

ASN.1 specifications of the communication service parameters are provided in Annex A.

5.3 Operational communication service parameters

5.3.1 List of requirements

Operational communication service parameters specified in this Technical Specification are:

— "Logical channel" communication service parameter CSP_LogicalChannelType (**mandatory**) as specified in 5.3.2.

— "Session continuity" communication service parameter CSP_SessionCont (optional) as specified in 5.3.3.

— "Average ADU generation rate" communication service parameter CSP_AvgADUrate (optional) as specified in 5.3.4.

— "FlowType" communication service parameter CSP_FlowType (optional) as specified in 5.3.5.

— "Maximum Priority" communication service parameter CSP_MaxPrio (optional) as specified in 5.3.6.

— "Port Number" communication service parameter CSP_PortNo (**mandatory**) as specified in 5.3.7.

— "Expected flow lifetime" communication service parameter CSP_ExpFlowLifetime (optional) as specified in 5.3.7.

5.3.2 Logical channel

CSP_LogicalChannelType indicates the logical channel to be used for communications. It shall always be presented by an ITS-S application process. CSP_LogicalChannelType shall be of ASN.1 type LogicalChannelType specified in ISO/TS 17419.

Logical channels are subject to registration as specified in ISO/TS 17419. Some examples of logical channels are presented in Table 1.

Table 1 — Examples of logical channels

Acronym	Name	Description
CCH	Control channel	For dissemination and exchange of basic channel control information, communication information, and application management information.
SaCH	Service advertisement channel	For advertising of applications and services currently being offered by an ITS-SU with service provider role, e.g. using FSAP. [5]
SfCH	Safety of life and property channel	For dissemination and exchange of safety of life and property critical information.
SCH	Service channel	For exchange of peer to peer ITS-S application process data, and for general message dissemination.

5.3.3 Session continuity

CSP_SessionCont indicates that the flow is related to a session. CSP_SessionCont shall be of ASN.1 type ContConnect specified in Annex A.

CSP_SessionCont is a binary flag indicating whether a session may be interrupted or not. In case the binary flag is set to zero, an active session should not be interrupted by the ITS-S management.

5.3.4 Average ADU generation rate

CSP_AvgADUrate indicates the average rate at which ADUs will be presented for transmission. It is applicable only for information dissemination. CSP_AvgADUrate shall be of ASN.1 type AvgADUrate specified in Annex A.

The value zero indicates an unknown average rate.

In case CSP_AvgADUrate is not presented, then the value of zero shall apply.

5.3.5 Flow type

CSP_FlowType presents a well-known registered flow type identifier FlowTypeID specified in ISO/TS 17419 which uniquely points to a set of pre-defined communication service parameters. CSP_FlowType shall be of ASN.1 type FlowTypeID specified in Annex A.

5.3.6 Maximum priority

CSP_MaxPrio presents the maximum allowed priority for flows. In case CSP_MaxPrio is not present, lowest priority 0 is assumed. CSP_MaxPrio shall be of ASN.1 type ITSapObPriority specified in Annex A.

5.3.7 Port number

CSP_PortNo is a mandatory communication service parameter that consists of two parts, a direction indicator of ASN.1 type PortRxTx and the port number of ASN.1 type PortNumber. CSP_PortNo is presented for communication sources *and* communication sinks to indicate a well-known port number to be associated with the interface. CSP_PortNo shall be of ASN.1 type PortNoInfo specified in Annex A.

In case the given interface is not associated with a well-known port, the port number PORT_UNK specified in ISO/TS 17419 shall be presented.

5.3.8 Expected flow lifetime

CSP_ExpFlowLifetime indicates the expected lifetime of a flow. CSP_ExpFlowLifetime shall be of ASN.1 type ExpFlowLifeTime specified in Annex A.

ExpFlowLifeTime consists of a time information of ASN.1 type TimeDurationValue. TimeDurationValue indicates the expected time for a flow. A time value of zero indicates “time unknown”.

In case CSP_ExpFlowLifetime is not presented, then the value of zero shall apply.

5.4 Destination communication service parameters

5.4.1 List of communication service parameters

Destination communication service parameters specified in this Technical Specification are:

— “Destination type” communication service parameter CSP_DestinationType (**mandatory**) as specified in 5.4.2.

— “Destination domain” communication service parameter CSP_DestinationDomain (**mandatory**) as specified in 5.4.3.

— “Communication distance” communication service parameter CSP_CommDistance (optional) as specified in 5.4.4.

— “Directivity” communication service parameter CSP_Directivity (optional) as specified in 5.4.5.

NOTE Destination address information is provided by the ITS-S application process at time of FlowID allocation.[6]

5.4.2 Destination type

CSP_DestinationType indicates the type of transmission. It shall always be presented by an ITS-S application process. CSP_DestinationType is of ASN.1 type DestinationType specified in Annex A.

DestinationType indicates the following different casting types:

— 1 for broadcast transmission, or

— 2 for multicast transmission to a defined multicast group, or

— 4: for unicast transmission to a specific station.

— 8: for anycast transmission to exactly one undefined station,

— 16: for geocast transmission to an area given by geo-coordinates.

5.4.3 Destination domain

CSP_DestinationDomain indicates the domain of communications. It shall always be presented by an ITS-S application process. CSP_DestinationDomain is of ASN.1 type DestDomain specified in Annex A.

DestDomain supports selection of the following communication domains:

— 1: ITS station-internal domain

— 2: local domain (including single-hop communications, e.g. performed with FNTP[Z])

— 4: site local domain

— 8: ITS network local domain without Internet access

— 16: global domain (=Internet)

5.4.4 Communication distance

CSP_CommDistance indicates the required minimum communication distance in meter to reach the next neighbour node (next node outside the ITS-SU), if applicable. CSP_CommDistance is of ASN.1 type CommDistance specified in Annex A. The value zero shall indicate a distance larger than the maximum possible value of 65 535 metres.

5.4.5 Directivity

CSP_Directivity provides information on the required antenna aperture as specified in ISO 21218 and Reference [10]. CSP_Directivity is of ASN.1 type Directivity specified in Annex A. This communication service parameter is only applicable for some access technologies.[10]

5.5 Performance communication service parameters

5.5.1 List of communication service parameters

Performance communication service parameters specified in this Technical Specification are:

— “Resilience” communication service parameter CSP_Resilience (optional) as specified in 5.5.2.

— “Minimum required throughput” communication service parameter CSP_MinThP (optional) as specified in 5.5.3.

— “Maximum allowed latency” communication service parameter CSP_MaxLat (optional) as specified in 5.5.4.

