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Intelligent transport systems — Cooperative systems — Application requirements and objectives

Systèmes de transport intelligents — Systèmes coopératifs — Exigences d'application et objectifs

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Contents

Page

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ISO 17423:2018
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This document was prepared by ISO/TC 204, *Intelligent transport systems*.

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This first edition cancels and replaces ISO/TS 17423:2014, which has been technically revised.

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 21217:2014.

Applications and communications are linked together using the concepts of flows and paths and communication profiles described in ISO 21217:2014 with related flow and path management procedures specified in ISO 24102-6[2)][11]. 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 ISO 24102-6[11]. There may be well-known registered Flow Types as specified in ISO 17419.

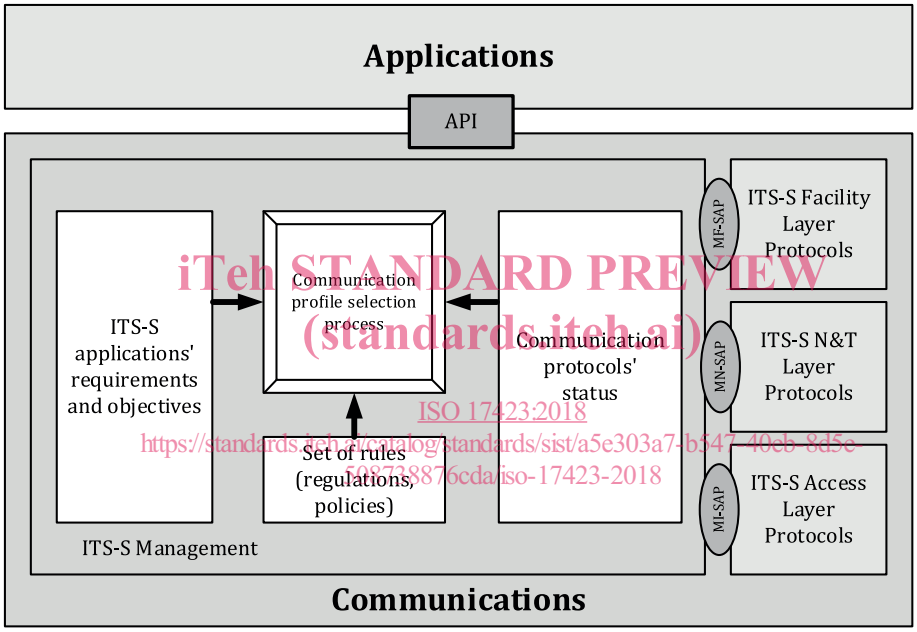

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Figure 1 — ITS-S communication profile selection process

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 ISO 24102-6[11].

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

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.

1) The term “Cooperative ITS” (C-ITS) indicates specific features of ITS [4]. For the purpose of this document, no distinction between ITS and C-ITS is needed.

2) To be published.

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Intelligent transport systems — Cooperative systems — Application requirements and objectives

1 Scope

This document

— 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 are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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ISO 4217:2015, *Codes for the representation of currencies*

ISO/IEC 8824-1:2015, *Information technology — Abstract Syntax Notation One (ASN.1): Specification of basic notation*

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ISO 17419, *Intelligent transport systems — Identifiers — Globally unique identification*

ISO 21217:2014, *Intelligent transport systems — Communications access for land mobiles (CALM) — Architecture*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
authorization
prescription that a particular behaviour shall not be prevented

Note 1 to entry: Unlike a *permission* (3.10), an authorization is an empowerment.

Note 2 to entry: From ITU-T X.911[14].

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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

Note 1 to entry: Examples of ITS-S application processes are ITS-S applications, ITS-S facility applications (e.g. for CAM), and ITS-S management applications (e.g. FSAP specified in ISO 22418[10]).

[SOURCE: ISO 21217:2014, 3.19, modified — Note 1 to entry has been added.]