— "Maximum APDU size" communication service parameter CSP_MaxADU (**mandatory**) as specified in 5.5.5.

5.5.2 Resilience

CSP_Resilience requests provision of appropriate means to increase the likelihood of proper delivery of messages. CSP_Resilience is of ASN.1 type Resilience specified in Annex A.

Appropriate means to increase the likelihood of proper delivery of messages include:

— **Acknowledgement of messages**: Acknowledgements can be at the ITS-S access layer, at the ITS-S networking & transport layer, or at the ITS-S facilities layer. Acknowledgements can be from the destination node or from any interim node. Acknowledgement of messages should be selected only in case of unicast transmission.

— **Repeated transmission of the same message**: This should only be selected in case of information dissemination.

5.5.3 Minimum required throughput

CSP_MinThP indicates the required average data rate in integer multiples of 100 bit/s. CSP_MinThP is of ASN.1 type MinThP specified in Annex A.

The range is from zero to 429 496 729 500 bit/s in steps of 100 bit/s. The value zero should not be used, as it only indicates that no requirement for throughput is presented. This communication service parameter is especially meaningful for flows of audio and video streams. It is less meaningful for transmission of single messages, e.g. DENM.

5.5.4 Maximum allowed latency

CSP_MaxLat indicates the maximum acceptable latency. CSP_MinThP is of ASN.1 type MaxLat specified in Annex A.

Possible value ranges that can be indicated by MaxLat are:

— response within less than 10 ms,

— response within less than 100 ms,

— response within less than 1 second,

— response within less than 10 seconds,

— response within less than 1 minute,

— response within less than 10 minutes,

— response within less than 1 hour.

This communication service parameter may be meaningful for transmission of single messages, e.g. SPaT, CAM, DENM.

5.5.5 Maximum ADU size

CSP_MaxADU indicates the maximum size of protocol data units from an ITS-S application process flow. CSP_MaxADU shall be of ASN.1 type MaxADU specified in Annex A.

The maximum ADU size can be presented in steps of 100 bytes in the range from zero to 6 553 400 bytes. The value zero indicates an unknown APDU size. The value MaxADU = 65 535 indicates an ADU size in excess of 6 553 400 bytes.

This communication service parameter is necessary in case of "large ADUs" where fragmentation is potentially needed due to frame size restrictions in the ITS-S access technologies. It shall always be presented by an ITS-S application process.

5.6 Security communication service parameters

5.6.1 List of communication service parameters

Security communication service parameters specified in this Technical Specification are:

— "Need for data confidentiality" communication service parameter CSP_DataConfidentiality (optional) as specified in 5.6.2.

— "Need for data integrity" communication service parameter CSP_DataIntegrity (optional) as specified in 5.6.3.

— "Need for non-repudiation" communication service parameter CSP_NonRepudiation (optional) as specified in 5.6.4.

— "Need for data source authentication" communication service parameter CSP_SourceAuthentication (optional) specified in 5.6.5.

5.6.2 Need for data confidentiality

CSP_DataConfidentiality indicates that authentication is needed. CSP_DataConfidentiality is of ASN.1 type DataConfidentiality specified in Annex A. DataConfidentiality allows presentation of the cost factor, i.e. the relevance of this communication service parameter.

5.6.3 Need for data integrity

CSP_DataIntegrity indicates that encryption of the ADUs of the ITS-S application process is needed. CSP_DataIntegrity is of ASN.1 type DataIntegrity specified in Annex A. DataIntegrity allows presentation of the cost factor, i.e. the relevance of this communication service parameter.

5.6.4 Need for non-repudiation

CSP_NonRepudiation indicates that the ITS-S application process needs to be protected from repudiation of protocol data units which it is producing. CSP_NonRepudiation is of ASN.1 type ReqNonrepudiation specified in Annex A. ReqNonrepudiation allows presentation of the cost factor, i.e. the relevance of this communication service parameter.

5.6.5 Need for source ITS-S application process authentication

CSP_SourceAuthentication indicates that the ITS-S application process needs the source of the protocol data units which it is producing to be authenticable at the receiver side. CSP_SourceAuthentication is of ASN.1 type SourceAuthentication specified in Annex A. SourceAuthentication allows presentation of the cost factor, i.e. the relevance of this communication service parameter.

5.7 Protocol communication service parameter

The optional "Protocol communication service parameter" communication service parameter CSP_Protocol allows identifying a complete communication protocol stack needed for a specific flow. CSP_Protocol indicates a globally unique registered communication protocol stack identifier specified in ISO/TS 17419.

CSP_Protocol is of ASN.1 type ProtocolReq specified in Annex A.

5.8 Communication service parameters overview

Table 2 presents an overview of all communication service parameters specified in this Technical Specification. Mandatory communication service parameters are presented in bold.

Table 2 — Communication service parameters overview

Communication service parameter	ASN.1 type	Comment
Operational communication service parameters		
CSP_LogicalChannelType	LogicalChannelType	**Mandatory** communication service parameter.
CSP_SessionCont	SessionCont	Applicable only for session based flows.
CSP_AvgADUrate	AvgADUrate	Applicable only for information dissemination flows.
CSP_FlowType	FlowTypeID	Identifier of a flow type
CSP_MaxPrio	ITSapObPriority	Maximum allowed priority of flow.
CSP_PortNo	PortNoInfo	**Mandatory** communication service parameter, applicable for communication sources and communication sinks.
CSP_ExpFlowLifetime	ExpFlowLifeTime	Expected lifetime of a flow; not necessarily a flow related to a session.
Destination communication service parameters		
CSP_DestinationType	DestType	**Mandatory** communication service parameter.
CSP_DestinationDomain	DestDomain	**Mandatory** communication service parameter.
CSP_CommDistance	CommDistance	Applicable only to indicate distance to next neighbour node (outside the ITS-SU).
CSP_Directivity	Directivity	Applicable only to indicate communication direction towards the next neighbour node (outside the ITS-SU).
Performance communication service parameters		
CSP_Resilience	Resilience	Any means suited to increase the likelihood of proper delivery of messages.
CSP_MinThP	MinThP	Especially meaningful for flows of audio and video streams. Less meaningful for transmission of single messages, e.g. DENM.
CSP_MaxLat	MaxLat	Especially meaningful for transmission of single messages, e.g. CAM, DENM, SPaT.
CSP_MaxADU	MaxADU	**Mandatory** communication service parameter. Necessary in case of "large ADUs" where due to frame size restrictions in the ITS-S access technologies potentially fragmentation is needed.
Security communication service parameters		
CSP_DataConfidentiality	DataConfidentiality	
CSP_DataIntegrity	DataIntegrity	
CSP_NonRepudiation	ReqNonrepudiation	
CSP_SourceAuthentication	SourceAuthentication	
Protocol communication service parameter		
CSP_Protocol	ProtocolReq	

6 Policies and regulations

In the context of this Technical Specification, the terms policy and regulation are used to indicate rules used in the decision process to select a communication protocol stack, see Figure 1. Policies are not enforceable, and may be presented by the user of an ITS-SU, an organization, or an authority. Regulations are enforceable, and may be presented only by an authority. How policies and regulations are made available in an ITS-SU is outside the scope of this Technical Specification. Some information on policies and regulations is provided in ISO/TS 17419. Policies and regulations may apply either for specific ITS-S application processes, or for specific communication protocols, e.g. frequency regulation. Policies and regulations typically are valid in a specific region. ISO/TS 17419 distinguishes policy regions and regulatory regions.

Examples of policies set up by the user of an ITS-SU are identified in this Technical Specification:

— Cost policy specified in 6.1.

— Station anonymity policy specified in 6.2.

— Station location privacy policy specified in 6.3.

— Station authentication policy specified in 6.4.

6.1 Cost policy

6.1.1 List of rules

Cost rules specified in this Technical Specification are:

— "Flat rate" rule specified in 6.1.2.

— "Maximum rate per data unit" rule specified in 6.1.3.

— "Maximum rate per connection time" rule specified in 6.1.4.

— "Maximum rate per connection" rule specified in 6.1.5.

All of these rules are based on the ASN.1 type MediumCost specified in Annex A.

6.1.2 Flat rate

The "Flat rate" rule R_FlatRate indicates that cost for communications shall be limited based on a flat rate price.

MediumCost shall be applied as specified in Table 3

Table 3 — R_FlatRate

Element of MediumCost	Value	Semantics
costClass	1 or 2	Value 1 shall be selected for zero cost. Otherwise value 2 shall be selected.
costAmount	Currency unit	Present in case of costClass = 2. Indicating the flat rate price. Price information consists of a currency unit (three digit number code specified in ISO 4217:2008), the integer part of the value, and the fractional part of the value.
timeUnit	—	Optional element is not present for R_FlatRate.
amountUnit	—	Optional element is not present for R_FlatRate.

6.1.3 Maximum rate per data unit

The "Maximum rate per data unit" rule R_DataUnitRate indicates that cost for communications shall be limited based on a price per data unit.

MediumCost shall be applied as specified in Table 4.

Table 4 — R_DataUnitRate

Element of MediumCost	Value	Semantics
costClass	4	Maximum rate per data unit.
costAmount	Currency unit	Price per data unit. Price information consists of a currency unit (three digit number code specified in ISO 4217:2008), the integer part of the value, and the fractional part of the value.
timeUnit	—	Optional element is not present for R_DataUnitRate.
amountUnit	Present	Possible data units to be selected in the ASN.1 type CostAmountUnit: 1 kbyte, 10 kbyte, 100 kbyte, 1 Mbyte, 10 Mbyte, 100 Mbyte, 1 Gbyte, 10 Gbyte.

6.1.4 Maximum rate per connection time

The "Maximum rate per connection time" rule R_ConnectTimeRate indicates that cost for communications shall be limited based on a price per connection time.

MediumCost shall be applied as specified in Table 5.

Table 5 — R_ConnectTimeRate

Element of MediumCost	Value	Semantics
costClass	3	Maximum rate per connection time.
costAmount	Currency unit	Price per time unit. Price information consists of a currency unit (three digit number code specified in ISO 4217:2008), the integer part of the value, and the fractional part of the value.
timeUnit	Time unit	Possible time units to be selected in the ASN.1 type CostTimeUnit: µs, ms, second, minute, hour, day, week, month, year
amountUnit	—	Optional element is not present for R_ConnectTimeRate.

6.1.5 Maximum rate per connection

The "Maximum rate per connection" rule R_ConnectRate indicates that cost for communications shall be limited based on a price per connection.

MediumCost shall be applied as specified in Table 6.

Table 6 — R_ConnectRate

Element of MediumCost	Value	Semantics
costClass	5	Maximum rate per connection.
costAmount	Currency unit	Price per connection. Price information consists of a currency unit (three digit number code specified in ISO 4217:2008), the integer part of the value, and the fractional part of the value.
timeUnit	—	Optional element is not present for R_ConnectRate.
amountUnit	—	Optional element is not present for R_ConnectRate.

6.2 Need for station anonymity

The "Need for station anonymity" rule R_StationAnonymity indicates whether station anonymity is needed or not. R_StationAnonymity is of ASN.1 type Anonymity specified in Annex A. Anonymity allows presenting the cost factor, i.e. the relevance of this rule. Default is the value zero, i.e. "not needed".

6.3 Need for station location privacy

The "Need for station location privacy" rule R_StationLocationPrivacy indicates whether station location privacy is needed or not. R_StationLocationPrivacy is of ASN.1 type LocPrivacy specified in Annex A. LocPrivacy allows presentation of the cost factor, i.e. the relevance of this rule. Default is the value zero, i.e. "not needed".

6.4 Support of station authentication

The "Support of station authentication" rule R_StationAuthentication whether support for authentication of the ITS-SU by a peer station is needed or not. R_StationAuthentication is of ASN.1 type StationAuthentication specified in Annex A. StationAuthentication allows presentation of the cost factor, i.e. the relevance of this rule. Default is the value zero, i.e. "not needed".

7 ITS-S procedures for ITS-S communication profile selection

7.1 Overview

The following procedures are identified:

— Presentation of communication service parameters by ITS-S application processes, specified in 7.2.

— Monitoring of capabilities of communications, specified in 7.3.

— Monitoring of change in regulations and policies, specified in 7.4

— Selection of ITS-S communication profiles, specified in 7.5.

— Provision of additional rules and policies by user of ITS-SUs, specified in 7.6.

— ITS-S communication profile assignment for applications which are not certified to be installed in an ITS-SU, specified in 7.7.

As ITS-S application processes may reside e.g. in the ITS-S application entity, the ITS-S management entity, and the ITS-S facilities layer, the services REQUEST and COMMAND of the MA-SAP, the MS-SAP and the MF-SAP are used to exchange information and command between the ITS-S management entity and the ITS-S application entity, the ITS-S management entity, and the ITS-S facilities layer, respectively. These services and related .request and .confirm service primitives are specified in ISO 24102-3. This Technical specification specifies functions carried in these service primitives. The ASN.1 definition of these functions is specified in Annex A.