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

[SOURCE: ISO 21217:2014, 3.9 — modified: Note 1 to entry was deleted.]

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

[SOURCE: ISO 21217:2014, 3.11]

3.5
ITS-S application
ITS-S application process residing in the ITS-S application entity

[SOURCE: ISO 21217:2014, 3.18]

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

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[SOURCE: ISO 17419:2018, 3.14]

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

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

3.9
ITS-S application process RX/TX interface
sink or source of an ITS-S application process

3.10
permission
rule that a particular behaviour is allowed to occur

Note 1 to entry: From ITU-T X.911[14].

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4 Symbols and 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_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”
CSP_SpecificCommsProts	Communication service parameter “Specific communications protocols”
ITS-S-FlowID	Flow Identifier, see ISO 24102-6[11]
IICP	ITS station-internal management communications protocol, see ISO 24102-4[9]
ITS-S	ITS station, see ISO 21217:2014
ITS-SCP	ITS station communication profile

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ITS-SCPS	ITS station communication protocol stack
ITS-SCU	ITS station communication unit, see ISO 21217:2014
ITS-SU	ITS station unit, see ISO 21217:2014
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
ITS-S-FlowTypeID	ITS-S flow type identifier (from ISO 24102-6)

5 Communication service parameters

5.1 Abstraction of application processes from communications

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The ITS station (ITS-S) reference architecture presented in Figure 2 and specified in ISO 21217:2014 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 17419, is enabled by

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— abstraction of ITS-S application processes (e.g. 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 21217:2014,

— procedures by which instances of ITS-S application processes running in an ITS station unit (ITS-SU) specified in ISO 21217:2014 can present requirements for communication services in an abstract and standardized way to the ITS station management as specified in this document,

— 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" (CSP) as identified in this document. 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. The cost function needs to be extremized (maximized or minimized) as discussed in Annex C.

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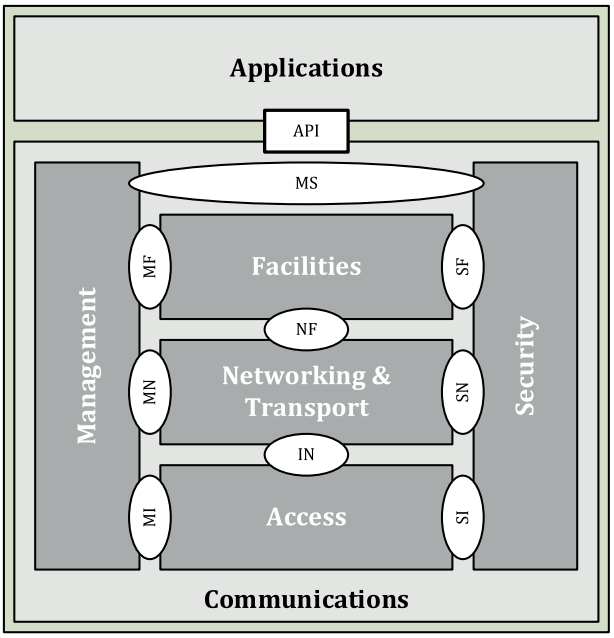

Figure 2 — ITS station architecture [ISO 21217:2014]

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

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— ITS-S application processes located in the ITS-S facilities layer (e.g. CAM source, specified in ETSI EN 302 637-2[15]),

— ITS-S application processes located in the ITS-S management entity (e.g. SAM and SRM sources specified in ISO/TS 16460[1] and ISO 22418[10]),

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

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

There are also other application processes that can get access to the communication services 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 21217:2014 and ISO 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.

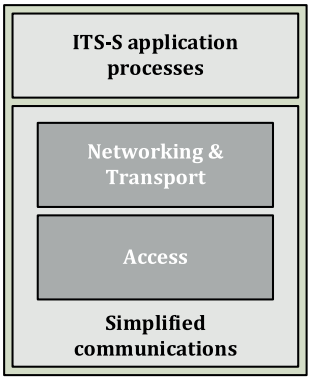

Figure 3 — Simplified architecture

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Application processes are classified in ISO 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 ITU-T X.911[14].