These functions provide the mechanisms to present communication service parameters to the ITS-S management entity, and the mechanisms to present feedback to the ITS-S application processes on the selection of ITS-S communication profiles.

7.2 Presentation of communication service parameters

Communication service parameters are presented by ITS-S application processes to the ITS-S management entity using the service primitives A-REQUEST(ITS-S-Appl-Reg), or MF-REQUEST(ITS-S-Appl-Reg), or MS-REQUEST(ITS-S-Appl-Reg), respectively. ITS-S-Appl-Reg consists of a sequence of

elements of ASN.1 type ITSSappCPReqReg illustrated in Table 7. ITS-S-Appl-Reg and ITSSappCPReqReg are specified in Annex A.

NOTE In case several sources have identical communication service parameters, a single call of ITSSappCPReqReg is possible.

Table 7 — Communication service parameters per source

Element of ITSSapp-CPReqReg	Value	Semantics
applicationID	ApplicationID	Implementation specific identifier of an ITS-S application process in an ITS-SU[[3]].
txInterfaceNo	InterfaceNo	Reference number of a source of the ITS-S application process identified by applicationID which is unique for this ITS-S application process.
requirements	ITSSappReq	List of communication service parameters for txInterfaceNo of applicationID.

The request introduced directly above shall be acknowledged with A-REQUEST(ITS-S-Appl-RegConf), or MF-REQUEST(ITS-S-Appl-RegConf), or MS-REQUEST(ITS-S-Appl-RegConf), respectively. ITS-S-Appl-RegConf consists of a sequence of elements of ASN.1 type ITSSappCPReqConf which are illustrated in Table 8. ITS-S-Appl-RegConf and ITSSappCPReqConf are specified in Annex A.

In the case that an appropriate ITS-S communication profile is not currently available, the request is confirmed with error / return code = 10 “VALUE NOT AVAILABLE” as specified in ISO 24102-3. Otherwise the request is confirmed with error / return code = 0 “SUCCESS” as specified in ISO 24102-3. The confirmation ITS-S-Appl-RegConf consists of details as illustrated in Table 8.

Table 8 — Confirmation of communication service parameters per source

Element of ITSSapp-CPReqConf	Value	Semantics
applicationID	ApplicationID	Implementation specific identifier of an ITS-S application process in an ITS-SU.[3]
txInterfaceNo	InterfaceNo	Reference number of a source of the ITS-S application process identified by applicationID which is unique for this ITS-S application process.
confDetails	ITSSappReqConf	List of information on success or failure for txInterfaceNo of applicationID. This information is either presenting the BOOLEAN information TRUE = success or FALSE = failure, or it shows an achievable value which is outside of the required range, or it may be the ASN.1 NULL type.

7.3 Monitoring of capabilities of communications

Capabilities of communications are related to protocols contained in the ITS-S access layer, the ITS-S networking & transport layer, and the ITS-S facilities layer, and possibly also in the ITS-S security entity and the ITS-S management entity. Such capabilities depend on the installation and on the actual status of the implemented protocols.

Specification of functionality in support of monitoring of capabilities of communication interfaces is outside the scope of this Technical Specification. This functionality is specified elsewhere, e.g. in ISO 21218 and Reference [3] for capabilities of communication interfaces (ITS-S access layer), and in References [2], [6] and [7] for capabilities of the ITS-S networking & transport layer.

7.4 Monitoring of regulations and policies

Regulations and policies are applicable in specific regions. ISO/TS 17419 specifies how regulatory regions and policy regions are identified. Procedures to get updates of regulations and policies may use push or pull mechanisms.

Functionality in support of monitoring of radio regulations is specified in ISO 21218 and Reference [3].

7.5 Selection of ITS-S communication profiles

Upon presentation of communication service parameters for each source of an ITS-S application process, the ITS-S management will try to identify applicable initial communication protocol stacks for each source, and will initialize the best suited communication protocol stack. Success and failure to identify such protocol stacks will be reported as specified in 7.2. Resolution of conflicting rules (regulations and policies) is outside the scope of this Technical Specification.

The cost value of ASN.1 type CostObjective indicates the relevance of a communication service parameter and may have values in the range from zero to 255. A value of zero means that the related communication service parameter is not at all relevant. A value of 255 indicates highest relevance. Communication service parameters not presenting a cost value have an implicit cost value of 255. How a communication profile selection process uses the cost value is outside the scope of this Technical Specification, allowing for different implementations.

In the case that no appropriate ITS-S communication profile could be selected, and all BOOLEAN information in Table 8 reports success, the ITS-S application process shall notify the ITS-S management whether it accepts to operate on an available ITS-S communication profile with the confirmed values, or whether it will stop operation. In the latter case, the user of the ITS-SU should be informed about a non-resolvable conflict. The notification shall use the REQUEST(ITS-S-Appl-RegFinal) service.

Upon successful assignment of a communication protocol stack for each given source, an ITS-S application process can start requesting FlowIDs and producing related flows as specified in Reference [6].

7.6 Interaction with user of ITS-SU

Interaction with the ITS-SU user depends on implementation. Details are outside the scope of this Technical Specification.

7.7 Support of other application processes

The ITS-S is specified in ISO 21217 as a “Bounded Secured Managed Domain”, which implies that any kind of software (ITS-S application processes, communication protocols, etc.) running in an ITS-SU must be certified. A large number of applications related to ITS already exists, e.g. as apps in smart phones, which are not certified to run in an ITS-SU. Nevertheless such applications should also get reasonable access to the communication tools available in an ITS-SU. In this Technical Specification, the meaning of ITS-SU is generalized such that it may consist of two parts:

— the part operated as a BSMD,

— the part operated outside of the BSMD.

In support of such application processes operated outside of the BSMD in a generalized ITS-SU, ISO 21217 defines the application adaptation interface providing ITS-S gateway functionality. Such an application adaptation interface interconnects an “external protocol stack” to the ITS-S management entity, to the ITS-S facilities layer, and to the ITS-S networking & transport layer, and thus supports also direct routing on a default path to Internet which enables end to end communications.

Two main classes of application processes operated outside of the BSMD are identified:

a) Application processes which know how to present communication service parameters as specified in this Technical Specification.

b) All other applications.

Class a) application processes may get a best effort ITS-S communication profile as decided by the ITS-S management.

Class b) application processes shall only get a default path to Internet as decided by the ITS-S management.

All application processes operated outside of the BSMD shall always only get lowest priority access to the communication tools (referred to as ITS-S services in ISO 21217) compared to ITS-S application processes as specified in ISO/TS 17419. When required, the ITS-S management entity may even block completely any data flow between the “other stations” and the ITS-S, or the data flow for selected “other applications”, in order to ensure proper operation of the ITS-S application processes.

Annex A
(normative)

ASN.1 modules

A.1 Overview

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

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

Updates of this annex will be published on http://standards.iso.org/iso/ts/17423/ and become an integral part of this Technical Specification.

A.2 Module CITSapplReq

This module specifies ASN.1 type definitions and ASN.1 value definitions.

Encoding of these data depends on the purpose of usage. For usage in narrow-band ITS communication links, unaligned packed encoding rules (PER) as specified in ISO/IEC 8825-2 shall be applied.

ASN.1 modules are imported from ISO/TS 17419, from ISO 21218, from ISO 24102-1, and from ISO 29281-1.

```
CITSapplReq {iso(1) standard(0) cits-applReq (17423) asnm-1 (1) version1 (1)}

DEFINITIONS AUTOMATIC TAGS::=BEGIN

IMPORTS
DataRate, Directivity, TimeUnit FROM CALMllsap {iso(1) standard(0) calm-ll-sap(21218)
asnm-1 (1) version1 (1)}

VarLengthNumber2 FROM CITSapplMgmtIDs {iso(1) standard(0) cits-applMgmt (17419) ids (1)
version1 (1)}

ITSaid , FlowTypeID, InterfaceNo, ITSapObPriority, PortRxTx FROM CITSapplMgmtApplReg
{iso(1) standard(0) cits-applMgmt (17419) applRegistry (2) version1 (1)}

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

ApplicationID, ITS-scuId FROM CALMmanagement { iso (1) standard (0) calm-management
(24102) local (1) asnm-1 (1) version1 (1)}

PortNumber FROM CALMfntp { iso (1) standard (0) calm-nonip(29281) fntp(1) asnm-1 (1)
version1 (1)}
;

-- End of IMPORTS

-- Types

-- Communication service parameters per communication source identified by InterfaceNo

-- Used in REQUEST.request service primitive

ITSSappCPReqReg::=SEQUENCE{
       applicationID ApplicationID,
--ID of ITS-S application process unique in an ITS-SCU
       txInterfaceNo InterfaceNo,
       requirements  ITSSappReq
       }
```

```
ServiceRef::=SEQUENCE{
       appID  ApplicationID,
       interfaceNo   InterfaceNo
       }

-- Used in REQUEST.confirm service primitive
ITSSappCPReqConf::=SEQUENCE{
       applicationID ApplicationID,
       txInterfaceNo InterfaceNo,
       confDetails   ITSSappReqConf
       }

-- Confirmation of presented requirements
RefREQSCP ::= INTEGER {
       c-logChannel  (0),
       c-sessionCont (1),
       c-destType    (2),
       c-avgADUrate  (3),
       c-destDomain  (4),
       c-flowType    (5),
       c-maxAPDU     (6),
       c-commDistance      (7),
       c-portNo      (8),
       c-directivity (9),
       c-resilience  (13),
       c-minThP      (15),
       c-maxLat      (17),
       c-protocolReq (19),
       c-dataConfidentiality       (21),
       c-dataIntegrity     (23),
       c-nonReputability   (25),
       c-dataAuthentication        (27),
       c-maxPriorityFlow   (29),
       c-expFlowLifeTime   (31)
       } (0..255)

REQSCP::=CLASS {
       &ref   RefREQSCP,
       &ReqParam
       }

ITSSappReq::=SEQUENCE OF SEQUENCE{
       refNo  REQSCP.&ref({Req-SCP}),
       param  REQSCP.&ReqParam({Req-SCP}{@refNo})
       }

REQSCPCONF::=CLASS {
       &ref   RefREQSCP,
       &ReqConfParam
       }

ITSSappReqConf::=SEQUENCE OF SEQUENCE{
       refNo  REQSCPCONF.&ref({ReqConf-SCP}), -- same as in request
       param  REQSCPCONF.&ReqConfParam({ReqConf-SCP}{@refNo})
       }

-- Notification of final decision of ITS-S application process
ITSSappCPFinal::=SEQUENCE{
       applicationID ApplicationID, -- same as in .request
       final   Logic
       }


--  CSPs


Req-SCP REQSCP::={logChannel | destType | destDomain | maxAPDU | sessionCont | avgADUrate
| flowType | commDistance | directivity | resilience | minThP | maxLat | protocolReq |
dataConfidentiality | dataIntegrity | nonReputability | dataAuthentication | maxPriority-
```

```
Flow | portNo | expFlowLifeTime, ...}

-- Mandatory requirements (only even ref numbers)
logChannel    REQSCP::={&ref c-logChannel, &ReqParam LogicalChannelType}
destType      REQSCP::={&ref c-destType, &ReqParam DestinationType}
destDomain    REQSCP::={&ref c-destDomain, &ReqParam DestDomain}
maxAPDU       REQSCP::={&ref c-maxAPDU, &ReqParam MaxADU}
portNo REQSCP::={&ref c-portNo, &ReqParam PortNoInfo}


DestinationType::=INTEGER{
       broadCast     (1),
       multiCast     (2),
       uniCast       (4),
       anyCast       (8),
       geoCast       (16)
       }(0..255)

DestDomain::=INTEGER{
       stationInternal     (1),
       linkLocal     (2),
       siteLocal     (4),
       itsNWlocal    (8),
       global (16)
       } (0..255)

MaxADU::=INTEGER(0..65535) -- multiples of 100 byte

-- Optional CSPs (only odd ref numbers)
sessionCont   REQSCP::={&ref c-sessionCont, &ReqParam SessionCont}
avgADUrate    REQSCP::={&ref c-avgADUrate, &ReqParam AvgADUrate}
flowType      REQSCP::={&ref c-flowType, &ReqParam FlowTypeID}
commDistance  REQSCP::={&ref c-commDistance, &ReqParam CommDistance}
directivity   REQSCP::={&ref c-directivity, &ReqParam Directivity}
resilience    REQSCP::={&ref c-resilience, &ReqParam Resilience}
minThP REQSCP::={&ref c-minThP, &ReqParam MinThP}
maxLat REQSCP::={&ref c-maxLat, &ReqParam MaxLat}
protocolReq   REQSCP::={&ref c-protocolReq, &ReqParam ProtocolReq}
dataConfidentiality  REQSCP::={&ref c-dataConfidentiality, &ReqParam DataConfidentiality}
dataIntegrity REQSCP::={&ref c-dataIntegrity, &ReqParam DataIntegrity}
nonReputability     REQSCP::={&ref c-nonReputability, &ReqParam ReqNonrepudiation}
dataAuthentication  REQSCP::={&ref c-dataAuthentication, &ReqParam SourceAuthentication}
maxPriorityFlow     REQSCP::={&ref c-maxPriorityFlow, &ReqParam ITSapObPriority}
expFlowLifeTime     REQSCP::={&ref c-expFlowLifeTime, &ReqParam ExpFlowLifeTime}

ExpFlowLifeTime::=TimeDurationValue -- expected time of a flow

SessionCont::=Logic -- false: session may be interrupted