CSPs for ITS-S application process sources are specified in 5.3, 5.4, 5.5, 5.6 and 5.7. An overview is presented in 5.9. An ITS-S application process shall present the mandatory CSPs, and may present those optional CSPs which are relevant for it. Mandatory CSPs shall be treated as optional in case CSP_FlowType is presented.

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 1 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 (/ sink)[3] (ITS-S application process RX/TX interface), 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 `ITSappTrackedLinkSourceNo` specified in ISO 17419 which is unique in the scope of that ITS-S application process. For each communication source an ITS-S application process presents a set of communication requirements to the ITS-S management as specified in this document. Such a set of communication requirements is linked to an ITS flow type identifier (ITS-S-FlowTypeID). ITS-S-FlowTypeIDs may be well-known registered identifiers pointing to pre-defined well-known sets of requirements or may be dynamically assigned in an ITS-SU.

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Information contained in a registry for ITS flow types is given by the ASN.1 type `ITSflowTypeRegistry` specified in Annex A. This registry shall contain entries for ITS flow types given by the ASN.1 type `ITSflowType` specified in Annex A and listed in Table 1. A registration authority may add further information elements to properly identify and support management of ITS flow types. A registration authority shall clearly distinguish the range of well-known registered ITS-FlowTypeIDs and dynamically assigned ITS-FlowTypeIDs.

NOTE 2 A general introduction on registries for unique identifiers in ITS is provided in ISO 17419.

Table 1 — Registry components of ITSflowType

Component of `ITSflowType`	Semantics
`id`	`FlowTypeID`
`req`	List of applicable communication service parameters `ITSSappCPReqReg`. The communication service parameter CSP_FlowType presenting a value of ITS-FlowTypeID is prohibited in `req`. The `CostObjective` used in some communication service parameters is not part of a registered ITS flow type. Thus the value presented in the registry is not relevant. The convention shall be to use the value 255 (maximum relevance) in the registry, and to replace it by an applicable value upon usage.

CSPs 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.

3) An ITS-S application process might need to maintain flows for different communication sources, e.g. audio, video and messages.

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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 refusal 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 ITS-S-FlowID has been assigned to an ITS-S application process, see ISO 24102-6[11], the ITS-S application process can

— present ADUs for transmission,

— publish data objects, and

— subscribe to reception of data objects,

e.g. using the procedures specified in ISO/TS 17429:2017, Clause 8[3].

Once a ITS-S-FlowID has been assigned to an ITS-S application process, see ISO 24102-6[11], the ITS-S application process cannot update CSPs associated with the flow.

An ITS-S application process may also present requirements on communication sinks (ITS-S application process RX/TX interface), e.g. to request opening a receive port identified by an ITS port number (ITS-PN). Similarly to the communication sources of an ITS-S application process these communication sinks are uniquely identified by a reference number of ASN.1 type `ITSappProcSinkSourceNo` specified in ISO 17419. CSPs for ITS-S application process sinks are specified in 5.8.

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[8]. Details of APIs depend on the operating system used to implement them.

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ITS-S application processes may reside in the ITS-S application entity, 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 document.

Management procedures and service primitives related to these CSPs 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

CSPs are grouped into classes. The following communication service parameter classes are identified in this document:

— The class of operational CSPs is specified in 5.3.

— The class of destination CSPs is specified in 5.4.

— The class of performance CSPs is specified in 5.5.

— The class of security CSPs is specified in 5.6.

— The class of protocol CSPs is specified in 5.7.

— CSPs relevant for ITS-S application process sinks, specified in 5.8

— An overview of all CSPs identified in this document is presented in 5.9.

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

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