TimeDurationValue::=SEQUENCE {
       value  INTEGER(0..1023), -- (10 bits in PER)
       unit   TimeUnit
       } -- 16 bits in PER

AvgADUrate::=TimeDurationValue

CommDistance::=SEQUENCE{
       minDistance   INTEGER(0..65535), -- m
       cost   CostObjective
       }

Resilience::=CostObjective -- true: resilience requested

MinThP::=SEQUENCE{
       minThP DataRate,
       cost   CostObjective
       }

MaxLat::=SEQUENCE{
       lat    INTEGER{
       unknown       (0), -- unknown latency
```

```
        any    (1), -- any latency - not further specified
        ms     (2), -- response within less than 10 ms
        ms10   (4), -- response within less than 100 ms
        ms100  (8), -- response within less than 1 second
        sec    (16), -- response within less than 10 seconds
        sec10  (32), -- response within less than 1 minute
        min    (64), -- response within less than 10 minutes
        min10  (128) -- response within less than 1 hour
        } (0..255),
        cost   CostObjective
        }

ProtocolReq::=ITSprotocolStackID -- this type must be octet aligned.

DataConfidentiality::=CostObjective

DataIntegrity::=CostObjective

ReqNonrepudiation::=CostObjective

SourceAuthentication::=CostObjective

PortNoInfo::=SEQUENCE{
        direction    PortRxTx,
        number PortNumber
        }

-- Confirmation CSPs requested

ReqConf-SCP REQSCPCONF::={logChannelConf | destTypeConf | destDomainConf | maxAPDUConf |
sessionContConf | avgADUrateConf | flowTypeConf | commDistanceConf | directivityConf |
resilienceConf | minThPConf | maxLatConf | protocolReqConf | dataConfidentialityConf |
dataIntegrityConf | nonReputabilityConf | dataAuthenticationConf | maxPriorityFlowConf |
portNoConf | expFlowLifeTimeConf, ...}

-- Mandatory (only odd ref numbers): ok (TRUE) / nok or possible values
logChannelConf      REQSCPCONF::={&ref c-logChannel, &ReqConfParam Logic}
destTypeConf  REQSCPCONF::={&ref c-destType, &ReqConfParam Logic}
destDomainConf      REQSCPCONF::={&ref c-destDomain, &ReqConfParam Logic}
maxAPDUConf   REQSCPCONF::={&ref c-maxAPDU, &ReqConfParam MaxADU}
portNoConf    REQSCPCONF::={&ref c-portNo, &ReqConfParam NullType}


-- Optional (only even ref numbers):
sessionContConf     REQSCPCONF::={&ref c-sessionCont, &ReqConfParam Logic}
avgADUrateConf      REQSCPCONF::={&ref c-avgADUrate, &ReqConfParam Logic}
flowTypeConf  REQSCPCONF::={&ref c-flowType, &ReqConfParam Logic}
commDistanceConf    REQSCPCONF::={&ref c-commDistance, &ReqConfParam CommDistance}
directivityConf     REQSCPCONF::={&ref c-directivity, &ReqConfParam Directivity}
resilienceConf      REQSCPCONF::={&ref c-resilience, &ReqConfParam Logic}
minThPConf    REQSCPCONF::={&ref c-minThP, &ReqConfParam MinThP}
maxLatConf    REQSCPCONF::={&ref c-maxLat, &ReqConfParam MaxLat}
protocolReqConf     REQSCPCONF::={&ref c-protocolReq, &ReqConfParam Logic}
dataConfidentialityConf     REQSCPCONF::={&ref c-dataConfidentiality, &ReqConfParam Logic}
dataIntegrityConf   REQSCPCONF::={&ref c-dataIntegrity, &ReqConfParam Logic}
nonReputabilityConf REQSCPCONF::={&ref c-nonReputability, &ReqConfParam Logic}
dataAuthenticationConf     REQSCPCONF::={&ref c-dataAuthentication, &ReqConfParam Logic}
maxPriorityFlowConf REQSCPCONF::={&ref c-maxPriorityFlow, &ReqConfParam NullType}
expFlowLifeTimeConf REQSCPCONF::={&ref c-expFlowLifeTime, &ReqConfParam NullType}

-- Policies
RefPOLICY ::= INTEGER {
        c-policyMediumCost  (0),
        c-policyLocPrivacy  (1),
        c-policyAnonymity   (2)
        } (0..255)

POLICYC::=CLASS {
        &ref   RefPOLICY,
        &PolParam
        }
```

```
Policies::=SEQUENCE OF SEQUENCE{
       refNo  POLICYC.&ref({Policy}),
       param  POLICYC.&PolParam({Policy}{@refNo})
       }

Policy POLICYC::={policyMediumCost | policyLocPrivacy | policyAnonymity, ...}

policyMediumCost    POLICYC::={&ref c-policyMediumCost, &PolParam MediumCost}
policyLocPrivacy    POLICYC::={&ref c-policyLocPrivacy, &PolParam LocPrivacy}
policyAnonymity     POLICYC::={&ref c-policyAnonymity, &PolParam Anonymity}


-- Financial policies

MediumCost::=SEQUENCE{
       fill    BIT STRING (SIZE(2)), -- bits set to zero
       costClass    CostClass, -- uses 3 bits
       costAmount   CostAmount OPTIONAL,
       timeUnit     CostTimeUnit OPTIONAL,
       amountUnit   CostAmountUnit OPTIONAL
       }

CostClass::=INTEGER{
       tempUnavailable     (0),
       noCharge     (1),
       flatRate     (2),
       perTime      (3),
       perAmount    (4),
       perConnection (5)
       } (0..7)

CostAmount::=SEQUENCE{
       currency     INTEGER(0..1023), -- ISO 4217 three digit numeric code
       value  CostValue
       } -- presented in 4 octets

CostValue::=SEQUENCE{
       main   INTEGER(0..4095), -- in currency unit
       fraction     INTEGER(0..1023) -- in 1/1000 of currency unit
       }

CostTimeUnit::=SEQUENCE{
       value  INTEGER(0..1023), -- valid parameter number (10 bits in PER)
       fill    BIT STRING (SIZE(1)), -- set to zero, extends TimeUnit size.
       unit   TimeUnit -- presented in 5 bits
       } -- 2 octets in PER

CostAmountUnit::=INTEGER{
       tempUnavailable     (0),
       kbyte  (1), -- units of kilobytes
       tkbyte (2), -- units of tens of kilobytes
       hkbyte (4), -- units of hundreds of kilobytes
       mbyte  (8), -- units in megabytes
       tmbyte (16), -- units in tens of megabytes
       hmbyte (32), -- units of hundreds of megabytes
       gbyte  (64), -- units of gigabytes
       tgbyte (128) -- units of tens of gigabytes
       } (0..255)

-- Security
LocPrivacy::=CostObjective

Anonymity::=CostObjective

StationAuthentication::=CostObjective

-- MA-SAP / MF-SAP / MS-SAP functions
-- Some functions are used in these three SAPs
```

```
ITS-S-Appl-Reg::= SEQUENCE OF ITSSappCPReqReg -- used in 24102-3

ITS-S-Appl-RegConf::= SEQUENCE OF ITSSappCPReqConf  -- used in 24102-3

ITS-S-Appl-RegFinal::=ITSSappCPFinal

-- General
Logic::=INTEGER{
       false  (0),
       true   (255)
       } (0..255)

CostObjective::=INTEGER(0..255) -- 0: not relevant, 255: highest relevance

NullType::=NULL

-- values

version INTEGER(0..255)::=1 -- Version of this ASN.1 module

/*
   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
```

Annex B
(informative)

Example of presentation of communication service parameters

B.1 Flows of an ITS-S application

This informative annex illustrates how an ITS-S application presents its communication service parameters. The ITS-S application used in this example is "In-vehicle signage"[8]. This application has three sources for potential flows with different communication service parameters:

a) Broadcast from roadside ITS-S to vehicle ITS-S.

   Push-service (push from roadside).

   Intended usage of 5,9 GHz access technology.

b) Unicast between central ITS-S to vehicle ITS-S.

   Pull-service (pull from vehicle).

   Intended usage of cellular network or public WiFi access technology.

c) Unicast between central ITS-S to roadside ITS-S for configuration purposes.

   Intended usage of 2G or optic fibre.

B.2 Source a)

Table B.1 illustrates the communication service parameters for source a) of the "In-vehicle signage" ITS-S application in a roadside ITS-S.

Table B.1 — Flow a) communication service parameters

Communication service parameter	Value	Comment
Operational communication service parameters		
CSP_LogicalChannelType	SfCH	Safety channel
CSP_SessionCont	N/A	No continuous connectivity needed
CSP_AvgADUrate	1s	Repeat at 1 Hz until flow is cancelled
CSP_FlowType	N/A	No well-known flow type presented
CSP_MaxPrio	value	as allowed
CSP_PortNo	tx, PORT_UNK	No well-known ITS port number presented for this communication source
CSP_ExpFlowLifetime	N/A	Not known
Destination communication service parameters		
CSP_DestinationType	geocast	
CSP_DestinationDomain	site-local	
CSP_CommDistance	N/A	
CSP_Directivity	N/A	

Table B.1 *(continued)*

Communication service parameter	Value	Comment
Performance communication service parameters		
CSP_Resilience	N/A	
CSP_MinThP	N/A	
CSP_MaxLat	N/A	
CSP_MaxADU	<max message size>	
Security communication service parameters		
CSP_DataConfidentiality	required	
CSP_DataIntegrity	N/A	
CSP_NonRepudiation	required	
CSP_SourceAuthentication	required	
Protocol communication service parameters		
CSP_Protocol	N/A	

B.3 Source b)

Table B.2 illustrates the communication service parameters for source b) of the "In-vehicle signage" ITS-S application in a central ITS-S and in a vehicle ITS-S.

Table B.2 — Flow b) communication service parameters

Communication service parameter	Value	Comment
Operational communication service parameters		
CSP_LogicalChannelType	GPCH	General purpose channel
CSP_SessionCont	N/A	No session continuity needed
CSP_AvgADUrate	N/A	No repetition
CSP_MaxPrio	value	as allowed
CSP_FlowType	N/A	No well-known flow type presented
CSP_PortNo	tx, PORT_UNK	No well-known ITS port number presented for this communication source
CSP_ExpFlowLifetime	N/A	Not known
Destination communication service parameters		
CSP_DestinationType	unicast	
CSP_DestinationDomain	global	
CSP_CommDistance	N/A	
CSP_Directivity	N/A	
Performance communication service parameters		
CSP_Resilience	Required	ACK preferred
CSP_MinThP	N/A	
CSP_MaxLat	N/A	
CSP_MaxADU	<max message size>	
Security communication service parameters		

Table B.2 *(continued)*

Communication service parameter	Value	Comment
CSP_DataConfidentiality	required	
CSP_DataIntegrity	N/A	
CSP_NonRepudiation	required	
CSP_SourceAuthentication	required	
Protocol communication service parameters		
CSP_Protocol	N/A	

B.4 Source c)

Table B.3 illustrates the communication service parameters for source c) of the "In-vehicle signage" ITS-S application in a central ITS-S and in a roadside ITS-S.

Table B.3 — Flow c) communication service parameters

Communication service parameter	Value	Comment
Operational communication service parameters		
CSP_LogicalChannelType	GPCH	General purpose channel
CSP_SessionCont	N/A	No session continuity needed
CSP_AvgADUrate	N/A	No repetition
CSP_FlowType	N/A	No well-known flow type presented
CSP_MaxPrio	value	as allowed
CSP_PortNo	tx, PORT_UNK	No well-known ITS port number presented for this communication source
CSP_ExpFlowLifetime	N/A	Not known
Destination communication service parameters		
CSP_DestinationType	unicast	
CSP_DestinationDomain	global	
CSP_CommDistance	N/A	
CSP_Directivity	N/A	
Performance communication service parameters		
CSP_Resilience	required	ACK preferred
CSP_MinThP	N/A	
CSP_MaxLat	N/A	
CSP_MaxADU	<max message size>	
Security communication service parameters		
CSP_DataConfidentiality	required	
CSP_DataIntegrity	N/A	
CSP_NonRepudiation	required	
CSP_SourceAuthentication	required	
Protocol communication service parameters		
CSP_Protocol	N/A	

Annex C
(informative)

On communication requirements and objectives

C.1 Communication profile selection process

The process of selecting an ITS-S communication profile (ITS-SCP) to meet a set of communication requirements and objectives (CRO) is functionally a constrained optimization problem. This process is referred to as the "communication profile selection process" (CPSP). Since there are only a finite number of possible ITS-SCPs (determined by the number of communication protocols in any ITS-S implementation), and since the CPSP does not involve optimization parameters that belong to a continuous domain, it is a tractable discrete optimization problem with minimal computational requirements.

There is a difference between a "communication requirement" and a "communication objective" which is important from the perspective of the CPSP. A "requirement" on a communication service parameter (CSP) is mathematically equivalent to the statement that the value which the CSP may assume must lay within a constrained set of values, and within that set of values, there is no preference for one over the other. For example, the "logical channel type must be the SfCH for this application", or the "communication throughput must be greater than 10Mbps for this flow" are both "requirements" that restrict the values the associated parameter may assume. In the former case, it is a restriction to a single value while in the later, there may be a number of values the CSP can assume, any of which would satisfy the "requirement" equally well from the standpoint of the ITS-S application. Thus, "requirements", as used in this Technical Specification, divides the set of communication parameters associated with communication profiles into two sets; a feasible set and a non-feasible set. If a communication profile with all parameters feasible cannot be found, the ITS-S application requirements cannot be met and an error is returned to that application. On the other hand, a "communication objective" is based on the assumption that a particular CSP may take on a number of possible values and that there is a means for ordering the choices within the set. Examples of simple communication objectives include:

— minimize cost,

— minimize latency,

— maximize data rate, and

— maximize transmit power (e.g. for the purpose to maximize coverage area).

Using as an example cost, the objective of minimizing cost is turned into a mathematical problem by creating a function whose input is the cost of a particular ITS-S communication profile, and whose output is a number (in cost-function units). The requirement on the function in this case is monotonicity with respect to input cost. An example of such a function is the square of the cost, i.e. the square of the difference between the cost and the objective of 0. More complex objectives can be formulated as combinations (most often linear) of these and other simple objectives where the relative weighting of the simple objective functions expresses the relative importance of each in the CPSP. So an ITS-S application process can express it wants to minimize a combination of cost and data rate, where the cost objective is 0, and the data rate objective is some desired upper bound.

Somewhat interestingly, objectives can be mathematically formulated to express requirements (i.e. constraints) by appropriate construction of the cost function employed to order the choices. For example, if there is a set of possible values for a particular CSP and that set is divided into two subsets, assigning infinite cost to all members of one subset and zero cost to all members of the other is equivalent to a constraint on the CSP.

More interestingly for the purposes of the CPSP, requirements can often be "softened" by converting them into objectives with a large, but finite cost for assuming values in the prior set of unallowed values. For example, rather than imposing a 10Mbps minimum on the communication throughput CSP, the application can make communication throughput values less than 10Mbps very costly, however not prohibitively so.

NOTE There are requirements that cannot be "softened" in the situation where there is no logical means for ordering the various alternatives. An example is the requirement (i.e. constraint) that a flow use a particular logical channel (e.g. the SfCH) or that all ADUs are to be broadcast. Such requirements are generally related to system specifications on the communication system that all communication nodes are designed to meet so that the system can function properly.

In general, objectives can be more complex as alluded to above, involving mathematical functions of a set of "objective parameters". The mathematical functions would be part of the CSP object specification. For example, a polynomic function parameterized by an "exponent", "width", and "relative weighting" parameter could be specified. The CPSP is passed these three parameters along with a target value of the *CSP* (*CSP0*). The objective function

$$J = \sum_{i=1}^{N_p} \alpha_i \cdot J_i$$

for the ITS-S communication profile selection would be formed by taking the absolute of the difference between each *CSP* and its target value *CSP0* and dividing this by a width parameter *w* associated with the *CSP*, and raising this value to an associated power indicated by the exponent parameter *n*,

$$J_i = \left(\frac{|CSP_i - CSP0_i|}{w_i} \right)^{n_i}$$

As indicated above, the objective function *J* is formed by weighted sum of these J_i's. The relative weighting parameter α can be positive or negative to indicate a minimization or maximization of the elements of the cost function relative to others in the overall cost function.

C.2 Basic CPSP operation

Objectives are used to select the "best" solution from the set of possible solutions to this resource allocation problem. At an abstract level, the CPSP first assembles all possible ITS-SCPs from the set of all communication protocols implemented in the ITS-S, The CPSP then uses requirements (i.e. constraints) associated with a requested flow to construct a "feasible set" of ITS-SCPs from the set of all possible ITS-SCPs by eliminating from that set all ITS-SCPs that violate one or more of the constraints. In real-time operation, the set is further reduced by selecting only those ITS-SCPs that are currently operational. Selection of the "optimal" ITS-SCP from the set of feasible ITS-SCPs is performed by computing a "cost function" for each feasible ITS-SCP and selecting the ITS-SCP that, without loss of generality, minimizes the cost function. In an implementation, these costs can be pre-computed and stored for real-time use.

Note that any combination of the CSPs can be used in the CPSP. Equality and inequality constraints given to the CPSP are used in setting up the constraints and arriving at feasible sets of ITS-SCPs. CSPs received by the CPSP that contain more complex weighting function descriptions are used to create the cost function that is to be minimized. Generally, an ITS-S application process presents to the CPSP only those CROs which are relevant for it.

Users of ITS-SUs may also present CROs by means of user policies. CROs may also come from authorities (regulations) or other entities (policies) as illustrated in Figure 1.

C.3 Multiple sources and flows

An ITS-S application process may have several communication sources each with its own set of communication requirements and objectives. For each communication source, an ITS-S application process would present a set of communication requirements and objectives to the ITS-S management.

Such a set of communication requirements and objectives may be linked to an ITS flow type identifier (ITS-FlowTypeID).

NOTE A single communication source may result in N different flows each identified by a unique FlowID, transmitted via N different paths to N different destinations.

Requirements and objectives presented by ITS-S application processes for each communication source are used by the ITS station management to select the best suited ITS-S communication profile per communication source. As before, if ITS-S management is not able to provide a communication protocol stack which fully complies with the requirements, i.e. fails to identify and select an ITS-S communication profile for a given flow, ITS-S management reports the failure to the requesting ITS-S application process. ITS-S application processes could then choose to "soften" their requirements as described above so as to allow ITS-S management to a "best-effort" selection from among the set of all possible communication profiles available.

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